Tuesday

104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

RSNA 2018
TOMORROW'S
RADIOLOGY TODAY

SPDL30

The RAD Files: The Truth is Out There (Case-based Competition)

Tuesday, Nov. 27 7:15AM - 8:15AM Room: E451B

ER MK

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Eric B. England, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
Carl C. Flink, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

eric.england@uc.edu

LEARNING OBJECTIVES

1) Be introduced to a series of radiology case studies via an interactive team game approach designed to encourage 'active' consumption of educational content. 2) Use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) Receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. *This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.*

SPSC30

Controversy Session: Prostate Cancer Imaging: Is the Endorectal Coil Necessary?

Tuesday, Nov. 27 7:15AM - 8:15AM Room: E350

GU MR OI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Andrew B. Rosenkrantz, MD, New York, NY (*Moderator*) Nothing to Disclose
Aytekin Oto, MD, Chicago, IL (*Presenter*) Research Grant, Koninklijke Philips NV; Research Grant, Guerbet SA; Research Grant, Profound Medical Inc; Medical Advisory Board, Profound Medical Inc; Consultant, AbbVie Inc; ;
Baris Turkbey, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand pros and cons of using an endorectal coil for Prostate MRI. 2) To describe clinical scenarios in which it may be particularly beneficial to use a specific coil arrangements (endorectal or external pelvic). 3) To recognize practical aspects of optimizing image quality and overall workflow for both coil arrangements.

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/ Aytekin Oto, MD - 2013 Honored EducatorAytekin Oto, MD - 2017 Honored Educator

SPSH30

Hot Topic Session: Management of DCIS and Minimal Risk Lesions

Tuesday, Nov. 27 7:15AM - 8:15AM Room: E450B

BR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Linda Moy, MD, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

SPSH30A LORIS Trial-Will it Address the Overtreatment of Low Grade DCIS?

Participants
Matthew G. Wallis, MD, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Matthew.wallis@addenbrookes.nhs.uk

LEARNING OBJECTIVES

1) To learn about the risk of overdiagnosis and overtreatment. 2) To become familiar with the risk of avoiding surgery. 3) To appreciate the prospective for the future.

ABSTRACT

Breast screening has led to an inexorable rise in the number of women living with a diagnosis of DCIS predominantly but not exclusively as a result of the detection of micro-calcification. It is clear from long term follow up that conventional treatment fails the 15 to 20% who develop invasive disease a few of whom then die from breast cancer. There is larger group that never progress with in their life time which means we have either cured them or just over treated them. Traditional pathology and genetics suggest that there is a low risk group that either never progress or if they do they develop 'low risk' invasive disease. I will describe the 4 international trials LORIS (The LOw RISk DCIS trial), LORD (LOw Risk DCIS) , COMET (Comparison of Operative versus Medical Endocrine Therapy for Low Risk DCIS) and LORETTA (Low Risk Tamoxifen Treatment And surveillance) . In particular commenting on their differences. Using LORIS as my main example I will discuss how we have attempted to resolve the hurdles of setting up a 'no treatment trial' and talk about some of the lessons learnt from successfully steering LORIS from feasibility to full trial. Anecdotally patient views have been more entrenched than those of surgeons

SPSH30B Pathologic Interpretation of Borderline Breast Lesions

Participants
Laura C. Collins, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

lcollins@bidmc.harvard.edu

LEARNING OBJECTIVES

1) To have a greater level of understanding of the nuances of interpreting atypical ductal proliferations. 2) To have a greater level of understanding of the quantitative criteria for a diagnosis of low grade ductal carcinoma in situ. 3) Learners will have a greater level of understanding of the limitations of providing definitive diagnosis of some atypical ductal proliferations on core needle biopsy samples.

ABSTRACT

This presentation will cover the nuances of pathologic interpretation of borderline atypical ductal proliferations of the breast, particularly in the setting of core needle biopsy samples. Features that favor a diagnosis of atypical ductal hyperplasia versus low nuclear grade ductal carcinoma in situ will be discussed. Finally, the ramifications of definitive distinctions rendered on borderline lesions will be reviewed.

SPSH30C High Risk DCIS and What are We Prepared To Do About it

Participants
Brian J. Czerniecki, MD, PhD, Tampa, FL (*Presenter*) Advisory Board, ImmunoRestoration

LEARNING OBJECTIVES

1. Understand that there are subgroups of women with DCIS in whom there is an increased risk of subsequent breast cancer deaths and they include women under 40, African American females and those with hormone receptor negative breats cancer. 2. Disseminated cancer cells may seed even from very early DCIS lesions 3. Surgery and Radiation do not appear to reduce the risk of death from breast cancer in high risk groups

ABSTRACT

Controversy exists concerning whether all ductal carcinoma in situ (DCIS) lesions represent premalignant precursors destined to become invasive breast cancer (IBC). There is also evidence that cancer cells can disseminate very early during the process of tumorigenesis even prior to invasive breast cancer developing. There is a also evidence that certain groups of patients with DCIS have increased risk of mortality from DCIS and they include those diagnosed under 40, African American females and those that are hormone receptor negative. Local therapy with surgery and radiation does not decrease risk of mortality from DCIS. Many of these high risk lesions have expression of HER2 which is associated with both invasion and dissemintation of cancer cells (DCC). Targeting HER2 maybe benficial for eliminating both DCC and reducing risk of subsequent IBC. Dendritic cell (DC) vaccines administered in a neoadjuvant trials to patients with HER2 expressing DCIS has resulted in complete regression of disease in about 30% of DCIS patients. Vaccines drive anti-HER2 CD4 Th1 cells especially in sentinel nodes. Complete regression of DCIS is associated with diminshed breast cancer events. Combinations of other immune therapies with DC vaccines may result in greater numbers of complete responses. In summary, high grade and HER2 expressing DCIS in young women, African American females requires novel approaches to reduce mortlaity and subsequent breast cancer events.

RCA31

Prostate MRI (Hands-on)

Tuesday, Nov. 27 8:00AM - 10:00AM Room: S401AB

GU MR

AMA PRA Category 1 Credits ™: 2.00
ARRT Category A+ Credits: 2.25

Participants
Jelle O. Barentsz, MD, PhD, Nijmegen, Netherlands (*Presenter*) Advisor, SPL Medical BV
Daniel J. Margolis, MD, Los Angeles, CA (*Presenter*) Consultant, Blue Earth Diagnostics Ltd
Roel D. Mus, MD, Groesbeek, Netherlands (*Presenter*) Nothing to Disclose
Joyce G. Bomers, Arnhem, Netherlands (*Presenter*) Nothing to Disclose
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Siemens AG
Rianne R. Engels, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Renske L. van Delft, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Michiel Sedelaar, MD, PhD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Antonio C. Westphalen, MD, Mill Valley, CA (*Presenter*) Scientific Advisory Board, 3DBiopsy, Inc;
Geert M. Villeirs, MD, PhD, Ghent, Belgium (*Presenter*) Nothing to Disclose
Leonardo K. Bittencourt, MD, PhD, Rio De Janeiro, Brazil (*Presenter*) Nothing to Disclose
Vibeke B. Logager, MD, Herlev, Denmark (*Presenter*) Nothing to Disclose
Joseph J. Busch, MD, Chattanooga, TN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Renske.vandelft@radboudumc.nl

LEARNING OBJECTIVES

1) Understand the PI-RADS v2 category assessment to detect and localize significant cancer for both peripheral zone and transitional zone lesions. 2) Recognize benign pathology like inflammation and BPH and to differentiate these from significant prostate cancers.

ABSTRACT

In this Hands-on Workshop, the participants will able to review up to 47 multi-parametric MRI cases with various prostatic pathology using a dedicated workstation. Focus will be on the overall assessment of PI-RADS v2 category, which enables them to score the probability of the presence of a significant cancer in patients with elevated PSA and/or clinical suspicion. All cases are from daily non-academic practice, and have various levels of difficulty. The cases include: easy and difficult significant peripheral-transition- and central zone cancers, inflammation, BPH, and the most common pitfalls. Internationally renowned teachers will guide the participants during their PI-RADS v2 scoring. The coursebook can be found at: http://bit.ly/rsna2018 Please note: To guarentee the best learning experience we can only allow 100 people in the room (2 per computer). It will be first come first serve.

Active Handout:Renske Lian van Delft

http://abstract.rsna.org/uploads/2018/16002000/Workshop RSNA 2018 Coursebook small RCA.pdf

MSAS31

Radiology Safety: Effective Strategies in Patient Care (Sponsored by the Associated Sciences Consortium) (Interactive Session)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S105AB

MR SQ

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

Participants
Kendra Huber, RT, BS, Castle Rock, CO (*Moderator*) Nothing to Disclose
JoAnn Balderos-Mason, PhD,RT, Chicago, IL (*Moderator*) Nothing to Disclose

Sub-Events

MSAS31A Radiation Safety and Protection in Diagnostic Imaging

Participants
Steffen Sammet, MD,PhD, Chicago, IL (*Presenter*) Research Grant, Koninklijke Philips NV

For information about this presentation, contact:

ssammet@uchicago.edu

LEARNING OBJECTIVES

1) Radiation Units and Measurements. 2) Biological Effects of Ionizing Radiation. 3) Radiation Exposures in Diagnostic Radiology. 4) Principles of Radiation Protection and Radiation Safety.

ABSTRACT

Since the discovery of x-rays in 1895 by the German physicist Wilhelm Conrad Röntgen and the first reports of radiation injuries in 1896, radiation safety and protection of patients have been fundamental responsibilities in diagnostic imaging. The fast advancements in equipment that uses x-rays to form diagnostic images require radiation protection, dose monitoring and radiation safety strategies. This course will present and review the most current radiation safety and protection requirements in Diagnostic Radiology.

MSAS31B MRI Contrast and Protocol Optimization

Participants
Matt Rederer, BS, RT, Elgin, IL (*Presenter*) CEO, RITE Advantage, LLC

MSAS31C MRI Safety Made Complicated and Dangerous

Participants
Mark A. Smith, MS, ARRT, Columbus, OH (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mark.smith@nationwidechildrens.org

LEARNING OBJECTIVES

1) Identify MR safety concerns. 2) Recognize previous mistakes. 3) Identify proper MR safety policies and procedures. 4) Identify MR safety update on implants/devices. 5) Recognize strategies for successful MR safety practices.

ABSTRACT

MR technology and it's clinical applications have expanded rapidly in recent years. As a result, the safety of patients, family and staff is a primary concern, with MR safety awareness and training has become increasingly important. This presentation will review the essentials of MR safety that all personnell present in the MR environment should be familiar with.

Active Handout:Mark Aaron Smith

http://abstract.rsna.org/uploads/2018/18001114/RSNA 2018 MRI Safety handoutMSAS31C.pdf

MSCC31

Case-based Review of Nuclear Medicine: PET/CT Workshop-Head and Neck PET/CT (In Conjunction with SNMMI) (Interactive Session)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: E450B

CT NR NM

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

FDA Discussions may include off-label uses.

Participants
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Director*) Nothing to Disclose
Katherine A. Zukotynski, MD, Ancaster, ON (*Director*) Nothing to Disclose
Katherine A. Zukotynski, MD, Ancaster, ON (*Moderator*) Nothing to Disclose

Sub-Events

MSCC31A Imaging of Dementia

Participants
Phillip Kuo, MD,PhD, Tucson, AZ (*Presenter*) Author, MD Training at Home; Research Grant, Astellas Group; Consultant, Endocyte, Inc; Consultant, General Electric Company; Education Grant, General Electric Company; Speakers Bureau, Eli Lilly and Company; Consultant, inviCRO, LLC; Consultant, Imaging Endpoints; Consultant, Progenics Pharmaceuticals, Inc

LEARNING OBJECTIVES

1) Discuss appropriate use criteria for PET in the work-up of dementia. 2) Review imaging signs of amyloid deposition and pitfalls of image interpretation. 3) Illustrate a systematic approach to interpretation of PET imaging in dementia.

MSCC31B Head and Neck PET/CT

Participants
Rathan M. Subramaniam, MD,PhD, Dallas, TX (*Presenter*) Consultant, Blue Earth Diagnostics Ltd; Speaker, Blue Earth Diagnostics Ltd

For information about this presentation, contact:

rathan.subramaniam@utsouthwestern.edu

LEARNING OBJECTIVES

1) To review the best clinical practices of head and neck PET/CT in oncologic imaging. 2) To review the common sites of tumor location in head and neck and patterns of tumor spread. 3) To review pitfalls of head and neck PET/CT interpretations.

ABSTRACT

This talk will review the best clinical practices of head and neck PET/CT in oncology, patterns of tumor spread and common and unusual intepretation pitfalls.

MSES31

Essentials of Chest Imaging

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S100AB

CH CT OI

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

Sub-Events

MSES31A CT of Pleural Diseases

Participants
Travis S. Henry, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Differentiate the common causes of unilateral and bilateral pleural effusions. 2) Prioritize a differential diagnosis of unilateral pleural effusions on CT based on relevant imaging findings. 3) Produce a differential of at least 3 causes of pleural masses.

Active Handout:Travis S. Henry

http://abstract.rsna.org/uploads/2018/18000942/CT of Pleural Disease Handout MSES31A.pdf

Honored Educators

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MSES31B Lung Cancer Staging 8th Edition

Participants
Jeremy J. Erasmus, MD, Houston, TX (*Presenter*) Nothing to Disclose

Honored Educators

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MSES31C ACR Lung RADS / Lung Cancer Screening

Participants
Ella A. Kazerooni, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

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MSES31D 2017 Fleishner Society Criteria for Pulmonary Nodules

Participants
Geoffrey D. Rubin, MD, Durham, NC (*Presenter*) Consultant, Fovia, Inc; Consultant, HeartFlow, Inc; Consultant, General Electric Company;

LEARNING OBJECTIVES

1) To apply the 2017 Fleischner Society Guidelines for the assessment and management of incidentally detected pulmonary nodules in clinical practice.

ABSTRACT

The Fleischner Society Guidelines for management of solid nodules were published in 2005, and separate guidelines for subsolid nodules were issued in 2013. Since then, new information has become available; therefore, the guidelines have been revised to reflect current thinking on nodule management. The revised guidelines incorporate several substantive changes that reflect current thinking on the management of small nodules. The minimum threshold size for routine follow-up has been increased, and recommended follow-up intervals are now given as a range rather than as a precise time period to give radiologists, clinicians, and patients greater discretion to accommodate individual risk factors and preferences. The guidelines for solid and subsolid nodules have been combined in one simplified table, and specific recommendations have been included for multiple nodules. These guidelines represent the consensus of the Fleischner Society, and as such, they incorporate the opinions of a multidisciplinary international

group of thoracic radiologists, pulmonologists, surgeons, pathologists, and other specialists. Changes from the previous guidelines issued by the Fleischner Society are based on new data and accumulated experience. MacMahon H, Naidich DP, Goo JM, et al. Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017. Radiology. 2017;:161659.

MSQI31

Quality Improvement Symposium: Value in Imaging 1: Value in Radiology

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S402AB

AI SQ

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

Participants
Jonathan B. Kruskal, MD, PhD, Boston, MA (*Moderator*) Author, Wolters Kluwer nv

LEARNING OBJECTIVES

1) To define the concept and definition of value relative to clinical radiology practice. 2) To describe how value can be measured. 3) To define strategies for improving delivery of value.

Additional Information

RSNA will award Quality Essentials Certificates of Completion to RSNA 2018 attendees who successfully participate. Participants who achieve a score of 80% or higher on the SAM test questions will be eligible to receive the certificates.

Sub-Events

MSQI31A What is Value in Radiology?

Participants
Jonathan B. Kruskal, MD, PhD, Boston, MA (*Presenter*) Author, Wolters Kluwer nv

For information about this presentation, contact:

jkruskal@bidmc.harvard.edu

LEARNING OBJECTIVES

1) To define the concept and definition of value relative to clinical radiology practice. 2) To describe how value can be measured. 3) To define strategies for improving delivery of value.

Honored Educators

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MSQI31B The Patient Perspective on Radiology Value

Participants
Tessa S. Cook, MD, PhD, Philadelphia, PA (*Presenter*) Royalties, Osler Institute

For information about this presentation, contact:

tessa.cook@uphs.upenn.edu

LEARNING OBJECTIVES

1) Discuss what patients value most in their encounters with a radiology practice. 2) Describe challenges patients face in navigating their care in radiology. 3) Understand innovations in care design that could address challenges patients face in radiology.

MSQI31C How Machine Learning will Optimize our Value

Participants
Curtis P. Langlotz, MD,PhD, Menlo Park, CA (*Presenter*) Advisory Board, Nuance Communications, Inc; Shareholder, whiterabbit.ai; Advisory Board, whiterabbit.ai; Shareholder, Nines.ai; Consultant, Nines.ai; Shareholder, TowerView Health; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, Alphabet Inc;

LEARNING OBJECTIVES

1) Review the clinical constraints and needs that radiologists face. 2) Critique the role of computer aided detection in radiology. 3) Understand the role of artificial intelligence across the image life cycle, including detection. 4) Discuss how artificial intelligence will change the practice of radiology.

MSRO31

BOOST: Gastrointestinal-Oncology Anatomy (Interactive Session)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S103AB

GI OI RO

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

Participants

Zhen J. Wang, MD, Hillsborough, CA (*Presenter*) Stockholder, Nextrast, Inc
Mary U. Feng, MD, San Francisco, CA (*Presenter*) Self: Consultant, Varian, Inc and RefleXion Medical Inc; Spouse (Felix Feng, MD), Advisory Boards Dendreon, Janssen, Bayer, Sanofi, Ferring, EMD Serono, Medivation/Astellas, Blue Earth Diagnostics, Progenics; Spouse, honorarium Clovis
Edward Y. Kim, MD, Seattle, WA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

Jane.Wang@ucsf.edu

Mary.feng@ucsf.edu

LEARNING OBJECTIVES

1) Describe relevant liver anatomy and key imaging features of liver tumors. 2) Describe new techniques for imaging liver tumors and monitoring treatment response.

MSRO35

BOOST: Lung-Oncology Anatomy (Interactive Session)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S103CD

CH OI RO

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

Participants
Subba R. Digumarthy, MD, Boston, MA (*Presenter*) Nothing to Disclose
Amita Sharma, MBBS, Boston, MA (*Presenter*) Nothing to Disclose
Melin J. Khandekar, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

sdigumarthy@mgh.harvard.edu

LEARNING OBJECTIVES

1) Explain the different techniques and approaches for radiation therapy delivery. 2) Identify the anatomy relevant for thoracic oncology treatment planning. 3) Define targets and organs at risk for thoracic radiation therapy.

Honored Educators

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RC301

Pulmonary Vascular Imaging

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S104B

CH CT MR VA

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

FDA Discussions may include off-label uses.

Sub-Events

RC301A Imaging of Acute Pulmonary Embolism

Participants
Ioannis Vlahos, MRCP,FRCR, London, United Kingdom (*Presenter*) Research Consultant, Siemens AG Research Consultant, General Electric Company

LEARNING OBJECTIVES

1) Overview current imaging strategies and key facts in acute pulmonary embolism imaging. 2) Provide an update on current issues and challenges in acute pulmonary embolism imaging.

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RC301B Imaging of Chronic Pulmonary Embolism and Pulmonary Hypertension

Participants
Carole J. Dennie, MD, Ottawa, ON (*Presenter*) Speaker, Bayer AG; Spouse, Consultant, Abbott Laboratories

For information about this presentation, contact:

cdennie@toh.ca

LEARNING OBJECTIVES

1) Review the classification of pulmonary hypertension. 2) List CT and MRI features of PH. 3) Describe imaging characteristics of chronic pulmonary embolism.

RC301C Imaging of Pulmonary Arteriovenous Malformations

Participants
Kristopher W. Cummings, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Cummings.Kristopher@mayo.edu

LEARNING OBJECTIVES

1) Explain the role MDCT plays in the evaluation of suspected hereditary hemorrhagic telangiectasia. 2) List the most important information provided by MDCT for management of pulmonary arteriovenous malformations.

RC301D Pulmonary MRA: Practical Applications

Participants
Christopher J. Francois, MD, Madison, WI (*Presenter*) Departmental research support, General Electric Company;

For information about this presentation, contact:

cfrancois@uwhealth.org

LEARNING OBJECTIVES

1) Identify roles for magnetic resonance angiography (MRA) in imaging patients with pulmonary artery disease, particularly on the use of MRA in pulmonary embolism. 2) Describe techniques and protocols for robust, clinical pulmonary MRA. 3) Summarize the evidence supporting the use of pulmonary MRA for pulmonary embolism.

ABSTRACT

1) Pulmonary MRA is appropriate for imaging patients suspected of having pulmonary embolism who have contra-indications to CTA, particularly those in whom avoiding iodinated contrast (due to allergy or decreased renal function) or minimizing radiation exposure

(younger patients) would be beneficial. 2) Current, commercially available MRA sequences that take advantage of newer parallel imaging techniques help ensure consistent pulmonary MRA in a clinical setting. 3) Following multi-center studies (using older MRA techniques and protocols) in the last decade that indicated that pulmonary MRA may not be accurate enough for routine clinical use, more recent studies suggest that pulmonary MRA is effect in identifying clinically significant pulmonary embolism.

Active Handout:Christopher Jean-Pierre Francois

http://abstract.rsna.org/uploads/2018/17000303/RSNA2018_PulmonaryMRA RC301Dpdf.pdf

RC302

What's New from the ABR?

Tuesday, Nov. 27 8:30AM - 10:00AM Room: N230B

ED

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Valerie P. Jackson, MD, Tucson, AZ (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the need for professional self-regulation. 2) Understand the importance of public trust for physicians. 3) Describe ABR's Online Longitudinal Assessment (OLA) program. 4) Discuss advantages of ABR OLA. 5) Describe ABR finances.

Sub-Events

RC302A Board Certification: Where Professional Self-Regulation Meets the Public Trust

Participants
Brent J. Wagner, MD, West Reading, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the importance of professional self-regulation as it relates to the practice of the various disciplines within radiology. 2) Discuss the role of certification as it relates to expectations of patients and the public.

RC302B Online Longitudinal Assessment is Almost Here! What Will It Mean for You?

Participants
Vincent P. Mathews, MD, Hartland, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe ABR's Online Longitudinal Assessment program. 2) Discuss advantages of ABR OLA compared to traditional MOC examinations.

RC302C Things You Always Wanted to Know About ABR Finances

Participants
Robert M. Barr, MD, Charlotte, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the basic finances of the ABR as well as the oversight process. 2) To gain insight into the philosophy of the executive team with regard to ABR spending. 3) To learn how your fees are used to administer and improve the board certification process.

RC303

Cardiac Series: Emerging Cardiovascular MR and CT Imaging Techniques

Tuesday, Nov. 27 8:30AM - 12:00PM Room: E350

CA BQ CT MR

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants
Hildo J. Lamb, MD, PhD, Leiden, Netherlands (*Moderator*) Nothing to Disclose
Gautham P. Reddy, MD, Seattle, WA (*Moderator*) Researcher, Koninklijke Philips NV;
Karen G. Ordovas, MD, San Francisco, CA (*Moderator*) Advisor, Arterys Inc
Albert Hsiao, MD,PhD, La Jolla, CA (*Moderator*) Founder, Arterys, Inc; Consultant, Arterys, Inc; Consultant, Bayer AG; Research Grant, General Electric Company;
Karin E. Dill, MD, Worcester, MA (*Moderator*) Nothing to Disclose

Sub-Events

RC303-01 Spectral Detector CT

Tuesday, Nov. 27 8:30AM - 8:55AM Room: E350

Participants
Suhny Abbara, MD, Dallas, TX (*Presenter*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

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RC303-02 Spectral Detector Computed Tomography Enabled Contrast Media Reduction for TAVR Planning CT: Evaluation in 60 Patients

Tuesday, Nov. 27 8:55AM - 9:05AM Room: E350

Participants
Nils Grosse Hokamp, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Rahul B. Thomas, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Amit Gupta, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Omer Alabar, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Leslie Ciancibello, RT, Cleveland , OH (*Abstract Co-Author*) Consultant, Cassling Group Consultant, Siemens AG
Armando Cavallo, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Computed tomography is imaging method of choice for procedural planning in patients prior to transcatheter aortic valve replacement (TAVR). The patients eligible for TAVR constitute an elderly population which frequently have an impaired kidney function. We aimed to evaluate if TAVR imaging with reduced contrast media is enabled by spectral detector computed tomography (SDCT).

METHOD AND MATERIALS

60 patients (31 female, mean age 81.6±10.3) were included in this retrospective, IRB-approved and HIPPA-compliant study. The imaging protocol comprised a prospective-ECG gated study of the entire chest (Th) immediately followed by a retrospective, ECG-gated covering the heart (Car) and a non-gated study of the abdomen and pelvis (Abd). For both, Th/Car and Abd, 25 ml of iodinated contrast media (c=350 mg/ml ioversol) was administered through an antecubital vein followed by a 40 ml saline flush. 25 ml constitutes a reduction by 50% as compared to the institutional standard. Th/Car/Abd images were reconstructed in axial plane with a slice thicknesses of 2/0.9/2 mm as conventional images (CI) and virtual monoenergetic images of 40-200 keV (VMI). Objective image evaluation was performed based on regions of interest placed in the aortic bulb, the descending aorta and the external iliac arteries. Further, one cardiologist and one radiologist evaluated the studies with respect to their utility for TAVR planning. Pre- and post-proecedural serum creatinine was collected. Data was assessed statistically using ANOVA with Dunnet's post-hoc or Wilcoxon test.

RESULTS

VMI 40keV resulted in a significant improvement in image contrast as compared to CI, this accounts for all, e.g. in the aortic bulb

VMI_40keV resulted in a significant improvement in image contrast as compared to CI, this accounts for all, e.g. in the aortic bulb and the external iliac arteries 215.9±81.3 HU/604.9±274.4 HU and 205.3±74.6 HU/583.3±241.5 HU (p<=0.05). Out of all studies, 2 studies were not diagnostic due to missed contrast bolus. All other studies provided sufficient image quality for TAVR evaluation. No patient showed adverse renal effects.

CONCLUSION

Pre-TAVR examinations can be carried out using SDCT using the described protocol. Moreover, SDCT enables a reduction of contrast media by 50% possibly limiting adverse renal effects.

CLINICAL RELEVANCE/APPLICATION

In patients with impaired kidney function, examination on SDCT should be considered for TAVR planning as it enables contrast dose reduction by 50%.

RC303-03 Myocardial Rest Perfusion CTA Improves Stenosis Quantification in Regions of Artefact from Calcified Plaque and Motion: Dual Energy CTA Compared With Catheter Coronary Angiography

Tuesday, Nov. 27 9:05AM - 9:15AM Room: E350

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To assess the utility of resting CT dual energy myocardial perfusion in improving the diagnostic performance of CT coronary angiography in assessment of coronary artery stenosis in areas of artefact due to calcified plaque and motion: direct comparison with catheter coronary angiography.

METHOD AND MATERIALS

1347 CT coronary angiograms were performed in our institute from January 2104 to December 2017, out of with 32 cases with dual energy CT angiography(DE-CTA) and catheter coronary angiography performed within a span on 2 weeks from each other were included in this study. DE-CTA was performed using a 64 detector row CT scanner with fast KvP switching and ECG gating in the prospective mode. High calcium score in these patients prompted the use of DE-CTA. Iodine-water material decomposition images in the short axis plane using minimum intensity projections of 5 mm thickness, were reviewed for the presence of resting perfusion defects. Diagnostic accuracy was assessed by comparison with CAG. Coronary segments with indeterminate stenosis due to blooming artefact from heavily calcified plaque or motion artefact were reclassified as significant stenosis if there was a perfusion defect in the corresponding myocardial segment. Significant coronary stenosis was defined as a > 50% stenosis on CAG. Sensitivity, specificity, positive predictive value and negative predictive value of DE-CTA alone and DE-CTA combine with perfusion assessment for the detection of significant stenosis were calculated.

RESULTS

DE-CTA combined with perfusion assessment for the detection of significant stenosis showed improvement over DE-CTA alone. mean age of 58 ± 7. The calcium scores ranged from 40 to 344 AU.The sensitivity, specificity, positive predictive value and negative predictive value increased from 81% to 85%, 87% to 94%, 63% to 79% and 95% to 96%, respectively. The area under the receiver operating characteristic curve for detecting CAD also increased from 0.84 to 0.89 (p=0.02).

CONCLUSION

Dual energy CT with rapid KvP switching showed a high sensitivity and negative predictive value of the detection of significant coronary stenoses. There was improvement in diagnostic performance when both CTCA and perfusion assessment were used for stenosis evaluation.

CLINICAL RELEVANCE/APPLICATION

Myocardial rest perfusion CT has additional value is assessment of coronary stenoses in vessels with heavily calcified plaque and motion artefacts.

RC303-04 Quantifying Regional Myocardial Function-Strain, Torsion and Twist

Tuesday, Nov. 27 9:15AM - 9:40AM Room: E350

Participants
Bernd J. Wintersperger, MD, Toronto, ON (*Presenter*) Speaker, Siemens AG; Research support, Siemens AG; Institutional research agreement, Siemens AG; Speaker, Bayer AG

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LEARNING OBJECTIVES

1) Describe the principle architecture of the LV related to cardiac function. 2) Describe the principles of regional myocardial function assessment. 3) Compare different imaging approaches for quantification of regional myocardial function. 4) Identify

possible applications of regional function analysis in clinical cardiac imaging.

ABSTRACT

A complex joint effort of the entire heart muscle facilitates normal ventricular output. While the evaluation of cardiac volumes and global function aims at assessment of the gross ventricular status, measures of regional myocardial function provide a more detailed analysis of myocardial function at tissue level.Parameters of regional myocardial function generally describe the relationship between force and resulting deformation of finite elements. Furthermore, such regional parameters are used to describe these relationships along various directions of the cardiac axis and coordinate system. The complex composition of myocardial layers including the change of fiber orientation with location may also allow more insight into the effect of pathologies on function.Different modalities (Echo, MRI, CT) have been proposed for the assessment of such parameters. While in MRI regional parameters have predominately been used for research purposes, the development of speckle-tracking echocardiography (STE) and its evaluation has pushed towards clinical applications of regional myocardial functional parameters. In MRI, the recent push towards analysis of strain based on standard cine SSFP techniques enables further analysis without impact on scanning workflow; and with the use of modern post-processing semi-automated/automated approaches appear feasible. At this stage, normal ranges and the test-retest variability of the different algorithms are under evaluation.The clinical use of such techniques may allow for earlier identification of subclinical pathology and as such may trigger therapy decisions at earlier time points.Standardization of approaches and definition of normal ranges may be required for different techniques; preferably black box approaches should be avoided.

Active Handout:Bernd J. Wintersperger

http://abstract.rsna.org/uploads/2018/16001381/WinterspergerRSNA2018 RC303-04.pdf

RC303-05 Standardization for FT-CMR Strain Analysis: The Long Road to an Imaging Biomarker

Tuesday, Nov. 27 9:40AM - 9:50AM Room: E350

Participants
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PURPOSE

While post-processing feature tracking cardiac magnetic resonance (FT-CMR) imaging is rapidly evolving, the literature available still remains scarce. This is especially striking for the right ventricle (RV), where only 9 out of the 17 publications recently compiled in a meta-analysis by Vo et al. included the RV. In order to establish imaging biomarkers however, it is essential to have a broad dataset to analyze and then standardize for various influencing factors.

METHOD AND MATERIALS

CMR was performed on 62 carefully selected healthy volunteers at 3T (Magnetom Skyra®, Siemens Healthineers). Eligible for inclusion were adults without any cardiac disease history from 20 to 80 years old who were then stratified in 3 age groups with uniform distribution of men and woman. A semi-automatic tissue tracking software (CVI42 Circle®) then subsequently tracked the myocardial movement enabling us to calculate strain parameters, standardize for age and sex using ANOVA and establish reference values for the right ventricle.

RESULTS

The following mean normal values for the RV were found: global radial strain 13.47% (+- 6.46), global circumferential strain -7.61% (+- 3.92) and median global longitudinal strain -24.35% (+- 5.22). RV strains values were significantly different between old and young individuals ($p<0.05$), while sex had a smaller impact. Interestingly, all global left ventricular strains showed statistically significant differences with regard to sex (all $p<0.05$) but not with regard to age.

CONCLUSION

Parts of our results contrast those of recently published studies. These differences might be explained by the use of different software, number of slices used for tracking and measured strain parameters. This stresses the urgent need of further standardization before we can effectively employ FT-CMR in clinical routine.

CLINICAL RELEVANCE/APPLICATION

FT-CMR derived imaging biomarkers hold a great potential to increase the diagnostic accuracy for myocardial pathologies while simultaneously reducing the need for more invasive diagnostic measures.

RC303-06 Strain Analysis Using Feature Tracking Cardiac Magnetic Resonance (FT-CMR) In Assessment of Myocardial Viability in Chronic Ischemic Patients

Tuesday, Nov. 27 9:50AM - 10:00AM Room: E350

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To determine the strength of peak circumferential and radial strain analysis by FT-CMR using routinely acquired cine images in differentiating between viable and non-viable myocardium in chronic ischemic patients.

METHOD AND MATERIALS

CMR exams were performed on a 1.5T machine to assess viability in 30 patients with chronic ischemia, 26 males and 4 females, with a mean age of 55 (range=33-85 years). Mean ejection fraction was 40±12%. Short axis standard steady-state in free-precession(SSFP) cine images were used in peak circumferential and radial strain quantification, and results were compared with regional wall motion and visually evaluated late gadolinium enhancement (LGE) scar transmurality. A total of 480 segments for ischemic patients were analyzed. 135 segments were hypokinetic, 78 were akinetic and only 1 segment was dyskinetic. 76 segments were non-viable and 404 segments were viable based on LGE. CMR exams of a control group of 10 healthy volunteers with a mean age of 38±11 were used. 160 normal myocardial segments were analyzed.

RESULTS

Peak global circumferential strain was statistically significantly impaired in ischemic patients compared to controls(-13.29 ±8.98 vs. -19.63 ±7.08),P< 0.0001. Similarly, peak global radial strain was statistically significantly impaired in ischemic patients compared to controls(21.88 ±17.96 vs. 30.90 ±18.59),P<0.0001. Segmental circumferential strain was statistically significantly impaired in non-viable segments compared to viable segments(-8.21 ±9.32 vs. -14.26 ±8.64),P<0.0001. Segmental radial strain was statistically significantly impaired in non-viable segments compared to viable segments(14.68 ±13.59 vs. 23.24 ±18.49),P<0.0001. A cut-off point of circumferential strain of -8 was attained (below which the segment is considered as non-viable) with sensitivity 58 %, specificity 84%, NPV 90%, PPV 44% and diagnostic accuracy 79%. A cut-off point of radial strain of 14 was attained (below which the segment is considered as non-viable) with sensitivity 55%, specificity 73%, NPV 90%, PPV 28% and diagnostic accuracy 70%.

CONCLUSION

FT-CMR is a time-efficient post processing tool than can reliably aid in differentiating viable and non-viable myocardium with no need for additional sequence acquisition or contrast administration.

CLINICAL RELEVANCE/APPLICATION

FT-CMR can robustly predict prognosis by viability assessment and is recommended in routine CMR exams before percutaneous intervention.

RC303-07 Valvular Flow Quantification with Phase Contrast Imaging (2D, 4D)

Tuesday, Nov. 27 10:20AM - 10:45AM Room: E350

Participants
Michael Markl, PhD, Chicago, IL (*Presenter*) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;

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LEARNING OBJECTIVES

1) Understand principles and techniques for cardiovascular flow quantification using 2D phase contrast MRI and 4D flow MRI. 2) Describe advantages of 4D flow MRI for the comprehensive assessment of valvular flow characteristics. 3) Identify possible applications of 2D and 4D flow MRI in clinical cardiovascular imaging.

RC303-08 4D Flow in vitro Evaluation of Aortic Valve Replacements Reveals Physiologic Hemodynamics Distal to Mechanical Valves in Contrast to Biological Valves

Tuesday, Nov. 27 10:45AM - 10:55AM Room: E350

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PURPOSE

To evaluate hemodynamics distal to mechanical and biological aortic valves in vitro by 4d flow MRI.

METHOD AND MATERIALS

Five aortic valve prostheses of identical diameter [mechanical valves, MV: trileaflet valve (prototype), On-X (CryoLife); biological valves, BV: Perimount Magna Ease (Carpentier-Edwards), Trifecta valve (Abbott), Tribio (protoype); all 21mm] were placed in a flexible silicone aortic phantom (Elastrat, Switzerland). Scans were conducted at 3T with and without valves under pulsatile flow conditions (60 bpm with home-built piston pump) in a pressure-controlled model using Gadolinium-doped blood mimicking fluid (36.6% glycerin solution). Three levels of cardiac output (CO) were tested to simulate ascending flow conditions (CO-1, CO-2, CO-3). Time-resolved velocity information of every voxel was measured and analyzed using GTFlow (GyroTools, CH). Hemodynamic parameters and presence of secondary flow patterns were evaluated.

RESULTS

There was a pronounced central ejection jet in the aortic bulb distal to biological valves at all COs with higher peak velocities compared to mechanical ones (e.g. CO-2 Bulb: MV 138±12cm/s; Tribio+Perimount: 198±15cm/s; Trifecta: 159cm/s), indicating a relative stenosis of BV compared to MV with the same diameter. All valves were regurgitant with an average retrograde volume of 10±3ml. While mechanical valves resulted in near-physiological aortic flow patterns with pronounced sinus vortices, there was marked formation of secondary helices and vortices in the ascending aorta distal to biological valves at all CO-levels altering commonly observed primary flow patterns.

CONCLUSION

Biological valves result in increased flow velocities in the aortic bulb and ascending aorta as compared to mechanical valves. The valve leaflets of the Trifecta valve are attached at the outside of the commissures in contrast to other BV. Apparently, this results in a lesser degree of relative stenosis with peak velocities between those of MV and BV. In addition, biological valves also caused secondary flow patterns in contrast to mechanical valves that revealed near-to-normal hemodymamics. These results are in line with previous turbulent kinetic energy measurements and CFD simulations.

CLINICAL RELEVANCE/APPLICATION

Aortic flow patterns distal to mechanical valves more closely mirror physiology which may translate in alterations in kinetic energy or wall shear forces and thus influence patients' long-term health.

RC303-09 4D Flow MRI Evaluation of a New Technique of Valve-Sparing Aortic Root Replacement (VSARR)

Tuesday, Nov. 27 10:55AM - 11:05AM Room: E350

Participants
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PURPOSE

The aim of this study was to evaluate hemodynamics and blood flow patterns by 4D flow MRI after a modified VSARR in comparison with the standard David procedure. The new technique is conceived to ease the operative procedure, avoid prosthesis and annular deformation and facilitate coronary reimplantation.

METHOD AND MATERIALS

27 patient (23 males; mean age= 59.5 ±13.14) including 13 patients after David procedure (group 1) and 14 patients after the modified one (group 2) underwent 4D flow evaluation with a 1.5 T MRI system (Siemens MAGNETOM Aera, Siemens Healthineers, Erlangen, Germany). Four-dimensional flow CMR data were acquired using a sagittal oblique volume covering the thoracic aorta. Data were transferred to an onsite computer equipped with a commercially available software CAAS (Pie Medical Imaging, Maastricht, The Netherlands). Average interval from surgery was 8.7 ±1.7 years. Analysis included (a) wall shear stress (WSS) measurements performed at different levels of the thoracic aorta (neo-sinuses, sinotubular junction, ascending aorta and proximal arch), (b) qualitative assessment of flow pattern (laminar, helical or turbulent) and (c) flow eccentricity using a 3-point scale.

RESULTS

No significant differences were found between the two groups in terms of: (a) WSS (neo-sinuses: 1183 mPa ±610 vs 1418 ±664, p=0.35; sinotubular jonction: 1577 ±519 vs 1864 ±673, p=0.23; ascending aorta: 1464 ±598 vs 1697 ±430, p=0.25; arch: 835 ±401 vs 898 ±214, p=0.62) and (b) flow pattern mainly rated as turbulent in both groups (p=0.12). A higher overall degree of flow eccentricity was observed in group2 mainly rated as moderate (6/14, 43%) without significant difference with group1 (6/13, 46% rated as central; p=0.34).

CONCLUSION

4D flow MRI demonstrates similar haemodynamics and blood flow patterns with the simplified David procedure compared with the classical one.

CLINICAL RELEVANCE/APPLICATION

MRI 4D flow allows a detailed analysis of post-surgical hemodynamic profile of the thoracic aorta.

RC303-10 Multiparametric Myocardial MR Mapping (T1, T2 and T2*)

Tuesday, Nov. 27 11:05AM - 11:30AM Room: E350

Participants

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LEARNING OBJECTIVES

1) Describe the basic techniques of myocardial MR mapping. 2) Explain the role of myocardial MR mapping. 3) Identify findings of common diseases on T1, T2, and T2* maps.

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/ Kate Hanneman, MD, FRCPC - 2017 Honored EducatorKate Hanneman, MD, FRCPC - 2018 Honored Educator

RC303-11 Comparison of Different Cardiovascular Magnetic Resonance Sequences for Native, Stress and Post-Contrast Myocardial T1 Mapping: Preliminary Results

Tuesday, Nov. 27 11:30AM - 11:40AM Room: E350

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PURPOSE

To compare the native, stress and post-contrast T1 values obtained from different sequences for T1 mapping of the myocardium.

METHOD AND MATERIALS

We compared three T1 mapping sequences (FFM, MPI and LONG/SHORT) of 211 consecutive populations (patients and healthy volunteers) using conservative septal technique as the standardized approach. We calculated ventricular septum and related blood T1 in vivo through subsequent parametric mapping. We also analyzed the T1 differences of these sequences in native, stress and post-contrast conditions.

RESULTS

T1 values differed significantly depending on the sequence, with MPI providing consistently higher mean values than FFM (1310±62 ms vs. 1150±63 ms in native condition, 1327±63 ± 28 ms vs. 1153±61 ms in stress condition and 604±65 ms vs. 588±64 ms in post-contrast condition, mid-ventricular, respectively; p < 0.001), LONG providing higher and SHORT providing lower mean values than FFM (1075±109 ms vs. 1042±80 ms in native condition, 519±77 ms vs. 535±68 ms in post-contrast condition, mid-ventricular, respectively; p < 0.001) . T1 values also differed significantly depending on the stress, with stress FFM and MPI providing higher mean values than the native (1147±69 ms vs. 1135±63 ms, 1327±63 ms vs. 1302±57 ms, mid-ventricular, respectively; p < 0.001). On Passing-Bablok regression analysis, MPI is significantly correlated with FFM in native, stress and post-contrast (r=0.501, 0.450, 0.871, respectively; p < 0.001). FFM is significantly correlated with LONG, SHORT in mid-ventricular segment (r=0.805, 0.966, respectively; p < 0.001). On Bland-Altman analysis, the mean difference (95% limits of agreement) between MPI and FFM in native, stress and post-contrast is 160.1ms(48.8ms-271.4), 173.8ms(46.1ms-301.6ms), 16.8ms(42.4ms-75.9ms), respectively. The mean difference (95% limits of agreement) between FFM and LONG, SHORT in mid-ventricular segment is 32.3ms(-79.3ms-144.0), -17.2ms(-58.3ms-23.9ms), respectively.

CONCLUSION

FFM and MPI showed good agreement with MPI values are much higher than FFM. FFM and LONG/SHORT showed good agreement with LONG values are higher than FFM and SHORT values are lower than FFM. Stress increase the T1 values of myocardium in FFM and MPI.

CLINICAL RELEVANCE/APPLICATION

T1 values differed significantly depending on the sequence and therefore it is necessary to respectively establish the T1 normal reference range according to different sequences.

RC303-12 Native T1 Value and Extracellular Volume of Infarct Myocardium for Predicting Adverse Left Ventricular Remodeling

Tuesday, Nov. 27 11:40AM - 11:50AM Room: E350

Participants
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PURPOSE

In T1-mapping techniques, native T1 value and extracellular volume (ECV) of infarct myocardium are applied to assess the severity of injury and predict functional recovery in patients with acute myocardial infarction (MI). We sought to investigate whether native T1infarct value and ECVinfarct is affected by microvascular obstruction (MVO) and have predict value for adverse left ventricular (LV) remodeling post-MI.

METHOD AND MATERIALS

54 MI patients underwent acute and 3-month 3T CMR, including cine, T1-mapping and late gadolinium enhancement (LGE). Infarct zone was determined by LGE image and then transposed to native T1-mapping and ECV mapping images for native T1infarct value and ECVinfarct measurement. The visible hypo-intensity core within infarct zone was eliminated when MVO presented.

RESULTS

Among 54 patients, 36 (66.67%) had MVO in acute phase and 20 (37.04%) developed adverse LV remodeling in chronic phase. There wasn't significant difference in T1infarct value between patients with and without MVO (1474.7 ± 63.5ms vs. 1495.4 ± 98.0ms, P = 0.352), while ECVinfarct is higher in patients with MVO than those without (58.66 ± 8.71% vs. 49.64 ± 8.82%, P = 0.001). T1infarct value merely had the correlation with the 3-month change of end-diastolic LV volume (rMVO absent = 0.483, P = 0.042) and predicted LV remodeling in patients without MVO (rMVO absent = 0.659, P = 0.003); ECVinfarct had the correlation with the change of end-diastolic LV volume (rall patients = 0.564, P < 0.001) and predicted LV remodeling in all patients (rMVO absent = 0.626, P = 0.005; rMVO present = 0.686, P < 0.001; rall patients = 0.622, P < 0.001). In multivariable logistic analysis, ECVinfarct was also associated with LV remodeling (ß= 0.312, P = 0.007).

CONCLUSION

In infarct myocardium, native T1 value might be influenced by MVO but ECV isn't. T1infarct value predicts LV remodeling in MVO absent MI and ECVinfarct predicts LV remodeling in all MI.

CLINICAL RELEVANCE/APPLICATION

The combination of native T1 value and ECV in infarct myocardium has the potential to predict adverse LV remodeling post-MI and select high-risk patients who need more aggressive treatments.

RC303-13 Artificial Intelligence Machine Learning-based Prediction of Hematocrit Values from Native MRI Myocardial T1-maps to Avoid Blood Sampling for Extracellular Volume Fraction Analysis

Tuesday, Nov. 27 11:50AM - 12:00PM Room: E350

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PURPOSE

To evaluate a machine learning (ML) algorithm developed in-house to estimate blood hematocrit levels (Hct) from native MRI myocardial T1-maps in order to avoid blood sampling prior to cardiac MRI studies involving extracellular volume fraction (ECV) analysis.

METHOD AND MATERIALS

A total of 51 consecutive patients (age 56±13y) selected from a prospective study who underwent cardiac MRI (Avanto, Siemens, Erlangen, Germany) at 1.5T were included. MRI protocol consisted of native (MOLLI scheme 5(3)3) and post-contrast (15-min post-Gd, scheme 4(1)3(1)2) T1-maps of the myocardium. Native blood R1 (1/T1) values were measured in the left ventricle for Hct estimation. A linear regression (LR) analysis was applied to model the relationship between the image-derived data and laboratory Hct values. For the ML approach, 31 additional features based on patient demographics, clinical history, and imaging parameters were extracted and used to train a linear Support Vector Machine employing k-fold cross validation. ECV values were calculated based on each Hct and compared by the Friedman-test. Derived Hct values were compared using linear regression and the Friedman-test.

RESULTS

Average native blood T1 and R1 measurements were 1654±142ms and 0.60±0.04s-1, respectively. Hct derived from native T1-maps by the LR and ML algorithms were 38.7±3.3% and 39.1±3.6%, respectively, and did not show statistical difference when compared to laboratory Hct values (38.7±4.8; P=0.446). The LR approach provided the following model for Hct calculation: Hct[%]=89.8×R1[native,blood] -19.0]. The LR model-based Hct demonstrated a weaker relationship with laboratory Hct values (r=0.70; P<0.001). The ML model showed a moderate relationship to blood-sampled Hct values (r=0.78; P<0.001). Analysis of the residuals demonstrated an increase in accuracy for the ML approach compared to the LR model (RMSE 3.07 vs. 3.47). ECV values derived from LR, ML, and lab techniques were in good agreement (38.1±16.9, 37.9±16.8, and 37.9±17.0%, respectively; P=0.475).

CONCLUSION

The ML-based algorithm provides accurate Hct estimation and reliable myocardial ECV calculation, highlighting its potential in clinical workflows to generate ECV without the need for same-day laboratory Hct measurement.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates the benefit of a ML strategy to eliminate the need for blood sampling prior to cardiac MRIs involving myocardial ECV measurement.

RC304

Musculoskeletal Series: Ultrasound

Tuesday, Nov. 27 8:30AM - 12:00PM Room: E450A

MK US

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

Participants
Viviane Khoury, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose
Linda Probyn, MD, Toronto, ON (*Moderator*) Nothing to Disclose
Jon A. Jacobson, MD, Ann Arbor, MI (*Moderator*) Research Consultant, BioClinica, Inc; Advisory Board, General Electric Company; Advisory Board, Koninklijke Philips NV; Royalties, Reed Elsevier
Marnix T. van Holsbeeck, MD, Detroit, MI (*Moderator*) Minor stockholder, Koninklijke Philips NV; Minor stockholder, General Electric Company; Stockholder, MedEd3D; Grant, Siemens AG; Grant, General Electric Company;

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LEARNING OBJECTIVES

Moderator

ABSTRACT

Moderator

Sub-Events

RC304-01 Shoulder Ultrasound (Demonstration)

Tuesday, Nov. 27 8:30AM - 9:05AM Room: E450A

Participants
Viviane Khoury, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the ultrasound anatomy of shoulder structures evaluated in a routine shoulder examination. 2) Learn the standardized approach used in the evaluation of the shoulder with US. 3) Demonstrate the scanning technique for the dynamic examination of common shoulder lesions. 4) Outline how to position patients optimally for the evaluation of the shoulder respecting ergonomics.

RC304-02 The Use of Dynamic Ultrasound in the Diagnosis and Follow-up of Patients with Clinically Suspected Slipping Rib Syndrome

Tuesday, Nov. 27 9:05AM - 9:15AM Room: E450A

Participants
Dane Carlisle Van Tassel, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose
Kevin Wong, DO, East Lansing, MI (*Abstract Co-Author*) Nothing to Disclose
Lisa McMahon, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Slipping Rib Syndrome (SRS) is a condition that affects adolescents and young adults. Dynamic Ultrasound imaging has a potential and likely significant role; however, limited data exists describing the protocol and techniques available. It is our intent to describe the development of an effective and reproducible protocol for dynamic imaging in patients with SRS.

METHOD AND MATERIALS

Retrospective review was performed of suspected SRS patients presenting to the Radiology or Surgery department from March to

December 2017. 29 patients were evaluated. Focused history was taken, and imaging was performed at the site of pain. Images of the bilateral 6th-11th ribs were obtained at rest and with dynamic maneuvers. Dynamic maneuvers included Valsalva, crunch, focal rib push/compression, and any provocative movement that elicited pain per the patient. Imaging was correlated with medical/surgical records generated by the pediatric surgeon specializing in treatment of slipping ribs. Group comparisons were conducted using the Wilcoxon rank sum and Fisher's exact test. Sensitivity and specificity were provided with the 95% confidence interval (CI) based on the binomial distribution and exact confidence limits.

RESULTS

21 of 29 patients had a clinical diagnosis of SRS, with an average age of 17 years. 4 patients were scanned twice for a total of 33 scans. 21 patients were female, while 8 were male. 66% (19/29) were athletes, with average BMI of 22.7. Dynamic ultrasound correctly detected SRS in 92% (23/25) of cases and correctly excluded SRS in 100% (8/8) of cases. The push maneuver demonstrated the highest sensitivity (87% (0.62,0.98)) followed by morphology (76% (0.55,0.91)) and then crunch maneuver (73% (0.50,0.89)). Valsalva was the least sensitive (10% (0.01,0.32)). Both false negative examinations did not utilize dynamic crunch or push maneuvers.

CONCLUSION

Dynamic Ultrasound imaging of the ribs, particularly with utilization of crunch and push maneuvers, is an effective and reproducible tool for the diagnosis of SRS. Valsalva has a limited role for the detection of slipping rib given low sensitivity. Ultrasound has the ability to give the surgeon morphological data and information on additional ribs that are at risk, thereby assisting in surgical planning.

CLINICAL RELEVANCE/APPLICATION

Dynamic Ultrasound is a valuble tool in the diagnosis and surgical planning of an uncommon and likely underrecognized entity; Slipping Rib Syndrome.

RC304-03 Supraspinatus Muscle Shear Wave Elastography (SWE): Detection of Biomechanical Differences with Varying Tendon Quality Prior to Gray-scale Morphologic Changes

Tuesday, Nov. 27 9:15AM - 9:25AM Room: E450A

Awards
Student Travel Stipend Award

Participants
Dana Lin, MD, New York, NY (*Presenter*) Nothing to Disclose
Christopher J. Burke, MBChB, New York, NY (*Abstract Co-Author*) Nothing to Disclose
James S. Babb, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Ronald S. Adler, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to determine whether SWE can detect biomechanical changes in the supraspinatus muscle that occur with increasing supraspinatus tendon abnormality prior to morphologic gray-scale changes.

METHOD AND MATERIALS

An IRB approved, HIPAA compliant mixed retrospective/prospective study of shoulder ultrasounds from 2013-2018 was performed. Images were acquired by a single radiologist with 26 years musculoskeletal ultrasound experience on a Siemens Acuson S3000 with Virtual Touch™ IQ in longitudinal orientation to the supraspinatus muscle with shear wave velocity (SWV) point quantification. Tendon and muscle were graded in order of increasing tendinosis/tear (e.g. tendon grade 1=normal tendon or mild tendinosis without tear to grade 4=full-thickness tear) and increasing fatty infiltration (0-3 scale). Mixed model analysis of variance, analysis of covariance, and Spearman rank correlation were used for statistical analysis.

RESULTS

The cohort consisted of 79 patients (mean age 54±15 years-old; 47% male, 53% female) with 100 ultrasounds. There was no statistically significant age or sex dependence for supraspinatus muscle SWV ($p=0.886$, 0.119, respectively). There was no significant correlation between muscle SWV and muscle or tendon grade ($p=0.744$, 0.377, respectively). In patients with morphologically normal muscle on gray-scale ultrasound, there were significant differences in muscle SWV when comparing tendon grade 3 with grades 1, 2, and 4 ($p=0.018$, 0.025, 0.014, respectively), even when adjusting for gender and age ($p=0.044$, 0.028, 0.018, respectively). Pairwise comparison of tendon grades other than those mentioned did not achieve statistical significance ($p>0.05$).

CONCLUSION

SWE can detect biomechanical differences within the supraspinatus muscle that are not morphologically evident on gray-scale ultrasound. Specifically, supraspinatus partial tears with at least moderate tendinosis may correspond to biomechanically distinct muscle properties compared to both lower grades of tendon abnormality and full-thickness tears.

CLINICAL RELEVANCE/APPLICATION

SWE may be a novel tool to quantitatively evaluate muscle quality in the setting of rotator cuff disease. Further research is needed to determine whether this may aid prognosis for repair outcomes.

RC304-04 Prevalence of Pseudoerosions of the Hand and Wrist: Ultrasound Findings in 100 Asymptomatic Volunteers

Tuesday, Nov. 27 9:25AM - 9:35AM Room: E450A

Awards
Student Travel Stipend Award

Participants

Anna L. Falkowski, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose
Jon A. Jacobson, MD, Ann Arbor, MI (*Abstract Co-Author*) Research Consultant, BioClinica, Inc; Advisory Board, General Electric Company; Advisory Board, Koninklijke Philips NV; Royalties, Reed Elsevier
Vivek Kalia, MD, MPH, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Angela Atinga, MBBCHIR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Girish Gandikota, MBBS , Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Ralf G. Thiele, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Identification of cortical erosions with ultrasound is an important finding that can indicate inflammatory arthritis. While cortical depressions have been described in several metacarpal heads that may potentially simulate an erosion, we have noted similar "pseudoerosions" more frequently than prior descriptions, and with more extensive involvement of the wrist. Thus, our purpose is to evaluate the frequency and location of these pseudoerosions in asymptomatic volunteers.

METHOD AND MATERIALS

After IRB approval and obtaining informed consent,100 subjects without hand or wrist symptoms were examined bilaterally with ultrasound. Dorsal metacarpal heads, lunate, triquetrum, and distal ulna were examined. Cortical depressions were characterized with regard to location (central, marginal, both), morphology (irregularity, ring-down artifact), and dimensions (length and depth) by two fellow-trained musculoskeletal radiologists in consensus.

RESULTS

Study group consisted of 52 male and 48 female subjects with mean age of 47 ± 16 years. Metacarpal (MC) heads showed a central pseudoerosion in various frequencies (MC1: 21.5%; MC2: 92%; MC3: 85.5%; MC4: 59.5%; MC5: 81%). Only one marginal erosion was present at a MC5 and a marginal plus central at a MC2. Pseudoerosions were present at the lunate (82%), triquetrum (84%), and distal ulna (20%), and were multiple (lunate: 40%; triquetrum: 27%, ulna 5%). Ring-down artifact (30.25 - 49.7%) was present more than cortical irregularity (12.6 - 27.9%) of the pseudoerosions. Mean pseudoerosion length and depth of MC was 3 mm (range: 0.6 - 9 mm) and 0.7 mm (range: 0.2 - 8), respectively. Wrist dimensions for pseudoerosions varied slightly for the lunate (length: 2.1; depth: 0.8), triquetrum (length: 1.7; depth: 1.0), and ulna (length: 1.7; depth: 1.1) with a range of 0.3 - 6 mm in length, and 0.3 - 5 mm in depth.

CONCLUSION

Central pseudoerosions are a typical finding of metacarpal heads, lunate, triquetrum, and distal ulna in asymptomatic patients and should not be misinterpreted as inflammatory arthritis.

CLINICAL RELEVANCE/APPLICATION

Knowledge of erosion mimickers and their characteristics will enable the differentiation between a physiologic finding and a true inflammatory bone defect.

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/ Jon A. Jacobson, MD - 2012 Honored EducatorJon A. Jacobson, MD - 2017 Honored Educator

RC304-05 Wrist Ultrasound (Demonstration)

Tuesday, Nov. 27 9:35AM - 10:10AM Room: E450A

Participants
Linda Probyn, MD, Toronto, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe an approach to ultrasound examination of the wrist including dynamic imaging. 2) Identify potential pitfalls. 3) Review important anatomy of the wrist including tendons, ligaments, nerves and common sites of pathology.

RC304-06 Hip Ultrasound (Demonstration)

Tuesday, Nov. 27 10:20AM - 10:55AM Room: E450A

Participants
Jon A. Jacobson, MD, Ann Arbor, MI (*Presenter*) Research Consultant, BioClinica, Inc; Advisory Board, General Electric Company; Advisory Board, Koninklijke Philips NV; Royalties, Reed Elsevier

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LEARNING OBJECTIVES

1) Be able to list the components of an ultrasound scanning protocol to evaluate the hip. 2) Recognize normal hip anatomy as seen with ultrasound. 3) Understand ultrasound scanning pitfalls.

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/ Jon A. Jacobson, MD - 2012 Honored EducatorJon A. Jacobson, MD - 2017 Honored Educator

RC304-07 Ultrasound Guided Targeted High Volume Injection (HVI) of the Rotator Cuff Interval versus Supervised Physical therapy for Primary Adhesive Capsulitis of Shoulder: A Randomized Control Study

Tuesday, Nov. 27 10:55AM - 11:05AM Room: E450A

Participants
Joban Babhulkar, MBBS,DMRD, Pune, India (*Presenter*) Nothing to Disclose
Vishal Walasangikar, MD,MBBS, Pune, India (*Abstract Co-Author*) Nothing to Disclose
Vishnu R. Unnithan, MBBS,DO, Pune, India (*Abstract Co-Author*) Nothing to Disclose
Ashish Babhulkar, MBBS,DO, Pune, India (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

High volume injection (HVI) is a promising treatment option for severe adhesive capsulitis, for faster rehabilitation. We present a single center, single blinded, matched parallel randomized control trial (RCT) comparing ultrasound-guided HVI through rotator cuff interval followed by supervised physical therapy, versus supervised physical therapy alone for severe primary adhesive capsulitis of shoulder joint.

METHOD AND MATERIALS

40 patients were randomized in to two groups: Group-A (n=20) underwent supervised physiotherapy in addition to HVI, and Group-B (n=20) underwent supervised physiotherapy in isolation. A blinded researcher carried out assessments at 0,3 & 6 months. The primary outcome measure was shoulder range of motion (ROM), especially external rotation. In addition UCLA score, VAS score, cuff strength, failure rates and return to pre-disease activity levels were assessed.

RESULTS

Group-A fared better in all parameters at 2 weeks and 3 months, but by 6 months the outcome results of both the groups were similar. In Group-A, the external rotation improved significantly from 4.50 (-300 to 200) at baseline to 43.250 (150 to 800; P<0.05) at 3 months and 51.250 (150 to 850) at 6 months; which were 6.250 (-200 to 250), 36.750 (150 to 600) and 47.50 (150 to800) respectively in Group-B. Group-A had statistically significant improvement in UCLA score (p<0.05) compared to Group-B at 3 months, but which were almost similar by 6 months. In both the groups, all the outcome measures improved significantly from baseline to 6 months (p<0.05).

CONCLUSION

In conclusion, HVI is distinct from hydrodilation and patients who underwent HVI had rapid pain relief with earlier regaining of movements and earlier returning to their pre-disease activity levels.

CLINICAL RELEVANCE/APPLICATION

HVI is distinct from Hydrodilataion in which the former targets the basic pathological component in adhesive capsulitis, namely Coroco-Humeral Ligament, unlike causing diffuse capsular breakage like the later procedure. HVI is a relatively simple, cost effective and safer procedure producing superior outcomes, if given as an adjunct to physical therapy.

RC304-08 Diagnostic Performance of High-Resolution Ultrasound in the Evaluation of Intrinsic and Extrinsic Ligaments of the Wrist in Patients with Previous Trauma or Carpal Instability

Tuesday, Nov. 27 11:05AM - 11:15AM Room: E450A

Participants
Salvatore Gitto, MD, Milan, Italy (*Presenter*) Nothing to Disclose
Domenico Albano, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose
Carmelo Messina, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Angelo Corazza, MD, Genova, Italy (*Abstract Co-Author*) Nothing to Disclose
Santi Rapisarda, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Luca Maria Sconfienza, MD, PhD, Milano, Italy (*Abstract Co-Author*) Travel support, Bracco Group; Travel support, Esaote SpA; Travel support, ABIOGEN PHARMA SpA; Speakers Bureau, Fidia Pharma Group SpA

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PURPOSE

To investigate the role of ultrasound (US) in the evaluation of intrinsic and extrinsic ligaments of the wrist having magnetic resonance arthrography (MRA) as reference standard.

METHOD AND MATERIALS

This IRB-approved prospective study included 19 patients (12 men, 7 women; mean age 44 ± 19 SD years) referred for MRA of the wrist and having history of a previous trauma or carpal instability. All patients provided informed consent. US examination was performed just before MRA by a musculoskeletal radiologist using a commercially available US system equipped with a 14-6 MHz linear transducer. The intrinsic interosseus and midcarpal, collateral, and extrinsic ligaments were evaluated on both the dorsal and volar sides of the wrist. Ligament thickness was measured and tears were detected. After a delay of 2-3 months aimed at minimizing the recall of specific cases, the same radiologist re-assessed ligament thickness and integrity on the MRA images that were previously obtained with a 1.5 T unit. Ligament detection rate between US and MRA was calculated using the Chi-square test. Ligament thickness reproducibility between US and MRA was assessed using the Bland-Altman method.

RESULTS

On the dorsal side, US detected more ligaments (108/114, 94.7%) than MRA (96/114, 84.2%; P=0.016), while on the volar side the difference was not significant (149/171, 87.1% vs. 156/171, 91.2%, respectively; P=0.296). Among detectable ligaments, thickness reproducibility ranged between 44% (COR=0.9, bias=-0.8, P<0.001) of the volar ulnocapitate ligament and 71% (COR=0.05, bias=-0.1, P<0.001) of the volar scaphotriquetral ligament. Diagnostic performance of US for ligaments where a tear was found was 100% sensitivity, 100% specificity, 100% VPP, 100% VPN, 100% accuracy for the volar and dorsal scapholunate ligaments, and the ulnar collateral ligament; it was 100%, 94%, 50%, 100%, 94%, respectively, for the volar ulnolunate ligament.

CONCLUSION

US has similar diagnostic performance to MRA in the assessment of intrinsic and extrinsic carpal ligaments and ligamentous tears. Future studies focused on a larger cohort of patients are warranted.

CLINICAL RELEVANCE/APPLICATION

High-resolution US seems to be a valuable and promising technique for the assessment of intrinsic and extrinsic carpal ligaments and ligamentous tears.

RC304-09 Short and Long Term Outcomes of Ultrasound Guided Percutaneous Tenotomy for Lateral Epicondylitis

Tuesday, Nov. 27 11:15AM - 11:25AM Room: E450A

Participants
Faysal Altahawi, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Brittani Demarest, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Michael C. Forney, MD, Cleveland, OH (*Presenter*) Nothing to Disclose

PURPOSE

In this study, we evaluate long and short-term outcomes of ultrasound guided percutaneous tenotomy of the common extensor origin in the elbow for patients with lateral epicondylitis.

METHOD AND MATERIALS

Institutional review board approval was obtained. 44 consecutive patients that had received ultrasound-guided percutaneous tenotomy of the common extensor origin for lateral epicondylitis were retrospectively identified. All included cases were performed by a single operator using the Tenex Health TXTM system. The patients were surveyed and asked to retrospectively evaluate their symptoms before the procedure, 2 weeks after the procedure, 3 to 6 months after the procedure, and 1 year after the procedure using the Disabilities of the Arm, Shoulder and Hand Score (QuickDASH) survey as well as the Oxford Elbow Score (OES) survey. Scores were compared using paired two-tailed students T-test.

RESULTS

QuickDASH survey scores were significantly improved for symptoms 3-6 months and 1 year after ultrasound guided percutaneous tenotomy as compared to symptoms before intervention (P=0.023 and P=0.008, respectively), but were not significantly changed for symptoms 2 weeks after the procedure (P=0.903). Oxford Elbow Score survey similarly demonstrated improved scores in the pain, elbow function, and social-psychological domain sub-scales as compared to pre-procedural scores for symptoms 3-6 months after the procedure (P=0.023, P=0.009, and P=0.008, respectively) and 1 year after the procedure (P=0.008, P<0.001, and P=0.038, respectively), but were not significantly changed for symptoms 2 weeks after procedure (P=0.903, P=0.718, and P=0.387, respectively).

CONCLUSION

When retrospectively surveyed, patients that receive ultrasound guided percutaneous tenotomy using the Tenex Health TXTM system for lateral epicondylitis feel their symptoms are significantly better 3-6 months and 1 year after the procedure, and that symptoms are not significantly better or worse 2 weeks after the procedure.

CLINICAL RELEVANCE/APPLICATION

Ultrasound guided percutaneous tenotomy for lateral epicondylitis is effective and may provide an alternative to surgical tenotomy.

RC304-10 Ankle Ultrasound (Demonstration)

Tuesday, Nov. 27 11:25AM - 12:00PM Room: E450A

Participants
Marnix T. van Holsbeeck, MD, Detroit, MI (*Presenter*) Minor stockholder, Koninklijke Philips NV; Minor stockholder, General Electric Company; Stockholder, MedEd3D; Grant, Siemens AG; Grant, General Electric Company;

LEARNING OBJECTIVES

1) Describe an approach to ultrasound examination of the ankle using a four quadrant approach and including dynamic imaging. 2) Identify potential pitfalls of scanning that mimic disease. 3) Review important anatomy of the ankle including retinacula, tendons, ligaments, nerves and common sites of pathology.

RC305

Neuroradiology Series: Artificial Intelligence in Neuroradiology

Tuesday, Nov. 27 8:30AM - 12:00PM Room: S406B

AI IN NR

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

Participants
Greg Zaharchuk, MD, PhD, Stanford, CA (*Moderator*) Research Grant, General Electric Company; Stockholder, Subtle Medical;
Christopher P. Hess, MD, PhD, Mill Valley, CA (*Moderator*) Nothing to Disclose

Sub-Events

RC305-01 AI: An Introduction for Neuroradiologists

Tuesday, Nov. 27 8:30AM - 9:00AM Room: S406B

Participants
Yvonne W. Lui, MD, New York, NY (*Presenter*) Research collaboration, Siemens AG; Advisor, Bold Brain Ventures

LEARNING OBJECTIVES

1) Introduce basic concepts, ideas, and terminology of machine learning. 2) Review array of machine learning applications in neuroimaging.

RC305-02 Residual Extraction Approach in the Deep Learning With 3D Convolutional Ladder Network for Differential Diagnosis of Idiopathic Normal Pressure Hydrocephalus and Alzheimer's Disease

Tuesday, Nov. 27 9:00AM - 9:10AM Room: S406B

Participants
Ryusuke Irie, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose
Yujiro Otsuka, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Koji Kamagata, Tyuuouku, Japan (*Abstract Co-Author*) Nothing to Disclose
Michimasa Suzuki, MD, Minato-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose
Akihiko Wada, MD, Izumo, Japan (*Abstract Co-Author*) Nothing to Disclose
Masaaki Hori, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Tomoko Maekawa, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Shohei Fujita, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Christina Andica, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
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Masakazu Miyajima, Hongo, Japan (*Abstract Co-Author*) Nothing to Disclose
Yumiko Motoi, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Shigeki Aoki, MD, PhD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Idiopathic normal pressure hydrocephalus (iNPH) and Alzheimer's disease (AD) are geriatric diseases and common as causes of dementia. As a treatment approach is quite different, it is important to diagnose iNPH and AD correctly. The purpose of this study was to differentiate iNPH and AD by deep learning method.

METHOD AND MATERIALS

Twenty-three patients with iNPH (11 male and 12 female: mean age 74.6 years) and 23 patients with AD (11 male and 12 female: mean age 75.0 years) were included in this study. Diagnosis of iNPH was made according to the criteria of probable iNPH proposed by the Japanese Clinical Guidelines for Idiopathic Normal Pressure Hydrocephalus, and that of AD was made according to the criteria of probable AD by the National Institute of Neurologic and Communicative Disorders and Stroke/Alzheimer's Disease and Related Disorders Association. All patients underwent brain MRI with 3 T unit and we used only whole-brain three dimensional (3D) T1-weighted images in this study. We designed fully-automated, end-to-end 3D deep learning model to differentiate iNPH and AD. The model consists of residual extraction part followed by neural network classifier. In the residual extraction part, we build 3D convolutional ladder network to reconstruct 3D volume to be extracted from original 3D volume. The residual volume is then fed again into the encoder to obtain residual feature map. The feature map is used as an input of subsequent neural network classifier. We evaluated an accuracy of our model in differentiation of iNPH and AD by leave-one-out cross-validation. We also evaluated validity of the result by visualizing important area in the original input image with Gradient-weighted Class Activation Mapping.

RESULTS

Twenty out of 23 cases in iNPH and 20 out of 23 cases in AD were correctly diagnosed (predictive value was 87.0%). The area under the receiver operating characteristic curve was 0.91. The time taken for diagnosis was about 1 to 2 seconds per case.

CONCLUSION

Residual extraction approach in the deep learning method was useful for the differential diagnosis of iNPH and AD.

CLINICAL RELEVANCE/APPLICATION

Deep learning with residual extraction approach can help radiologists in the diagnosis of dementia which is difficult to be differentiated clinically.

RC305-03 Automated Classification of Alzheimer's Disease by Interregional Correlation Matrix in Structural MR Images

Tuesday, Nov. 27 9:10AM - 9:20AM Room: S406B

Participants
Xiangzhu Zeng, MD, Beijing, China (*Presenter*) Nothing to Disclose
Huishu Yuan, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Yan Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Ling Wang, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Zheng Wang, MS, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Based on compartmental sparse feature selection method, interregional correlation matrix of structural magnetic resonance data was built for identification of Alzheimer's disease (AD) from the healthy and compared with voxel-based volume of gray matter (GM) method.

METHOD AND MATERIALS

198 AD (AD group) cases and 148 healthy control (HC group) cases were investigated (table 1). For all cases, High-resolution 3D T1WI images were acquired on a SIEMENS Trio 3T scanner or a GE 750 3T scanner. 148 AD and 100 HC cases were in training set and 50 AD and 50 HC for testing. Sparse principal component analysis (SPCA) method was used to extract sparse principal components (SPCs) for 32 ROIs of the cerebrum according to AAL template and feature parameter value Yi of SPCs was obtained for each ROI. Then interregional correlation matrix of Yi of 32 ROIs is built and 16 distinct ROIs are selected according to analyzing the interregional correlation coefficients between Hippocampus and other ROIs. Yi of SPCs and the volume of GM of 17 distinct ROIs as variables in support vector machine (SVM) classifier (Figure 1).

RESULTS

1. Interregional correlation matrix of Yi of 32 ROIs is built and 16 distinct ROIs (Amygdala, parahippocampal gyrus, caudate, anterior cingulum, middle cingulum, posterior cingulum, superior orbital frontal lobe, inferior orbital frontal lobe, middle orbital frontal lobe, medial orbital frontal lobe, fusiform gyrus, insula, putamen, thalamus, middle temporal pole and superior temporal pole) with high correlation with Hippocampus were selected ($r>0.3$, $p< 0.05$) (Figure 2). 2. Yi and the volume of GM of 17 ROIs (above 16 ROIs and Hippocampus) used as feature variable of SVM, The classification accuracy for Yi and the volume of GM is 0.84 and 0.82 respectively. 3. There is a strong correlation between Yi of hippocampus and volume of it ($r=0.963$, $p<0.001$). Yi has much higher correlation with MMSE score ($r=0.586$, $p<0.001$) than volume ($r=0.393$, $p<0.001$) (Table 2).

CONCLUSION

Our results revealed high classification accuracy for AD diagnosis by using SPCA method combined with interregional correlation matrix of structural MR data. The feature parameter value Yi of our method is more accurate than volume of GM to quantify cerebral atrophy of AD.

CLINICAL RELEVANCE/APPLICATION

The method of SPCA combined with interregional correlation matrix is an effective computer-aided diagnosis method to help clinician to identify AD.

RC305-04 Comparison of Machine Learning Models for Prediction of Alzheimer's Disease (AD)

Tuesday, Nov. 27 9:20AM - 9:30AM Room: S406B

Participants
Qingchen Diao, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose
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Sang Na, MS, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Alzheimer's disease (AD) is a type of neurodegenerative disease that is the most common form of dementia. The purpose of this study is to compare investigate the diagnostic accuracy of machine learning methods for predicting AD via structural information of brain.

METHOD AND MATERIALS

T1-weighted 3D MPRAGE images were collected from the Alzheimer's Disease Neuroimaging Initiative (ADNI). We recruited 88 AD patients and 142 normal controls (mean age 71.7 ± 5.9 vs 71.4 ± 4.8, $p>0.05$). The raw data was firstly processed by FreeSurfer to generate the subcortical segmentation, cortical parcellation and segmentation of hippocampus. We then trained three types of machine learning algorithms, namely support vector machine (SVM), random forest (RF) and naive bayes, on the 80% of dataset and evaluated accuracy, sensitivity, positive predictive value (PPV), specificity and negative predictive value (NPV) on the rest of dataset. Grid search associated with cross validation is used to get the best hyper-parameter (including kernels of SVM) of each algorithm.

RESULTS

For each patient, 163 brain structural data were generated including 70 cortex thickness, 68 brain volume, 10 volume of ventricle, 15 subsegment of hippocampus for each raw MRI images. In terms of classify AD patients, RF has best diagnostic accuracy of 95.7%, sensitivity of 83.3%, PPV of 100%, specificity of 100% and NPV of 94.4%. However, SVM (accuracy 84.8%, sensitivity 58.3%, precision 77.8%, PPV 94.1%, NPV 86.5%) and naive bayes (accuracy 82.6%, sensitivity 58.3%, PPV 70.0%, specificity 91.2%, NPV 86.1%) show worse performances. We further found that entorhinal cortical thickness, hippocampal tail volume and molecular layer of hippocamus, especially in left brain, are top-3 important features, which have largest Gini importance and mean decrease impurity (0.1038, 0.0514, 0.0457 respectively).

CONCLUSION

Random forestRF has better diagnostic performance compared to SVM and naive bayes. RF shows highly precision and specificity and thus is appropriate for screening testing use in population study. In addition, machine learning identifies that thinner of entorhinal cortical thickness and smaller of hippocampal tail play a key role in AD patients.

CLINICAL RELEVANCE/APPLICATION

Machine learning based on FreeSurfer-processed MRI images may accuraty predict AD,

RC305-05 Radiomics Based on Multi-Contrasts MRI Allows Precisely Differentiate Glioma Subtypes and Predict Tumor Proliferative Behaviors

Tuesday, Nov. 27 9:30AM - 9:40AM Room: S406B

Participants
Changliang Su, Wuhan, China (*Presenter*) Nothing to Disclose
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PURPOSE

To explore the feasibility of radiomics based on anatomical, diffusion- and perfusion-weighted MRI in differentiating gliomas subtypes and predicting tumor proliferation.

METHOD AND MATERIALS

220 pathology confirmed gliomas and ten contrasts were included in the retrospective analysis. After registed to T2FLAIR images and resampled to 1 mm3 isotropically, 431 radiomics features were extracted from each included contrast maps in semi-automatic defined tumor volume. For single contrast and the combination of all contrast maps, partial correlation analysis revealed correlations between radiomics features and pathological biomarkers, and multivariate models were built to identify the best predictive models with adjusted 0.632+ bootstrap AUC.

RESULTS

In univariate analysis, both non-wavelet and wavelet radiomics features correlated significant with tumor grades and Ki-67. The max R was 0.557 (p=2.04E-14) in T1C for tumor grades, and 0.395 (p=2.33E-07) in ADC for Ki-67. In multi-variate analysis, the combination of all contrast radiomics features had the highest AUCs in both differentiating glioma subtypes and predicting proliferation, when compared with single contrast images. For low/high-grade gliomas, the best AUC was 0.911. In differentiating subtypes gliomas, the best AUC was 0.896 in grade II-III, 0.997 for grade II-IV, and 0.881 in grading III-IV. In reflecting levels of proliferation, multi-contrasts features leaded to an AUC of 0.936.

CONCLUSION

Multi-contrasts Radiomics supplys complementary information on both geometric characters and molecular biological traits, which correlated significantly with tumor grades and proliferation. Combined all contrasts radiomics models might precisely predict glioma biological behaviors, which may attribute to pre-surgical personal diagnosis.

CLINICAL RELEVANCE/APPLICATION

The precisely predicting tumor subtypes and proliferation levels based multi-contrasts MRI radiomics allows accurate evlation of pre-surgical gliomas, which may facillate the development of precise medicine, even in those patients from poor areas, who suffer from expensive cost on genetic detections.

RC305-06 Accelerating and Standardizing Stroke Patient Triaging with Deep Learning

Tuesday, Nov. 27 9:40AM - 10:10AM Room: S406B

Participants
Kim Mouridsen, Aarhus, Denmark (*Presenter*) Shareholder and Officer, Cercare Medical

LEARNING OBJECTIVES

1) Describe how deep learning may be applied to predict most likely tissue outcome in acute ischemic stroke. 2) Compare different approaches to prediction of outcome with machine learning. 3) Explain basic considerations in constructing and training deep learning models.

RC305-07 Data Preparation, Segmentation, and Deployment for Neuroradiology AI Applications

Tuesday, Nov. 27 10:20AM - 10:50AM Room: S406B

Participants
Michael Muelly, MD, Mountain View, CA (*Presenter*) Employee, Google LLC; Partner, ClariPACS LLC

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LEARNING OBJECTIVES

1) Recognize the impact of data and label quality on machine learning models. 2) Understand the components involved in end to end development of machine learning models for clinical applications.

RC305-08 Whole-Tumor Texture and Morphology Analyses of Conventional and Diffusion Tensor Imaging For Determination of Grades and Histological Subtypes in Meningiomas Using Machine Learning

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S406B

Participants
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PURPOSE

To evaluate the role of texture and morphology analyses of postcontrast T1-weighted images, apparent diffusion coefficient (ADC) and fractional anisotropy (FA) maps bases on the entire tumor volume, in differentiation of grades and histological subtypes of meningiomas.

METHOD AND MATERIALS

Eighty-five patients with pathologically diagnosed meningiomas (low grade [benign], 61; high-grade [atypical and anaplastic], 24), who underwent postcontrast T1-weighted and diffusion tensor imaging, were included in the discovery set. The postcontrast-T1 weighted image, ADC and the fractional anisotropy maps were analyzed to derive volume-based data of the entire tumor. Texture and morphology analyses were correlated with the meningioma grades and histological subtypes. Support vector machines were trained to build classification models for the determination of meningioma grade. We tested the model in a temporal external validation set (37 patients; low-grade,27; high-grade,10).

RESULTS

Various texture and morphology parameters differed significantly according to meningioma grades. The best classification system for the prediction of meningioma grades had a maximum area under the curve of 0.905 and 0.878 in the discovery and validation sets, respectively. Various texture parameters differed significantly between fibroblastic and non-fibroblastic subtypes.

CONCLUSION

Whole-tumor texture and morphology features of postcontrast T1-weighted images, ADC and fractional anisotropy maps are useful for differentiating meningioma grades.

CLINICAL RELEVANCE/APPLICATION

Texture and morphology features of postcontrast T1-weighted images, ADC and fractional anisotropy maps may aid in preoperative grading of meningiomas, which influences treatment planning.

RC305-09 The Added Prognostic Value of Radiological Phenotypes to Clinical Features in IDH-Wild Type Lower Grade Gliomas Using Machine Learning

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S406B

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To investigate the additional prognostic value of MR imaging phenotypes to clinical features using machine learning in patients with IDH-wild type lower grade gliomas

METHOD AND MATERIALS

Preoperative MRIs of 112 patients with histopathologically confirmed IDH-wild type grade II or III gliomas were retrospectively

Preoperative MRIs of 112 patients with histopathologically confirmed IDH-wild type grade II or III gliomas were retrospectively analyzed according to the Visually Accessible Rembrandt Images (VASARI) features set. A radiologic risk score (RRS) for overall survival (OS) and progression free survival (PFS) was produced by selected features and their regression coefficients from Elastic net regression model with 100 times of repeated cross validation. Multivariable Cox analysis was performed including age, Karnofsky Performance score (KPS), grade, extent of resection and RRS. The added predictive value of RRS was calculated by comparing C-indices between multivariable Cox models with and without RRS. The difference of C-indices was validated by bootstrap with 1,000 times of resampling.

RESULTS

Elastic net Cox regression model revealed 15 different MR imaging phenotypes that were significantly associated with OS and PFS, respectively. According to multivariable Cox analysis, RRS obtained from these imaging phenotypes was an independent predictor for both OS (HR 3.322, $p < 0.001$) and PFS (HR 2.605, $p < 0.001$). The model with RRS showed better performance in predicting survival than that without RRS (C-index for OS: 0.722 vs. 0.806, C-index for PFS: 0.706 vs. 0.773). The differences of C-indices in two models were statistically significant after bootstrap testing.

CONCLUSION

RRS derived from MRI features was independent predictors for survival in patients with IDH-wild type lower grade gliomas. Addition of RRS to prognosis prediction model significantly improved performance.

CLINICAL RELEVANCE/APPLICATION

IDH-wild type lower grade gliomas are known to be similar to glioblastoma in terms of genetic alterations and prognostically heterogeneous. Radiological phenotypes may have added prognostic value in patients with IDH-wild type lower grade gliomas.

RC305-10 Magnetic Resonance Textural Analysis on Contrast Enhanced 3D-SPACE Images in Assessment of Consistency of Pituitary Macroadenoma

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S406B

Participants
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PURPOSE

To explore the value of magnetic resonance textural analysis (MRTA) in assessing consistency of pituitary macroadenoma (PMA) based on contrast enhanced 3D-SPACE images.

METHOD AND MATERIALS

Fifty-three patients with PMA that underwent contrast enhanced 3D-SPACE scanning by 3.0T MRI and endoscopic trans-sphenoidal surgery were included in the present study. Consistency levels of PMA were evaluated intraoperatively by two neurosurgeons. Each resection specimen was stained with H&E and anti-collagen IV. MRTA was conducted and texture features were calculated by Omni Kinetics software. An unpaired t-test was used to analyze the differences of texture features between relative soft and hard PMAs. Receiver operating characteristic curves by individual and combined features were used to calculate the diagnostic accuracy of MRTA in predicting consistency.

RESULTS

First-order energy and second-order correlation negatively correlated with hard PMAs, while first-order entropy and second-order variance, sum variance, and sum entropy positively correlated with tumor stiffness. All showed significant differences between soft and medium consistency PMAs ($P<0.05$). Diagnostic accuracy of combined negative features could achieve an area under the curve (AUC) of 0.819, sensitivity of 88.9%, specificity of 61.5%, positive predictive value (PPV) of 70.6%, negative predictive value (NPV) of 84.2% and positive features could achieve an AUC of 0.836, sensitivity of 85.2%, specificity of 69.2%, PPV of 74.2%, NPV of 81.8% ($P<0.001$).

CONCLUSION

MRTA using contrast enhanced 3D-SPACE images is helpful for assessing PMA consistency preoperatively and noninvasively.

CLINICAL RELEVANCE/APPLICATION

Consistency level of PMA determines surgery approach and resection rates. MRTA based on contrast enhanced 3D-SPACE images may help assess consistency of PMAs preoperatively and noninvasively, which can guide the appropriate surgery approach to increase resection rates and reduce long-term recurrence.

RC305-11 Real-World Performance of Deep-Learning-based Automated Detection System for Intracranial Hemorrhage

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S406B

Participants
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Mohammad Mansouri, MD, MPH, Framingham, MA (*Abstract Co-Author*) Nothing to Disclose
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Michael H. Lev, MD, Boston, MA (*Abstract Co-Author*) Consultant, General Electric Company; Institutional research support, General Electric Company; Stockholder, General Electric Company; Consultant, MedyMatch Technology, Ltd; Consultant, Takeda Pharmaceutical Company Limited; Consultant, D-Pharm Ltd
Synho Do, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Most of currently published deep learning studies in medical image analysis report their performance using carefully selected data. To use such tools in the clinical practice, however, it is critical to know how they work with the real-world data. Here, we evaluated the applicability of our ICH detection system in the clinical setting by comparing the model performance on the real-world cases to the performance on the selected dataset.

METHOD AND MATERIALS

We previously trained and validated the deep learning system for ICH detection using a total of 904 cases of 5mm, non-contrast head CT scans - 625 cases with ICH and 279 cases without ICH. Six board-certified neuroradiologists annotated all 2D axial slices according to the presence of ICH based on consensus. For evaluating the model, we retrieved an additional, non-overlapping set of 200 cases - 100 with ICH and 100 without ICH - with exclusion of cases with any history of brain surgery, intracranial tumor, intracranial device placement, skull fracture, or cerebral infarct. For performance evaluation in the real-world setting, all non-contrast head CT scans acquired at a single emergency department for three months from September to November 2017 were obtained. Collected were 2,606 consecutive cases including 163 cases with ICH.

RESULTS

Area under the receiver operating curve (AUC) was 0.993 for detecting the presence of ICH on the 200 selected cases with sensitivity of 98.0%, specificity of 95.0%, and negative predictive value of 97.9%. The same model achieved AUC of 0.834 on the real-world cases with sensitivity of 87.1%, specificity of 58.3%, and negative predictive value of 98.5% at the high sensitivity operating point.

CONCLUSION

The deep-learning-based ICH detection model achieved lower sensitivity and specificity when tested on real-world data compared to when tested on the selected data that excluded potentially confusing cases. However, the negative predictive values were similar in the two test datasets.

CLINICAL RELEVANCE/APPLICATION

The performance of deep-learning based systems should be evaluated on the real-world data before being used in the clinical practice to assist clinicians in interpreting the automated output.

RC305-12 The Present and Future of Deep Learning in Neuroradiology: What Can We Do Now and What We Will Be Able to Accomplish

Tuesday, Nov. 27 11:30AM - 12:00PM Room: S406B

Participants
Peter Chang, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

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RC306

Best Head & Neck Cases of 2018: The Experts Share Their Most Interesting and Educational Neck, Sinonasal, and Temporal Bone Cases

Tuesday, Nov. 27 8:30AM - 10:00AM Room: E451B

HN NR

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

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LEARNING OBJECTIVES

1) Challenge one's head and neck imaging interpretation skills by viewing a series of cases that have not been previously presented. 2) Consider appropriate differential diagnoses. 3) Evalueat imaging protocols and techniques to insure use of optimized protocols at one's home institution. 4) Improve knowledge of common sinonasal conditions relevant to clinical practice. 5) Recommend the most appropriate imaging technique for evaluation of inflammatory and neoplastic sinonasal lesions. 6) Identity additional findings such as adenopathy, perineural spread, and second primary lesions. 7) Review standard MR and CT imaging protocols of the temporal bone to include optimizing studies for the detection of particular pathologies. 8) Highlight critical anatomic relationships within the middle and inner ear that are useful in the detection and identification of common and uncommon diseases affecting the temporal bone. 9) Improve the diagnostic acumen of the radiologist interpreting imaging studies of the temporal bone.

Sub-Events

RC306A Best Neck Cases of 2018

Participants
Nancy J. Fischbein, MD, Stanford, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Challenge one's head and neck imaging interpretation skills by viewing a series of cases that have not been previously presented. 2) Consider appropriate differential diagnoses. 3) Evalueat imaging protocols and techniques to insure use of optimized protocols at one's home institution.

RC306B Best Sinonasal Cases of 2018

Participants
Michelle A. Michel, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Improve knowledge of common sinonasal conditions relevant to clinical practice. 2) Recommend the most appropriate imaging technique for evaluation of inflammatory and neoplastic sinonasal lesions. 3) Identity additional findings such as adenopathy, perineural spread, and second primary lesions.

RC306C Best Temporal Bone Cases of 2018

Participants
John I. Lane, MD, Rochester, MN (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review standard MR and CT imaging protocols of the temporal bone to include optimizing studies for the detection of particular pathologies. 2) Highlight critical anatomic relationships within the middle and inner ear that are useful in the detection and identification of common and uncommon diseases affecting the temporal bone. 3) Improve the diagnostic acumen of the radiologist interpreting imaging studies of the temporal bone.

RC307

Genitourinary Series: Prostate MRI in the PI-RADS Era: Detection, Diagnosis and MRI Guided/Targeted Interventions

Tuesday, Nov. 27 8:30AM - 12:00PM Room: E353B

GU BQ MR

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

Participants
Clare M. Tempany-Afdhal, MD, Boston, MA (*Moderator*) Research Grant, InSightec Ltd; Research Grant, Gilead Sciences, Inc; Advisory Board, Profound Medical Inc; Spouse, Employee, Spring Bank Pharmaceuticals, Inc; Spouse, Director, Trio Healthcare; Spouse, Consultant, Gilead Sciences, Inc; Spouse, Consultant, Merck & Co, Inc; Spouse, Consultant, Echosens SA; Spouse, Consultant, Shinogi; Spouse, Consultant, Ligand Pharmaceuticals, Inc; Spouse, Stock options, Spring Bank Pharmaceuticals, Inc; Spouse, Stock options, Allurion; Spouse, Stock options, Trio Healthcare; ;

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LEARNING OBJECTIVES

1) The role of prostate MRI in urological practice will be reviewed and discussed. 2) Current issues in Prostate cancer care MpMRI Interpretation and Reporting using PI-RADS v2 MR assessment and reporting will be reviewed and attendee will learn how to apply PI-RADS v2. 3) To understand the complementary nature of MR based-quantitative metrics. 4) Prostate biopsy: when to biopsy and how. Cognitive, fusion and In bore biopsy approaches will be outlined. 5) Impact of PI-RADS on outcomes of prostate biopsy and treatment. Meta-analytic and other reviews of population studies will be presented. 6) Updates on MR interventions including focal therapy will be discussed.

Sub-Events

RC307-01 mpMRI in Clinical Practice: Changes in Urology Practice Patterns in US

Tuesday, Nov. 27 8:30AM - 8:50AM Room: E353B

Participants
Srinivas Vourganti, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC307-02 Update on Prostate Cancer Care and Role of Imaging

Tuesday, Nov. 27 8:50AM - 9:10AM Room: E353B

Participants
Clare M. Tempany-Afdhal, MD, Boston, MA (*Presenter*) Research Grant, InSightec Ltd; Research Grant, Gilead Sciences, Inc; Advisory Board, Profound Medical Inc; Spouse, Employee, Spring Bank Pharmaceuticals, Inc; Spouse, Director, Trio Healthcare; Spouse, Consultant, Gilead Sciences, Inc; Spouse, Consultant, Merck & Co, Inc; Spouse, Consultant, Echosens SA; Spouse, Consultant, Shinogi; Spouse, Consultant, Ligand Pharmaceuticals, Inc; Spouse, Stock options, Spring Bank Pharmaceuticals, Inc; Spouse, Stock options, Allurion; Spouse, Stock options, Trio Healthcare; ;

LEARNING OBJECTIVES

View learning objectives under main course title.

RC307-03 Practice Patterns and Challenges of Performing and Interpreting Prostate MRI: A Survey by the Society of Abdominal Radiology (SAR) Prostate Disease Focus Panel

Tuesday, Nov. 27 9:10AM - 9:20AM Room: E353B

Participants
Silvia D. Chang, MD, Vancouver, BC (*Presenter*) Nothing to Disclose
Sadhna Verma, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Baris Turkbey, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Daniel J. Margolis, MD, Los Angeles, CA (*Abstract Co-Author*) Consultant, Blue Earth Diagnostics Ltd

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PURPOSE

To report on the practice patterns and challenges of performing and interpreting prostate MRI.

METHOD AND MATERIALS

After ethics approval an electronic survey was emailed to SAR members.

RESULTS

The response rate was 15% (212/1446). Majority were academic abdominal radiologists (65%) with 1-5 (52%), 6-10 (20%), 11-20 (15%) or >20 (19%) years of experience reporting prostate(p)MRI.Those not yet interpreting pMRI (8%) preferred workshop (56%), web-based (35%) or other formats (9%) for training. Number of pMRI exams reported per week were: 0-5 (43%), 6-10 (38%), 11-20 (12%), 21-30 (5%), > 30 (2%) and imaged at 3T (58%), 1.5T (20%) or either (21%). Most exams were performed without an endorectal (ER) coil (83%). Highest b-values varied from 800-5000, with 1400 (26%) and 1500 (30%) the most common. Most acquire DCE with temporal resolution of < 10s (79%). Majority of these pMRIs were used for fusion biopsies (71%), performed by urologists (74%), radiologists (18%) or both (8%). PIRADSv2 was used by 86% of the respondents and template reporting in 75%. Sixty-four percent of respondents did not have wait lists. Sixty-three percent staff tumor boards and 46% perform quality assurance. Challenges to performing and interpreting pMRI were scored on a 1-5 Likert scale: 1 = easy, 2=somewhat easy, 3=neutral, 4=somewhat difficult and 5 = very difficult. The median score were 2 or 3 for patient prep such as emptying bladder/rectum, using enema or anti-spasmotic agent. Image acquisition and reporting factors (access to 3T, using b values > 1400, temporal resolution of < 10s, reporting with PIRADSv2) were scored 1-2, whereas performing spectroscopy or using an ER coil scored 4. Acquiring patient history (PSA, medications, past treatment) scored 2. Quality factors (time to report, training/maintaining skills, funding, quality control) scored 3. Additional challenges include: acquiring image quality, having sufficient cases for maintaining skills and interobserver variability of PIRADS scores.

CONCLUSION

The majority of academic radiologists perform prostate MRI at 3T without an ER coil and interpret them using PIRADSv2. Challenges include obtaining image quality, acquiring feedback and interobserver variability of PIRADS scores.

CLINICAL RELEVANCE/APPLICATION

A knowledge of the practice patterns and challenges to performing and interpretting prostate MRI will enable us to design educational programs and guide improvements for the next version of PIRADS.

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/ Sadhna Verma, MD - 2013 Honored Educator

RC307-04 Serial mpMRI Reporting in Men on Active Surveillance For Prostate Cancer: Initial Experience Using the PRECISE Recommendations

Tuesday, Nov. 27 9:20AM - 9:30AM Room: E353B

Participants
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Stefano Cipollari, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Caroline M. Moore, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The PRECISE recommendations were developed to facilitate robust data collection and assess the natural history of mpMRI findings in men on active surveillance (AS) for prostate cancer (PCa). We report our initial validation of these guidelines in terms of radiological monitoring and imaging reclassification.

METHOD AND MATERIALS

Seventy-three patients with previously diagnosed Gleason 3 + 3 PCa were included in our AS program, with antwo mpMRI scans at baseline and after 1 year. Inclusion criteria were : PSA density < 0.15 and PSA > 2 ng/ml. Exclusion criteria were: PSA > 10/25 ng /ml and any previous treatment for PCa. We used the PRECISE case report form and reported according to PI-RADS v2 guidelines. The following parameters were assessed: changes on PI-RADS score, change in lesion size and features of the index lesion and the likelihood of extra-prostatic extension. When radiological progression was suspected, a TRUS-MRI fusion targeted biopsy was performed. Patients with stable imaging findings continued the regular imaging follow-up.

RESULTS

Mean follow-up was 24 months . Baseline PRDADs score was 1-2 in xx3 men, 3 in xx40 men and 4 or 5 in xx30 man. Sixty out of 73 men (82%) had stable imaging findings with no change in PI-RADS score. Six out of 73 men (8%) had a decrease in PI-RADS score. Seven out of 73 (10%) men showed an increase in PI-RADS score and underwent targeted biopsy, which confirmed a higher Gleason score (3+4 or 4+3) in 6/7 cases (86%).

CONCLUSION

The PRECISE case report form is an appropriate method for the standardization of serial imaging evaluations in men on AS. Data analysis and collection according to the PRECISE recommendations allows to identify men with imaging progression and direct them to repeat targeted biopsy.

CLINICAL RELEVANCE/APPLICATION

Multiparametric MRI of the prostate can be a valuable adjunct tool for the management of patients on active surveillance.

RC307-05 Targeted Biopsy Validation of Magnetic Resonance Fingerprinting-Relaxometry and Apparent Diffusion Coefficient Mapping for Differentiation of Cancer from Non-Cancerous Lesions in Prostate

Tuesday, Nov. 27 9:30AM - 9:40AM Room: E353B

Awards

Trainee Research Prize - Fellow

Participants
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Lee E. Ponsky, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Vikas Gulani, MD, PhD, Cleveland, OH (*Abstract Co-Author*) Research support, Siemens AG; Licensed Technology, Siemens Healthineers - both myself and my spouse. MR Fingerprinting, on which we are both inventors, has been licensed by Siemens.

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PURPOSE

To provide targeted biopsy validation of quantitative exam comprising of MRF-relaxometry & ADC mapping for distinguishing prostate cancer from non-cancerous lesions and cancer grades

METHOD AND MATERIALS

In IRB approved study,122 patients underwent MRF,clinical prostate MRI(high resolution T2w & DWI) & targeted biopsy(cognitive targeting:76 patients,in-gantry targeting:46 patients).A MRF-FISP acquisition was used to cover whole prostate.ADC mapping was performed using b-values 50-1400sec/mm2.Based on clinical reads by body radiologists,another radiologist blinded to pathology diagnosis drew ROIs on targeted lesions and contralateral normal peripheral zone(NPZ) & transition zone(NTZ) on T2 MRF maps.Both T1 & T2 relaxation times were obtained simultaneously from ROIs drawn on T2 map.ROIs were replicated on ADC maps in same locations.Mean T1,T2 &ADC were compared & logistic regression analysis was used to evaluate MRF & ADC in differentiating cancer grades,prostatitis and biopsy-proven benign lesions

RESULTS

Mean T1,T2 & ADC in PZ & TZ prostate cancer were lower than NPZ & NTZ and together produced best separation(AUC=0.989 for PZ; 0.983 for TZ).Mean T2 & ADC values in low-grade PZ cancer were higher than intermediate/high-grade PZ cancer.Combination of T2+ADC had higher discriminatory ability(AUC=0.898) compared to T2(AUC=0.801) and ADC(AUC=0.827) for cancer grades.Mean T2 & ADC values in PZ cancer were lower than prostatitis.T2 was significant predictor for cancer over prostatitis(p=0.019) while ADC was barely significant(p=0.049).For separation of PZ cancer from biopsy-proven benign tissue,T1+ADC had higher discriminatory ability(AUC=0.861) compared to ADC(AUC=0.840).In TZ,mean T1,T2 & ADC in TZ cancer were lower than prostatitis.Multiparametric combinations had higher diagnostic performance(AUCs: T1+T2:0.849, T1+ADC:0.878, T2+ADC:0.854) than ADC(AUC=0.842) for differentiating TZ cancer from prostatitis and from both prostatitis and biopsy-proven benign tissue(AUCs: T1+ADC 0.886,T1+T2+ADC:0.892,AUC ADC=0.861)

CONCLUSION

Based on targeted biopsy validation of MRF and ADC mapping,both T1 & T2 mapping added utility to ADC for improved characterization of suspicious lesions seen on T2w images & DWI

CLINICAL RELEVANCE/APPLICATION

MRF relaxometry added utility to ADC mapping. Quantitative evaluation may decrease subjectivity of T2w images & improve non-invasive characterization of indeterminate lesions in mpMRI of prostate.

RC307-06 Improvement of Prostate Cancer Detection: Combining Computer-aided Diagnostic System and TRUS-MRI Targeted Biopsy

Tuesday, Nov. 27 9:40AM - 9:50AM Room: E353B

Participants
Stefano Cipollari, Rome, Italy (*Presenter*) Nothing to Disclose
Valeria Panebianco, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Riccardo Campa, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
Giovanni Barchetti, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
Maurizio Del Monte, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the role of multiparametric MRI (mpMRI) combined with a CAD system (WATSON Elementary) to increase the detection rate of prostate cancer (PCa) and to validate it using TRUS-MRI fusion targeted biopsy as a reference test for pathology.

METHOD AND MATERIALS

We included patients with high clinical suspicion of prostate cancer (total PSA >4 ng/mL, or >2.5 ng/mL in patients with family history, and/or a positive DRE) and with no previous prostate biopsy positive for PCa. A total of 167 patients, aged 47-79 years, with a mean PSA value of 7,62 ng/ml (IQR 2.45-18.6), underwent diagnostic 3T mpMRI. Images were evaluated using PIRADSv2

(radiologist evaluation) and Watson Elementary CAD system (CAD Evaluation). Patients with a PIRADS score > 3, and patients with PIRADS score equal to 3 and with a PSA density >= 0.15 were directed to biopsy of the CAD targets. When a CAD target overlapped with a radiologic one, biopsy was performed in the overlapping area, defined as Target-in-Target (TiT). Sixty-three patients underwent TRUS-MRI fusion biopsy, for a total of 212 sampled targets, including radiologist-selected targets, CAD-selected targets and TiTs. MRI data were compared to biopsy pathology reports and to whole-mount pathology slides (when radical prostatectomy was performed). Receiver Operating Characteristics (ROC) curves were computed for both the radiologist evaluation and the CAD analysis.

RESULTS

Radiologist evaluation achieved better diagnostic performance compared to CAD system (AUC vs AUC) for a cancer detection rate of 35.8% and 68.6%, respectively. The highest detection rate was 81.81% obtained when biopsying TiT lesions. Overall cancer detection rate was 60.37%.

CONCLUSION

Radiologist Evaluation was more accurate than CAD in the diagnosis of prostate cancer. CAD system proved useful in identifying the neoplastic area within radiologist detected lesions (Target-in-Target). Accordingly, CAD may represent a valuable tool in identifying biopsy targets to improve cancer detection rates, although it's not advisable its use as an independent tool for the selection of biopsy targets.

CLINICAL RELEVANCE/APPLICATION

The use of CAD in conjunction with radiologist evaluation increases the accuracy of TRUS/MRI biopsy when selecting Target-in-Target lesions.

RC307-07 Standard and New Quantitative MR Techniques - Added Value to PI-RADS

Tuesday, Nov. 27 9:50AM - 10:10AM Room: E353B

Participants
Andrew B. Rosenkrantz, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC307-08 Overview and Current Impact of PI-RADS v2 in Clinical Practice

Tuesday, Nov. 27 10:20AM - 10:40AM Room: E353B

Participants
Katarzyna J. Macura, MD,PhD, Baltimore, MD (*Presenter*) Author with royalties, Reed Elsevier; Research Grant, Profound Medical Inc; Research Grant, GlaxoSmithKline plc; Research Grant, Siemens AG

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LEARNING OBJECTIVES

View learning objectives under main course title.

Honored Educators

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RC307-09 MR Guided Prostate Biopsy - The Approaches and New Guidelines

Tuesday, Nov. 27 10:40AM - 11:00AM Room: E353B

Participants
Clare M. Allen, MBBCh, London, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC307-10 Defining a Learning Curve for PIRADS Version 2: A Change-Point Analysis of Cancer Detection Rates for Detected Lesions on Prostate MRI

Tuesday, Nov. 27 11:00AM - 11:10AM Room: E353B

Participants
Marcin Czarniecki, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Julie Y. An, MD, Akron, OH (*Abstract Co-Author*) Nothing to Disclose
Graham R. Hale, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Stephanie A. Harmon, PhD , Bethesda, MD (*Abstract Co-Author*) Research funded, NCI
Sherif Mehralivand, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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Intellectual property, Koninklijke Philips NV; Intellectual property, BTG International Ltd; Royalties, Invivo Corporation; Royalties, Koninklijke Philips NV; ; ;
Peter Pinto, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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Joanna Shih, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To determine a change-point in cancer detection rate for PIRADS categories and to define a learning curve for PIRADSv2.

METHOD AND MATERIALS

This prospective single-center study included patients who underwent multi-parametric MRI followed by MR-guided transrectal ultrasound biopsy (FBx). All images were prospectively interpreted using PIRADSv2 by a radiologist with over 10 years of experience in reporting prostate MRI. Change-point analysis was used to find the optimal threshold in time for change in lesion-base cancer detection rate (CDR) in each PI-RADSv2 category. Changes in CDR were compared using permutation-based testing. Stratified change-point analysis was performed to account for clinical characteristics which were correlated with change in CDR.

RESULTS

Between May 14, 2015 and December 14, 2017, 658 patients (median age 65 years, PSA 6.66ng/ml) with 1375 detected lesions on mpMRI underwent FBx. There were 604 detected and FBx-confirmed PIRADS 4 lesions, which was the only category that demonstrated significant improvement in CDR after the optimal change point occurring at 275 days (CDR=16.9% vs 28.3%, p=0.033), corresponding to 251 MRI reads. Clinical characteristics except prostate volume were comparable before and after the change point (p=0.889, 0.481 and 0.431, and 0.045 for DRE positivity, PSA, ethnicity and prostate volume, respectively). In patients with above median prostate volume (55 ml), CDR was below 20% and did not show improvement over time (p=0.71). In prostate volume <=55 ml, CDR demonstrated a persistent upward shift after the optimal change point (CDR=22% vs 38%, p=0.054), and a borderline significant trend for the peripheral zone, irrespective of volume (CDR=17% vs. 28%, p=0.07).

CONCLUSION

An experienced reader's CDR of PIRADS 4 lesions improved following 251 mpMRI reads over 9 months, whereas CDR performance remained stable in other PIRADS categories.

CLINICAL RELEVANCE/APPLICATION

Current literature suggests relatively low cancer detection rate (CDR) for PIRADS category 4. For this category, CDR improves over time, with the optimal change point occurring at 275 days or 251 MRIs. The remaining PIRADS categories did not show any significant change over time.

RC307-11 Comprehensive Deep-Learning-Based Quantitative Prostate MRI Evaluation

Tuesday, Nov. 27 11:10AM - 11:20AM Room: E353B

Participants
Peter Chang, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Justin Glavis-Bloom, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Michelle Bardis, Orange, CA (*Presenter*) Nothing to Disclose
Michael Nguyentat, MD, Denver, CO (*Abstract Co-Author*) Nothing to Disclose
Alexander Ushinsky, MD, Orange, CA (*Abstract Co-Author*) Nothing to Disclose
Daniel S. Chow, MD, Orange, CA (*Abstract Co-Author*) Nothing to Disclose
Edward Uchio, MD, Orange, CA (*Abstract Co-Author*) Nothing to Disclose
Roozbeh Houshyar, MD, Orange, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate a comprehensive deep learning based pipeline for prostate MRI evaluation including prostate segmentation as well as nodule detection, segmentation and PI-RADS scoring.

METHOD AND MATERIALS

After IRB approval, an institutional database was queried to identify patients with prostate MRI obtained between September 2014 and December 2016. For each patient, co-registered T2W and ADC series were used to manually generate segmentations masks for prostate and any detected nodules. For each nodule, composite as well as T2W/ADC subcomponent PI-RADS scores were assessed by a board-certified abdominal radiologist. A 3D/2D fully convolutional neural network (CNN) based on U-net architecture was used to perform prostate segmentation. Subsequently, a 3D/2D mask R-CNN architecture based on a feature pyramid backbone was used to identify potential bounding-box abnormalities, perform nodule segmentation and assess PI-RADS score (Figure 1A-D). Rather than a simple 5-score classification problem, quantitative PI-RADS evaluation was implemented by explicitly engineering the network to regress along dimensions of PI-RADS criteria (Figure 1E-F). For all experiments, five-fold cross-validation was performed.

RESULTS

A total of 303 nodules from 217 patients were included in this study. Prostate segmentation Dice score was 0.891 (0.832-0.917). AUC for nodule detection was 0.788; by varying detection thresholds sensitivity/PPV could range from 0.935/0.535 to 0.602/0.870. For detected nodules, segmentation Dice score was 0.762 (0.719-0.803). Weighted Cohen's kappa for PI-RADS scoring agreement was 0.63, 0.71, 0.51 for composite, T2W, and ADC subcomponents, respectively.

CONCLUSION

A comprehensive deep learning based pipeline is presented as a clinically feasible tool for end-to-end prostate MRI evaluation, including prostate/nodule segmentation (volume calculation) as well as quantitative PI-RADS scoring. By explicitly engineering the network to learn the components of PI-RADS criteria, the algorithm provides visual feedback into the interpretation process (Figure 1E-F). Overall, accuracy of PI-RADS scoring is comparable to reported human-human inter-observer agreement.

CLINICAL RELEVANCE/APPLICATION

A comprehensive deep learning pipeline may significantly improve speed, accuracy, reproducibility and objectivity of MR evaluation of prostate cancer, the second most common malignancy in men.

RC307-12 Men Avoiding Prostate Biopsy by Using Multiparametric MRI: A Retrospective Analysis of PI-RADS Scored in 4259 Patients

Tuesday, Nov. 27 11:20AM - 11:30AM Room: E353B

Participants
Wulphert Venderink, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
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Sjoerd Jenniskens, MD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Michiel Sedelaar, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Christina A. Hulsbergen-Van De Kaa, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Christiaan G. Overduin, MSc, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

As a consequence of the limitations of systematic transrectal ultrasound (TRUS) biopsy, multiparametric (mp)MRI is increasingly being used in the diagnostic work up of patients suspected of having prostate cancer. The aim of our study was to determine which proportion of patients avoided biopsy because of negative mpMRI findings in our clinical routine.

METHOD AND MATERIALS

Patients having mpMRI of the prostate in our institution were retrospectively included between January 2012 and December 2017. We included patients suspected to have prostate cancer with either a history of negative TRUS biopsy or those who were biopsy naïve. Lesions were classified according to Prostate Imaging Reporting and Data System (PI-RADS) by one of our eight radiologists, with varying degree of experience. Primary outome was the proportion of patients with a negative mpMRI, defined as an index lesion classified PI-RADS < 3. Descriptive statistics were used. Hystopathologic follow up until 26 March 2018 was collected by searching the Dutch Public Pathology Database.

RESULTS

A total of 4259 men were included. The median age was 64 years (interquartile range [IQR], 60-70) and median PSA was 8.5 ng/ml (IQR, 6.0-13.0). Patients had a history of prior negative TRUS biopsy in 47.9% (2039/4259) and were biopsy naïve in 52.1% (2220/4259). In 53.6% (2281/4259) an index lesion was classified PI-RADS < 3. Deciding not to biopsy lesions classified PI-RADS 3 with a PSA density below 0.15 ng/ml/ml would result in an additional 5.8% (total proportion 59.4%) of patients avoiding biosy. In 0.4% (9/2281) of the patients with a negative mpMRI, csPCa (Gleason >= 3+4) was detected after a median period of 29 months (IQR, 16-49).

CONCLUSION

More than half of patients having mpMRI of the prostate avoided biopsy because of negative findings on mpMRI.

CLINICAL RELEVANCE/APPLICATION

In a daily clinical setting, approximately half of patients suspected of having prostate cancer may considered to avoid biopsy because of a negative prostate mpMRI.

RC307-13 MRI-Guided Transurethral Ultrasound Ablation (TULSA) in Patients with Localized Prostate Cancer

Tuesday, Nov. 27 11:30AM - 11:40AM Room: E353B

Participants
David Bonekamp, MD, PhD, Heidelberg, Germany (*Presenter*) Speaker, Profound Medical Inc
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Katarzyna J. Macura, MD,PhD, Baltimore, MD (*Abstract Co-Author*) Author with royalties, Reed Elsevier; Research Grant, Profound Medical Inc; Research Grant, GlaxoSmithKline plc; Research Grant, Siemens AG
Masoom A. Haider, MD, Toronto, ON (*Abstract Co-Author*) Advisory Board, Siemens AG; ;
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Derek W. Cool, MD,PhD, London, ON (*Abstract Co-Author*) Patent agreement, Eigen
Zahra Kassam, MD, London, ON (*Abstract Co-Author*) Nothing to Disclose
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Aytekin Oto, MD, Chicago, IL (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV; Research Grant, Guerbet SA; Research Grant, Profound Medical Inc; Medical Advisory Board, Profound Medical Inc; Consultant, AbbVie Inc; ;

PURPOSE

MRI-guided transurethral ultrasound ablation (TULSA) uses MRI thermometry to control conformal ultrasound ablation of prostate tissue with a transurethral device. We report 3 year (yr) Phase I outcomes and early results from the TULSA-PRO Ablation Clinical Trial (TACT) Pivotal study.

METHOD AND MATERIALS

Phase I addressed safety and ablation precision in 30 patients (pts) at 3 sites, aged >=65, <=cT2a, PSA<=10 ng/ml, Gleason score (GS) <=3+4. To assess delayed necrosis a 3-mm 55°C margin spared 1-3 mm of peri-capsular prostate tissue. TACT enrolled 115 pts at 13 sites, aged 45-80 with biopsy-proven organ-confined PCa <=cT2b, PSA<=15 ng/ml, GS<=3+4. TULSA was delivered with intent of whole-gland ablation to the capsule by using a 2-mm 57°C reduced margin. Primary efficacy is %pts achieving PSA reduction >=75%. Secondary includes biopsy and PI-RADSv2 MRI at 12 months (mo). Safety endpoints are 12 mo AE and QoL.

RESULTS

Phase I AEs were minimal. Urinary incontinence (pads) was 0% at 12 mo, 20/21 potent maintained potency (IIEF Q2>=2). Median (IQR) PSA decreased 91% from 5.8 (3.8-8.0) ng/ml to nadir 0.5 (0.2-0.8) and 0.8 (0.4-1.6) at 3 yr. 12-mo MRI and biopsy showed 88% reduced prostate volume and 75% reduced cancer length, reflecting peri-capsular margin sparing. By 36 mo, 7/30 men (23%) had salvage therapy. TACT pre-treatment median (IQR) age was 64 (59-69), PSA 6.3 (5.0-8.3) ng/ml, with 39% GS6 and 61% GS7, 34% low- and 66% intermediate-risk (D'Amico). Baseline MRI detected PIRADSv2 >=3 and >=4 lesions in 82% and 66% of pts. Actual treatment time was 55 (41-70) min. Targeted prostate volumes ranged 15-88 cc, with spatial ablation precision of 0.1±1.4 mm, confirmed by contrast-enhanced MRI. There was no rectal injury and no Grade >=4 AE. Serious attributable AEs included 2 pts with urinary retention, 2 UTI, 1 epididymitis, 1 urine extravasation into abdomen, 1 ileus, and 1 DVT, all resolved. Median PSA reduction to-date is 94% (nadir 0.41 ng/ml). 95% (103/108) of pts met the endpoint of >=75% reduction.

CONCLUSION

The TACT Pivotal study of MRI-TULSA for whole-gland ablation in pts with localized PCa confirms safety and precision. PSA reduction >=75% was met in 95% of pts.

CLINICAL RELEVANCE/APPLICATION

Precise whole-gland ablation can be safely achieved using MRI-guided TULSA. It demonstrates potential as a minimally-invasive treatment for organ-confined prostate cancer. Data from the ongoing TACT study will further evaluate its safety and efficacy.

Honored Educators

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RC307-14 MR Guided Focal Therapy for Prostate Cancer: The Approaches and New Guidelines

Tuesday, Nov. 27 11:40AM - 12:00PM Room: E353B

Participants
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Siemens AG

LEARNING OBJECTIVES

View learning objectives under main course title.

RC308

Current Imaging of the Appendix

Tuesday, Nov. 27 8:30AM - 10:00AM Room: E353C

CT ER GI PD

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

Participants
Douglas S. Katz, MD, Mineola, NY (*Moderator*) Nothing to Disclose

Sub-Events

RC308A Appendicitis in Children

Participants
Steven L. Blumer, MD, Wilmington, DE (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To review the prevalence as well as the clinical signs and symptoms of appendicitis in the pediatric population. 2) To discuss the role of various modalities in the imaging work-up of pediatric appendicitis including plain film, ultrasound, CT and MR. 3) To review the techniques of imaging pediatric appendicitis with ultrasound, CT and MR. 4) To illustrate the imaging findings of pediatric appendicitis on ultrasound, CT and MR. 5) To review potential mimickers of pediatric appendicitis. 6) To discuss potential complications of appendicitis in the pediatric population.

RC308B Appendicitis in Non-pregnant Adults

Participants
Michael N. Patlas, MD,FRCPC, Hamilton, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To discuss optimal use of different cross-sectional modalities for the diagnosis of acute appendicitis. 2) To illustrate common mistakes in interpretation. 3) To review potential mimics of acute appendicitis.

RC308C Uncommon and Atypical Appendiceal Disorders on CT

Participants
Douglas S. Katz, MD, Mineola, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To review a series of uncommon and unusual/rare disorders of the appendix which may present as appendicitis clinically and on CT examinations. 2) To demonstrate examples of these entities from clinical practice, using CT. 3) To briefly review the current imaging and clinical literature on uncommon and unusual/rare disorders of the appendix. 4) To briefly explain the current management of these appendiceal disorders.

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RC308D Appendicitis in Pregnancy

Participants
Vincent M. Mellnick, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Compare ultrasound and MRI for accuracy in the setting of suspected appendicitis in the pregnant patient. 2) Utilize MRI

protocols that consider the needs of the pregnant patient, including exam length, SAR, and multiplanar sequences. 3) Recognize the findings of acute appendicitis on MRI and understand the meaning of a nonvisualized appendix. 4) Identify common alternative diagnoses to appendicitis to direct management.

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RC309

Gastrointestinal Series: Advances in Abdominal CT (The In-Person Presentation is Supported by an Unrestricted Educational Grant from GE Healthcare, Life Sciences)

Tuesday, Nov. 27 8:30AM - 12:00PM Room: E451A

AI BQ CT GI

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

Participants
Benjamin M. Yeh, MD, San Francisco, CA (*Moderator*) Research Grant, General Electric Company; Consultant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextrast, Inc; Research Grant, Koninklijke Philips NV; Research Grant, Guerbet SA; ;
Avinash R. Kambadakone, MD, Boston, MA (*Moderator*) Nothing to Disclose
Meghan G. Lubner, MD, Madison, WI (*Moderator*) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson;
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;
Arun Krishnaraj, MD, MPH, Charlottesville, VA (*Moderator*) Nothing to Disclose

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LEARNING OBJECTIVES

1. Review topics around Machine Learning 2. Discuss applications of multi-energy CT 3. Review usage of oral contrast media and associated controversies 4. Discuss CT imaging biomarkers for oncologic and non oncologic applications 5. Review innovations in Health IT.

Sub-Events

RC309-01 Machine Learning

Tuesday, Nov. 27 8:30AM - 8:55AM Room: E451A

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

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LEARNING OBJECTIVES

1) Basic concepts of machine learning and deep learning. 2) Exciting areas of abdominal machine learning research. 3) Future of abdominal AI.

RC309-02 Machine Learning-based Radiomics Improve Prediction of Metastatic Disease Progression in Patients with Colon Cancer

Tuesday, Nov. 27 8:55AM - 9:05AM Room: E451A

Participants
Dania Daye, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Azadeh Tabari, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Michael S. Gee, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Intra-tumor heterogeneity is independently associated with worse patient prognosis in several cancer subtypes. This study investigates the role of quantitative tumor heterogeneity MRI features in predicting metastatic disease progression in patients with colon cancer.

METHOD AND MATERIALS

In this IRB-approved retrospective study, we identified 51 patients with stage 4 colon cancer who underwent MRI for liver

In this IRB-approved retrospective study, we identified 51 patients with stage 4 colon cancer who underwent MRI for liver metastasis evaluation. Standard clinical prognostic variables were collected. The largest hepatic lesion was identified on the portal venous phase T1-weighted post-contrast images and segmented. MR radiomic feature vectors were extracted from each lesion using 50 morphological and texture features. Six-month metastatic disease progression was assessed, with progression defined as appearance of new hematogeneous metastatic lesions. Univariate logistic regression analysis was used to assess the contribution of the features to disease progression prediction. A linear support vector machine (SVM) machine learning technique was applied to the imaging phenotype vector and to the clinical prognostic variables to predict disease progression. The classifiers were trained and tested using 10-fold cross validation. ROC analysis, area under the curve (AUC) and Delong's test were used to assess classification performance.

RESULTS

13 of 51 patients (26%) exhibited metastatic disease progression. Mean time to disease progression was 109±5.9 days. Tumor entropy, dissimilarity and GLCM standard deviation exhibited significant differences in mean values between patients exhibiting progression and those who did not (p=0.02, p=0.03 and p=0.03, respectively). Univariate regression revealed three features independently associated with metastatic disease progression: tumor promenance (p=0.03), homogeneity (p=0.03), and variance (p=0.02). An SVM model that incorporates imaging-based heterogeneity features resulted in improved model performance for disease progression prediction (AUC of 0.86), compared to the model that only included standard prognostic clinical variables (AUC=0.54) (p<0.001).

CONCLUSION

Quantitative tumor heterogeneity MRI features improve prediction of metastatic disease progression in patients with colon cancer.

CLINICAL RELEVANCE/APPLICATION

Machine learning-based tumor radiomics may improve disease progression prediction and may inform decisions regarding locoregional vs systemic therapy in patients with oligometastatic disease.

RC309-03 A Multiphase Convolutional Dense Network For Classification of Focal Liver Lesions on Dynamic Contrast-Enhanced CT

Tuesday, Nov. 27 9:05AM - 9:15AM Room: E451A

Participants
Cao Sue, MD, Guangzhou, China (*Presenter*) Author
Hui Liu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Meng Ye, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
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Claude B. Sirlin, MD, San Diego, CA (*Abstract Co-Author*) Research Grant, Gilead Sciences, Inc; Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Bayer AG; Research Grant, ACR Innovation; Research Grant, Koninklijke Philips NV; Research Grant, Celgene Corporation; Consultant, General Electric Company; Consultant, Bayer AG; Consultant, Boehringer Ingelheim GmbH; Consultant, AMRA AB; Consultant, Fulcrum Therapeutics; Consultant, IBM Corporation; Consultant, Exact Sciences Corporation; Advisory Board, AMRA AB; Advisory Board, Guerbet SA; Advisory Board, VirtualScopics, Inc; Speakers Bureau, General Electric Company; Author, Medscape, LLC; Author, Resoundant, Inc; Lab service agreement, Gilead Sciences, Inc; Lab service agreement, ICON plc; Lab service agreement, Intercept Pharmaceuticals, Inc; Lab service agreement, Shire plc; Lab service agreement, Enanta; Lab service agreement, Virtualscopics, Inc; Lab service agreement, Alexion Pharmaceuticals, Inc; Lab service agreement, Takeda Pharmaceutical Company Limited; Lab service agreement, sanofi-aventis Group; Lab service agreement, Johnson & Johnson; Lab service agreement, NuSirt Biopharma, Inc ; Contract, Epigenomics; Contract, Arterys Inc
Jin Wang, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To develop and assess an automated multiphase convolutional dense network (MP-CDN) to classify focal liver lesions (FLLs) of different pathological types on multiphase computed tomography (CT).

METHOD AND MATERIALS

Following ethics committee approval with waived informed consent requirement, 359 patients with a total of 517 FLLs scanned on a 320-row CT scanner using a multiphase (pre-contrast, arterial, portal venous, and delayed phases) protocol between 2012-2017 were retrospectively enrolled. FLLs were classified by contemporaneous histology as hepatocellular carcinoma (HCC, n=111), metastases (mets, n=112), benign FLL (i.e., hemangioma, focal nodular hyperplasia, adenoma; n=162), and hepatic abscess (n=132). A MP-CDN classifier with a sequential input of 4 CT contrast-enhanced phases was developed to automatically classify each FLL. 410 FLLs (88 HCCs, 89 mets, 128 benign FLLs, 105 abscesses) were used for training; 107 FLLs (23 HCCs, 23 mets, 34 benign FLLs, 27 abscesses) were used for testing. The performance of MP-CDN classification was assessed in the testing dataset: accuracy was calculated from the confusion matrix; the area under the receiver operating characteristic curve (AUC) was calculated from the softmax probability outputted from the last layer of the MP-CDN.

RESULTS

The mean classification accuracy in the testing dataset was 81.3% (87/107). The AUC for differentiating each lesion type from the other 3 lesion types was 0.92, 0.99, 0.88 and 0.96 for HCC, mets, benign FLLs, and hepatic abscess, respectively.

CONCLUSION

A MP-CDN accurately classified FLLs detected on multiphase CT over a 6-year period as HCC, mets, benign FLLs and hepatic abscess. If independently validated in a large, diverse cohort imaged with a variety of CT scanners and protocols, MP-CDN may be a potential method to assist radiologists for differential diagnosis of malignant and benign FLLs.

CLINICAL RELEVANCE/APPLICATION

MP-CDN may be a potential method to assist radiologists for differential diagnosis of malignant and benign FLLs and to facilitate management decisions in clinical practice.

RC309-04 Development and Validation of a Deep Learning System for Staging Liver Fibrosis Using Contrast-Enhanced CT Images of the Liver

Tuesday, Nov. 27 9:15AM - 9:25AM Room: E451A

Participants
Jong Keon Jang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Gyu Jin Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seung Soo Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yu Sub Sung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Bo-Kyeong Kang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Eunsil Yu, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To develop and validate a deep learning system (DLS) based on convolutional neural network for staging liver fibrosis using computed tomography (CT) images of the liver.

METHOD AND MATERIALS

A DLS for CT-based staging of liver fibrosis was created using a development dataset that included portal venous phase CT images for 7461 patients with pathologically confirmed liver fibrosis. The diagnostic performance of the DLS was evaluated in test datasets for 891 patients. The influence of patient characteristics and CT techniques on the accuracy of the DLS was evaluated by logistic regression analysis. In a subset of 421 patients, the diagnostic performance of the DLS was compared with that of the radiologist's assessment, aminotransferase-to-platelet ratio index (APRI), and fibrosis-4 index using the area under the receiver-operating characteristic curve (AUROC) and Obuchowski index.

RESULTS

DLS had a staging accuracy of 79.4% (707/891) and an AUROC of 0.96 (95% CI 0.95-0.97), 0.97 (CI 0.96-0.98), and 0.95 (CI 0.94-0.96) for diagnosing significant fibrosis (F2-4), advanced fibrosis (F3-4), and cirrhosis, respectively. In multivariate analysis, only pathologic fibrosis stage significantly affected the staging accuracy of the DLS ($P = .016$ and $P = .013$ for F1 and F2, respectively, compared with F4), while etiology and CT technique did not. The DLS (Obuchowski index 0.94) outperformed the radiologist's interpretation, APRI, and fibrosis-4 index (range of Obuchowski indices, 0.71-0.81, $P < .001$) for staging liver fibrosis.

CONCLUSION

The DLS allows accurate staging of liver fibrosis using CT images and appears to be a promising assessment tool.

CLINICAL RELEVANCE/APPLICATION

Considering its high diagnostic performance and robustness to CT imaging techniques, the CT-based deep learning system would be a useful clinical tool for assessing liver fibrosis using routine portal venous phase CT images of the liver.

RC309-05 New Applications of Multi-energy CT

Tuesday, Nov. 27 9:25AM - 9:50AM Room: E451A

Participants
Benjamin M. Yeh, MD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company; Consultant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextrast, Inc; Research Grant, Koninklijike Philips NV; Research Grant, Guerbet SA; ;

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LEARNING OBJECTIVES

1) Review scenarios in which single-energy CT and other diagnostic imaging tests may be problematic. 2) Describe capabilities of multi-energy CT, including recent advances. 3) Discuss case scenarios where multi-energy CT improves diagnoses or clinical decision making. 4) Review potential pitfalls of multi-energy CT. 5) Describe future advances and applications of multi-energy CT.

RC309-06 Measuring Fat Fraction with Dual-Layer Spectral CT Material Attenuation Decomposition Plots: An Iodine-Independent Method for Imaging Hepatic Steatosis

Tuesday, Nov. 27 9:50AM - 10:00AM Room: E451A

Participants
Todd C. Soesbe, PhD, Dallas, TX (*Presenter*) Nothing to Disclose
Matthew A. Lewis, PhD, Dallas, TX (*Abstract Co-Author*) Research collaboration, CMR Naviscan Corporation; Research collaboration, QT Ultrasound, LLC
Lakshmi Ananthakrishnan, MD, Irving, TX (*Abstract Co-Author*) Nothing to Disclose

John R. Leyendecker, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Yin Xi, PhD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Takeshi Yokoo, MD, PhD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Robert E. Lenkinski, PhD, Dallas, TX (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV Research Consultant, Aspect Imaging

PURPOSE

To determine the accuracy and iodine-independence of fat fraction measurements obtained from dual-layer spectral CT material attenuation decomposition (MAD) plots. Accuracy was evaluated using an MRI verified phantom, while iodine-independence was evaluated in patients with contrast-enhanced multiphase CT.

METHOD AND MATERIALS

Spectral CT derived photoelectric effect and Compton scatter images were used to create a 2D histogram (MAD plot) that allowed for differentiation and segmentation of fat, liver, and iodine. MAD plot fat fraction accuracy was determined using an anthropomorphic phantom and four 50 mL vials containing different ratios of homogenized bovine liver and lard (0, 25, 50, and 100% fat by volume). The phantom was scanned on both a Philips Ingenia 3.0 T MRI and a Philips IQon dual-layer spectral CT (120 kVp and 140 kVp) with the MRI fat fraction measurements (mDIXON Quant) used as the reference standard. ROI data from the MRI and spectral CT fat fraction maps were compared to the known fat fraction. For proof of concept in vivo, MAD plot fat fraction accuracy between pre- and post-contrast spectral CT was determined in four patients with varying degrees steatosis. Non-contrast and contrast-enhanced MAD plot fat fraction maps were compared using three ROIs per image, placed in similar liver locations.

RESULTS

For the phantom data, Bland-Altman analysis showed the mean difference (mean+/-sigma) between the known and measured fat fraction percent was MRI = 1.61+/-1.23, 120kVp = 0.52+/-1.77, and 140kVp = 0.80+/-1.94. MAD plot fat fraction maps at 120 kVp and 140 kVp were comparable in accuracy to the MRI mDIXON quant fat fraction map. Bland-Altman analysis for the in vivo liver data showed that the mean difference between the pre- and post-contrast measured fat fraction percent was Venous = 0.21+/-1.57 and Delayed = -0.61+/-1.78. Therefore, the MAD plot fat fraction map was independent of iodine.

CONCLUSION

MAD plots are an accurate method for measuring fat fraction with dual-layer spectral CT ex vivo, with potential for in vivo contrast-enhanced CT. The MAD plot method is translatable to other types of dual-energy spectral CT systems and could potentially measure volumetric fat fraction.

CLINICAL RELEVANCE/APPLICATION

With this method any patient receiving an abdominal CT (with or without iodine) can have their liver fat fraction measured, which would help to detect early stage and asymptomatic fatty liver disease.

RC309-07 Can Quantitative Iodine Parameters on DECT Replace Perfusion CT Parameters in Colorectal Cancers?

Tuesday, Nov. 27 10:00AM - 10:10AM Room: E451A

Participants
Hyo-Jin Kang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Se Hyung Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jae Seok Bae, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sun Kyung Jeon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joon Koo Han, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine the correlation between iodine concentrations derived from dual-energy CT (DECT) and perfusion CT (PCT) parameters in patients with pathologically-proven colorectal cancers (CRC), and to evaluate their reproducibility and respective radiation exposures.

METHOD AND MATERIALS

Institutional review board approval and written informed consents were obtained for this study. Forty-one patients with CRCs who underwent same day DECT and PCT were prospectively enrolled. Three radiologists independently analyzed iodine concentration of the tumors and iodine ratios (ratio of lesion to aorta (IRa) or to infrarenal IVC (IRv)) from DECT as well as blood flow (BF), blood volume (BV), permeability (PMB), and mean transit time (MTT) from PCT. Pearson R and linear correlation, paired t-test and intraclass correlation coefficients (ICCs) were used.

RESULTS

Significant correlations were found between iodine parameters from DECT and PCT parameters: iodine concentration of tumors and BF (r=0.29,P=0.06), BV (r=0.32,P=0.04), PMB (r=0.34,P=0.03), and MTT (r=-0.38,P=0.02); iodine ratio (IRa) and MTT (r=-0.32,P=0.04); and iodine ratio (IRv) and BF (r=0.32,P=0.04) and PMB (r=0.44,P=<0.01). DECT showed better intra- and inter-observer agreements (ICC=0.98, 0.90 in iodine concentration; 0.98, 0.91 in IRa; and 0.91, 0.93 in IRv, respectively) than PCT (ICC=0.90, 0.78 in BF; 0.82, 0.76 in BV; 0.75, 0.75 in PMB; 0.64, 0.79 in MTT, respectively). As for radiation dosage, CTDIvol and DLP in DECT (10.48±1.84mGy and 519.7±116.7mGy·cm) were significantly lower than those of PCT (75.76mGy and 911mGy·cm) (P<0.01).

CONCLUSION

Iodine parameters from DECT are significantly correlated with PCT parameters, but have higher intra- and inter-observer agreements and lower radiation exposure.

CLINICAL RELEVANCE/APPLICATION

As iodine parameters derived from DECT are significantly correlated with perfusion parameters while allowing better intra- and inter-observer agreements and lower radiation exposure, DECT may be a good alternative to PCT in the assessment of the tumor hemodynamics in patients with CRC.

RC309-08 Oral Contrast Media Controversies

Tuesday, Nov. 27 10:15AM - 10:40AM Room: E451A

Participants
Avinash R. Kambadakone, MD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Explain the indications and benefits of oral contrast media in abdomen/pelvis CT. 2) Understand the controversies in the role of oral contrast media in various clinical settings including ER, oncology and routine abdominal scans. 3) Optimize the use of oral contrast media to improve diagnosis.

RC309-09 Spectral Photon-Counting CT Multi-Phase Liver Imaging with Dual Contrast Agent

Tuesday, Nov. 27 10:40AM - 10:50AM Room: E451A

Participants
Salim Si-Mohamed, Lyon, France (*Presenter*) Nothing to Disclose
Valerie Tatard-Leitman, PhD, Lyon, France (*Abstract Co-Author*) Nothing to Disclose
Daniela Pfeiffer, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Monica Sigovan, PhD, Lyon, France (*Abstract Co-Author*) Nothing to Disclose
Daniel Bar-Ness, Bron, France (*Abstract Co-Author*) Nothing to Disclose
Loic Boussel, MD, Lyon, France (*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

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PURPOSE

To demonstrate the feasibility of dual-contrast multiphase imaging of the liver using Spectral Photon-Counting CT via K-edge imaging.

METHOD AND MATERIALS

The experiments were performed on 3 rabbits following approval by the local ethics committee. We used a 5 energy bins prototype spectral photon-counting CT (Philips Healthcare, Haifa, Israel), tube voltage of 120 kVp, tube current of 100 mA. The iodine contrast agent (Iomeron, 400 mg/mL, 1.5 mL/kg, Bracco) was injected first, followed by the gadolinium contrast agent (gadoteridol, 0.5 M, 5 mL/kg, Bracco) 21 seconds later, and acquisitions were done 10 seconds after the second injection. This protocol allowed performing two different phases imaging of the liver, i.e. arterial (gadolinium) and portal (iodine). Conventional HU and quantitative material decomposition iodine and specific K-edge gadolinium images were obtained.

RESULTS

The gadolinium K-edge and iodine material decomposition images allowed the discrimination between the two contrast agents, which was not possible using the conventional CT images. Moreover, we observed a dual-phase imaging matching the expected pharmacokinetics of the two contrast media. The iodine injected enhanced the liver parenchyma while the gadolinium injected enhanced the arteries. These results were confirmed by measuring the attenuation values (HU) and the concentrations (mg/mL) of contrast agents in the aorta (conventional CT: 1130 ± 17.6 HU; gadolinium: 20.9 ± 1.2; iodine: 6.8 ± 0.4), hepatic arteries (conventional CT: 474.6 ± 44.3; gadolinium: 7.7 ± 0.8; iodine: 0.7 ± 0.4), portal vein (conventional CT: 233.6 ± 15.1; gadolinium: -0.1 ± 0.6; iodine: 2.5 ± 0.4) and liver parenchyma (conventional CT: 143.9 ± 11.2; gadolinium: - 0.6 ± 0.7; iodine: 3.6 ± 0.4).

CONCLUSION

Spectral Photon-Counting CT allows in vivo dual contrast qualitative and quantitative liver multi-phase imaging in a single acquisition. This finding pinpoints major clinical applications in multiphase imaging with no registration issues and with the additional value of reducing radiation dose to patients by decreasing the number of acquisitions.

CLINICAL RELEVANCE/APPLICATION

Spectral Photon-Counting CT allows the qualitative discrimination between two contrast agents injected sequentially in the liver, enabling to reduce radiation dose to patients by combining liver arterial and portal phases into a single acquisition.

RC309-10 Machine Learning Based Quality Assurance for CT Arterial Phase Timing to Ensure Robust Measurement of Tumor Density in Hepatocellular Carcinoma Patients

Tuesday, Nov. 27 10:50AM - 11:00AM Room: E451A

Awards
Trainee Research Prize - Fellow

Participants
Laurent Dercle, MD, New York, NY (*Presenter*) Nothing to Disclose
Jingchen Ma, NYC, NY (*Abstract Co-Author*) Nothing to Disclose
Fatima-Zohra Mokrane, MD, Toulouse, France (*Abstract Co-Author*) Nothing to Disclose
Ai-ping Chen, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose
Deling Wang, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

Lin Lu, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Lawrence H. Schwartz, MD, New York, NY (*Abstract Co-Author*) Committee member, Celgene Corporation Committee member, Novartis AG Committee member, ICON plc Committee member, BioClinica, Inc
Chuanmiao Xie I, MD,PhD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Binsheng Zhao, DSc, New York, NY (*Abstract Co-Author*) License agreement, Varian Medical Systems, Inc; Royalties, Varian Medical Systems, Inc; License agreement, Keosys SAS; License agreement, Hinacom Software and Technology, Ltd;

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PURPOSE

Several treatment response criteria shifted towards categorizing response as a decrease in tumor size and/or density. We aimed to increase the reproducibility of the measurement of tumor density at the arterial phase in Hepatocellular carcinoma (HCC) by developing and validating a semi-Automatic arterial-timing Classification Algorithm based on the analysis of the pharmacokinetiC distribution of the Iodinated contrast Agent a Single timepoint (ACACIAS).

METHOD AND MATERIALS

Using dynamic CT-images of 69 HCC pts, we trained (48 pts, 1930 timepoints) and validated (21 pts, 837 timepoints) ACACIAS to categorize arterial-timing into five phases according to the time to arterial peak: early (E0) < -15s < pre-peak (Pre1) < -5s < peak (P2) < +5s < post-peak (Post3) < +15s < late (L4). The random forest algorithm built the model based on the average density in predefined ROIs. Using an independent testing set, we delineated and calculated the average density of biopsy-proven HCC in 90 pts with cirrhotic liver at three phases: non-contrast enhanced 'NCP', arterial 'AP' and portal 'PVP'.

RESULTS

In the validation set, ACACIAS predicted correctly phases E0, Pre1, P2, Post3, and L4 in respectively 92%, 58%, 86%, 30%, and 99% of pts. Inter-patient variability in the duration of the arterial peak (5-95th percentiles of Full Width at Half Maximum: 10.6-27.5s) explained lower accuracies of ACACIAS in Pre1 and Post3 phases. In the testing set, 96% of NCP and 97% of PVP were correctly classified. The predicted arterial timing of AP was E0, Pre1, P2, Post3, and L4 in respectively 1, 34, 13, 25, and 17 pts and was associated with a significant difference in mean tumor density: 68, 55, 60, 71, and 60HU. The arterial HCC enhancement peaked at phase Post3 (+17%), (P<0.02, ANOVA).

CONCLUSION

ACACIAS predicted arterial timing accurately based on iodine biodistribution on medical images. A peak of HCC tumor density (+17%) was observed at the arterial phase 'Post3'. ACACIAS could improve extraction of tumor quantitative imaging biomarkers and monitoring of anti-cancer therapy efficacy by ensuring reproducible arterial phase acquisitions.

CLINICAL RELEVANCE/APPLICATION

ACACIAS ensures a reproducible tumor density measurement at arterial phase for treatment response assessment, as well as wide-ranging applications since tumor density is a surrogate of vascularity.

RC309-11 CT Imaging Biomarkers

Tuesday, Nov. 27 11:00AM - 11:25AM Room: E451A

Participants
Meghan G. Lubner, MD, Madison, WI (*Presenter*) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson;

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LEARNING OBJECTIVES

1. Discuss known and emerging CT imaging biomarkers in non-oncologic applications using liver disease as an example. 2. Review oncologic applications of CT texture analysis using colorectal neoplasms and renal cell carcinoma as examples.

LEARNING OBJECTIVES

1) Discuss a variety of quantitative features (size/volume, morphology, texture) that can be obtained retrospectively from CT data for both oncologic and non-oncologic applications.

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/ Meghan G. Lubner, MD - 2014 Honored EducatorMeghan G. Lubner, MD - 2015 Honored EducatorMeghan G. Lubner, MD - 2018 Honored Educator

RC309-12 Quantitative Imaging in Spectral Detector CT: Suitability of Iodine Maps for Oncologic Imaging: An Initial Evaluation in Phantoms and 75 Patients

Tuesday, Nov. 27 11:25AM - 11:35AM Room: E451A

Participants
Nils Grosse Hokamp, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Nuran Abdullayev, MD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose
Max Schlaak, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian Wybranski, MD, Magdeburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Thorsten Persigehl, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Thomas Streichert, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose

Jasmin A. Holz, PhD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose
Hatem Alkadhi, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
David C. Maintz, MD, Koln, Germany (*Abstract Co-Author*) Nothing to Disclose
Stefan Haneder, MD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Iodine maps are available from spectral detector computed tomograph (SDCT). They visualize the distribution of iodinated contrast media and allow for its quantification. Hence, they are a promising technique in oncologic imaging with respect to both, initial diagnosis (benign vs malignant) and follow-up examinations (therapy monitoring). In order to exploit a potential benefit in this respect, it is necessary to understand the intra- and inter-individual consistency of these.

METHOD AND MATERIALS

To evaluate accuracy of the reconstruction algorithm, an anthropomorphic liver phantom was repetitively examined at different time points; further images were reconstructed repetitively. Regions of interest (ROI) were placed automatically at identical positions using an in-house developed software. In addition, we included 75 patients, that underwent double (n=50) or triple (n=25) SDCT examination in this retrospective, IRB-approved study. Patients with significant change in liver function as indicated by laboratory results were excluded. Three ROI were drawn in each the liver parenchyma and the portal vein (PV) in portal-venous phase. Iodine uptake (IU) was normalized to the PV (IU_norm). Empirical standard deviation of the mean (ESD) was used and used to determine inter-scan and intra-individual consistency of IU_norm in phantoms and patients, respectively.

RESULTS

In phantoms, ESD between different acquisitions and timepoints was as low as 1.3%. InMean iodine uptake of the liver parenchyma was 2.2 ± 0.8 mg/ml (ranging from 0.5 - 4.8 mg/ml), IU_norm was 0.40 ± 0.07. Intra-individual consistency was rather high as indicated by an ESD of 7.7% showing a wide range from -44% - +36%.

CONCLUSION

Iodine quantification using Iodine maps from SDCT is technically feasible; however, in in-vivo measurements at different timepoints, intra-individual iodine quantification of the liver differs. Among other reasons, this is likely due to offsets in timing of image acquisition and not necessarily attributed to the specific reconstruction algorithm.

CLINICAL RELEVANCE/APPLICATION

Measurements of iodine uptake should be interpreted carefully when considering them for clinical decision making.

RC309-13 Innovations in Health IT

Tuesday, Nov. 27 11:35AM - 12:00PM Room: E451A

Participants
Arun Krishnaraj, MD, MPH, Charlottesville, VA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify policies impacting the spread of innovation in health IT. 2) Assess the role of greater transparency of health care data. 3) Describe how mobile and wearables are impacting the collection of health data.

RC310

Ultrasound in the First Trimester of Pregnancy

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S405AB

GU OB US

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

LEARNING OBJECTIVES

1) Describe the typical appearances of a tubal ectopic pregnancy. 2) List findings that suggest an interstitial ectopic pregnancy. 3) Differentiate a spontaneous abortion in progress from a cervical ectopic pregnancy. 4) Recommend the appropriate follow up for early pregnancies of unknown location (PUL) identified on transvaginal sonography. 5) Differentiate with certainty a failed pregnancy from a pregnancy suspicious for but not diagnostic of failed pregnancy based on the sonographer finding. 6) Diagnose ectopic pregnancy and identify its location. 7) Recognize normal fetal anatomy in the first trimester and differentiate the normal fetus from an abnormal fetus. 8) Predict the sex of the developing fetus during the first trimester and understand the importance of sex determination in some conditions. 9) Recognize 'must know' major anomalies evident in first trimester. 10) Understand the role of first trimester sex designation. 11) Evaluate first trimester assessment of multiple pregnancies.

Sub-Events

RC310A Ectopic Pregnancy

Participants
Mindy M. Horrow, MD, Philadelphia, PA (*Presenter*) Spouse, Employee, Merck & Co, Inc

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LEARNING OBJECTIVES

1) Describe the typical appearances of a tubal ectopic pregnancy. 2) List findings that suggest an interstitial ectopic pregnancy. 3) Differentiate a spontaneous abortion in progress from a cervical ectopic pregnancy.

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/ Mindy M. Horrow, MD - 2013 Honored EducatorMindy M. Horrow, MD - 2016 Honored Educator

RC310B Abnormal Early Intrauterine Pregnancies

Participants
Carol B. Benson, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recommend the appropriate follow up for early pregnancies of unknown location (PUL) identified on transvaginal sonography. 2) Differentiate with certainty a failed pregnancy from a pregnancy suspicious for but not diagnostic of failed pregnancy based on the sonographer finding. 3) Diagnose ectopic pregnancy and identify its location. 4) Recognize normal fetal anatomy in the first trimester and differentiate the normal fetus from an abnormal fetus. 5) Predict the sex of the developing fetus during the first trimester and understand the importance of sex determination in some conditions.

ABSTRACT

During this session, findings in early pregnancy on transvaginal ultrasound will be discussed including pregnancies of unknown location (PUL), intrauterine pregnancies of uncertain viability (IPUV), and ectopic pregnancy. Criteria for definitive diagnosis of failed pregnancy will be reviewed, as will sonographic findings suspicious for but not diagnostic of failed pregnancy. Diagnosis of ectopic pregnancy will be discussed, including sonographic findings and determination of the location of the ectopic pregnancy. In addition, sonographic evaluation of the fetus during the first trimester will be presented with attention to the early diagnosis of some fetal malformation and the importance of sex determination for some conditions.

Active Handout:Carol Beer Benson

http://abstract.rsna.org/uploads/2018/18000742/Abnormal early IUPs RSNA RC310B.pdf

RC310C First Trimester Anomalies, Sex, and Other Things

Participants
Phyllis Glanc, MD, Toronto, ON (*Presenter*) Advisory Board, General Electric Company

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LEARNING OBJECTIVES

1) Recognize 'must know' major anomalies evident in first trimester. 2) Understand the role of first trimester sex designation. 3) Evaluate first trimester assessment of multiple pregnancies.

ABSTRACT

This refresher course will review the major anomalies which must be recognized in the later half of first trimester. We will also discuss the role of assessment of external genitalia in first trimester and what key features should be documented in the assessment in twin gestation.

RC311

Advances and Updates in SPECT/CT

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S504CD

CT NM

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

Sub-Events

RC311A SPECT/CT in Endocrine/Oncology

Participants
Esma A. Akin, MD, Washington, DC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Through clinical case examples, this activity aims to refresh knowledge of SPECT-CT applications with emphasis on neuroendocrine disorders as well as parathyroid imaging.

RC311B SPECT/CT Technology: State of the Art

Participants
Timothy Turkington, PhD, Durham, NC (*Presenter*) Consultant, Data Spectrum Corporation

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LEARNING OBJECTIVES

1. After this course, the attendee should be able to describe the basic functioning of a conventional gamma camera. 2. After this course, the attendee should be able describe three recent innovations of currently-available gamma cameras and SPECT/CT systems.

RC312

Vascular Series: CT Angiography: New Techniques and Their Application

Tuesday, Nov. 27 8:30AM - 12:00PM Room: S502AB

CT VA

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

Participants
Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Moderator*) Medical Director, Imagia Cybernetics Inc
Dominik Fleischmann, MD, Stanford, CA (*Moderator*) Research Grant, Siemens AG

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LEARNING OBJECTIVES

1) To describe new methods that can be used to extract data from non-invasive vascular imaging. 2) To review best practices for vascular image acquisition. 3) To highlight interesting diagnoses that can be made with optimized vascular imaging protocols.

ABSTRACT

Vascular imaging contines to be a diagnositic mainstay in radiology practice. New emerging methods to derive blood flow metrics have entered the field over the last 10 years. These have been greatly emphasized in the last 2-3 years and have revitalized the field to include new daignostic domains. This series will review these methods as well as show the spectrum of diseases commonly encountered by the vascular and cardiovascular radiologist.

Sub-Events

RC312-01 Dual-energy and Low kVp CTA

Tuesday, Nov. 27 8:30AM - 9:05AM Room: S502AB

Participants
Shuai Leng, PHD, Rochester, MN (*Presenter*) License agreement, Bayer AG

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LEARNING OBJECTIVES

1) Understand basic principles of dual energy CT and different implementation methods. 2) Understand dual energy processing methods commonly used in CTA exams. 3) Use various types of dual energy CT images to improve diagnosis of CTA. 4) Asess impact of low kVp on image quality and radiation dose in CTA. 5) Select appropriate kVp for CTA scans for best diagnosis at lowest radiation dose.

RC312-02 Pre-clinical CT Imaging of Aortic Aneurysm and Dissection Using a Nanoparticle Contrast Agent

Tuesday, Nov. 27 9:05AM - 9:15AM Room: S502AB

Participants
Ketan B. Ghaghada, PhD, Houston, TX (*Presenter*) Research Consultant, Alzeca Biosciences, LLC
Pingping Ren, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Zbigniew Starosolski, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Alzeca Biosciences, LLC
Laxman Devkota, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Igor Stupin, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Eric Tanifum, PhD, Houston, TX (*Abstract Co-Author*) Consultant, Alzeca Bioscoences, LLC
Ananth Annapragada, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Alzeca Biosciences, LLC Stockholder, Sensulin, LLC Stockholder, Abbott Laboratories Stockholder, Johnson & Johnson
Scott A. Lemaire, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Ying H. Shen, MD,PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Non-invasive structural and functional evaluation of aortic aneurysm and dissection (AAD) can (1) improve our understanding of disease initiation and progression in pre-clinical rodent models, and (2) facilitate in the management of patients at risk for aortic expansion, dissection and rupture. In this pre-clinical study, we investigated contrast-enhanced CT (CECT) imaging of aorta in a mouse model of sporadic AAD using a long circulating liposomal-iodine (Lip-I) nanoparticle contrast agent.

METHOD AND MATERIALS

Test mice were fed high fat diet for 4 weeks followed by continuous angiotensin-II (AngII) infusion for 4 weeks via a subcutaneous osmotic pump (n=8). Control mice (n=8) were fed regular diet and saline treatment. CECT was performed on day 7 and day 28 after starting AngII infusion. Additionally, non-contrast CT scans were acquired on day 28, prior to Lip-I injection, to determine aortic wall permeability. Lip-I was administered at a dose of 1.65 g I/kg for CECT imaging. CT images were analyzed for changes in lumen diameter and for contrast agent accumulation in aortic wall. CT findings were compared with post-mortem pathological examination of excised aorta.

RESULTS

CECT using Lip-I contrast agent enabled imaging of aortic aneurysm and dissection. The long circulating property of Lip-I provided uniform vascular opacification, thereby facilitating the visualization of structural changes in the aorta. CT imaging at Day 7 and day 28 enabled functional imaging of the aortic wall. Non-contrast images on day 28 demonstrated signal enhancement in the aortic wall of test mice; none of the control mice showed wall enhancement. CECT imaging also enabled the visualization of enlarged ascending aorta; lumen diameter increased by as much as 43% compared to controls. CT results corroborated with necropsy findings of pathology in excised aortas: 75% of test mice showed evidence of aortic disease compared to none in the control group; 25% of test mice exhibited dissection in the descending aorta; large suprarenal aneurysm was seen in one mouse; 62.5% of test mice exhibited enlargement of the ascending aorta.

CONCLUSION

Contrast-enhanced CT using a liposomal-I agent enabled structural and functional imaging of aorta in a mouse model of sporadic AAD.

CLINICAL RELEVANCE/APPLICATION

Structural and functional evaluation of the aortic wall using CECT can facilitate in the stratification of patients at risk for aneurysm expansion and rupture.

RC312-03 CT Imaging Before Transcatheter Aortic Valve Implantation (TAVI)? Using One-Stop Scan for Combined CT Angiography (CTA) Of the Head, Neck, Coronary and Aortic Arteries and Its Performance for Diagnosing

Tuesday, Nov. 27 9:15AM - 9:25AM Room: S502AB

Participants
Tao Shuai, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the effectiveness of one-stop scan for combined CT angiography (CTA) of the head, neck, coronary and aortic arteries before TAVI on a 16cm wide-detector CT and its performance for diagnosing coronary artery disease (CAD) and craniocervical artery disease

METHOD AND MATERIALS

110 patients (73.6±9.3 years) scheduled for TAVI underwent one contrast injection, one-stop CT scan first: ECG-triggered one heartbeat axial scan for coronary CT angiography (CCTA) and aortic valve, followed immediately by the non-ECG-gated scan for craniocervical and thoracic and abdominal CTA. Patient weight-dependent contrast dose volume at 1.0ml/kg was used. We analyzed CT attenuation values of the coronary arteries, head, neck aorta, iliac and femoral arteries. The craniocervical and CCTA images quality. The presence of stenosis (>=50 %) in CCTA was also evaluated using invasive coronary angiography result as a reference standard. Radiation dose was assessed.

RESULTS

The total dose-length product for the entire examination was low at 413.11±28.53 mGy.cm, and the total contrast dose was also low at 50±3.7ml. There was adequate attenuation (greater than 400HU) in all arteries. We could evaluate the peripheral access vessels and dimensions of the ascending aorta, aortic root, and aortic annulus in all patients. The image quality of craniocervical arteries was 100% diagnostic. The one-stop CT showed sensitivity of 89.7% and negative predictive value (NPV) of 92.4 % on the per-patient analysis, and the values were 91.5% and 96.7% on the per-vessel analysis.

CONCLUSION

Using the one-stop CT scan on a 16cm wide-detector CT system before TAVI provided high sensitivity and NPV in excluding obstructive CAD, and we provided excellent image quality for analyzing craniocervical artery disease for TAVI patients before surgery

CLINICAL RELEVANCE/APPLICATION

Wide-detector one-stop CT scan for combined CTA of head, neck, coronary and aortic arteries before TAVI is feasible with diagnostic image quality and low radiation dose

RC312-04 Impact of Replacing Traditional Medical Therapy with a Novel Personalized Treatment Strategy in Patients with Initially Uncomplicated Type-B Aortic Dissections

Tuesday, Nov. 27 9:25AM - 9:35AM Room: S502AB

Participants
Anna M. Sailer, MD,PhD, West Hollywood, CA (*Presenter*) Nothing to Disclose
Patty Nelemans, Maastricht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Martin J. Willemink, MD,PhD, Menlo Park, CA (*Abstract Co-Author*) Speakers Bureau, Koninklijke Philips NV; Research Grant, Koninklijke Philips NV
Kai Higashigaito, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Lewis D. Hahn, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Dominik Fleischmann, MD, Stanford, CA (*Abstract Co-Author*) Research Grant, Siemens AG

PURPOSE

Medical treatment of initially uncomplicated acute Stanford type-B aortic dissection is associated with a high rate of late adverse events. A risk prediction model has been developed to predict individual risk of developing a complication within 5 years after diagnosis and thus identify individuals who potentially benefit from preventive endografting. The model is based on five baseline clinical and imaging parameters and has good discriminative ability with an AUC of 0.86. However, the potential clinical impact of basing clinical decisions on the model depends on the consequences of true positive (TP) versus false positive (FP) classifications. Early identification and correct treatment of patients who are at risk for an adverse event (TP) will lead to benefit, whereas unnecessary treatment of patients not at risk (FP) will cause harm.

METHOD AND MATERIALS

We used decision curve analysis (DCA) to assess applicability of the model in clinical practice. The net benefit of treating patients according to the prediction model is compared with the net benefit of the two alternative strategies 'treat all' and 'treat none' over a range of plausible threshold probabilities. A threshold probability reflects the relative weights that are attached to benefit versus harm, and can be different for individual doctors and patients. Data were used from 83 patients with initially uncomplicated type-B dissections who underwent follow-up with CT.

RESULTS

DCA showed that using a model for prediction of 1-year and 5-year risk of adverse events has higher net benefit than the strategy 'treat none' when one is not willing to treat more than 10 patients to prevent one patient with aortic dissection from having an adverse event. The strategy 'treat all' has highest net benefit only at threshold probabilities below 10%, i.e. when one is willing to treat 10 or even more patients to prevent one late adverse event from an aortic dissection.

CONCLUSION

Personalized risk assessment based on a prediction model to identify candidates for preventive treatment with endografting can lead to a net benefit in patient outcome when compared with the currently widely advocated wait-and-see approach.

CLINICAL RELEVANCE/APPLICATION

Personalized treatment based on imaging parameters and clinical parameters reduces the risk of late adverse events in patients with initially uncomplicated Type B aortic dissections.

RC312-05 Relationship between Contrast Dose and Radiation Dose in CTA

Tuesday, Nov. 27 9:35AM - 10:10AM Room: S502AB

Participants
Mannudeep K. Kalra, MD, Boston, MA (*Presenter*) Research Grant, Siemens AG; Research Grant, Canon Medical Systems Corporation

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LEARNING OBJECTIVES

1) How scan techniques and factors affect radiation dose and contrast enhancement in CT angiography studies. 2) How patient factors affect radiation dose and contrast enhancement in CT angiography. 3) Relationship between radiation dose and contrast media administration in CT angiography.

RC312-06 CTA: Acquisition Artifacts and Challenges

Tuesday, Nov. 27 10:20AM - 10:55AM Room: S502AB

Participants
Eric E. Williamson, MD, Rochester, MN (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify common imaging artifacts seen in CT angiography and address them, if possible. 2) Discuss techniques to address common challenges encountered in the clinical practice of vascular CT.

RC312-08 Diagnostic Accuracy of Single-Phase CTA for Acute Aortic Syndromes

Tuesday, Nov. 27 11:05AM - 11:15AM Room: S502AB

Participants
Matthew Thompson, MD, Orange, CA (*Abstract Co-Author*) Nothing to Disclose
Mayil S. Krishnam, MBBS, MRCP, Orange, CA (*Abstract Co-Author*) Nothing to Disclose
James Pao, MD, Orange, CA (*Presenter*) Nothing to Disclose

PURPOSE

Dual-phase CTA protocol has been the described standard protocol for evaluating acute aortic syndromes (AASs) for over 20 years without significant scrutiny over the necessity of the unenhanced scan, which is one of the highest exposure to radiation amongst CT examinations. However, with significant advances in diagnostic imaging quality and post-processing techniques available today, we sought to reevaluate the clinical utility of the unenhanced phase for AAS and hypothesize that single-phase CTA may be sufficiently accurate in the diagnosis of AAS, including intramural hematoma.

METHOD AND MATERIALS

We retrospectively reviewed patients who presented to our emergency department and underwent a dual-phase CTA for concern of acute aortic syndrome (AAS), within a consecutive 4 year period. Our reference standard of true positive and negative cases in our subject population were determined by a review panel of two cardiovascular radiologists. After discovering 50 positive cases of AAS, 72 controls were selected randomly from the group of subjects negative for AAS. A study worklist was then created with both cases and control subjects (n = 122). Two radiologists, blinded to the diagnosis and the other reviewer, were asked to evaluate for an AAS by viewing only the contrast-enhanced (CTA) portions of the exams.

RESULTS

A total of 434 patients were identified as our study population. We found a total of 50 cases positive for AAS, giving a frequency of AAS to be 11.5%. Of the 50 cases positive for AAS, 13 were due to isolated intramural hematoma, 18 dissection, 6 penetrating atherosclerotic ulcer, 4 aortic rupture, and 9 a combination of IMH with dissection or PAU. The two blinded readers had perfect agreement (100%) with all cases (122/122), each designating 51 positive AAS cases and 71 negative. Each reader independently identified the same false positive case, therefore specificity was 98.6% and accuracy 99.2%. Since there were no false negatives and all true positives were identified, sensitivity was 100% for each reader.::

CONCLUSION

Single-phase CTA for the diagnosis of acute aortic syndromes is highly accurate. The unenhanced portion of the dual-phase protocol could effectively be eliminated.

CLINICAL RELEVANCE/APPLICATION

Diagnosing acute aortic syndromes with single-phase CTA would significantly reduce CT radiation exposure in these patients.

RC312-09 The Value of MDCT in the Differential Diagnosis of Chronic Thromboembolic Pulmonary Hypertension Patients

Tuesday, Nov. 27 11:10AM - 11:25AM Room: S502AB

Participants
Nan Yu, MD, Xian Yang, China (*Presenter*) Nothing to Disclose
Haifeng Duan, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose
Yongjun Jia, MMed, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose
Yong Yu, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose
Shan Dang, Xian, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Background: Chronic thromboembolic pulmonary hypertension (CTEPH) should be differentiated from other causes of pulmonary hypertension(PH), because CTEPH is the only form of pulmonary hypertension that can be surgically treated. However, due to non specific clinical and imaging manifestations, CTEPH remains under-diagnosed. The purpose of this study was to discern imaging findings that separate CTEPH from other causes of PE .

METHOD AND MATERIALS

Methods: A total of 56 patients diagnosed with PH were enrolled in the study, All the patients were underwent MDCT angiography. The CT images were assessed for the presence of chronic pulmonary embolism (PE). therefore, the 72 patients were divided into two groups: group1, CTEPH group (n=25); and group2, other causes of PE (pulmonary arterial hypertension n=5, PH due to left heart disease n=6, PH due to lung disease n=18, PH due to unclear or multifactorial mechanisms n=2). The symptoms, clinical signs, risk factors, blood test and radiological features were analyzed and compared in the two group.

RESULTS

There was no significant difference in the frequencies of clinical symptoms, signs, risk factors, blood test between patients with CTEPH and patients with nonthromboembolic PH, except the history of suffering from acute pulmonary embolism (APE) once (x2=5.376, p=0.029). The frequencies of direct signs signs of chronic PE, mosaic attenuation, ground glass opacity, and pulmonary artery widened were statistically significantly higher in patients with CTEPH than in patients with nonthromboembolic PH (p<0.001).

CONCLUSION

The clinical symptoms, signs and risk factors can not be dependent factors in CTEPH diagnosis due to nonspecific. However, Acorrding to MDCT angiography, most patients with CTEPH have direct signs of chronic PE. The secondary signs include mosaic attenuation, ground glass opacity, and pulmonary artery widened , which also helpful to distinguish CTEPH from other causes of PH.

CLINICAL RELEVANCE/APPLICATION

The imaging findings of MDCT is valuable in separating chronic thromboembolic pulmonary hypertension (CTEPH) from other causes of pulmonary hypertension (PH).

RC312-10 CTA: Post Processing and Workflow

Tuesday, Nov. 27 11:25AM - 12:00PM Room: S502AB

Participants
Michael L. Steigner, MD, Boston, MA (*Presenter*) Consultant, Canon Medical Systems Corporation

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LEARNING OBJECTIVES

1) Define post-processing principles. 2) Apply post-processing techniques. 3) Implement post-processing in the clinical workflow. 4) Emerging techniques and applications.

RC313

Pediatric Series: Musculoskeletal Imaging

Tuesday, Nov. 27 8:30AM - 12:00PM Room: N228

MK PD

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants
Arthur B. Meyers, MD, Orlando, FL (*Moderator*) Author with royalties, Reed Elsevier; Editor with royalties, Reed Elsevier
Tal Laor, MD, Boston, MA (*Moderator*) Nothing to Disclose
Karen Rosendahl, Bergen, Norway (*Moderator*) Nothing to Disclose
Jie C. Nguyen, MD,MS, Philadelphia, PA (*Moderator*) Nothing to Disclose

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Sub-Events

RC313-01 Anterior Cruciate Ligament Imaging in Children and Adolescents

Tuesday, Nov. 27 8:30AM - 8:50AM Room: N228

Participants
Arthur B. Meyers, MD, Orlando, FL (*Presenter*) Author with royalties, Reed Elsevier; Editor with royalties, Reed Elsevier

LEARNING OBJECTIVES

1) List two structures that can prevent reduction of tibial eminence fractures. 2) Describe the main types of anterior cruciate ligament reconstruction procedures that are used in skeletally immature children. 3) Identify the normal post-operative imaging appearance after physeal sparring anterior cruciate ligament reconstruction procedures.

RC313-02 Insall-Salvati Ratio and Visual Diagnosis of Patella Alta on MR versus Radiography in the Pediatric Population

Tuesday, Nov. 27 8:50AM - 9:00AM Room: N228

Participants
Darya Kurowecki, MD, Hamilton, ON (*Presenter*) Nothing to Disclose
Ravi Shergill, MD, Hamilton, ON (*Abstract Co-Author*) Nothing to Disclose
Kelly M. Cunningham, MD, Hamilton, ON (*Abstract Co-Author*) Nothing to Disclose
Devin Peterson, MD, Hamilton, ON (*Abstract Co-Author*) Nothing to Disclose
Heba S. Takrouri, MBBS, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Neuman Habib, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Kelly E. Ainsworth, MD, Burlington, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine whether the Insall-Salvati ratio (ISR) measured on MR images is equivalent to that measured on radiographs in the pediatric population, and whether a visual diagnosis of patella alta corresponds to an ISR diagnosis of patella alta on MR and radiographs.

METHOD AND MATERIALS

A retrospective review of 49 pediatric patients (age range 7.5-17 years) with unfused growth plates who underwent knee MR imaging and lateral knee radiographs. All patients had knee imaging obtained for a variety of reasons. Measurements for calculating ISR (ratio of the patella tendon length to patella length) and a visual estimate of the presence of patella alta were obtained by three independent radiologists. Data were analyzed using paired t-tests and Pearson's correlation. A reliability assessment and inter-rater and inter-method agreements were calculated. Patella alta was defined visually as the middle third of the patella bisecting the growth plate and as ISR >1.2. Additional cut-off values of ISR >1.3 and >1.4 were also analyzed.

RESULTS

There is a statistically significant but not clinically significant difference between ISR determined on MR (mean=1.19) and radiographs (mean=1.25, $p < 0.05$). There is a strong correlation between ISR as determined on MR and radiographs (Pearson's r=0.6) with moderate consistency (Cronbach's alpha=0.78). There is a good level of agreement between the diagnosis of patella alta on MR and radiographs when defined as ISR greater than 1.2 and 1.3 (Cohen's Kappa=0.61), but not 1.4 (Kappa=0.22). There is low agreement between a visual diagnosis of patella alta and a diagnosis of patella alta based on ISR across the two modalities (Kappa=0.09), and no agreement within the two modalities.

CONCLUSION

The study results demonstrate a strong association between ISR derived from MR images and radiographs in the pediatric population who are 7.5 years of age or older. Additionally, the results suggest that patella alta cannot be diagnosed visually on either modality.

CLINICAL RELEVANCE/APPLICATION

Clinically, it has been presumed that because ISR correlates well between radiographic and MRI measurements in adults that the same holds true in the pediatric population. This study confirms that ISR correlates well between radiographs and MRI in patients 7.5 years of age and older.

RC313-03 Clinical Implications of Focal Periphyseal Edema (FOPE): A Retrospective Review

Tuesday, Nov. 27 9:00AM - 9:10AM Room: N228

Participants
Leah C. Davis, DO, Charleston, SC (*Presenter*) Nothing to Disclose
William Davis, MD, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose
Bashir Hakim, MD, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose
Heather R. Collins, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Courtney E. Scher, DO, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The growth plate is a dynamic cartilaginous structure with distinct layers including resting, proliferative and hypertrophic zones. Focal periphyseal edema, or FOPE lesion, was originally described as focal bone marrow edema centered about a closing physis and is characterized by T2/STIR hyperintense and T1 hypointense signal on both sides of the physis. It may represent physiologic changes of physeal closure, with the marrow edema resulting from early osseous bridging, or tethering. Assuming this, FOPE lesions should be transiently present and resolve after physeal closure. No study has been performed to assess the clinical significance and natural course of FOPE lesions. The purpose of our study is to evaluate whether the presence of a FOPE lesion on MRI is associated with clinical symptoms of pain at the time of imaging, and whether symptoms resolve or persist on follow-up clinical examinations performed 9-12 months later.

METHOD AND MATERIALS

Inclusion criteria for our study was ages 11-18 years with knee pain and no acute trauma or surgery. 884 knee MRIs were returned from our initial search; 21 FOPE lesions were identified in 19 patients. Age and gender-matched patients were selected for the control group. Each FOPE lesion was evaluated for anatomic location, cross sectional location and size. Clinical data including age, gender, laterality, focal location of pain and reported trauma was obtained from a clinical note at or within 3 weeks of the MRI examination and from follow-up note 9-12 months later. When pain was reported using at least one cross-sectional descriptor in which the FOPE lesion was located, the lesion was described as 'concordant.'

RESULTS

Patients with FOPE lesions were significantly more likely to report resolution/improvement in pain at follow-up (64.29%) than persistent pain (7.14%) or no mention of pain (28.57%) in the follow up note [p=0.03], although there was no statistically significant difference in pain resolution at follow up between FOPE and control groups. FOPE patients were significantly more likely to have concordant rather than discordant pain [p = 0.04].

CONCLUSION

Our findings support previous suggestions that FOPE lesions themselves may be a symptomatic phenomenon of physeal closure.

CLINICAL RELEVANCE/APPLICATION

FOPE lesions on MRI should be recognized by their characteristic appearance and location around a closing physis and may be transiently painful.

RC313-04 Do Diffusion-tensor Imaging Parameters of the Physis Correlate with Subsequent Growth?

Tuesday, Nov. 27 9:10AM - 9:20AM Room: N228

Participants
Maria A. Bedoya-Velez, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Christian A. Barrera, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
J. C. Edgar, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Jorge Delgado, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Nancy A. Chauvin, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Diego Jaramillo, MD, MPH, Miami, FL (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

It has been demonstrated that Diffusion-Tensor imaging (DTI) parameters of the femoral physis (ADC, track length and volume) are higher when the growth rate is fastest. The aim of this study is to determine the correlation between DTI tractography of the distal femoral physis and the amount of height change during a 1-year period in children who are at puberty.

METHOD AND MATERIALS

Retrospectively, we identified children who had undergone DTI tractography of the knee and had recorded heights at the time of study and 10-14 months later. We included girls >= 11 yr. and boys >= 13 yr., all with open physes. DTI parameters of the femoral physis included: 20 directions, b values of 0 and 600 sec/mm², fractional anisotropy (FA) threshold of 0.15 and an angle threshold of 40°. We measured apparent diffusion coefficient (ADC), tract length, tract number, tract volume and tract concentration. Height change was calculated by subtracting the height at the DTI exam from the height recorded 10-14 months later. We correlated DTI parameters with height change during the following year.

RESULTS

25 children were included (10 girls, mean age 14.2 yr. range 11.9 - 16.1 yr.). The mean height at MRI was 165 cm (range 151 - 184 cm), and the mean height after 1 year was 169 cm (range 150 - 188 cm). Mean height change was 3.17 cm (range 0 - 12.7cm). Children with higher tract volumes, tract lengths and ADC values had a greater height change in 1 year (all $p < 0.001$). Linear regression showed that age was a predictor of height change, accounting for 23% of the variance ($p < 0.001$). After accounting for the variance associated with age, DTI parameters predicting additional variance in height change included femoral track number (R2 change = 0.42), tract volume (R2 change = 0.40), tract length (R2 change = 0.38) and tract concentration (R2 change = 0.31) ($p < 0.001$) (Figure 1).

CONCLUSION

Children with greater femoral track number and volume have greater height change. DTI parameters can help predict subsequent growth, suggesting that DTI of the knee is a biomarker for short-term growth potential.

CLINICAL RELEVANCE/APPLICATION

DTI of the knee is a growth biomarker. This may be useful in the evaluation of growth hormone (GH) therapeutic effectiveness in children with idiopathic short stature, GH deficiency or GH resistance.

RC313-05 Demonstration of the Fetal Bone Cortex on MRI Scans: Preliminary Clinical Study on Normal Fetal Specimens

Tuesday, Nov. 27 9:20AM - 9:30AM Room: N228

Participants
Yoshiko Matsubara, Hiroshima, Japan (*Presenter*) Nothing to Disclose
Chihiro Tani, MD, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Toru Higaki, PhD, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Shogo Kamioka, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Yuko Nakamura, MD, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation; Research Grant, Hitachi, Ltd; Research Grant, Fujitsu Limited; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Medical Advisory Board, General Electric Company; ;

PURPOSE

Computed tomography (CT) studies of fetuses can be used to evaluate systemic bone disorders. As radiation exposure is a critical issue, we developed a novel magnetic resonance imaging (MRI) sequence that demonstrates the bone cortex and compared MRI- and CT findings on fetal bones.

METHOD AND MATERIALS

We placed 14 normal human fetal specimens (gestational age 28-32 weeks) in a plastic cylindrical container and scanned them with a 3T MRI scanner (TRILLIUM OVAL, Hitachi, Tokyo, Japan). We used our original sequence based on T2*WI (TE=7.2 ms ,FA=40°) edited with the Dixon method. CT scans obtained with adaptive iterative dose reduction (AIDR) were the reference images. We evaluated metacarpal and a metatarsal images of the 5th finger and the shape of the spine. Their visualization on MRI scans was scored as 4=better than on-, 3=almost the same as on CT images, 2=not clearly visible but evaluable, and 1=not visible. A score of 2 or higher was considered diagnostically acceptable.

RESULTS

The average visualization score of the metacarpal and the metatarsal on MRI scans was 3.4 and 3.1, respectively. The visualization score of the spine differed by location, it was 3.3 for the cervical and thoracic- and 2.6 for the lumber spine. None of the MRI scans had a score of 1.

CONCLUSION

With our MRI technique, the small bones were more clearly visible than on CT scans. Our MRI sequence can replace CT study.

CLINICAL RELEVANCE/APPLICATION

We document the utility of MRI for fetal bone scanning. Our method can be used for evaluating human fetal bone systems without radiation exposure.

RC313-06 It's A Thin Line: Development and Validation of Dixon MRI-Based Semi-Quantitative Assessment of Physeal Stress in the Wrists of Young Gymnasts and Non-Gymnasts

Tuesday, Nov. 27 9:30AM - 9:40AM Room: N228

Participants
Laura S. Kox, MD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose
Rik B. Kraan, MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To reliably assess maturity- and stress-related metaphyseal water distribution in the wrists of gymnasts and non-gymnasts, using a semi-quantitative Dixon MRI-based method to aid early diagnosis of gymnastic physeal stress injury.

METHOD AND MATERIALS

Twenty-four gymnasts with wrist pain (12 girls), 18 asymptomatic gymnasts (9 girls), and 24 non-gymnast controls (12 girls) aged 12±1.5 years prospectively underwent hand radiographs and MRI of the wrist on a 3T scanner, including coronal T1-weighted and T2-weighted Dixon sequences. Skeletal age was determined using the radiographs. Two observers measured metaphyseal water signal fraction in 13 radial and ulnar regions of interest (ROIs) on Dixon MR images. Inter- and intra-rater reliability, inter-slice reliability (between 3 middle radial slices) and inter-ROI reliability (between 3 ROIs on same level) were assessed using intraclass correlation coefficients (ICCs). Water signal fractions and their within-person ratios in distal versus most proximal reference ROIs were compared between groups using one-way analysis of variance.

RESULTS

Inter- and intra-rater ICCs were 0.79-0.99 and 0.94-1.0 for T1-weighted, and 0.88-1.0 and 0.88-1.0 for T2-weighted Dixon. Inter-slice and inter-ROI ICCs were 0.55-0.94 and 0.95-0.97 for T1-weighted, and 0.70-0.96 and 0.96-0.97 for T2-weighted Dixon. Metaphyseal water signal fraction in symptomatic gymnasts was higher in six distal ROIs compared to asymptomatic gymnasts and in nine ROIs compared to non-gymnasts ($p<0.05$). Radial metaphyseal water score (defined as the ratio of a ROI located 5-10 mm proximal to the physis versus a ROI located 20-25 mm proximal to the physis) was 1.61 in symptomatic gymnasts and 1.35 in asymptomatic gymnasts on T2-weighted Dixon ($p<0.05$).

CONCLUSION

Semi-quantitative Dixon MRI-based water signal fraction assessment has good to excellent reproducibility and shows increased metaphyseal water scores in symptomatic gymnasts compared to asymptomatic gymnastic peers.

CLINICAL RELEVANCE/APPLICATION

This reliable, off-the-shelf semi-quantitative method for assessing metaphyseal bone marrow water content with short scan times can potentially be used as an indicator of bone marrow edema in the early diagnosis of gymnastic physeal stress injury.

RC313-07 Growth Plate Complex and Injuries

Tuesday, Nov. 27 9:40AM - 10:00AM Room: N228

Participants
Jie C. Nguyen, MD,MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review the histoanatomy of the growth plate and the physiology behind endochondral ossification. 2) Review the key components of the growth plate complex and the different injury patterns 3) Review the role of imaging in the treatment algorithm.

ABSTRACT

The growth plates (physes) are visible on virtually all imaging studies obtained in skeletally immature children. The proper function of these growth plates depends on an intricate balance between chondrocyte proliferation (requiring nourishment by the epiphyseal vessels) and death (facilitated by the metaphyseal vessels). Therefore, injury to either the growth plate (direct insult) or vascular compromise on either side of the growth plate (indirect insult) can cause growth plate dysfunction. Direct growth plate insults most commonly occur with Salter-Harris fractures and injuries that allow for transphyseal communication of vessels are at a higher risk for subsequent bone bridge formation. Indirect insults produce different sequelae depending upon whether the epiphyseal or metaphyseal blood supply is compromised. Epiphyseal osteonecrosis can produce slowed longitudinal bone growth with possible growth plate closure and is often accompanied by an abnormal secondary ossification center. In contrast, the loss of metaphyseal blood supply disrupts endochondral ossification and allows the persistence of chondrocytes within the metaphysis, which appear as growth plate widening that can be either focal or diffuse. Imaging remains critical for detecting acute injuries and identifying subsequent growth disturbances. Depending on the imaging findings and patient factors, these growth disturbances may be amenable to conservative or surgical treatment options. Therefore, an understanding of the normal growth plate anatomy and physiology and associated pathophysiologies can increase diagnostic accuracy, allow anticipation of future growth disturbances, and ensure optimal imaging by the radiologist with the ultimate goal of timely and appropriate intervention.

RC313-08 Orthopedic Imaging of Children with Cerebral Palsy

Tuesday, Nov. 27 10:20AM - 10:40AM Room: N228

Participants
Tal Laor, MD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To identify the impact of cerebral palsy on musculoskeletal development in children. 2) To recognize the radiographic manifestations of cerebral palsy on the lower extremities. 3) To understand how radiographic findings in children with cerebral palsy can direct treatment.

RC313-09 The Glenohumeral Joint in Brachial Plexus Birth Palsy (BPBI): Cartilage and Shoulder Muscle Evaluation with T2 Relaxation Time Mapping and Correlation with Disease Severity

Tuesday, Nov. 27 10:40AM - 10:50AM Room: N228

Participants
Mi-Jung Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Roger Cornwall, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Kendra Eckstein, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Hee Kyung Kim, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the T2 relaxation times of glenoid cartilage and shoulder muscles in children with brachial plexus birth injury (BPBI) as they relate to glenohumeral dysplasia and shoulder function.

METHOD AND MATERIALS

This retrospective study included children with unilateral BPBI who underwent bilateral shoulder 1.5T or 3T MRI. On axial images, mean T2 relaxation times were measured in the glenoid cartilage and in the deltoid, subscapularis, and infraspinatus muscles. Glenoid retroversion and posterior humeral head displacement were measured, and glenohumeral dysplasia was classified by Waters grade. Shoulder function measured by the Mallet Scale and Active Movement Scale (AMS) was evaluated in the subset of patients in whom an MRI and clinical examination were available prior to any surgery and less than 4 months apart. Relationships among all imaging and clinical data were assessed with Pearson correlations for continuous variables and Kendall's Tau-b for categorical variables. T2 values were compared between sides with paired t-tests.

RESULTS

74 children (age 5-216 months, mean 66 months) were included. Age negatively correlated with glenoid cartilage T2 values in unaffected (rho=-0.455, $p<0.001$) and affected (rho=-0.444, $p<0.001$) sides, but not with muscle T2 values. Glenoid cartilage T2 values did not differ between affected and unaffected sides. T2 values of all shoulder muscles were significantly higher on the affected side (all $p<0.001$) and positively correlated with Waters grade (tau=0.22, p=0.016 in deltoid; tau=0.21, p=0.019 in subscapularis; and tau=0.18, p=0.039 in infraspinatus). In the clinical subset (n=24), muscle T2 values did not correlate with global shoulder function on the Mallet scale, but individual muscle T2 values correlated inversely with corresponding specific AMS shoulder functions (tau=-0.33, p=0.036 for deltoid/abduction; tau=-0.55, $p<0.001$ for infraspinatus/external rotation).

CONCLUSION

Glenoid cartilage T2 relaxation time decreases with age in children, but is unaffected by BPBI. Shoulder muscle T2 relaxation time does not change with age, but is affected by BPBI and correlates with glenohumeral dysplasia and clinical muscle function.

CLINICAL RELEVANCE/APPLICATION

T2 relaxation time can be used to quantify denervation-induced atrophy of specific muscles and to assess the role of this atrophy in the pathophysiology, prognosis, and outcomes of BPBI in children.

RC313-10 How and How Much are the Muscles Affected in Juvenile Localized Scleroderma? A Qualitative and Quantitative MR Study

Tuesday, Nov. 27 10:50AM - 11:00AM Room: N228

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Juvenile localized scleroderma (JLS) is characterized by skin thickening and subcutaneous tissue involvement, but it can also extend to the deep tissues affecting muscles and bones. Thus, aim of our study was to perform a qualitative and quantitative MR-based evaluation of muscles in JLS patients (JLSp).

METHOD AND MATERIALS

An electronic search of JLSp referring to our tertiary center from January 2012 to January 2018 was performed. Inclusion criteria were: at least one MR scan at diagnosis including axial T2w fat-sat and axial T1w images of both extremities. The last available follow-up MR, satisfying the above-mentioned criteria was also included. Fatty atrophy (Mercury Scale) and muscle edema (5 points scale) were assessed for the qualitative analyses. Subcutaneous area (SA), muscle perimeter (MP) and muscle area (MA) were measured (i.e., single slice evaluation at the mostly affected level) on the injured (i) and healthy contralateral (hc) extremity (Student's T-test; $p<0.05$). Two radiologists performed each measurement independently and the intraclass correlation coefficient was computed.

RESULTS

Fourteen JLSp (9 females; mean age 7.1±3.6 yrs) met the inclusion criteria and 23 MR examinations (i.e., 14 at diagnosis and 9 at follow-up) were evaluated. Muscle edema was detected in 12 patients (mean value 1.36) whereas fatty replacement was identified only in one case (grade 2). At diagnosis all quantitative parameters were significantly lower on the injured side (SAi=27.72±17.15cm2 vs SAhc=35.72±26.54cm2; MPi=22.91±5.78cm vs MPhc=26.66±6.91cm; MAi= 40.67±18.56cm2 vs MAhc=46.05±22.50cm2, p<0.05,each; ICC raters>.950, each). At follow-up the muscle edema decreased in 6 JSLp and SA, MP, and MA didn't show any significant difference between the two extremities (p>0.05).

CONCLUSION

JLSp showed low-grade muscle edema and significant hypoplasia rather than atrophic changes. The therapeutic treatment didn't reduce only the edema but also the quantitative differences between the two extremities. Further studies including a larger population and the evaluation of muscle volume should be performed to further assess this evidence.

CLINICAL RELEVANCE/APPLICATION

Muscle hypoplasia rather than atrophy affects JLSp thus an MR-based qualitative and quantitative muscle evaluation, at diagnosis and follow-up, is expected to have a strong clinical impact.

RC313-11 Automated Segmentation of the Femoral Head on MRI to Extract Biomarkers of Early Hip Disease Predictors in 9 Year Old Children: A Population-Based Prospective Cohort Study

Tuesday, Nov. 27 11:00AM - 11:10AM Room: N228

Participants
Desiree K. de Vreede, MD,MENG, Rotterdam, Netherlands (*Presenter*) Nothing to Disclose
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PURPOSE

The objective of the present study is to use a novel approach to automatically segment the femoral head from hip MR images and to extract biomarkers that represent early predictors of hip disease. These biomarkers will be related to BMI, physical activity and diet in a large population-based prospective cohort study.

METHOD AND MATERIALS

We collected hip MR images in 2870 children at the age of 9 years as part of a MRI study embedded in a prospective cohort study, which follows children from fetal life until early adulthood. The MRI hip protocol (3.0T) was identical for all participants and comprised of two coronal sequences; a T2 and a T1 -weighted sequence. The slice thickness was 1.2 mm for both sequences, all slices were contiguous. Automatic segmentation of the anatomical structure of interest from the MR image was performed using a multi-atlas appearance model, which is multi-modal in that it takes both weighted sequences as input. The model was evaluated using 10-fold cross-validation over a set of T2 and a T1 sequences with corresponding manually drawn femoral head segmentations. After segmentation, shape characteristics of the femoral head will be automatically extracted in a similar way.

RESULTS

We were able to segment the femoral bone from MR images accurately (with dice numbers of 0.793-0.869) and are currently working on a method to automatically extract several shape characteristics of the femoral head such as volume, neck-shaft angle and femoral neck width.

CONCLUSION

Automatic segmentation of the femoral head from MR images can be accurately done using a multi-atlas appearance model, and shape characteristics can be automatically derived from these segmentations.

CLINICAL RELEVANCE/APPLICATION

Automatic segmentation of biomarkers is the first step in relating biomarkers that are early identifiers of disease to BMI, physical activity and diet. With the knowledge obtained from a large population-based cohort, we could intervene in the diet or physical activity levels of young children with early disease characteristics.

RC313-12 Semantic Labeling of Pediatric Musculoskeletal Radiographs Using Deep Learning

Tuesday, Nov. 27 11:10AM - 11:20AM Room: N228

Awards
Trainee Research Prize - Resident

Participants
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PURPOSE

To develop and test the performance of deep convolutional neural networks (DCNNs) for the automated classification of pediatric musculoskeletal radiographs by anatomic area.

METHOD AND MATERIALS

We obtained 50 anonymized pediatric radiographs each of the shoulder (AP), elbow (lateral), hand (PA), pelvis (AP), and knee (AP) (250 total images). These radiographs were combined into a single database and used to train 5 DCNNs, one to detect each anatomic region. For each DCNN, the radiographs were randomly split into training (70%), validation (10%), and test (20%) datasets. The training and validation datasets were augmented 30x using multiple rotations, flipping, random cropping, and non-rigid deformation. These augmented images were used to train and validate the ResNet-18 DCNN pretrained on ImageNet. All DCNN development and testing was performed using PyTorch on a 2.5 GHz Intel Haswell dual socket (12-core processors) with 128 GB of RAM and 2 NVIDIA K80 GPUs. Receiver operating characteristic (ROC) curves with area under the curve (AUC) and standard diagnostic measures (e.g., sensitivity, specificity, and accuracy) were used to evaluate the DCNN's performance.

RESULTS

All 5 DCNNs trained for classification of the radiographs into anatomic region achieved AUCs of 1 (Table 1). Accuracy, sensitivity, and specificity were 100% for all DCNNs except for the shoulder DCNN, which had 97% accuracy, 90% sensitivity, and 100% specificity. The shoulder DCNN was incorrect in 2 of 60 test cases (both false negatives), which were correctly labeled by a musculoskeletal radiologist. Classification of test radiographs occurred at a rate of 33 radiographs per second.

CONCLUSION

DCNNs trained on a small set of images with 30x augmentation through standard processing techniques can classify pediatric musculoskeletal radiographs into anatomic region with near-perfect to perfect accuracy at superhuman speeds. DCNNs such as these may improve radiologist workflow through automated labeling of radiographs, identification of relevant comparison examinations, and improvement of hanging protocols. The proof-of-concept from our work may apply to other body parts and radiographic views to create an all-encompassing semantic labeling DCNN.

CLINICAL RELEVANCE/APPLICATION

DCNNs have good-to-perfect accuracy for automatically classifying pediatric musculoskeletal radiographs into anatomic region at superhuman speeds, which may enhance radiologist workflow.

RC313-13 Binomial Determination of Acute Orthopedic Pediatric Elbow Emergencies Using a Convolutional Neural Network: Initial Results

Tuesday, Nov. 27 11:20AM - 11:30AM Room: N228

Participants
Jesse C. Rayan, MD, Houston, TX (*Presenter*) Nothing to Disclose
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PURPOSE

The majority of pediatric elbow trauma requiring radiographic evaluation are initially interpreted by non-radiologists or by an adult radiologist unfamiliar with normal developmental variations. Accurate interpretation of acute orthopedic emergencies in the pediatric elbow can be challenging. Automated determination of normal versus abnormal radiographs can significantly improve workflow, patient care, and allow the emergency room provider to focus on other clinical duties. The purpose of this study is to determine if convolutional neural networks (CNN) can binomially classify pediatric elbow radiographs as normal versus abnormal.

METHOD AND MATERIALS

With IRB approval, we retrospectively retrieved 4311 radiographic studies containing 11988 images of the elbow and associated radiology reports over a 12-month period from January-December 2017 at a dedicated children's hospital. A text-classification model 'fast-text' (Joulin et al.) was trained to assist classification of radiology reports into normal and abnormal. A CNN based on the Inception-v3 architecture (Szegedy et al.) was modified to accept an input layer of 1100 x 1100 pixel single-channel images. Training was performed with transfer learning from a CNN pre-trained on radiographs from the 2017 RSNA Pediatric Bone Age Challenge on a desktop system with a GTX 1080 Ti. A separate validation dataset was created and verified with two radiology residents examining 911 images and reported findings from 330 studies. Training was performed for over 250 epochs until accuracy plateaued.

RESULTS

Evaluation (inference) takes 0.4 seconds per radiograph. Sensitivity for an individual radiograph was 88%, with a specificity of 68%. Combining results for a complete elbow radiographic series, sensitivity was 95%, and specificity was 50%.

CONCLUSION

Automated binomial classification of pediatric elbow radiographs into normal and abnormal is feasible using CNN. Initial results show that the product errs on sensitivity over specificity.

CLINICAL RELEVANCE/APPLICATION

At high volume centers or centers without a radiologist such as stand alone urgent care centers, automated diagnosis of elbow or other diagnostically challenging pediatric appendicular radiographs after acute injury can potentially improve patient care and workflow. CNN facilitated radiographic interpretation is a potential viable tool as improvements in CNN algorithms improve specificity.

RC313-14 SPARCC Magnetic Resonance Imaging Scoring System for Assessment of Sacroiliitis in Pediatric Patients with Juvenile Spondyloarthritis/Enthesitis Related Arthritis: A Reliability, Validity, and Responsiveness Study

Tuesday, Nov. 27 11:30AM - 11:40AM Room: N228

Participants
Jyoti Panwar, MD, FRCR, Toronto, ON (*Presenter*) Nothing to Disclose
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PURPOSE

Intra- and inter-reader reliability, construct validity and responsiveness of the Spondyloarthritis Research Consortium of Canada (SPARCC) MRI scoring system were investigated for scoring sacroiliitis in pediatric juvenile spondyloarthritis (JSpA)/enthesitis related arthritis (ERA) patients who have received biologic and/or non-biologic treatment.

METHOD AND MATERIALS

Ninety whole body MRI examinations with dedicated coronal oblique planes of the sacroiliac joints in 46 patients were independently reviewed and scored by two pediatric musculoskeletal radiologists, blinded to clinical details, using the SPARCC system. Intra- and inter-reader reliability was assessed by intra-class correlation coefficients (ICCs). Construct validity testing was done by 1) correlating the SPARCC MRI scores of sacroiliitis with clinical disease activity indicators (cross-sectional validity); 2) correlating the change in the MRI score with the change in clinical indicators before and after treatment (longitudinal validity). Responsiveness of the MRI and clinical indicators was also evaluated, grouped by biologic and non-biologic treatment.

RESULTS

When applied in children with JSpA/ERA, the SPARCC showed almost perfect (ICC 0.79-1.00) intra- and inter-reader reliability. There was poor cross-sectional and longitudinal correlation between clinical assessment indicators and MRI scoring. SPARCC scores showed higher responsiveness to treatment-related change than most clinical outcome measures. Three clinical outcome measures correlated longitudinally with SPARCC score in non-biologic treatment: active joint count ($r=0.72$, $p<0.001$), FABER test ($r=0.58$, $p=0.012$), and Physician Global Assessment ($r=0.61$, $p=0.034$).

CONCLUSION

SPARCC MRI scoring system is a reliable tool with relatively higher responsiveness than clinical indicators and is suitable for objective quantification of sacroiliitis when applied to pediatric JSpA/ERA patients. If the results of this pilot study are reproduced in larger series this scoring system may serve as a reliable quantitative method for early detection of axial disease, to monitor disease activity and response to therapy.

CLINICAL RELEVANCE/APPLICATION

The application of this radiologic scoring index into clinical practice may serve as a reliable quantitative method to assess the degree of SI joint inflammation even in the subclinical stage and potentially to monitor disease activity, and response to therapy.

RC313-15 Imaging of Juvenile Idiopathic Arthritis

Tuesday, Nov. 27 11:40AM - 12:00PM Room: N228

Participants
Karen Rosendahl, Bergen, Norway (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To identify features of joint inflammation and destructive change on plain radiographs, ultrasound and MRI. 2) To appreciate the role of ultrasound for detecting and grading of inflammation in JIA. 3) To understand the appearances of synovitis and its mimickers on MRI.

RC314

Interventional Series: Venous Disease

Tuesday, Nov. 27 8:30AM - 12:00PM Room: E352

CH VA IR

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants
Kush R. Desai, MD, Chicago, IL (*Moderator*) Speakers Bureau, Cook Group Incorporated; Consultant, Cook Group Incorporated; Consultant, The Spectranetics Corporation; Consultant, AngioDynamics, Inc; Consultant, Boston Scientific Corporation
Akhilesh K. Sista, MD, New York, NY (*Moderator*) Research Grant, Penumbra Inc; Scientific Advisory Board, Thrombolex

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LEARNING OBJECTIVES

1) Describe current management of pulmonary embolism, including interventional techniques. 2) List rationale for venous thrombolysis. 3) Describe the current state of practice surrounding inferior vena cava filters. 4) Learn about techniques for endovascular management of chronic venous occlusions

Sub-Events

RC314-01 PE I: Diagnosis and Triage of Pulmonary Embolism

Tuesday, Nov. 27 8:30AM - 8:45AM Room: E352

Participants
Akhilesh K. Sista, MD, New York, NY (*Presenter*) Research Grant, Penumbra Inc; Scientific Advisory Board, Thrombolex

LEARNING OBJECTIVES

1) Understand the stratification of acute PE and its rationale.

RC314-03 Catheter-Directed Thrombolysis for Submassive Pulmonary Embolism: Retrospective Review of 113 Patients with 6 Month Follow-Up

Tuesday, Nov. 27 9:00AM - 9:10AM Room: E352

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Catheter-directed thrombolysis (CDT) is an established treatment option for patients with massive pulmonary embolism (PE); however, there is limited literature about its role for patients with submassive PE. This work evaluated the long-term clinical outcomes of CDT therapy for submassive PE.

METHOD AND MATERIALS

A single center retrospective observational study was performed with institutional IRB approval. Imaging and medical records of patients who underwent CDT for submassive PE (n=113, 52%M:48%F, 18% with cancer history) from 2013-2017 were reviewed. The primary outcomes evaluated were pre and post-procedure systolic pulmonary arterial pressure (PAP), post-procedure complications, follow up assessments at 1 and 6 months and right ventricular systolic pressure (RVSP) at 6 months post procedure.

RESULTS

Pre-procedural mean blood pressure was 132.0 ± 5.1 / 80.0 ± 3.0 mmHg, heart rate was 105.5 ± 3.4 bpm, RV/LV ratio by CT angiogram was 1.6 ± 0.1, PAP was 55.5 ± 2.7 mmHg, and RVSP was 48.3 ± 3.6 mmHg. Duration of tPA therapy was 20.7 ± 1.5 hrs and mean tPA dose was 23.7 ± 2.4 mg. Post-procedure, the mean PAP decreased to 38.3 ± 3.5 mmHg (p <0.01). Hemorrhagic complications relating to CDT occurred in 6.1% of patients who underwent treatment and the mortality rate, unrelated to the procedure, during hospitalization was 3.5%. During follow-up, 94.1% of patients expressed clinical improvement at 1 month and 90.3% at 6 months post-procedure. Of those with 6 month follow-up echocardiograms after treatment (n=36), RVSP significantly decreased to 32.2 ± 5.7 mmHg (p < 0.01).

CONCLUSION

With a low complication and mortality rate, decreased PAP and RVSP, and high rates of clinical improvement, long-term clinical outcomes support the use of CDT as a safe and effective treatment option for patients with submassive PE.

CLINICAL RELEVANCE/APPLICATION

The data regarding the long-term consequences of using CDT in patients with submassive PE is limited. The results of this large, single-center, retrospective study demonstrate improved PAP and RSVP, excellent clinical outcomes and low complication rates, supporting the use of CDT in this patient population.

RC314-04 Early Catheter Directed Thrombolysis (CDT) Has No Effect on Survival or Escalation to Massive Pulmonary Embolism (PE) in Patients Presenting with High Risk Submassive PE

Tuesday, Nov. 27 9:10AM - 9:20AM Room: E352

Participants
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PURPOSE

To evaluate the impact on time from diagnosis to catheter directed thrombolysis (CDT) in patients with acute, high-risk, submassive pulmonary embolism (PE) on escalation to massive PE and survival.

METHOD AND MATERIALS

This single-center, IRB approved, retrospective study identified 835 contiguous patients with acute submassive PE between January 2011 and July 2017. This cohort was reviewed to identify patients with high-risk submassive PE (simplified Pulmonary Embolism Severity Index (PESI) score >= 1, evidence of right ventricular (RV) dysfunction as seen on computed tomography or echocardiography, and an elevated RV biomarker, troponin or brain natriuretic peptide) treated with catheter directed thrombolysis (CDT). 76 contiguous patients (60.5 ± 15.5 years old, 45% male, PESI score 104.4 ± 29.3) were identified. Demographic, treatment, and outcome details were retrospectively reviewed. Patients were treated with intravenous heparin prior to initiation of CDT.

RESULTS

39 (51%) patients had CDT within 12 hours of diagnosis, 37 (49%) had CDT after 12 hours. 72 (95%) patients had bilateral thrombolysis, 5% had unilateral thrombolysis - 3 (4%) on the right and 1 (1%) on the right. The average duration of lysis was 20±6.9 hours with an average tPA infiusion rate of 1.5±0.6 mg/catheter/hour. Escalation to massive PE occurred in 4 patients (5.3%, 95% CI: 2-13%), 2 in each group (5.4% vs 5.1%, p=1.0). Survival at 30 and 90 days was 95.5% and 95.3%. Multiple regression analysis demonstrated that increased time to treatment (30-day p=0.413; 90-day p=0.44) and PESI score (30-day p=0.95; 90-day p=0.98) were not predictive of worse survival while escalation to massive PE prior to CDT was predictive of worse survival (30-day p=0.04; 90-day p=0.04).

CONCLUSION

In patients with acute, high-risk, submassive PE, up to 13% of patients may escalate to massive PE prior to CDT. Early CDT was not associated with decreased escalation to massive PE or increased survival at 30 and 90 days. However, escalation to massive was associated with worse survival.

CLINICAL RELEVANCE/APPLICATION

In patients with acute, high-risk, submassive PE, up to 13% of patients may escalate to massive PE prior to CDT. Early CDT was not associated with decreased escalation to massive PE or increased survival at 30 and 90 days. However, escalation to massive was associated with worse survival.

RC314-05 Chronic Venous Recanalization

Tuesday, Nov. 27 9:20AM - 9:35AM Room: E352

Participants
Kari J. Nelson, MD, Orange, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To review indications and techniques for chronic venous recanalization. 2) To discuss clinical follow-up and management of chronic venous recanalization patients.

RC314-06 Biology of Pulmonary Embolism

Tuesday, Nov. 27 9:35AM - 9:50AM Room: E352

Participants
Akhilesh K. Sista, MD, New York, NY (*Presenter*) Research Grant, Penumbra Inc; Scientific Advisory Board, Thrombolex

LEARNING OBJECTIVES

1) Describe the method by which pulmonary embolism causes right ventricular failure.

RC314-07 Two Methods for Blocking Superficial Venous Blood Flow during Thrombolytic Treatment on Lower Extremity Deep Venous Thrombosis: A Comparative Study

Tuesday, Nov. 27 9:50AM - 10:00AM Room: E352

Participants
Yan Li, Nanjing, China (*Presenter*) Nothing to Disclose
Yu-Chen Chen, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose
Jian-Ping Gu, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare the effectiveness and patient comfort between two methods for blocking superficial venous blood flow during thrombolytic treatment on lower extremity deep venous thrombosis (DVT) so as to provide the evidence for clinical choice.

METHOD AND MATERIALS

Eighty patients with lower extremity DVT were randomly divided into sphygmomanometer and tourniquet group (group A and group B), 40 patients for each group. All the patients were treated with daily dosage of urokinase using dial sphygmomanometer cuff and tourniquet to block lower extremity superficial vein blood flow, respectively. The pressure of the dial sphygmomanometer blocking lower extremity superficial vein blood flow was measured during lower extremity venography. Leg swelling reduction rate, venous patency, thrombus removal rate and average comfort index were observed during the blocking process.

RESULTS

The average pressure value for group A was 70mmHg±10mmHg. The difference of the swelling reduction rate and venous patency was significant between groups. Comparing the two groups at different time points, the average thrombus clearance rate of group A was higher than that of group B. The leg pain scores of group A were lower than those of group B. Postoperative comfort ratio of group A was higher than that of group B, and the proportion of severe discomfort in group A was lower than that of group B.

CONCLUSION

Compared with the tourniquet, using dial sphygmomanometer cuff to block lower extremity superficial vein blood flow would get better thrombolytic effect on DVT and higher patient comfort during the treatment process.

CLINICAL RELEVANCE/APPLICATION

In summary, compared with the tourniquet, using the dial sphygmomanometer cuff to block the superficial vein of lower extremity blood flow will obtain a better thrombolytic effect, higher patients' comforts during the treatment process, and provide a simpler and easier nursing tool that is worth spreading in clinical use.

RC314-08 Compressive Venous Syndromes

Tuesday, Nov. 27 10:00AM - 10:15AM Room: E352

Participants
Sanjeeva P. Kalva, MD, Dallas, TX (*Presenter*) Consultant, General Electric Company; Royalties, Reed Elsevier; Royalties, Springer Nature; Investor, Althea Healthcare; Consultant, C. F. Koo Foundation; Consultant, Medtronic plc; Research Grant, AngioDynamics, Inc

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LEARNING OBJECTIVES

1) Discuss the pathophysiology of compressive venous syndromes. 2) Review the etiology, symptoms, work up and imaging findings of common venous compression syndromes - May Thurner, Thoracic outlet, Nutcracker Syndrome, Popliteal Venous Compression. 3) Discuss the management options of these entities.

RC314-09 IVC Filters: Evidence and Ongoing Trials

Tuesday, Nov. 27 10:30AM - 10:45AM Room: E352

Participants
Matthew S. Johnson, MD, Indianapolis, IN (*Presenter*) Research Consultant, Bayer AG; Research Consultant, Bristol-Myers Squibb Company; Research Consultant, Boston Scientific Corporation; Research Consultant, Cook Group Incorporated; Research Consultant, BTG International Ltd; Research support, BTG International Ltd; Research Consultant, Surefire Medical, Inc; Research support, Surefire Medical, Inc; Research Consultant, Johnson & Johnson; Research Consultant, Avantec; ;

LEARNING OBJECTIVES

1) Describe caval filters currently available for use in the United States. 2) Understand accepted indications for filter placement and

areas of controversy in those indications. 3) Describe potential complications related to vena cava filter usage. 4) Discuss the rationale for the PRESERVE trial. 5) Apply understanding of the indications and potential complications of vena cava filters to their clinical use.

RC314-10 A Retrospective Comparison of Patients Receiving EKOS Thrombolysis for Massive or Sub-Massive Pulmonary Embolism to Historic Controls Receiving Medical Therapy

Tuesday, Nov. 27 10:45AM - 10:55AM Room: E352

Awards
Student Travel Stipend Award

Participants
Anushi Patel, MD, Longwood, FL (*Presenter*) Nothing to Disclose
Marsela H. Campbell, DO, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose
Mario Agrait-Bertran, MD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose
Daniel A. Siragusa, MD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Treatment of massive or sub-massive pulmonary embolism (PE) poses a unique challenge as conventional medical therapy alone may be insufficient to restore adequate cardiac function in patients with right ventricular dysfunction. This has led to growing interest in alternative therapy, specifically EKOS thrombolysis, with hopes to improve outcomes in this specific patient population. We evaluated differences in outcomes between patients receiving both EKOS thrombolysis plus systemic anticoagulation versus systemic anticoagulation alone.

METHOD AND MATERIALS

Retrospective single center data was compiled of ICU patients with imaging proven PE admitted between January 2014 and December 2016. 31 patients received adjunctive EKOS thrombolysis in addition to systemic anticoagulation. 92 control patients were treated with systemic anticoagulation alone. At our institution, patients that receive EKOS thrombolysis have radiologic and clinical signs of sub-massive or massive PE including right heart strain. Groups were compared using the non-parametric Wilcoxon rank sum test for continuous data (total length of stay [LOS], ICU LOS, and total hospitalization costs) and using Fisher's exact tests for categorical data (survival rates at discharge, 30- and 90-days after treatment).

RESULTS

All 31 patients in the treatment group and 75 patients (82%) in the control group were alive 90 days after treatment ($p=0.006$). Higher 30-day survival rate was seen in the treatment group (100%) compared to control group (86%, $p=0.037$). The length of stay (LOS) was significantly longer for the control group (median 384 hours) compared to EKOS group (median 168 hours, $p<0.001$). ICU LOS was longer ($p<0.001$) and total cost was higher ($p<0.001$) in the control group as well. The exception is no statistically significant difference in survival at time of discharge.

CONCLUSION

Patients treated with adjunctive EKOS thrombolysis benefited from improved outcomes, specifically, lower total and ICU LOS and higher 30- and 90- day survival rates. In addition, lower total care costs suggests that EKOS is a cost-effective treatment.

CLINICAL RELEVANCE/APPLICATION

Compared to systemic anticoagulation alone, adjunctive EKOS thrombolysis demonstrates improved clinical outcomes and cost-effectiveness and is recommended in the appropriate patient population.

RC314-11 Low-Voltage Computed Tomography Venography for Patients with Deep Vein Thrombosis of the Lower Extremities: A Comparison with Venous Ultrasonography

Tuesday, Nov. 27 10:55AM - 11:05AM Room: E352

Participants
Tatsuhiko Sato, MD, Niigata-City, Japan (*Presenter*) Nothing to Disclose
Norihiko Yoshimura, MD, PhD, Niigata, Japan (*Abstract Co-Author*) Nothing to Disclose
Yosuke Horii, Niigata, Japan (*Abstract Co-Author*) Nothing to Disclose
Rei Ogawa, Chuo, Japan (*Abstract Co-Author*) Nothing to Disclose
Ken Sato, Niigata-Shi, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuki Kumagai, Niigata, Japan (*Abstract Co-Author*) Nothing to Disclose
Motohiko Yamazaki, MD, Niigata, Japan (*Abstract Co-Author*) Nothing to Disclose
Hidefumi Aoyama, MD, PhD, Niigata, Japan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare the ability of computed tomography venography (CTV) with that of venous ultrasonography (US) to visualize deep vein thrombosis (DVT) of the lower extremities from the femoropopliteal to calf veins.

METHOD AND MATERIALS

We retrospectively reevaluated CTV data sets for 308 consecutive patients suspected of DVT or pulmonary embolism (PE). Fifty-five of the 308 patients who had undergone US within 1 day of low-voltage CTV (SIEMENS) were included. In these patients, we compared CTV and US regarding the distribution of DVT in 10 segments of the lower extremities (each side of the femoral, popliteal, posterior-tibial, peroneal and soleus veins). Sixteen of the total 550 segments were not examined by US; hence, 534 segments in

all were evaluated.

RESULTS

CTV readings were evaluated using US as the standard. As a result, 64 of the 534 segments were true positive, 46 were false positive, 23 were false negative, and 401 were true negative. Total sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were 73.6%, 89.7%, 58.2%, 94.6% and 87.1%, respectively. Results for the 216 segments above the knee (each side of femoral and popliteal veins) vs 318 segments below the knee (each side of posterior-tibial, peroneal and soleus veins) were as follows: sensitivity, 90.0% vs 71.4%, specificity, 93.2% vs 86.7%, PPV, 39.1% vs 63.2%, NPV, 99.5% vs 90.5% and accuracy, 93.1% vs 83.0%, respectively.

CONCLUSION

Compared to US, low-voltage CTV has sufficient sensitivity and specificity above the knee and useful specificity below the knee for evaluation of DVT.

CLINICAL RELEVANCE/APPLICATION

(dealing with low-voltage CT venography) 'Compared to US, low-voltage CTV has sufficient sensitivity and specificity above the knee and useful specificity below the knee for evaluation of DVT.'

RC314-12 DVT Lysis: An Update

Tuesday, Nov. 27 11:05AM - 11:20AM Room: E352

Participants
Kush R. Desai, MD, Chicago, IL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Consultant, Cook Group Incorporated; Consultant, The Spectranetics Corporation; Consultant, AngioDynamics, Inc; Consultant, Boston Scientific Corporation

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LEARNING OBJECTIVES

1) Understand the morbidity and long term sequelae of deep venous thrombosis, including post-thrombotic syndrome. 2) Review the trials governing the interventional treatment of deep venous thrombosis. 3) Describe procedural techniques available in modern endovascular treatment of acute DVT.

RC314-13 IVC Filters: Past, Present, and Future

Tuesday, Nov. 27 11:20AM - 11:35AM Room: E352

Participants
John A. Kaufman, MD, Portland, OR (*Presenter*) Advisory Board, Argon Medical Devices, Inc; Medical Advisory Board and Owner, Bio2Medical; Consultant, Cook Group Incorporated; Consultant, NOvate Medical Technologies; Owner, Veniti, Inc;

RC314-14 Evaluation of Recurrence of Pulmonary Arteriovenous Malformations after Coil Embolization by CT or Time-Resolved MR Angiography

Tuesday, Nov. 27 11:35AM - 11:45AM Room: E352

Participants
Katsuki Oji, Yufu, Japan (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the accuracy of CT and time-resolved MR (TR-MRA) angiography for evaluation of recurrence of pulmonary arteriovenous malformations (PAVMs) after coil embolization in comparison with selective pulmonary angiography (PAG).

METHOD AND MATERIALS

Between 2007 and 2017, consecutive 37 patients with PAVM were treated by coil embolization. Among the 37 patients, 23 patients underwent follow-up PAG after embolization with 25.6months mean follow-up period. We retrospectively reviewed CT, TR-MRA, and selective pulmonary angiography in the 23 cases. In all cases, CT and/or TR-MRA were performed within 3 months prior to PAG. We evaluated recurrence rate by MDCT and TR-MRA compared with PAG as gold standard. The "recurrence" on TR-MRA and PAG was defined as the embolized lesion showing the early venous filling. For evaluation of CT, recurrence was defined as less than 70% reduction in size of dilated sac or draining vein.

RESULTS

All 49 PAVMs were successfully occluded immediately after embolization. 36 PAVMs were evaluated by TR-MRA, and 46 PAVMs were evaluated by MDCT. Recurrence was detected in 6 lesions (12.2%) by PAG. Sensitivity of TR-MRA and CT were 25%, 33.3%, and specificity were 96.9% and 77.5%, respectively.

CONCLUSION

More than half of recurrent PAVMs could not be detected by CT and/or TR-MRA, PAG are required for accurate evaluation of recurrent PAVMs.

CLINICAL RELEVANCE/APPLICATION

Recurrent PAVMs could not be correctly diagnosed by CT and/or TR-MRA. Furthermore, specificity of CT was lower than TR-MRA, PAG are required for accurate diagnosis of recurrent PAVMs.

RC314-15 Advanced Filter Retrieval Techniques

Tuesday, Nov. 27 11:45AM - 12:00PM Room: E352

Participants
Thuong G. Van Ha, MD, Chicago, IL (*Presenter*) Research Grant, Cook Group Incorporated

LEARNING OBJECTIVES

1) List reasons for failure of standard IVC filter retrieval techniques. 2) Describe different advanced retrieval techniques and when to use them. 3) Discuss risk and benefits of advanced retrieval techniques. 4) List potential complications of advanced retrieval techniques.

RC315

Breast Series: MRI

Tuesday, Nov. 27 8:30AM - 12:00PM Room: Arie Crown Theater

BR MR

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

Participants
Bonnie N. Joe, MD, PhD, San Francisco, CA (*Moderator*) Nothing to Disclose
Hiroyuki Abe, MD, Chicago, IL (*Moderator*) Nothing to Disclose

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Sub-Events

RC315-01 Outcome Data: Does MRI Help?

Tuesday, Nov. 27 8:30AM - 8:50AM Room: Arie Crown Theater

Participants
Francesco Sardanelli, MD, San Donato Milanese, Italy (*Presenter*) Speakers Bureau, Bracco Group; Advisory Board, Bracco Group; Research Grant, Bayer AG; Advisory Board, General Electric Company; Reserach Grant, General Electric Company; Speakers Bureau, Siemens AG; Reserach Grant, Real Imaging Ltd;

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LEARNING OBJECTIVES

1) Know the current debate about the need of outcome data for an appropriate use of breast MRI in clinical practice. 2) Understand why the acceptance of breast MRI has a large variability by other clinicians depending on indication, from screening of BRCA1/2 or P53 mutated women to the preoperative setting. 3) Appraise the high complexity of the current debate on the evidence in favor or against preoperative breast MRI. 4) Identify those applications where more research is needed for an increased use of breast MRI, also considering the perspective of prognostic breast MRI.

RC315-02 Comparison of Diagnostic Performance of DBT and MRI Added to Mammography for Preoperative Staging of Screening-Detected Breast Cancer: Which Method Is More Appropriate Depending On the Mammographic Density?

Tuesday, Nov. 27 8:50AM - 9:00AM Room: Arie Crown Theater

Participants
So Yeon Yang, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ko Woon Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Mi-Ri Kwon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To compare the diagnostic performance of digital breast tomosynthesis (DBT) and magnetic resonance imaging (MRI) added to mammography for preoperative staging of screening-detected breast cancer depending on mammographic density.

METHOD AND MATERIALS

This retrospective study enrolled 281 patients with 332 screening-detected breast cancers recruited from Jan to Dec 2013. Three radiologists independently reviewed three image sets of (mammography alone, DBT plus mammography and MRI plus mammography) of the patients, and they recored final BI-RADS categories of detected lesions. BI-RADS categories 4-5 defined positive results and BI-RADS category 1-3 defined negative results. Readers' sensitivities and positive predictive values (PPVs) were analyzed for each reading mode. Readers' performances with the three reading modes were compared for dense breast (heterogeneously or extremely dense, n=263) and non-dense breast (entirely fatty or scattered areas of fibroglandular density, n=120) groups, respectively.

RESULTS

In non-dense breast group, readers' sensitivities with DBT plus mammography (92.5-94.4%) were lower than MRI plus mammography (96.3-98.1%), but higher than mammography alone (88.8-92.5%). Readers' PPVs with DBT plus mammography (97.1-100%) were higher than those with MRI plus mammography (94.7-100%) and mammography alone (94.7-97.0%). However, there was no statistically significant difference in both readers' sensitivities and PPVs between DBT plus mammography and MRI plus mammography (p>0.05). In dense breast group, sensitivities with MRI plus mammography (93.3-98.2%) were significantly higher than those with DBT plus mammography (87.6-92.0%) or mammography alone (84.9-87.6%) (p<0.05), but PPVs with MRI plus mammography (92.1-97.5%) were lower than those with DBT plus mammography (96.1-97.6%) or mammography alone (96.1-97.5%) without a statistical significance.

CONCLUSION

In non-dense breast group, diagnostic performances of DBT and MRI for preoperative staging of screening-detected breast cancer were not significantly different when using as an adjunctive to mammography. In dense breast group, however, DBT had lower sensitivitiy than MRI.

CLINICAL RELEVANCE/APPLICATION

In non-dense breast group, DBT plus mammography may provide similar diagnostic performance to MRI plus mammography for preoperative staging of screening-detected breast cancer.

RC315-03 Pre-Chemotherapy Morphology and ADC Characteristics of Primary Breast Cancers Vary By Hormone-Receptor and HER2 Subtype

Tuesday, Nov. 27 9:00AM - 9:10AM Room: Arie Crown Theater

Participants
Bo La Yun, MD, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose
Wen Li, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Ella F. Jones, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Lisa Wilmes, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
David Newitt, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Jessica Gibbs, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Nola M. Hylton, PhD, San Francisco, CA (*Abstract Co-Author*) Research support, General Electric Company

PURPOSE

To evaluate the hormone-receptor (HR) and HER2 subtype dependence of pre-treatment MRI morphology and apparent diffusion coefficient (ADC) characteristics of primary breast cancers.

METHOD AND MATERIALS

A retrospective analysis of DCE-MRI, DW-MRI and T2WI was performed on pre-treatment MRI studies of 220 breast cancer patients who were enrolled in a neoadjuvant breast cancer trial. DCE-MRI and T2WI were reviewed according to the BI-RADS lexicon, and MRI morphologic pattern was categorized using a 1-5 scale for tumor containment. Extent of necrosis and presence of peritumoral edema were also ranked. ADC values at 5, 15, 25, 50, 75 and 95 percentile were computed from the DW-MRI based on an ROI encompassing the entire tumor volume. Fisher's exact test was used to compare the morphologic features and one-way ANOVA and Scheffe post hoc test were used to compare ADC measurements among all breast cancer subtypes.

RESULTS

The triple negative (TN) subtype exhibited mass more frequently than non-mass enhancement (NME) (p=0.004), with masses showing irregular versus spiculated margin (p=0.034). HR-/HER2+ subtype had NME more frequently than mass (p=0.027). HR+/HER2+ showed heterogeneous enhancement rather than rim enhancement (p<0.001). There was no specific pattern observed in NME among subtypes. In the MRI morphologic pattern, TN showed a well-defined pattern with more than 10% necrosis versus other subtypes. The difference in ADC values at the lower 5 and 15 percentiles was found to be statistically significant between TN vs. HR-/HER2+ (p=0.007 in 5 percentile and p=0.014 in 15 percentile), HR-/HER2+ vs. HR+/HER2- (p=0.002 in 5 percentile and p=0.004 in 15 percentile), and HR+/HER2- vs. HR+/HER2+ (p=0.028 in 5 percentile and p=0.014 in 15 percentile).

CONCLUSION

The BI-RADS lexicon (lesion classification, internal enhancement pattern and margin of the mass), MR morphologic pattern, and the amount of necrosis may be useful for distinguishing breast cancer subtypes. Among the variable measurements, the lower 5 or 15 percentiles of the ADC distributions showed potential to distinguish breast cancer subtypes.

CLINICAL RELEVANCE/APPLICATION

Adding the lower 5 or 15 percentile ADC with MR morphologic patterns may help refine MRI methods for distinguishing breast cancer subtypes prior to neoadjuvant chemotherapy.

RC315-04 Pre-Operative Breast Magnetic Resonance Imaging: Relationship Between Magnetic Resonance-Detected Additional Cancer and Survival Outcomes

Tuesday, Nov. 27 9:10AM - 9:20AM Room: Arie Crown Theater

Participants
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ko Woon Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine the additional cancer detection yield of pre-operative MRI in women with invasive breast cancer that was occult on mammogrpahy and ultrasonography (US), to identify a subgroup of women who are likely to have additional cancer, and to investigate whether the presence of MRI-detected additional cancer (MDAC) affects patients' long-term survival outcomes.

METHOD AND MATERIALS

The pre-operative MRI examinations of 1,843 women who had undergone surgery for invasive breast cancer were reviewed for the presence of additional multifocal/multicentric /contralateral disease that was occult on mammgoraphy and US. Clinicopathological findings and mammographic breast density were compared between patients with MDAC and those without. Logistic regression analysis was conducted to find factors associated with MDACs. A Cox proportional hazards model was used to analyze the effects of MDACs or other variables on disease-free survival (DFS) or overall survival (OS). Kaplan-Meier curves and log-rank tests were used to analyze survival between the two groups.

RESULTS

Of 1,843 patients, 178 (9.7%) had an MDAC. Multivariate analysis showed that invasive lobular cancer (odds ratio: 1.151, 95% confidence interval [CI]: 1.080, 1.239; P = 0.0002) and extensive intraductal component (odds ratio: 1.113, 95% CI: 1.080, 1.148; P < 0.0001) were independently associated with a higher probability of MDAC. Kaplan-Meier curves did not show that MDACs affected DFS (P = 0.343) or OS (P = 0.991).

CONCLUSION

MDACs had no significant impact on survival outcomes.

CLINICAL RELEVANCE/APPLICATION

No studies have focused on survival outcomes in MRI-detected additional cancers (MDACs) that were occult at mammography and ultrasonography (US).

RC315-06 Long-Term Survival Outcomes in Invasive Lobular Carcinoma Patients with and Without Preoperative MR Imaging: A Matched Cohort Study

Tuesday, Nov. 27 9:30AM - 9:40AM Room: Arie Crown Theater

Participants
Su Min Ha, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ga Young Yoon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate and compare the effect of preoperative breast magnetic resonance (MR) imaging on recurrence-free survival (RFS) and overall survival (OS) outcomes among patients with invasive lobular carcinoma (ILC).

METHOD AND MATERIALS

A total of 287 ILC patients (age range, 31-82 years; mean age, 49.8 years) between January 2005 and December 2012 were included in the analysis. Of these patients, 120 (41.8%) had undergone preoperative breast MR imaging (MR group) and the remaining 167 (58.2%) had not (no MR group). These two study groups were matched for 21 covariates in term of patient demographics, tumor characteristics, and various clinical features. The RFS and OS outcomes were compared using Kaplan-Meier estimates. MR effects were estimated after adjusting for significant potential confounders of specific outcomes in the multivariate modeling.

RESULTS

In the matched cohort, no statistically significant association was observed between MR imaging and total recurrence (hazard ratio [HR], 1.096; 95% CI: 0.497-2.416; P=0.821), loco-regional recurrence (HR, 1.204; 95% CI: 0.294-4.924; P=0.796), contralateral breast recurrence (HR, 0.945; 95% CI: 0.147-6.061; P=0.952), or distant recurrence (HR, 1.020; 95% CI: 0.339-3.070; P=0.973). MR imaging was associated with an improved OS with 51% reduction, but not significantly (HR, 0.485; 95% CI: 0.149-1.585; P=0.231). Analysis with a multivariate Cox regression model indicated that MR imaging was not a significant independent factor for better RFS (HR, 0.823; 95% CI: 0.409-1.658; P=0.586) or improved OS (HR, 0.478; 95% CI: 0.167-1.366; P=0.168).

CONCLUSION

Preoperative MR imaging is not a prognostic factor and produces no recurrence or survival outcome benefits in ILC patients.

RC315-07 Preoperative Breast MRI: Multicenter Prospective Study

Tuesday, Nov. 27 9:40AM - 9:50AM Room: Arie Crown Theater

Participants
Fusun Taskin, MD, Istanbul, Turkey (*Presenter*) Nothing to Disclose
Nermin Tuncbilek, Edirne, Turkey (*Abstract Co-Author*) Nothing to Disclose
Gulden Acunas, MD, Istanbul, Turkey (*Abstract Co-Author*) Nothing to Disclose
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Fahrettin Kilic, MD, Istanbul, Turkey (*Abstract Co-Author*) Nothing to Disclose
Aysenur Oktay, MD, Izmir, Turkey (*Abstract Co-Author*) Nothing to Disclose
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Erkin Aribal, Istanbul, Turkey (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate the effect of breast MRI for preoperative staging on clinical evaluation and treatment plan in women diagnosed with breast cancer.

METHOD AND MATERIALS

In the prospective, multicenter study, the institutional ethics committee approval was obtained for all centers. Conventional imaging (mammography and ultrasonography) findings, preoperative breast MRI findings, treatment plan and histopathology results were evaluated in 432 consecutive breast cancer patients at nine centers. Cases that were scheduled to receive neoadjuvant chemotherapy were excluded. The effect of preoperative breast MRI added to conventional breast imaging on clinical-radiological evaluation and on surgical treatment plan was investigated. Chi-square and McNemar tests were used for statistical analysis.

RESULTS

Two-hundred thirty-four cases (54.2%) were premenopausal and 198 cases (45.8%) were postmenopausal. Cancer was detected in 134 women (31%) at the time of screening, and cancer was found in 298 (69%) women who had undergone diagnostic radiological evaluation due to complaints or physical examination. Physical examination was positive in 248 (57%) women and negative in 184 (43%) women. 23 women had bilateral breast cancer. The frequencies of multifocal and multicentric tumor detection were 9-7%, 16-11%, 17-28% for MG, US and MRI, respectively. Breast-conserving surgery (BCS) was performed on a total of 210 cancers and modified radical mastectomy (MRM) on 255 cancers. A total of 8 cases required re-excision surgery due to positive surgical margin. MRI changed the surgical treatment plan in 14% of patients for whom BCS was planned based on conventional imaging. The difference between the conventional imaging and MRI in the preoperative evaluation was considered statistically significant (p=0.001).

CONCLUSION

Breast MRI added to conventional breast imaging in the preoperative evaluation of patients with breast cancer contributes to an accurate treatment plan by lower need for re-excision surgery and providing accurate treatment of the 14% cases.

CLINICAL RELEVANCE/APPLICATION

This study showed that breast MRI contributes to the preoperative evaluation and treatment plan in women who were diagnosed with breast cancer.

RC315-08 Ongoing Trials Update

Tuesday, Nov. 27 9:50AM - 10:10AM Room: Arie Crown Theater

Participants
Christiane K. Kuhl, MD, Aachen, Germany (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

To list the current studies published on the use of MRI for screening To list cancer detection rates and predictive values of abbreviated MRI for screening in comparison to those of digital breast tomosynthesis and breast ultrasound.

RC315-09 Breast MRI-based Radiomics Nomogram for the Prediction of Recurrence in Patients with Triple-negative Breast Cancer: A Nested Case-Control Matched Study

Tuesday, Nov. 27 10:10AM - 10:20AM Room: Arie Crown Theater

Participants
Su Min Ha, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Hwa Jung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ki Chang Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ga Young Yoon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To develop a breast MRI-based radiomics nomogram including clinicopathologic factors for individualized prediction of local or distant recurrences in patients with triple-negative breast cancers (TNBC).

METHOD AND MATERIALS

From 2006 to 2013, a total of 2604 patients were diagnosed as TNBC and 836 patients underwent preoperative breast MRI. Among them, patients with recurrence and without recurrence were matched in terms of age, stage, and type of chemotherapy, and developed 115 nested case-control pairs. Within the intratumor and peritumoral regions on early post-contrast T1-weighted images, percent enhancement (PE) map, signal enhancement ratio (SER) map, and T2-weighted images, a total of 1029 quantitative MR radiomic features, each referred to as a computer-extracted image phenotypes (CEIP), were calculated based on the semiautomatically derived three-dimensional tumor segmentations. Elastic Net was used for feature selection and radiomics score building. A radiomics nomogram was constructed from a multivariable logistic regression prediction model with the radiomics score and independent pathologic predictors. We divided 115 case-control pairs into a training set (n=154) and a validation set (n=76), and the internal validation for the validation set was performed.

RESULTS

The radiomics score, consisted of 20 selected CEIPs, was significantly associated with the prediction of recurrence (C-index of 0.867 for training set and 0.778 for validation set). Independent pathologic factors in the nomogram were lymphovascular invasion, Ki-67 status, and lymph node ratio (C-index of 0.665 for training set and 0.668 for validation set). Radiomics nomogram showed better prediction of recurrence (C-index of 0.879 for training set and 0.802 for validation set) due to incremental value of 0.214 and 0.134, respectively, by addition of radiomics score to the pathologic predictors.

CONCLUSION

Our results indicate that the radiomics nomogram which incorporates the MRI-based radiomics score and pathologic features, show promise for the individualized prediction of local or distant recurrence in patients with TNBC.

CLINICAL RELEVANCE/APPLICATION

Nomogram using breast MRI-based radiomics score and pathologic predictors can facilitate the individualized prediction of recurrence in patients with TNBC.

RC315-11 Advanced Sequences

Tuesday, Nov. 27 10:40AM - 11:00AM Room: Arie Crown Theater

Participants
Nariya Cho, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review the standard dynamic contrast-enhanced MRI (DCE-MRI) and quantitative MRI using two compartment model. 2) Understand the current status of abbreviated breast MRI. 3) Explore the clinical value of ultrafast DCE-MRI.

ABSTRACT

Breast dynamic contrast-enhanced (DCE)-MRI refers to MR imaging techniques with temporal resolution of 2 minutes or less to assess the changes of contrast uptake and washout in tumors. Recent technological advances realize various combinations of spatial and temporal resolution of breast MRI. Refined quantification (Ktrans, Ve, Kep) of exchange of contrast agent between vascular space and interstitial space provide sophisticated hemodynamic information. Pre-contrast with only one post-contrast image makes MRI screening more feasible by reducing time and cost while maintaining diagnostic performance. DCE-MRI with a 4 to 7-second temporal resolution during the first minute before a standard image acquisition shows the potential to improve lesion conspicuity and characterization. This session will focus on the review of variations of breast DCE-MRI.

RC315-12 Agreement between Radiologist-Assigned Categories and Quantitative Measures of Background Parenchymal Enhancement on Breast MRI

Tuesday, Nov. 27 11:00AM - 11:10AM Room: Arie Crown Theater

Participants
Bethany L. Niell, MD,PhD, Tampa, FL (*Presenter*) Nothing to Disclose
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PURPOSE

Because background parenchymal enhancement (BPE) on breast magnetic resonance imaging (MRI) reflects the volume and intensity of contrast uptake, quantitative values of enhancement can be measured by 1) averaging the voxels of enhancement (PE = percent enhancement) above a pre-defined threshold, 2) computing the total volume of FGT that enhances above the threshold value (absolute volume of BPE), and 3) estimating the percentage of breast tissue that enhances above the threshold value relative to the total breast volume (BPE%). We developed a semi-automated segmentation algorithm to extract these quantitative measures of BPE. In this study, we investigated the agreement of computed measures of BPE with radiologist-assigned categories.

METHOD AND MATERIALS

In this IRB approved HIPAA compliant retrospective study, we identified 123 patients with breast MRI performed for screening indications. As previously described, the breast segmentation algorithm co-registers pre- and post-contrast T1-weighted fat-suppressed and non-fat-suppressed sequences. Active contours method merged chest components and non-fat voxels were clustered using Otsu's method to identify fibroglandular tissue (FGT) voxels. Within the segmented FGT on the first post-contrast phase, we computed median and inter-quartile ranges for absolute volume of BPE and BPE% using a PE=30% threshold. Student's t-test evaluated BPE volume and BPE% by radiologist-assigned categories.

RESULTS

Using the previously described 30% threshold, median and inter-quartile ranges for the volume of BPE by radiologist-assigned category were as follows (cm3): minimal (57.2, 24.4-100.1), mild (41.8, 30.7-65.4), moderate (70.6, 43.5-111.1), marked (67.1, 54.3-137.9). BPE% median and inter-quartile ranges were as follows (%): minimal (3.5, 1.7-5.5), mild (3.2, 1.7-4.6), moderate (4.7, 2.7-7.4), marked (5.7, 4.0-10.0). BPE volume and BPE% differed significantly between minimal/mild and moderate/marked radiologist-assigned categories (p=0.030 and 0.004, respectively) (Figure: Box plot of BPE% by BPE category).

CONCLUSION

Quantified BPE volume and BPE% were significantly different between minimal/mild and moderate/marked radiologist-assigned categories.

CLINICAL RELEVANCE/APPLICATION

Given the inter-reader variability in BPE categorical assessments, the development and validation of quantitative measures is a necessary step towards incorporation of BPE into future risk prediction models.

RC315-13 Correlation between 3T Multi-Parametric MRI and Molecular Subtypes of Breast Cancer

Tuesday, Nov. 27 11:10AM - 11:20AM Room: Arie Crown Theater

Participants
Stefania Montemezzi, MD, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose
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Lucia Camera, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose
Maria Grazia Giri, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose
Alice Pozzetto, MD, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To test whether 3T multi-parametric magnetic resonance imaging (mp-MRI) provides information related to molecular subtypes of breast cancer.

METHOD AND MATERIALS

Women with mammographic or US findings of breast lesions (BI-RADS 4-5) underwent 3T mp-MRI (DCE, DWI and MR spectroscopy). DCE-MRI was evaluated by classifying the wash-in/wash-out curve in three classes (I-III). DWI was used to calculate the mean ADC value within a region of interest centered on the tumor. MR spectroscopy (MRS) was evaluated by means of the signal-to-noise ratio (SNR) of the total choline peak (tCho). The histological type of breast cancer was assessed. Estrogen-receptor (ER), progesterone-receptor (PgR), Ki-67 status and HER-2 expression, assessed by immunohistochemistry (IHC), were used to identify four molecular subtypes: Luminal-A, Luminal-B, HER2-enriched and triple-negative tumors. Non-parametric tests (Kruskal-Wallis, k-sample equality of medians, and Mann-Whitney) and logistic regression were performed to investigate correlations between mp-MRI features (lesion volume, margins, ADC, type of DCE curve, and tCho SNR) and molecular subtypes.

RESULTS

483 patients (505 lesions) were included in the study. Volume was smaller in Luminal-B and larger in triple-negative tumors (non-parametric tests, $p<0.03$ and $p<0.004$, respectively). A prevalence of irregular margins was observed in triple negative tumors ($p<0.01$). The type of DCE curve was significantly different in Luminal-A (lack of type III curves compared to average, $p<0.03$). ADC values were higher in Luminal-A ($p<0.04$ and $p<0.016$ in non-parametric tests and logistic regression, respectively). tCho SNR was higher in triple-negative tumours ($p<0.05$ and $p<0.01$).

CONCLUSION

A significant correlation was found between some MRI features and molecular subtypes of breast tumors. The strongest correlations were observed between Luminal A tumors and ADC, Luminal A tumors and DCE-MRI findings, Triple negative tumors and tCho SNR. These results warrant further research to improve the prognostic value of multi-parametric MRI.

CLINICAL RELEVANCE/APPLICATION

Significant correlations were observed between multi-parametric MRI features and molecular subtypes of breast tumors. Further research is needed to improve the prognostic value of mp-MRI.

RC315-14 Apparent Diffusion Coefficient Difference Value on Diffusion-Weighted Imaging: Association with Distant Metastasis-Free Survival of Patients with Invasive Breast Cancer

Tuesday, Nov. 27 11:20AM - 11:30AM Room: Arie Crown Theater

Participants
Jin You Kim, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
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PURPOSE

To investigate whether apparent diffusion coefficient (ADC) parameters on diffusion-weighted imaging (DWI) are associated with distant metastasis (DM)-free survival in patients with invasive breast cancer.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. The requirement to obtain informed consent was waived. Between June 2013 and June 2014, 258 consecutive women (mean age, 50.9 years; age range, 23-85 years) with newly diagnosed invasive breast cancer who underwent preoperative breast MR imaging with DWI were evaluated. All DWI were retrospectively reviewed by two radiologists blinded to the clinical information. The mean, minimum, and maximum ADC values were measured by manually placing regions of interest within the lesions and the ADC difference value (which is the difference between minimum and maximum ADC) was calculated to evaluate intratumoral heterogeneity. Cox proportional hazards models were used to reveal the associations between ADC parameters and DM-free survival after adjusting for clinicopathological factors.

RESULTS

In 25 (9.7%) patients, DM developed without prior locoregional recurrence at a mean follow-up of 48.7 months. The mean of ADC difference value was significantly higher in patients with DM than in those without DM (0.781 × 10-3mm2/s vs. 0.620 × 10-3mm2/s, P = .007). Kaplan-Meier survival analysis showed that patients with high ADC difference value (>0.793 × 10-3mm2/s) had shorter DM-free survival times compared with those with low ADC difference value (<=0.793 × 10-3mm2/s) (log-rank test; P < .001). Furthermore, multivariate Cox proportional hazards analysis showed that a high ADC difference value (>0.793 × 10-3mm2/s) (hazard ratio [HR] = 3.448; 95% confidence interval [CI]: 1.567, 7.586; P = .002), presence of axillary node metastasis (HR = 5.101; 95% CI: 2.127, 12.234; P < .001), and estrogen receptor negativity (HR = 2.429; 95% CI: 1.104, 5.343; P = .027) were associated with worse DM-free survival.

CONCLUSION

High ADC difference value on DWI was significantly associated with worse DM-free survival of patients with invasive breast cancer.

CLINICAL RELEVANCE/APPLICATION

Quantitative analysis of ADC difference value as a biomarker of intratumoral heterogeneity can be used to identify a subgroup of breast cancer patients at higher risk of developing distant metastasis.

RC315-15 Bradiomics (Breast Radiomics) Can Improve Breast Cancer Detection: Preliminary Clinical Results Using Multivariate Magnetic Resonance Tensor Modeling Fitting

Tuesday, Nov. 27 11:30AM - 11:40AM Room: Arie Crown Theater

Participants
Anabel M. Scaranelo, MD, PhD, Toronto, ON (*Presenter*) Nothing to Disclose
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Pavel Crystal, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate performance measurements of a radiomics model breast lesions extracted from 30 directions fitting of MR images without gadolinium enhancement.

METHOD AND MATERIALS

Research ethics board approved this prospective study including data of 269 MR studies from patients of 3 institutions. All consented women presented with clinically/imaging suspicious or a biopsy proven breast cancer and an indication for dynamic contrast-enhanced (DCE) breast MRI. Before gadolinium injection, diffusion MR imaging (b values, 0, 800 sec/mm2) was performed using a dedicated 3.0T scanner with 16-channel breast coil. A total of 7 readers independently assessed DCE where BPE, lesion size and BIRADS category for each breast were recorded. Two readers blind to DCE results in consensus assessed the 11 features extracted from pixel-by-pixel fitting modeling optimized to lambda-1 values. Histopathology was used as the gold standard. Adequate statistical tests were used to compare the diagnostic values

RESULTS

There were 248 malignant and 37 benign lesions in 229 patients. 7 patients presented with bilateral cancers. The bradiomics feature tensor model reduced false-positive results from 57 to 29 (specificity 88.9% [95% IC 0.843-0.923]) and diffusion imaging alone was less sensitive 89.9% (95% CI 0.855-0.931) than the conventional reading of DCE that provided sensitivity of 95.1% (95% CI 0.916-0.973) and specificity of 78.2% (95% CI 0.727-0.83) at the threshold including in situ disease. Diagnostic accuracy was 89.41% (95% CI 0.8941-0.9190) for tensor modeling and 86.77% (95% CI 0.8358-0.8954) for DCE.

CONCLUSION

The bradiomics model based on diffusion tensor allowed for similar diagnostic accuracy of obtained using clinical set reading DCE. This may translate to less recalls and improve clinical outcomes.

CLINICAL RELEVANCE/APPLICATION

The use of MR techniques that lead to high diagnostic accuracy without IV contrast may play a role in the clinical set.

RC315-16 Computer-Aided Diagnosis (CAD)-assessed Kinetic Features of Invasive Breast Cancers: Correlation with Clinical-pathologic Prognostic Factors

Tuesday, Nov. 27 11:40AM - 11:50AM Room: Arie Crown Theater

Participants
Sung Eun Song, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation; Research Grant, Guerbet SA; Research Grant, Koninklijke Philips NV;
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Deuk Jae Sung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate the association of kinetic features with clinical-pathologic factors in breast cancer patients using computer-aided diagnosis (CAD).

METHOD AND MATERIALS

Between July 2016 and March 2017, 85 patients with invasive breast cancers (mean, 1.8cm; range, 0.8-4.8cm) who had undergone preoperative 3.0T MR imaging and surgery were retrospectively enrolled. All MR image were processed using CAD, and kinetic features of tumors were acquired: peak enhancement, angio-volume, early and delayed enhancement profiles. The relationships between kinetic features and clinical-pathologic factors were assessed. Mann-Whitney test, Spearman's correlation test and binary logistic regression analysis were used for statistical analysis.

RESULTS

In correlation tests, CAD-assessed peak enhancement and angio-volume were significantly correlated with histologic grade, Ki-67 index, and tumor size: r = 0.355 (*P* = .001), r = 0.330 (*P* = .002), and r = 0.231 (*P* = .033) for peak enhancement, r = 0.410 (*P* = .005), r = 0.341 (*P* < .001), and r= 0.505 (*P* < .001) for angio-volume. Plateau compoment at delayed phase was significanly correlated with Ki-67 index (r = 0.255 [*P* = .019]), but correlated coefficient between rapid component at early phase and Ki-67 index did not reach statistical significance (r = 0.202 [*P* = .063]). In binary logistic regression analysis, higher peak enhancement was a significant independent predictor of higher histologic grade (odds radio [OR] = 1.004; 95% CI: 1.001,1.008; *P* = .024), larger angio-colume was a predictor of larger tumor size (OR = 1.384; 95%CI: 1.141, 1.679; *P* = .001), higher plateau component was a predictor of negative estrogen receptor status (OR = 0.928; 95%CI: 0.877, 0.982; *P* = .010), and both higher plateau component and angio-volume were predictors of higher Ki-67 index (OR = 1.051; 95%CI: 1.011, 1094; *P* = .013 for plateau component. OR = 1.178; 95%CI:1.023;1.356; *P* = .023 for angio-volume).

CONCLUSION

Of the CAD-assessed preoperative breast MRI kinetic features, higher peak enhancement may predict higher histologic grade, larger angio-volume may predict larger tumor size, higher plateau component may predict negative estrogen receptor status, and both higher plateau component and angio-volume may predict higher Ki-67 index.

CLINICAL RELEVANCE/APPLICATION

CAD-assessed preoperative breast MRI kinetic features can be considered as a useful imaging biomarker reflecting clinical-pathologic prognostic factors.

RC315-17 Correlation of MRI Texture Features With Tumor Infiltrating Lymphocytes and Pathologic Complete Response in HER2 Positive and Triple Negative Subtypes of Breast Cancer

Tuesday, Nov. 27 11:50AM - 12:00PM Room: Arie Crown Theater

Participants
Gaiane M. Rauch, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose
Hongtu Zhu, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Heng Li, Houston, TX (*Abstract Co-Author*) Research funded, Varian Medical Systems, Inc
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PURPOSE

To evaluate associations of quantitative MRI texture features and tumor infiltrating lymphocytes (TIL) levels in HER2+ and triple negative (TN) subtypes of breast cancer (BC) receiving neoadjuvant chemotherapy (NAC), as potential prognostic non-invasive imaging markers for pathologic complete response prediction (pCR).

METHOD AND MATERIALS

Retrospective review of BC patients who had MRI at staging, neoadjuvant chemotherapy and surgery from January 1, 2008 through December 31, 2015 was performed. Demographic, imaging, and pathologic data including TIL levels were documented. Quantitative MRI texture analysis was performed using 3 types of textural features (TF): local binary patterns (LBP), gray-level co-occurrence matrix (GLCM), and threshold adjacency statistics (TAS). Associations between MRI quantitative TF, TIL levels, and pCR were evaluated by Pearson correlation and logistic regression.

RESULTS

There were 50 HER2+ and 38 TN patients (median age 51 years, range 29-59) with pretreatment MRI and TIL status for analysis; 27 HER2+ patients and 15 TN patients had pCR at surgery. For HER 2+ patients 9 TF significantly correlated with pCR ($p<0.05$): f1 (angular 2nd moment), l3 (75 percentile), l4 (standard deviation), t1-t6 (adjacency 0-5). Four TF were significantly associated with high TIL levels ($p<0.05$): texture l4 (standard deviation), t2 and t3 (adjacency 1 and 2). Additional 4 TF had weak association with TIL ($p<0.1$): feature f8 (sum entropy), t1, t3 and t4 (adjacency 0, 3 and 4). Three TF were significantly associated with both, pCR and TIL ($p<0.05$): texture l3 (75 percentile), l4 (standard deviation), t9 (adjacency 8). For TN patients 4 TF f2 (contrast), t1,t3 and t4 (adjacency 0 ,2,3) were significantly associated with pCR ($p < 0.005$). No TF were significantly associated with TIL levels for TNBC, only t3 and t4 (adjacency 4 and 5) showed weak association with TIL levels ($p<0.1$).

CONCLUSION

Quantitative tumor MRI texture analysis in HER2+ BC showed 9 TF associated with pCR, 8 TF with TIL and 3 TF with both pCR and TIL; for TNBC 4 TF were associated with pCR, and 2 TF weakly associated with TIL.

CLINICAL RELEVANCE/APPLICATION

Analysis of associations of MRI quantitative TF with pCR and TIL in HER2+ and TNBC may help to develop prognostic non-invasive imaging markers for treatment response prediction.

RC316

Communicating Effectively with Patients in the Digital Age (Sponsored by the RSNA Public Information Committee)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S503AB

PR

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

Participants
Max Wintermark, MD, Lausanne, Switzerland (*Moderator*) Advisory Board, General Electric Company; Consultant, More Health; Consultant, Magnetic Insight; Consultant, Icometrix; Consultant, Nines;
Christoph I. Lee, MD, Mercer Island, WA (*Presenter*) Research Grant, General Electric Company; Investigator, General Electric Company
Arvind Vijayasarathi, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose
Ashley H. Aiken, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Create patient-friendly radiology reports. 2) Use available technology to improve communication with patients. 3) Use digital tools and the Internet to inform patients of the value of imaging services and expertise.

ABSTRACT

Patients are becoming increasingly involved in their healthcare with direct access to their radiology reports and online information about radiologists and imaging procedures. Patients want radiology reports they can understand and informative, readily available information online about providers and services, so that they may make better informed decisions about their healthcare. This course will provide specific examples and a strategy for communicating honestly and directly with patients via a wealth of digital tools.

Active Handout:Ashley Hawk Aiken

http://abstract.rsna.org/uploads/2018/17001994/NIRADS.patientcommunication RC316.pdf

RC317

Emerging Technology: Dual Energy and Spectral CT Update 2018

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S505AB

CH CT GI MK NR

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

Participants
Savvas Nicolaou, MD, Vancouver, BC (*Moderator*) Institutional research agreement, Siemens AG

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LEARNING OBJECTIVES

1) Briefly review the principles of Dual Energy CT/Spectral imaging. 2) Review virtual non-contrast imaging, iodine mapping, 3 material decomposition, and monoenergetic imaging. 3) Review cases demonstrating abdominal organ perfusion and oncologic applications in the abdomen. 4) To outline novel applications of dual energy CT in assessing bone marrow edema, gout, ligament/tendon analysis and metal artifact reduction. 5) To outline novel techniques using Dual Energy CT in pulmonary embolism, cardiac ischemia assessment. 6) Review DECT/spectral imaging applications in the brain.

Sub-Events

RC317A Update on the Clinical Applications of Multi-Energy CT in Cardiothoracic Imaging

Participants
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To describe the different implementations of multi-energy CT technology. 2) To discuss the updates on the utility of multi-energy CT in cardiothoracic imaging. 3) To review the applications of multi-energy CT in cardiothoracic imaging.

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/ Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator

RC317B Novel Neuroradiology Dual Energy/Spectral CT Clinical Applications

Participants
Aaron D. Sodickson, MD,PhD, Boston, MA (*Presenter*) Institutional research agreement, Siemens AG; Speaker, Siemens AG; Speaker, General Electric Company

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LEARNING OBJECTIVES

1) Review Dual Energy CT fundamentals and post-processing applications. 2) Demonstrate the utility of Dual Energy CT to add value in neuro-imaging, including pathology detection, lesion characterization, diagnostic confidence, and reduced length-of-stay.

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/ Aaron D. Sodickson, MD,PhD - 2014 Honored EducatorAaron D. Sodickson, MD,PhD - 2017 Honored EducatorAaron D. Sodickson, MD,PhD - 2018 Honored Educator

RC317C Dual Energy/Spectral CT of the Abdomen: What Matters Most to the Clinician

Participants
Desiree E. Morgan, MD, Birmingham, AL (*Presenter*) Institutional Research Grant, General Electric Company

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LEARNING OBJECTIVES

1) Apply strategies of dual energy CT for streamlined characterization of incidentally detected intra-abdominal abnormalities such as hepatic steatosis, adrenal adenomas, and renal lesions. 2) Develop and utilize post processing techniques that improve detection and identification of clinically relevant imaging features of abdominal tumors. 3) Understand limitations and compare workflow differences among major dual/multienergy scanning systems for abdominal applications.

RC317D Current and New Clinical Applications in Musculoskeletal Dual Energy/Spectral CT

Participants
Fabio Becce, MD, Lausanne, Switzerland (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

fabio.becce@chuv.ch

LEARNING OBJECTIVES

1) Comprehend the basic principles and technical aspects of dual- and multi-energy CT when imaging the musculoskeletal system. 2) Apply dual-energy CT when assessing various musculoskeletal disorders, from crystal-related arthropathies to bone marrow edema. 3) Identify potential new applications of dual-energy CT in musculoskeletal imaging, such as CT arthrography and iron-related disorders.

RC318

Challenging Cases in Body Oncologic Imaging (Interactive Session)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: E353A

CT MR NM OI US

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

Participants
Gary A. Ulaner, MD, PhD, New York, NY (*Moderator*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd; Research support, Novartis AG

For information about this presentation, contact:

ulanerg@mskcc.org

LEARNING OBJECTIVES

1) Learn how to correlate CT and FDG PET findings to optimize diagnosis. 2) Identify iatrogenic effects which mimic malignancy on FDG PET/CT. 3) Learn histologies of breast cancer which may not be appreciably FDG-avid.

GENERAL INFORMATION

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC318A Magnetic Resonance Imaging

Participants
Alexander R. Guimaraes, MD, PhD, Portland, OR (*Presenter*) Consultant, Agfa-Gevaert Group

LEARNING OBJECTIVES

1) Updated understanding of soft tissue contrast mechanisms inherent in MRI including T1rho, diffusion weighted imaging, DCE-MRI. 2) Updated protocols for each organ site. 3) Potential benefits of PET/MRI in diagnosing disease.

ABSTRACT

This course is designed to update the attendee on novel MRI techniques and the benefits of MRI in diagnosing challenging cases within the abdomen and pelvis. Multiparametric MRI offers the unique ability to monitor the tumor microenvironment. Increasingly, multiparametric MRI is used for diagnosis and grading of malignancy in various organ systems (e.g. prostate 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/ Alexander R. Guimaraes, MD, PhD - 2018 Honored Educator

RC318B Ultrasound

Participants
Deborah J. Rubens, MD, Rochester, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the technical parameters to optimize to improve ultrasound diagnosis. 2) Identify discrete ultrasound features to discriminate between various pathologic entities. 3) Characterize disease processes in solid organs, vessels and soft tissues using the unique features of ultrasound and appreciate how ultrasound is complementary to CT, MRI and PET in the oncology patient.

ABSTRACT

This session will highlight a variety of disease processes in the oncology patient using grayscale, color and spectral Doppler ultrasound. Technique and potential pitfalls will be highlighted as they contribute to diagnostic acumen of the sonologist. Cases will include neoplastic, infectious and vascular processes in multiple organs. Differential diagnosis will be stressed with companion case examples, as well as when to use comparative imaging such as CT, MRI or PET/CT

RC318C PET/CT

Participants
Gary A. Ulaner, MD, PhD, New York, NY (*Presenter*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd; Research support, Novartis AG

For information about this presentation, contact:

ulanerg@mskcc.org

LEARNING OBJECTIVES

1) Learn where CT findings can improve FDG PET interpretation and where FDG PET findings can improve CT interpretation.

ABSTRACT

FDG PET/CT has become an indispensible modality in the treatment of cancer. While proven to be of great clinical benefit in the management of a wide array of malignancies, there are many potential pitfalls which may be detrimental if not properly identified and explained. In particular, FDG-avidity may be incorrectly ascribed to malignancy when corresponding CT findings demonstrate the FDG-avidity to be benign. In other cases, the presence of FDG avidity correctly deterimes the presence of malignancy despite to lack of correlate findings on CT. In this presentation, challenging FDG PET/CT cases will be used to demonstrate how correlation of FDG PET and CT findings leads to optimal FDG PET/CT interpretation.

RC320

Role of MR Imaging in Cancer Staging and Treatment

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S403B

BR GI MR RO

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

FDA Discussions may include off-label uses.

Participants
Kathryn J. Fowler, MD, San Diego, CA (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Overview of MRI use in cancer staging, treatment delivery, and response assessment. -Understand the imaging approach to staging rectal cancer -Review pertinent anatomy -Discuss reporting of stage -Understand response indicators and how to report

Sub-Events

RC320A Role of MR Imaging in GI Cancer Staging

Participants
Kathryn J. Fowler, MD, San Diego, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review basic MRI approach to staging gastrointestinal malignancies (pancreatic and rectal). 2) Understand the application of MR/imaging features for assessing response to therapy.

RC320B MR-guided Radiotherapy for GI Cancers

Participants
Michael F. Bassetti, MD, Madison, WI (*Presenter*) Research Grant, Merck KGaA; Research Grant, AstraZeneca PLC;

LEARNING OBJECTIVES

1) Identify the clinical sites where MR-guided radiation may have the highest impact. 2) Understand the unique sources of uncertainty of MR-guided radiation that differ from conventional LINAC radiation. 3) Identify the most common indications for on-line MR -guided adaptive radiotherapy observed in clinical practice.

RC320C Role of MR Imaging in Breast Cancer Staging

Participants
Bethany L. Niell, MD,PhD, Tampa, FL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify evidence-based indications for MR imaging in breast cancer staging. 2) Describe the frequencies of ipsilateral multifocal or multicentric disease and contralateral breast cancer detected on breast MRI. 3) Explain potential pitfalls and limitations of breast MRI performed for staging.

RC320D MR-guided Radiotherapy for Breast Cancer

Participants
Maria A. Thomas, MD, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Michael F. Bassetti, MD, Madison, WI (*Presenter*) Research Grant, Merck KGaA; Research Grant, AstraZeneca PLC;

LEARNING OBJECTIVES

1) Identify potential applications of MR-guided radiotherapy for breast cancer. 2) Describe the advantages and disadvantages of MR-guided radiotherapy for breast cancer.

RC321

Advances in CT: Technologies, Applications, Operations-Spectral CT

Tuesday, Nov. 27 8:30AM - 10:00AM Room: E351

CT PH

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; License agreement, 12 Sigma Technologies; License agreement, Gammex, Inc
Lifeng Yu, PhD, Chicago, IL (*Coordinator*) Nothing to Disclose

ABSTRACT

CT has become a leading medical imaging modality, thanks to its superb spatial and temporal resolution to depict anatomical details. New advances have enabled extending the technology to depict physiological information. This has enabled a wide and expanding range of clinical applications. These advances are highlighted in this multi-session course. The course offers a comprehensive and topical depiction of these advances with material covering CT system innovations, CT operation, CT performance characterization, functional and quantitative applications, and CT systems devised for specific anatomical applications. The sessions include advances in CT system hardware and software, CT performance optimization, CT practice management and monitoring, spectral CT techniques, quantitative CT techniques, functional CT methods, and special CT use in breast, musculoskeletal, and interventional applications.

Sub-Events

RC321A Data Acquisition and Rendition Methods

Participants
Cynthia H. McCollough, PhD, Rochester, MN (*Presenter*) Research Grant, Siemens AG

For information about this presentation, contact:

mccollough.cynthia@mayo.edu

LEARNING OBJECTIVES

1. Describe the various methods used to acquire multi-energy CT data. 2. Differentiate between the methods used to present the information obtained with multi-energy CT. 3. Choose the most appropriate image rendition method for a specified clinical task.

Active Handout:Cynthia H. McCollough

http://abstract.rsna.org/uploads/2018/16001048/McCollough - Multi energy CT Refresher Course 2018 (1).pdf

RC321B Applications

Participants
Sebastian T. Schindera, MD, Aarau, Switzerland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the various clinical applications of multi-energy CT. 2) Discuss the most important challenges of multi-energy CT in clinical routine. 3) Identify future opportunities of multi-energy CT.

RC321C Future Prospects-Photon Counting

Participants
Taly G. Schmidt, PhD, Milwaukee, WI (*Presenter*) Research Grant, General Electric Company

For information about this presentation, contact:

tal.gilat-schmidt@marquette.edu

LEARNING OBJECTIVES

1) Understand the potential benefits and current status of photon-counting detection for Spectral CT. 2) Understand the challenges of photon-counting Spectral CT.

RC322

Functional MR Imaging for Normal Tissue Response Assessment in Radiotherapy

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S104A

BQ MR PH RO

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

Participants
Kristy K. Brock, PhD, Houston, TX (*Moderator*) License agreement, RaySearch Laboratories AB

Sub-Events

RC322A State of the Art in Functional MR Imaging for Normal Tissue Assessment

Participants
Kiaran P. McGee, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify underlying biological processes associated with functional magnetic resonance imaging techniques. 2) List most commonly used functional imaging techniques in magnetic resonance imaging. 3) Explain the physics of various functional magnetic resonance imaging technique described in the presentation.

RC322B Clinical Need for Functional MR Imaging for Normal Tissue Assessment in Radiation Therapy

Participants
Aaron J. Grossberg, MD, PhD, Portland, OR (*Presenter*) Nothing to Disclose

RC322C Technical Challenges in the Integration of Functional MR Imaging for Normal Tissue Assessment into Radiotherapy

Participants
Martha M. Matuszak, PhD, Ann Arbor, MI (*Presenter*) Research funded, Varian Medical Systems, Inc; Consultant, Varian Medical Systems, Inc

LEARNING OBJECTIVES

1. Discuss the challenges in incorporating functional MR into treatment planning

RC323

Evolving Perspectives on Ultrasound Safety

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S504AB

PH SQ US

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

FDA Discussions may include off-label uses.

Participants

J. Brian Fowlkes, PhD, Ann Arbor, MI (*Coordinator*) Equipment support, Koninklijke Philips NV; Equipment support, General Electric Company; Equipment support, Canon Medical Systems Corporation; Research collaboration, Sonetics Inc; Stockholder, HistoSonics, Inc; Founder, HistoSonics, Inc

For information about this presentation, contact:

fowlkes@umich.edu

LEARNING OBJECTIVES

1) Understand the physical principles related to ultrasound safety and the potential for biological effects of ultrasound. 2) Utilize ultrasound in a safe and effective manner in clinical practice. 3) Increase their knowledge and understanding of the regulatory environment associated with medical ultrasound.

Sub-Events

RC323A Ultrasound Safety: Understanding the Potential Bioeffects

Participants

J. Brian Fowlkes, PhD, Ann Arbor, MI (*Presenter*) Equipment support, Koninklijke Philips NV; Equipment support, General Electric Company; Equipment support, Canon Medical Systems Corporation; Research collaboration, Sonetics Inc; Stockholder, HistoSonics, Inc; Founder, HistoSonics, Inc

For information about this presentation, contact:

fowlkes@umich.edu

LEARNING OBJECTIVES

1) Understand the physics associated with the potential bioeffects of ultrasound. 2) Increase basic knowledge of the controls and operator feedback related to ultrasound safety. 3) Be sufficiently proficient to utilized on-screen displays related to ultrasound safety. 4) Identify additional resources for understanding the physical effects of ultrasound.

Active Handout:J. Brian Fowlkes

http://abstract.rsna.org/uploads/2018/17000402/SafetyBasics_Fowlkes2018_V3 RC323A.pdf

RC323B Ultrasound Safety: What the Clinician Should Know

Participants

Jacques S. Abramowicz, MD, Chicago, IL (*Presenter*) Author with royalties, Wolters Kluwer nv; Medical Advisory Board, Samsung Electronics Co, Ltd

For information about this presentation, contact:

jabramowicz@bsd.uchicago.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title.

ABSTRACT

Ultrasound is, arguably, one of the most common diagnostic procedures in clinical obstetrics. Its use for over more than 60 years has not been associated with fetal scientifically-proven harmful effects. Ultrasound, however, is a form of energy with potential rise of temperature and mechanical effects in insonated tissues. Knowledge of end-users on bioeffects of ultrasound and how to keep it safe is grossly lacking, but slowly improving, thanks to the efforts of various professional organizations. When a clear medical indication exists and the scan is performed by a professional knowledgeable in ultrasound bioeffects and safety and with respect to the As Low As Reasonably Achievable (ALARA) principle, risks to the fetus are minimal, if at all present. Education of clinical end-users continue to be of major importance, particularly given the ever-increasing use of new ultrasound technologies, such as Doppler and three/four-dimensional ultrasound.

Active Handout:Jacques S. Abramowicz

http://abstract.rsna.org/uploads/2018/17000403/Ultrasound Safety_ RC323B.pdf

RC323C Ultrasound Safety: What You Should Know About Therapeutic Ultrasound

Participants
Kenneth Bader, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

baderk@uchicago.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title

ABSTRACT

Ultrasound is known most ubiquitously as a diagnostic imaging modality. High-intensity insonation conditions can be utilized for therapeutic benefit, generally categorized as ablation or enhanced drug delivery. In this session, 1) the physical principles by which ultrasound can be utilized for therapeutic benefit will be identified. 2) An overview will be provided of clinical and pre-clinical devices, and the current target disease pathologies. 3) Finally, the image guidance methods and metrics for evaluating treatment efficacy will be reviewed.

Active Handout:Kenneth Bader

http://abstract.rsna.org/uploads/2018/17000405/BaderRSNA018_RC323TherapeuticUltrasound RC323C.pdf

RC324

A Primer of Primaries (In Conjunction with the American Institute for Radiologic Pathology)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S403A

OI

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

Participants
Mark D. Murphey, MD, Silver Spring, MD (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the typical clinical and pathological features that allow distinction of common malignancies in multiple organ systems. 2) Define the characteristic imaging patterns that are important to differentiate common primary malignancies in multiple organ systems. 3) Understand the pathological basis for imaging patterns of common malignancies in multiple organ systems.

ABSTRACT

Common primary malignancies in numerous organ systems will be reviewed. These include molecular subtypes of breast cancer, hepatocellular carcinoma, cholangiocarcinoma, renal cell carcinoma, lung cancer, glioma, neuroblastoma and chondrosarcoma. These diseases often reveal a characteristic appearence on imaging, reflecting their pathology which is emphasized in a multiorgan multimodality approach.

Sub-Events

RC324A Adenocarcinoma of the Lung: A Rapidly Evolving Disease

Participants
Jeffrey R. Galvin, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

Active Handout:Jeffrey R. Galvin

http://abstract.rsna.org/uploads/2018/17002322/AIRP Head to Toe Lung CancerRC324A.pdf

RC324B Imaging of Molecular Subtypes of Breast Cancer

Participants
Jennifer A. Harvey, MD, Charlottesville, VA (*Presenter*) Stockholder, Hologic, Inc; Research Grant, Volpara Health Technologies Limited; Stockholder, Volpara Health Technologies Limited;

For information about this presentation, contact:

jharvey@virginia.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title

Active Handout:Jennifer A. Harvey

http://abstract.rsna.org/uploads/2018/17002323/Harvey Molecular subtypes of BC handout RC324B.pdf

RC324C Cardiac Myxoma

Participants
Aletta Ann Frazier, MD, Kensington, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

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/ Aletta Ann Frazier, MD - 2013 Honored Educator

RC324D Imaging of Neuroblastoma

Participants
Ellen M. Chung, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC324E Imaging of Chondrosarcoma and Distinction from Enchondroma

Participants
Mark D. Murphey, MD, Silver Spring, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Highlight characteristic imaging appearances of glial neoplasms and their correlation with gross pathology and histopathology. 2) Introduce important revisions to the 2016 WHO classification of glial neoplasms, emphasizing molecular markers.

Honored Educators

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RC325

Mini-course: Image Interpretation Science - Radiologic Expertise: Incorporating Perception into Training

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S102CD

ED PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants

Elizabeth A. Krupinski, PhD, Atlanta, GA (*Coordinator*) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (*Coordinator*) Research Grant, General Electric Company; Research Grant, Siemens AG; Advisory Board, medInt Holdings, LLC; License agreement, 12 Sigma Technologies; License agreement, Gammex, Inc

For information about this presentation, contact:

ekrupin@emory.edu

LEARNING OBJECTIVES

1) Summarize evidence for changes in visual search as a function of expertise. 2) Describe other specialties where similar trends have been documented. 3) Provide an overview of attempts to predict who will make a good radiologist. 4) Summarize current training paradigms in medical imaging. 5) Describe alternative ways to teach image interpretation using expert visual search strategies. 6) Review the importance of self & group interpretation assessment. 7) Provide an overview of the PERFORMS project goals & methods. 8) Summarize PERFORMS progress & results to date.

ABSTRACT

Medical image perception has a long history in radiology, including an emphasis on training and education. This aspect is especially important as it impacts current and future learners (residents and fellows) as well as those out of trainig but gaining experience through everyday clinical interpretation. This course will focus on three important aspects of traiing and image perception: the importance of image perception in resident education; the potential role of preceptual training in radiographic image interpretatio; and the role of image perception and radiology litigation.

Sub-Events

RC325A On the Development of Expertise in Image Interpretation

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

For information about this presentation, contact:

ekrupin@emory.edu

LEARNING OBJECTIVES

1) Summarize evidence for changes in visual search as a function of expertise. 2) Describe other specialties where similar trends have been documented. 3) Provide an overview of attempts to predict who will make a good radiologist.

ABSTRACT

Medical images constitute a core portion of the information physicians utilize to render diagnostic and treatment decisions. At a fundamental level, the diagnostic process involves two aspects - visually inspecting the image (perception) and rendering an interpretation (cognition). Key indications of expert interpretation of medical images are consistent, accurate and efficient diagnostic performance, but how do we know when someone has attained the level of training required to be considered an expert? How do we know the best way to present images to the clinician in order to optimize accuracy and efficiency? The advent of digital imaging in many clinical specialties, including radiology, pathology and dermatology, has dramatically changed the way that clinicians view images, how residents are trained, and thus potentially the way they interpret image information, emphasizing our need to understand how clinicians interact with the information in an image during the interpretation process. With improved understanding we can develop ways to further improve decision-making and thus improve patient 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/ Elizabeth A. Krupinski, PhD - 2017 Honored Educator

RC325B Using Expert Interpretation Strategies to Teach Trainees

Participants
William Auffermann, MD, PhD, Salt Lake City, UT (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

william.auffermann@hsc.utah.edu

RC325C Formal Assessment of Practicing Radiologists

Participants
Yan Chen, Loughborough, United Kingdom (*Presenter*) Research Grant supported by Hologic

LEARNING OBJECTIVES

1) Comprehend how test sets of images can be employed to provide formal assessment of radiological skills. 2) Understand what causes inter and intra individual differences in performance and how to improve diagnostic skills. 3) Review the importance of self & group image interpretation assessment. 4) Provide an overview of the PERFORMS self-assessment scheme in breast screening. 5) Summarize progress of the PERFORMS scheme.

RC327

Health Policy & Practice Series: How to Take on the Role of Quality Officer in Radiology-Just Do It!

Tuesday, Nov. 27 8:30AM - 12:00PM Room: N229

HP SQ

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

Participants
Kimberly E. Applegate, MD, MS, Lexington, KY (*Moderator*) Nothing to Disclose
Nadja Kadom, MD, Atlanta, GA (*Moderator*) Nothing to Disclose
K. Pallav Kolli, MD, San Francisco, CA (*Moderator*) Investor, Adient Medical Inc

For information about this presentation, contact:

keapple@uky.edu

LEARNING OBJECTIVES

1) Understand how errors occur (commonly) in complex systems. 2) Be familiar with the use of checklists (reporting templates), and reminder systems in radiology. 3) Understand ways to build accountability (use policies, audits, and patient advisors).

Sub-Events

RC327-01 Quality and Safety in Radiology: The Basics

Tuesday, Nov. 27 8:30AM - 9:00AM Room: N229

Participants
Kimberly E. Applegate, MD, MS, Lexington, KY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC327-02 Starting a Quality and Safety Program

Tuesday, Nov. 27 9:00AM - 9:30AM Room: N229

Participants
Nadja Kadom, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the components of a Q&S Program. 2) Identify methods for growing the program. 3) Present program achievements.

RC327-03 Adopting Peer Learning: A Practical Approach for Improving Clinical Performance Feedback and Learning among Colleagues within a Radiologic Practice

Tuesday, Nov. 27 9:30AM - 9:40AM Room: N229

Participants
Jennifer C. Broder, MD, Burlington, MA (*Presenter*) Nothing to Disclose
Christopher D. Scheirey, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Dmitry Elentuck, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Jeffrey A. Hashim, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Mara M. Kunst, MD, Lawrence, MA (*Abstract Co-Author*) Nothing to Disclose
Karen L. Reuter, MD, Wellesley Hls, MA (*Abstract Co-Author*) Nothing to Disclose
Juan E. Small, MD, Brookline, MA (*Abstract Co-Author*) Nothing to Disclose
Christoph Wald, MD, PhD, Burlington, MA (*Abstract Co-Author*) Advisor, Koninklijke Philips NV

For information about this presentation, contact:

jennifer.c.broder@lahey.org

PURPOSE

We practice in a subspecialized hospital-based group with an annual exam volume of approximately 350,000 cases. Whereas published and retrospective error and disagreement rates in radiology literature are reported to be as high as 30%, our legacy peer review program yielded less than 1% discrepancy among submitted cases, anecdotally similar to other departments around the country. Under this circumstance of presumed under-reporting we were constrained in determining how our radiologists can improve their diagnostic performance. We aimed to implement a program that would effectively increase feedback to radiologists regarding their own clinical performance and allow others to also learn from these cases.

RESULTS

Baseline data (April 2016-March 2017): RADPEER data, n=4396, 98.5% (4332) cases with complete agreement and 1.5% (64) without complete agreement. Of the latter, 49 (1.1% of total) were RADPEER 2A or 2B and 15 were RADPEER 3 or 4 (0.4% of total). 'Great call' was an optional qualifier but not a single reviewer chose to assign that to a submission. During the year 47 cases were discussed in 12 monthly morbidity and mortality meetings, composed of anonymous case presentations by Section Heads as well as original author radiologists presenting their own cases. Specifications for a new system as determined by staff: Separation from ongoing performance evaluation; discourage judgment; encourage constructive feedback; allow people to share learning opportunities with each other; allow people to learn from other people's mistakes and successes; allow cases to be submitted anonymously; require conference presentations to be anonymous without revealing the radiologist who interpreted the exam; allow for subspecialized peer learning conferences. During the first year of our peer learning program implementation (April 2017-March 2018): 1036 cases with learning opportunities were submitted, an increase of identified learning opportunities by 1,519%. Submissions included 488 discrepancies (47%), 396 great calls (38%), 157 cases for discussion (15%). Peer learning conferences became more efficient: 296 number of cases were shown in a total of 24 number of peer learning conferences. Simultaneously, the random-scored peer review program evaluated an additional 6,087 cases, now generating 286 cases (5%) with learning opportunities. Of these, 252 (4.1% of total) were RADPEER 2A or 2B, 34 were RADPEER 3 or 4 (0.9% of total).

CONCLUSION

Implementation of a peer learning system has significantly increased sharing of cases with learning opportunities in our practice. The model has allowed us to learn from both discrepancies and from successful interpretations of challenging cases. This has increased the amount of feedback to individual radiologists, the number of cases shared with other members of the practice, and the number of times per year we come together to discuss improvement. After separating the random scored peer review from ongoing performance evaluation, we saw an increase in identification of discrepancies within the pool of random cases, though fewer cases of learning opportunities were identified than in the non-random peer learning submissions. This indicates that separating peer reviews from performance evaluation will increase colleague willingness to identify discrepancies, however random peer review is less productive in identifying learning opportunities.

METHODS

During an initial open forum we solicited ideas and concerns about our existing peer review program, our monthly morbidity and mortality conference, and suggestions for change from the radiology staff. Based on this, we understood specifications of an acceptable new peer review system. 'Peer learning' (as proposed by Larson, et al.) met these specifications. A department-wide 'peer learning program' proposal was developed, approved by the hospital administration, and implemented. Attending participation is required as part of Ongoing Professional Practice Evaluation (OPPE.) The program allows for anonymous submission of non-random cases identified by peers including discrepancies, great calls, and cases for discussion without scoring or other explicit judgment. Cases are routed to the appropriate Section Head for review. Submitted feedback is then shared with the interpreting radiologist. Monthly morbidity and mortality conference was replaced with a combination of regular subspecialty and whole-department peer learning conferences. These highlight a subset of high-yield cases with learning or systems improvement opportunities. The original scored peer review program which evaluates random cases was continued separately from the peer learning program, however, scores were no longer used for ongoing professional performance evaluation. These scored results are only shared with the interpreting radiologist on an ongoing basis; department Q/S Vice Chair reviews individual cases only when a specific request is made for review.

PDF UPLOAD

http://abstract.rsna.org/uploads/2018/18007549/18007549_dn3h.pdf

RC327-04 Notification System for Overdue Radiology Recommendations Improves Rates of Follow-up and Diagnosis

Tuesday, Nov. 27 9:40AM - 9:50AM Room: N229

Awards
Student Travel Stipend Award

Participants
Jaimee E. Mannix, MD , Boston, MA (*Presenter*) Nothing to Disclose
Justine Lavoye, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Michael Wasserman, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Nicholas Wilson, MD , Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Keita Onoue, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Marina C. Bernal Fernandez, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Khalid I. Hassan, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Rutuparna Sarangi, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Samir Haroon, MD, Lexington, MA (*Abstract Co-Author*) Nothing to Disclose
Mustafa Qureshi, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Avneesh Gupta, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

Jaimee.mannix@bmc.org

PURPOSE

To determine the impact of a dedicated communication system on completion of overdue workups advised on imaging.

METHOD AND MATERIALS

The institutional review board approved this HIPAA-compliant study. Informed consent was waived. A search of 4,539 imaging reports over 2 months in 2016 at our institution for the words 'recommend' or 'advised' yielded 1,599 patients. If recommended follow-ups were not performed within 1 month of the advised time per search of the electronic medical record, providers were subsequently notified. The rate of compliance was calculated without notification, and after notification if the recommended workup became overdue.

RESULTS

Of 1,599 patients studied, 823 had non-urgent but important findings on imaging with a firm recommendation for further workup. Of these, 125 were excluded as follow up was not yet overdue and 18 were excluded due to death or transfer of care to another institution. Of the remaining 680, follow up had been completed for 481 (70.7%) without additional notification. 199 (29.3%) were overdue for follow up, and providers were contacted regarding the recommendations. Of the 199 patients for whom reminders were sent to providers, 72 (36.2%) were lost to follow up, 5 (2.5%) had their recommendations ignored, 32 (16.1%) were declined for follow-up by the provider as not indicated, and 90 (45.2%) received the recommended follow up only after a reminder. This yielded 9 clinically important diagnoses, including 1 biopsy-proven malignancy, 3 growing mass lesions, 1 new mass lesion, 3 thyroid nodules requiring biopsy, and 1 molar pregnancy.This dedicated system of communication for overdue recommendations reduced incomplete follow-ups from 29.3% (199/680) to 16.0% (109/680; p <0.0001), and resolved a total of 61.3% of cases of overdue patients when including those deemed not clinically indicated (122/199).Extrapolation of this data for our institution would yield an additional 5,940 patients who receive recommended follow up, including an additional 594 clinically important diagnoses annually.

CONCLUSION

A dedicated system of communication of overdue recommendations significantly reduces the number of incomplete follow-ups, and yields clinically important diagnoses.

CLINICAL RELEVANCE/APPLICATION

A communication system for notification of overdue recommendations leads to a significant decrease in the number of incomplete follow-ups and an increase in clinically important diagnoses.

RC327-05 Educational Impact of High-Fidelity Simulation Training (HFST) in Improving Radiology Staff Compliance with Contrast Emergency Management (CEM) Treatment Guidelines

Tuesday, Nov. 27 9:50AM - 10:00AM Room: N229

Participants
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PURPOSE

Anaphylaxis is the most severe presentation of contrast reactions and can be fatal. However, adverse events from intravenous administration of contrast media are rare, resulting in infrequent opportunities for radiology personnel to manage such situations in clinical practice, and many studies have reported that radiologists lack sufficient knowledge in CEM. Thus, we evaluated the impact of HFST in the clinical management of adverse reactions to contrast media by comparing accurate diagnosis and compliance with treatment guidelines before and after implementation of the training program.

METHOD AND MATERIALS

In this IRB-approved study, a retrospective review of the contrast reactions departmental database was conducted between 2010 and the first quarter of 2017. The HFST annual program was implemented in October 2012 using a mannequin (SimMan 3G, Laerdal medical) to train staff in CEM per clinical guidelines based on the American College of Radiology (ACR) manual. The performance of radiology department personnel was assessed for each month, evaluating whether performance of radiology staff in CEM was compliant with clinical guidelines and compared their performance before and after HFST. The percentage of cases compliant with CEM guidelines for each month was analyzed using a statistical process chart. All analyses were conducted with QI Macros for Excel or Minitab version 17.1.

RESULTS

A total of 769 contrast reactions cases were included in this analysis (M: F 309:460). All patients underwent contrast-enhanced studies (CT or MRI). Up to 30% of CEM occurred at outpatient centers. There were no deaths occurred during the CEM provided by responding radiologists. Implementation of HFST began in October 2012 (dashed red line), with a trend towards better compliance for the first 2.5 years of training and significant and sustained improvement of staff compliance with clinical guidelines of CEM after July 2015 (red points in SPC chart above mean line).

CONCLUSION

HFST is an effective educational method to train radiology staff in CEM, with significant improvement in compliance with CEM guidelines in clinical practice.

CLINICAL RELEVANCE/APPLICATION

Delayed or inadequate patient treatment during contrast-induced anaphylaxis can lead to fatal outcomes. We have implemented a HFST program with significant improvement in staff compliance with ACR clinical guidelines in clinical practice.

RC327-06 Sonographer as a Source of Variability for Swear Wave Elastography: Separatingpatient and Sonographer Variability Using Complete Block Design

Tuesday, Nov. 27 10:00AM - 10:10AM Room: N229

Participants
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PURPOSE

Shear Wave elastography (SWE) is a non-invasive method of estimating liver fibrosis in patients with suspected liver disease. Variations in the elastic properties of soft tissue are measured by evaluating tissue behavior when a mechanical stress is applied. Quality assurance checks revealed that SWE values were systematically higher and more variable for some sonographers compared with others. These differences could be caused by differences between patients, SWE machines/probes, sonographers, or a combination thereof. The present study aims to determine the source of these differences.

METHOD AND MATERIALS

Complete balanced block design was conducted where 6 healthy liver subjects were scanned by the same 6 sonographers at the same time using the same machine. As recommended by the manufacturer, 12 SWE measurements were obtained from the right lobe of the liver; this was done for each subject by each sonographer. Generalized mixed modeling with sandwich estimation, where observations were nested within patients, was used to evaluate SWE differences between sonographers using SAS/GLIMMIX.

RESULTS

Because the same healthy subjects were scanned at the same time using the same machine by all sonographers, median SWE values obtained between sonographers should be almost identical. Nonetheless, statistically significant differences were observed between sonographers such that one sonographer's median SWE value was as low as 4.9 while another's was as high as 5.5 (which also passes a clinical threshold), $p<.001$. Variability was also different between sonographers, where some sonographers SWE values were more variable than others, $p<.01$.

CONCLUSION

These results highlight the need to standardize scanning protocols to reduce systematic differences and variability in SWE values between sonographers; these results may also justify a second scanning of patients who border clinical thresholds. Given that healthy liver volunteers, as a group, passed a clinical threshold, and if the variability inherent between sonographers cannot be controlled for in practice, then the reliability of clinical thresholds is placed into question.

CLINICAL RELEVANCE/APPLICATION

Liver shear wave elastography is subject to variability between sonographers. Caution should be used in interpreting shear wave values, particularly when relying on strict thresholds for determining treatment.

RC327-07 Quality & Safety: How to Teach Yourself to Be a Quality & Safety Expert

Tuesday, Nov. 27 10:20AM - 10:50AM Room: N229

Participants
Naomi R. Schechter, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List and define the National Academy of Medicine's 'Six Aims'. 2) Define and describe the elements of a 'Culture of Safety'. 3) Assemble a flow chart for basic radiology processes. 4) Interpret run charts, control charts, Ishikawa and Pareto diagrams. 5) Explain the basic rationale and procedure for conducting a Root Cause Analysis. 6) Describe the skill-set required to be effective at quality improvement in Radiology, assess and compare their own skill set in this space, and specify which, if any, additional skills they will need to acquire.

ABSTRACT

This course will provide guidance and resources to those who wish to develop expertise in Radiology Quality & Safety, and is especially designed to serve the needs of radiologists who are new to the field but ultimately seek to take on quality improvement leadership roles within their own organizations.

RC327-08 Preventive Effect of Changing Contrast Media in Patients with a Prior Mild Acute Hypersensitivity Reaction to Gadolinium-Based Contrast Agent

Tuesday, Nov. 27 10:50AM - 11:00AM Room: N229

Awards
Student Travel Stipend Award

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PURPOSE

Currently, premedication and changing the culprit contrast agent are used to prevent recurrent acute hypersensitivity reactions (HSRs) to iodinated contrast media. However, strategies for the prevention of acute HSRs to gadolinium-based MR contrast agents (GBCAs) have not yet been established. The purpose of this study was to evaluate effectiveness of premedication and changing contrast agent for prevention of HSR recurrence in patients with a history of mild acute HSR to gadolinium-based MR contrast agent (GBCA).

METHOD AND MATERIALS

The outcomes from patients with mild acute HSR to GBCA who subsequently underwent enhanced MRI between October 2012 and July 2017 were analyzed. Data on application of premedication, premedication regimen and types of GBCA used were obtained from the institutional contrast media monitoring system. Recurrence rates of acute HSR were compared according to preventive strategies.

RESULTS

186 patients with a history of mild acute HSR to GBCA were re-exposed to GBCA 397 times during the study period. The overall recurrence rate was 19% (78/397). Changing the culprit GBCA significantly reduced the recurrence rate, compared to reusing the culprit GBCA (26% and 6.9%, $p<0.0001$). Premedication using antihistamine or antihistamine plus steroid demonstrated no significant protective effect (recurrence rate, 20.4% and 17.3% with and without premedication respectively, $p=0.509$). Premedication in addition to changing CM also showed no additional protective effect (7.2% and 6.1%, respectively, $p=0.590$).

CONCLUSION

Changing the culprit GBCA could reduce a chance of HSR recurrence in patients with a prior mild acute HSR to GBCA, while premedication showed no protective effect.

CLINICAL RELEVANCE/APPLICATION

In patients with a history of HSR to GBCA, changing GBCA could be more effective than premedication.

RC327-09 Developing a Technologist-Focused Training Program to Improve 3D Mammographic Technical Recall Rates

Tuesday, Nov. 27 11:00AM - 11:10AM Room: N229

Awards
Student Travel Stipend Award

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PURPOSE

With conversion from 2D to 3D screening mammography, we noticed an increase in our institution's technical recall rate. The purpose of this study was to assess the effect of a technologist training program on technical recall rate and fulfillment of technical parameters of 3D mammograms.

METHOD AND MATERIALS

3D screening technical recall indications from 7/1/2017 to 12/31/2017 were reviewed. In December 2017, a training program was implemented requiring the technologist who initially scanned the screening exam to rescan with a senior technologist with enhanced training in the Mammography Quality Standards Act (MQSA) technical standards. Technical recalls acquired from 1/1/2018 to 3/15/2018 were then reviewed and compared to the pre-intervention data. Additionally, 100 consecutive screening mammograms performed pre- and post-intervention were reviewed for technical adequacy parameters. Data was analyzed with a student's T test and chi squared test. A p value <0.05 was considered statistically significant.

RESULTS

There were 76 exams with 114 indications for technical recall from 7/1/2017 to 12/31/2017 and 31 exams with 43 indications for technical recall from 1/1/2018 to 3/15/2018. Pre- vs post-training recall indications included: phototiming 9(8%) vs 4(9%), insufficient posterior visualization 52(46%) vs 29(67%), artifact 6(5%) vs 1(2%), motion 15(13%) vs 4(9%), nipple not in profile 4(4%) vs 1(2%), skin fold 12(11%) vs 1(2%), inadequate compression 9(8%) vs 0(0%), other reasons 7(6%) vs 3(4%). After the intervention, recalls for artifact, motion, nipple not in profile, skin folds, inadequate compression, and insufficient inferior visualization significantly decreased ($p < 0.05$). For the 100 pre- vs post- intervention mammograms, there was a significant decrease in breast cut off ($p=0.018$), distance from inframammary fold to bottom of film ($p=0.016$), and inadequate CC ($p=.0096$) and MLO ($p=0.019$) compression.

CONCLUSION

After implementing a technician training program, the number of recalls significantly decreased for multiple technical parameters, and the overall quality of exams improved. Our program is ongoing and improvement in other technical parameters will be the focus of the remaining program.

CLINICAL RELEVANCE/APPLICATION

A technologist training program can significantly improve technical quality of 3D screening mammograms.

RC327-10 Radiology Trainees' Perceptions and Likelihood of "Speaking Up' About Patient Safety Concerns and Unprofessional Behavior in the Clinical Learning Environment

Tuesday, Nov. 27 11:10AM - 11:20AM Room: N229

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PURPOSE

To (1) compare radiology trainees' perceptions regarding the climates for speaking up about patient safety and unprofessional behavior in the clinical environment and (2) assess their likelihood of speaking up in the medical hierarchy.

METHOD AND MATERIALS

58/61 (95%) trainees from nine hospitals who attended a communication workshop completed validated survey items (pre-workshop) assessing their perceptions of the extent to which their clinical environment supports speaking up about patient safety and unprofessional behavior. The survey also queried perceived potential for patient harm in a hypothetical vignette, and likelihood of speaking up about the error within a team hierarchy.

RESULTS

84% of trainees felt encouraged by colleagues to speak up about safety concerns; 57% reported the same for unprofessional behavior (p<0.001). 17% found it difficult to speak up about safety concerns compared to 34% who found it challenging to speak up about unprofessional behavior (p<0.018). Trainees were also less likely to agree that speaking up about unprofessional behavior (compared to safety concerns) resulted in meaningful change (66 vs 95%; p<0.001). In a 'bystander' role (situations not involving them or their patients directly), significantly fewer reported that the clinical culture makes it easy to speak up about unprofessional behavior compared to safety concerns (48 vs 76%; p<0.001). Likewise, fewer reported having observed others in bystander roles speaking up about unprofessional behavior compared to safety concerns (43 vs 76%; p<0.001). In a clinical vignette describing a breach in sterile technique, respondents were less likely to speak up to an attending (48%) compared to a nurse, intern, or resident (79, 84, and 81%, respectively; p<0.001). Even when perceiving high potential harm, residents were less likely to speak up to an attending compared to all other team members (67 vs 100%; p<0.001).

CONCLUSION

Although harms to communication and teamwork associated with unprofessional behavior are well-established, trainees in our sample perceived less support for speaking up about unprofessional behavior than patient safety concerns. Hierarchy remains a barrier to speaking up about safety.

CLINICAL RELEVANCE/APPLICATION

Open communication is crucial to patient safety. Radiology trainees indicate gaps in speaking up culture particularly around unprofessional behavior and team hierarchy.

RC327-11 It Takes a Village... Active Faculty Engagement in Quality Improvement Using a Departmental Quality Improvement Committee

Tuesday, Nov. 27 11:20AM - 11:30AM Room: N229

Participants
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PURPOSE

As healthcare transitions from volume care to value care, physicians and hospital systems must continually evaluate departmental quality to improve outcomes and patient satisfaction. It is imperative for radiologists to participate in quality improvement to maintain certification. However, departmental quality improvement initiatives and individual physician Patient Quality Initiative (PQI) projects are typically performed independently. As a result, radiology faculty members are often not fully engaged in departmental quality improvement initiatives. Even when asked to participate, radiologists can be reluctant because they often do not receive meaningful recognition for their time-consuming "behind the scenes" efforts. Similarly absence of departmental support for individual faculty PQI projects can render them impossibly difficult. To address this problem, we developed a physician- led departmental quality improvement committee.

RESULTS

Prior to the creation of the Quality Improvement Committee, individual faculty members were struggling to accomplish improvement efforts on their own. In the year prior to committee implementation, only 4 quality improvement projects were actively pursued or completed by the body imaging department's 13 faculty members. However, over 30 new projects were initiated within a year of the committee's initiation. Implemented projects stemming from the committee include: patient feedback surveys, MRI protocol updates, patient wait time reduction, CT oral contrast water utilization, structured reporting, technologist QA conferences, improved contrast reaction reporting, website improvement and faculty scheduling optimization. The creation of the committee generated several advantages. One advantage was a project management system to identify, track, timeline, and prioritize projects. Second, a fully sanctioned committee brought the advantage of full administrative support increasing buy-in, resources, and enthusiasm for projects. Lastly, by bringing several members together with different areas of expertise, projects could be solved quickly and efficiently often using similar resources and methods by using a multidisciplinary approach. Due to these factors and by increasing the numbers of stakeholders involved, the total number of projects in progress or completed is well over 30. Planned quarterly committee meetings allowed cross-talk to generate an overall improved patient experience. Also, each committee member reports becoming immediately more involved with interdepartmental staff and hospital leadership as a direct result of each improvement project.

CONCLUSION

Developing a formal quality improvement committee in the radiology department and actively engaging faculty members increased the number of faculty members engaged in patient quality improvement. The strong support and participation by the departmental leadership (chairman, vice chairs and department administrator) was crucial to the success of the committee. The committee facilitated an expeditious ability to complete improvement projects efficiently within the radiology department by developing a tracking system, prioritizing departmental resources, and using a multidisciplinary approach. In less than one year, we have successfully completed several projects and identified new areas for continuous quality improvement. We believe this committee could serve as a model for other radiology groups and hospital practices who are struggling with quality improvement success.

METHODS

Invitations to join the committee were sent to faculty members who had previously expressed interest in quality improvement initiatives. Additional invitations were sent to the departmental chair and vice chairs, the department administrator, modality supervisors, and the nursing supervisor. At the initial meeting, the committee established multiple subcommittees, each led by a faculty radiologist. These include: CT, MRI, Ultrasound, Nuclear Medicine, Interventional Radiology, Safety and Patient experience. Each subcommittee chair identified at least one project for improving quality and/or the patient experience. The subcommittees worked with other departmental and hospital staff to achieve their aims using a multidisciplinary approach. As projects progressed, committee members reported updates and obstacles to other faculty members for feedback and ideas for moving forward. To avoid additional long meetings, much communication utilized email, updates at already scheduled faculty, and division meetings as well as "water cooler chats" in the reading room.

PDF UPLOAD

http://abstract.rsna.org/uploads/2018/18008053/18008053_corx.pdf

RC327-12 Pre-Procedure Time Out in CT-Guided Procedures: Effect on Workflow and Patient Safety

Tuesday, Nov. 27 11:30AM - 11:40AM Room: N229

Participants
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PURPOSE

To audit completeness of the pre-procedural time out in Radiology procedures and its impact on the procedure outcomes and patients safety.

METHOD AND MATERIALS

In this IRB-approved, HIPAA-complaint study, pre-procedure time out was observed by an independent observer in the variety of CT-guided procedures performed between January and March 2018 in large academic institution. Pre-procedure time-out checklist (Figure 1) was introduced in 2007 in our institution and since then has been used as the standard protocol.

RESULTS

53 CT-guided procedures were observed: biopsies (27/53; 51%), drainages (13/53; 25%), tumor ablations (11/53; 21%), and fiducial seed placements (2/53; 4%). Average patient's age was 64.8±10.7 years with 26/53, 49% females. Pre-procedure timeout was performed in all 53 (100%) procedures. Scripted prompt was used in 31/53, 58% of the cases. Median duration of the time-out was 60 seconds (IQR 60-90). Patient identifiers (name, medical records number and date of birth) were reviewed during the time out in all cases. Allergies were reviewed in 51/53, 96% of the cases. Medications were reviewed in 51/53, 96% of the cases. Labs were reviewed in all (100%) of cases. All omissions occurred in time outs without use of scripted prompt. Elevated INR was discovered during time out in 1/53 (2%) case and that case were therefore postponed. Procedures were delayed in 3/53, 6% occasions by 3 minutes to find solutions to problems uncovered during the time out: to confirm when last dose of aspirin was taken; code status was unknown and needed to be confirmed with patient's son as the patient was intubated; patient reported allergy to Levocaine which needed to be differentiated from Lidocaine (used routinely in the procedure). Additional issues (3/53, 6%) raised during the time out included: confirmation of appropriate media for specimens to be collected, availability of gelfoam for patient with low platelet count, and confirmation of platelet count, previously not available.

CONCLUSION

Standardized pre-procedure time-out for CT-guided procedures takes one minute to execute, however it detects safety issues in up to 13% of the cases. Omissions occur when the scripted prompt is not being used.

CLINICAL RELEVANCE/APPLICATION

Standardized pre-procedure time-out should be performed routinely using a scripted prompt to improve patient's outcomes.

RC327-13 Get it Out before it Gets Away: Initiation of Dedicated IVC Filter Retrieval Program

Tuesday, Nov. 27 11:40AM - 11:50AM Room: N229

Participants

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PURPOSE

To assess the efficacy of a dedicated inferior vena cava (IVC) filter retrieval program on filter retrieval rates and number of patients lost to follow-up.

RESULTS

Prior to the program, 76 patients (31 males, 45 females; mean age: 64.2 years) had retrievable filters placed. 80.2% were placed due to a contraindication to anti-coagulation. 3 patients (3.9%) experienced a minor complication at the time of placement. From this group, five filters were removed (6.6%), 42 patients were lost to follow-up (55.3%), 22 patients died (28.9%), and seven filters were deemed permanent by a physician after placement (9.2%). All five retrievals were successful and no complications were reported. After program initiation, 106 patients (54 males, 52 females; mean age: 58.8 years) had retrievable filters placed. 81.1% were placed due to a contraindication to anti-coagulation. Two patients (1.9%) had a complication at the time of placement. In this group, an attempt at retrieval was made in 29 patients (27.4%), 10 patients were lost to follow-up (9.4%), 23 patients died (21.7%), 28 filters were deemed permanent by a physician after placement (26.4%), and decisions were still pending in 17 patients (16%). One filter retrieval was unsuccessful thus overall retrieval rate was 26.4%. One patient (3.4%) had a minor complication during filter retrieval. Initiation of a filter retrieval program increased our retrieval rate (6.6% vs. 26.4%; $p=0.0006$) and reduced the number of patients with filters that were lost to follow-up (55.3% vs. 9.4%; $p<0.0001$).

CONCLUSION

The dedicated IVC filter retrieval program was effective in increasing filter retrieval rates and decreasing the number of patients lost to follow-up and hence increasing accountability for IVC filters. Future directions include improvement in patient assessment prior to filter placement to reduce the number of retrievable filters being left in place as permanent filters. Additionally, referring physician and patient education efforts are underway to improve understanding about the importance of filter removal when appropriate.

METHODS

We initiated a dedicated IVC filter retrieval program in July 2016. The program consisted of tracking all patients with filters placed by interventional radiology (IR) via the electronic medical record (EMR). At the time of filter placement, patients were scheduled for a retrieval consult in the IR clinic and placed on a patient worklist in the EMR. The patient worklist is private and can only be viewed by our physician assistants (PA) and the lead IR supervising the program. The consults were scheduled for 2-3 months after filter placement. At the time of retrieval consult, the IR would schedule the patient for removal, recommend an additional follow-up appointment, or deem that the filter needed to stay in place as appropriate. Documentation of the plan was made in the patient's chart and on the private patient worklist in the EMR. Any missed appointments were followed up by a PA. When the PA was able to reach the patient, they re-scheduled the appointment. If the PA was unable to reach the patient after multiple attempts, we sent a letter to the patient's home address and a message to their primary care physician through the EMR requesting that they call our clinic to schedule a follow-up appointment. If a patient missed 3 clinic appointments despite re-scheduling, we also sent a letter to the patient's home address and a message to their primary care physician through the EMR requesting that they call our clinic to schedule a follow-up appointment. The program was overseen by a single IR physician. To assess this program's efficacy, we reviewed the records of all patients who had retrievable IVC filters placed by IR nine months prior to and nine months after program initiation. Demographics and clinical factors were then collected and compared. A p value of < 0.05 was considered statistically significant.

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http://abstract.rsna.org/uploads/2018/18005892/18005892_iszl.pdf

RC327-14 Natural Language Processing for Identification of Incidental Lung Nodules: Aiding the Evaluation of Radiology Recommendations for Guideline Concordance

Tuesday, Nov. 27 11:50AM - 12:00PM Room: N229

Awards
Student Travel Stipend Award

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PURPOSE

To develop a natural language processing (NLP) tool for finding incidental lung nodules in CT reports, and to use the tool to streamline assessment of recommendations for concordance with Fleischner Society guidelines.

METHOD AND MATERIALS

We searched the electronic health record for patients who had chest CT during 2014 and 2017, before and after implementation of an institution-wide macro for recommendations using Fleischner guidelines. We excluded those with malignancy, immunocompromised state, or indication of lung cancer screening. 906 unstructured chest CT reports were randomly selected and manually reviewed to determine the presence of incidental lung nodules, the presence of management recommendations, and whether recommendations agreed with the Fleischner Society guidelines at the time of the scan. Using nodule terminology, an NLP tool was trained and validated for detection of incidental lung nodules, and for exclusion of previously known or definitively benign nodules. The tool was used to identify incidental lung nodules from 2017 reports. Guideline concordance of recommendations was compared between 2014 and 2017 reports using the chi-squared test.

RESULTS

The NLP tool identified incidental lung nodules with sensitivity and specificity of 91.1% and 82.2%, respectively. Positive and negative predictive values were 59.7% and 97.0%. Comparing 2014 and 2017, there was no difference in the proportion of reports with incidental lung nodules [95/456 (20.8%) vs. 101/450 (22.4%); p=0.6], or in the proportion of reports with incidental lung nodules containing follow-up recommendations [67/95 (70.5%) vs. 80/101 (79.2%); p=0.2]. After implementation of a Fleischner guideline macro, a significantly higher proportion of incidental nodule reports contained guideline-concordant recommendations for low-risk patients [67/101 (66.3%) vs. 44/95 (46.3%); p<0.01].The difference in the proportion of reports with concordant recommendations for high-risk patients trended toward significance [70/101 (69.3%) vs. 53/95 (55.8%); p=0.05].

CONCLUSION

An NLP tool can streamline identification of incidental lung nodules in unstructured reports, aiding assessment of quality measures such as guideline concordance of recommendations.

CLINICAL RELEVANCE/APPLICATION

NLP can efficiently identify incidental lung nodules despite varied terminology and context, facilitating assessment of quality measures such as guideline-concordant management recommendations.

RC329

MR Imaging of Rectal Cancer Before and After Therapy and Recent Advances in Imaging (Interactive Session)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: N227B

GI 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

RC329A Pre-operative MRI Staging of Rectal Cancer: What Every Report Should Address

Participants
Kartik S. Jhaveri, MD, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss key relevant clinical background of imaging in rectal cancer. 2) Highlight structured reporting template for rectal cancer evaluation with MRI. 3) Review key points for reporting of MRI of rectal cancer staging.

RC329B Response to Chemoradiotherapy: How Do We Assess?

Participants
Marc J. Gollub, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

gollubm@mskcc.org

LEARNING OBJECTIVES

1) Review the available methods to evaluate response to chemoradiotherapy including T2 signal, DWI, volumetry and quantitative functional MRI. 2) Introduce the concept of complete response and its assessment at MRI. 3) Illustrate pitfalls in tumor and node assessment after therapy.

RC329C MRI and Its Value in Organ Preservation

Participants
Regina G. Beets-Tan, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about organ preservation in rectal cancer. 2) To understand the value of DWI MRI after CRT for assessment of complete response. 3) To learn about parametric imaging for prediction of response.

RC331

Tumor Ablation Beyond the Liver: Practical Techniques for Success

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S404AB

GI IR

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

Participants
Debra A. Gervais, MD, Boston, MA (*Presenter*) Nothing to Disclose
Muneeb Ahmed, MD, Boston, MA (*Presenter*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc
Terrance T. Healey, MD, Providence, RI (*Presenter*) Nothing to Disclose
Anil N. Kurup, MD, Rochester, MN (*Presenter*) Research Grant, Galil Medical Ltd; Research Grant, EDDA Technology, Inc; Royalties, Wolters Kluwer nv

For information about this presentation, contact:

kurup.anil@mayo.edu

thealey@lifespan.org

LEARNING OBJECTIVES

1) Describe indications for tumor ablation in extrahepatic sites. 2) Describe approaches and techniques to help prevent and manage organ specific complications. 3) Review results of tumor ablation in the lung, kidney, and bone.

ABSTRACT

Pulmonary malignancies, and specifically lung cancer, are a leading cause of death worldwide. Utilization of best current therapies results in an overall five-year relative survival rate for all stages combined to be only 15%, necessitating the use of alternative therapies. Image-guided ablation of lung malignancies is a revolutionary concept whose clinical applications are just beginning to be developed. It has some advantages over traditional radiotherapy and chemotherapy. Its safety profile is similar to percutaneous image guided lung biopsy. Almost all image-guided ablative procedures can be performed in an outpatient setting, mostly with conscious sedation. Multiple applications can be performed without any additional risks. Contraindications are few and include uncontrollable bleeding diathesis and recent use of anticoagulants. Image-guided ablation of lung malignancies is performed with two basic rationales. In the first group it is used with an intention of achieving definitive therapy. These are patients who are not candidates for surgery because of co-morbid medical contraindications to surgery, like poor cardiopulmonary reserve or patients refusing to undergo operation. This cohort could potentially derive significant benefit form a minimally invasive alternative therapy. In the second group it is used as a palliative measure as follows: (a) to achieve tumor reduction before chemotherapy (b) to palliate local symptoms related to aggressive tumor growth, such as chest pain, chest wall pain or dyspnea (c) hematogenous painful bony metastatic disease (d) tumor recurrence in patients who are not suitable for repeat radiation therapy or surgery Image-guided ablation is expanding treatment options for the local control of non-small cell lung cancer and metastatic disease. Skeletal metastases are extremely common and may be treated for palliation of pain or local control. Clinically significant, durable pain relief occurs in 75-100% of patients treated for this reason. Local control rates in bone/extravisceral soft tissue vary, and most series report rates of 70-98%. Patients selected for palliation of pain should have moderate-severe pain and a targetable, corresponding lesion. Lesions should be treatable with attention to critical structures, especially major nerves. Care should be used when placing probes in the constrained environment of intact bone. Cement should be added in weight-bearing regions.

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/ Debra A. Gervais, MD - 2012 Honored Educator

RC332

Clinical Optimization: Current and Future States

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S404CD

LM

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

Participants
Melissa A. Davis, MD, New Haven, CT (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

melissa.a.davis@yale.edu

LEARNING OBJECTIVES

1) Overview of optimization of radiology practices through the use of RAs and other non-MD support. Course participants will gain an understanding of how their practices can use these personnel for higher value/intellectual capital endeavors. 2) Optimization of radiology practices through technology. Course participants will gain an understanding of workflow management, electronic health record integration, and implementation of new systems through capital deployment. 3) Optimization of radiology through practice evaluation and redesign. Course participants will be presented with innovative ways to assess and optimize radiologist's time and workflows.

Sub-Events

RC332A Optimization of Radiology Practices through the Use of RAs and Other No-MD Support

Participants
Catherine J. Everett, MD, MBA, New Bern, NC (*Presenter*) Nothing financial to disclose

LEARNING OBJECTIVES

1) Describe the history and qualifications of radiology extenders. 2) Define the current role of radiology extenders in the practice of radiology.

RC332B Optimization of Radiology Practices through Technology

Participants
Amy L. Kotsenas, MD, Rochester, MN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kotsenas.amy@mayo.edu

LEARNING OBJECTIVES

1) Gain an understanding of how technology can aid in optimization of radiology practices. 2) Develop practical strategies to implement technology to improve practice efficiency.

RC332C Optimization of Radiology through Practice Evaluation and Redesign: Full Analysis of Radiologist Time and How to Optimize It

Participants
Melissa A. Davis, MD, New Haven, CT (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

melissa.a.davis@yale.edu

LEARNING OBJECTIVES

View Learning Objectives under main course title.

RC350

Contrast Reaction (Hands-on)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: E260

SQ

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

Participants
Carolyn L. Wang, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Carina W. Yang, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Erik Soloff, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Ryan O'Malley, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Robert P. Hartman, MD, Byron, MN (*Presenter*) Nothing to Disclose
Stephen C. O'Connor, MD, Boston, MA (*Presenter*) Nothing to Disclose
Patrick W. Eiken, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Richard H. Cohan, MD, Ann Arbor, MI (*Presenter*) Co-author, Wolters Kluwer nv
Senta M. Berggruen, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Anup J. Alexander, MD, Maywood, IL (*Presenter*) Nothing to Disclose
James H. Ellis, MD, Ann Arbor, MI (*Presenter*) Research Consultant, General Electric Company ; Medical Advisory Board, Nuance Communications, Inc
Rishi Agrawal, MD, Chicago, IL (*Presenter*) Speakers Bureau, Boehringer Ingelheim GmbH

For information about this presentation, contact:

wangcl@uw.edu

Stephen.o'connor@bhs.org

rcohan@umich.edu

LEARNING OBJECTIVES

1) Recognize various types of contrast reactions and the proper management of various types of contrast reactions through simulation-based training. 2) Learn with hands-on practice the proper administration of various routes of epinephrine as well as other medications to treat the more common allergic-like contrast reactions. 3) Recognize and manage a contrast reaction in a sedated patient. 4) Recognize and manage a contrast reaction in a pediatric patient. 5) Recognize and practice team communication skills necessarily for high stress infrequent scenarios using simulation-based training.

RC352

Live Ultrasound Interventional Procedures: Thermal Ablation, Cyst Aspiration, Abscess Drainage, Vascular Access, Core Biopsy, Foreign Body Removal (Hands-on)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: E264

US IR

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

Participants

Patrick Warren, MD, Columbus, OH (*Moderator*) Nothing to Disclose
Patrick Warren, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Veronica J. Rooks, MD, Honolulu, HI (*Presenter*) Nothing to Disclose
James W. Murakami, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Kristin M. Dittmar, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Carmen Gallego, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Mabel Garcia-Hidalgo Alonso, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Hollins P. Clark, MD, Winston Salem, NC (*Presenter*) Research Consultant, Galil Medical Ltd
Njogu Njuguna, MD, Springfield, MA (*Presenter*) Nothing to Disclose
Sara E. Zhao, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Jeremiah J. Sabado, MD, Wilmington , DE (*Presenter*) Nothing to Disclose
John D. Lane, MD, Bayside, WI (*Presenter*) Nothing to Disclose
Humberto G. Rosas, MD, Madison, WI (*Presenter*) Nothing to Disclose
William W. Mayo-Smith, MD, Boston, MA (*Presenter*) Nothing to Disclose
Yassine Kanaan, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Allison S. Aguado, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
Linda J. Warren, MD, Vancouver, BC (*Presenter*) Shareholder, Hologic, Inc
Kathleen M. Boyer, DO, Aiea, HI (*Presenter*) Nothing to Disclose
Michael A. Mahlon, DO, Tacoma, WA (*Presenter*) Nothing to Disclose
Robert M. Marks, MD, San Diego, CA (*Presenter*) Nothing to Disclose
Ulises Barajas, MD, Juarez, Mexico (*Presenter*) Nothing to Disclose
Kara D. Gaetke-Udager, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Remy Ngwanyam, MD, Boston, MA (*Presenter*) Nothing to Disclose
Jonathan R. Wood, MD, Honolulu, HI (*Presenter*) Nothing to Disclose

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TARSOMSN@HOTMAIL.COM

James.Murakami@nationwidechildrens.org

LEARNING OBJECTIVES

1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography. 2) Discuss and perform basic skills involved in thermal tumor ablation in a live learning model. 3) Perform specific US-guided procedures to include core biopsy, abscess drainage, vascular access, cyst aspiration, soft tissue foreign body removal, and radiofrequency tumor ablation. 4) Incorporate these component skill sets into further life-long learning for expansion of competency and preparation for more advanced interventional sonographic learning opportunities.

RC353

Deep Learning & Machine Intelligence in Radiology

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S406A

AI IN

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

Participants
Paul J. Chang, MD, Chicago, IL (*Moderator*) Co-founder, Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Researcher, Bayer AG; Advisory Board, Bayer AG; Advisory Board, Aidoc Ltd; Advisory Board, EnvoyAI; Advisory Board, Inference Analytics

Sub-Events

RC353A Introduction to Deep Learning

Participants
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Presenter*) Nothing to Disclose

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.

RC353B Deep Learning and Machine Intelligence in Radiology: A Reality Check

Participants
Paul J. Chang, MD, Chicago, IL (*Presenter*) Co-founder, Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Researcher, Bayer AG; Advisory Board, Bayer AG; Advisory Board, Aidoc Ltd; Advisory Board, EnvoyAI; Advisory Board, Inference Analytics

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?

RC353C Deep Learning: How to Get Started

Participants
Abdul Hamid Halabi, Santa Clara, CA (*Presenter*) Developer, NVIDIA Corporation; Spouse, Employee, Covenant Pathology

RC354

How Did I Miss That? Perceptual and Attentional Roots of Medical Errors

Tuesday, Nov. 27 8:30AM - 10:00AM Room: N226

IN SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Jeremy M. Wolfe, PhD, Cambridge, MA (*Presenter*) Research collaboration, Koninklijke Philips NV;

For information about this presentation, contact:

jwolfe@bwh.harvard.edu

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 current research in medical image perception. 4) Learn how perceptual & cognitive factors will impact the deployment of AI (e.g. deep learning) in radiology.

ABSTRACT

Perceptual decisions can be hard. Images are often ambiguous, but we still need to make a diagnostic decision (e.g., is this cell abnormal or not?). We cannot simultaneously recognize every object in our field of view. As a result, even if a breast mass or a lung nodule might be clear enough when you find it, the process of finding it involves deploying attention from object to object or place to place, searching for the target. This is true whether we are looking for the cat in the bedroom or those nodules in a stack of CT images. Becoming an expert does not cause you to develop a new search engine. You become an expert on using the standard human search engine on a specific set of stimuli. Unfortunately, our search engine does not work perfectly and we sometimes fail to find what we seek. At other times, we find things that are not really there. I will give a quick tour of the basics of perceptual decision making and then we will illustrate and discuss three classes of error that occur in medical image perception: - Search errors in which the observer never looks in the right spot. - Recognition errors where the observer looks at the target but fails to code it as potentially significant. - Decision errors where the target is scrutinized but the wrong conclusion is reached. This last class of errors can be subdivided into Perceptual decision errors and Cognitive decision errors in which the observer thinks about the problem in a way that leads to the wrong answer. In some cases, these errors arise from 'cognitive heuristics', mental shortcuts can be very useful, but can sometimes lead to errors, medical and other.

Active Handout:Jeremy Michael Wolfe

http://abstract.rsna.org/uploads/2018/17001001/Handout for Wolfe CourseRC354.pdf

RCB31

RSNA Diagnosis Live Interactive and Mobile Device Integrated Audience Response: Tips, Tricks, and How to Get Started (Hands-on)

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S401CD

ED IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants

Christopher G. Roth, MD,MS, Philadelphia, PA (*Moderator*) Nothing to Disclose
Christopher G. Roth, MD,MS, Philadelphia, PA (*Presenter*) Nothing to Disclose
Sandeep P. Deshmukh, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

sandeep.deshmukh@jefferson.edu

christopher.roth@jefferson.edu

LEARNING OBJECTIVES

1) Appreciate the higher receptiveness of interactive content by adult learners compared with traditional didactic techniques. 2) Understand the basic operational features of the Diagnosis Live audience participation authoring tool, including the types of questions offered and how to embed them into PowerPoint presentations. 3) Learn how to manage the Diagnosis Live administrator portal and launch and run interactive games and review analytics regarding student performance.

RCC31

Interoperability: Imaging and Beyond - IHE, Standards, and the RSNA Image Share

Tuesday, Nov. 27 8:30AM - 10:00AM Room: S501ABC

IN

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

Participants
David S. Mendelson, MD, Larchmont, NY (*Moderator*) Spouse, Employee, Novartis AG; Advisory Board, Nuance Communications, Inc; Advisory Board, General Electric Company; Advisory Board, Canon Medical Systems Corporation; Advisory Board, Bayer AG; Advisory Board, Nines
David S. Mendelson, MD, Larchmont, NY (*Presenter*) Spouse, Employee, Novartis AG; Advisory Board, Nuance Communications, Inc; Advisory Board, General Electric Company; Advisory Board, Canon Medical Systems Corporation; Advisory Board, Bayer AG; Advisory Board, Nines
Didi Davis, Knoxville, TN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ddavis@sequoiaproject.org

LEARNING OBJECTIVES

1) Understand the importance of interoperability throughout healthcare; imaging and beyond. 2) Understand the importance of standards to ensure interoperability. 3) Understand the role of IHE profiles in defining workflows and the applicable standards including IHE XDS-I and XCA-I. 4) Learn about real world implementations including Health Information Exchanges and Networks (The Sequoia Project, eHealth Exchange. Carequality and other national and international projects) and image enabled Personal Health Records (The RSNA Image Share). 5) Learn the status of the RSNA Image Share and the RSNA Image Share Validation Program.

ABSTRACT

This course will focuson HIT inteoperability and its importance in providing for the optimal care of patients. Interoperability has become a major focus of ONC in the United States as well as part of many international regulatory bodies. The evolution and current state of imaging interoperability will be discussed. The session will review the standards employed in delivering healthcare interoperability and the role of IHE nationally and internationally. The discussion will initially focus on imaging interoperability and progress to a broader discussion of healthcare interoperability. In addition to describing the RSNA Image Share Validation program and its recent enhancements, interoperability solutions such s PHRs and other efforts of The Sequoia Project will be presented including a review of nationwide health information networks, such as the eHealth Exchange, and interoperability frameworks, such as Carequality.

MSAS32

Understanding the Critical Relationships of Quality, Experience, and Performance for Effective Imaging Services (Sponsored by the Associated Sciences Consortium) (Interactive Session)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S105AB

IN SQ

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

Participants
Morris A. Stein, BArch, Phoenix, AZ (*Moderator*) Nothing to Disclose
William A. Undie, PhD, RT, Houston, TX (*Moderator*) Nothing to Disclose

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mstein@hksinc.com

Sub-Events

MSAS32A Planning and Physical Implications through Data, Modeling, and Vision

Participants
Carlos L. Amato, Los Angeles, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

camato@cannondesign.com

LEARNING OBJECTIVES

1) Understand the current status of Appropriate Use Criteria (AUC) consultation requirements. 2) Review workflow considerations for AUC consultations requirements for all process flow scenarios including employed and non-employed referring providers. 3) Understand how recent technological advances and discoveries will impact imaging space planning, and how to incorporate FDI guidelines in imaging department designs. 4) Understand how to adjust facility design(s) to align with the latest consumer expectations and trends affecting the patient experience. 5) Recognize the pitfalls and accomplishments of Clinical Decision Support Mechanism (CDSM) early adoption. 6) Explain the common barriers of CDSM interoperability with hospital electronic health record (EHR), standardization of operational flow of information, and key performance indicators (KPI) development.

MSAS32B The Changing World of How Clinical Support Systems Impact Quality and Delivery of Care

Participants
Melody W. Mulaik, Powder Springs, GA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

melody.mulaik@codingstrategies.com

LEARNING OBJECTIVES

1) Understand the current status of Appropriate Use Criteria (AUC) consultation requirements. 2) Review workflow considerations for AUC consultations requirements for all process flow scenarios including employed and non-employed referring providers. 3) Understand how recent technological advances and discoveries will impact imaging space planning, and how to incorporate FDI guidelines in imaging department designs. 4) Understand how to adjust facility design(s) to align with the latest consumer expectations and trends affecting the patient experience. 5) Recognize the pitfalls and accomplishments of Clinical Decision Support Mechanism (CDSM) early adoption. 6) Explain the common barriers of CDSM interoperability with hospital electronic health record (EHR), standardization of operational flow of information, and key performance indicators (KPI) development.

MSAS32C Lessons Learned in Adopting Clinical Decision Support Systems

Participants
Ernesto A. Cerdena, PhD, Atlantic City, NJ (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ernesto.cerdena@atlanticare.org

LEARNING OBJECTIVES

1) Recognize the pitfalls and accomplishments of Clinical Decision Support Mechanism (CDSM) early adoption. 2) Identify and explain the common barriers of CDSM interoperability with the hospital electronic health record (EHR) and standardization of flow of information. 3) Develop an understanding of the key performance indicators available within the CDSM system.

MSCC32

Case-based Review of Nuclear Medicine: PET/CT Workshop-Chest and Musculoskeletal PET/CT (In Conjunction with SNMMI) (Interactive Session)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: E450B

CH CT MK NM

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

Participants
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Director*) Nothing to Disclose
Katherine A. Zukotynski, MD, Ancaster, ON (*Director*) Nothing to Disclose
Delphine L. Chen, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

Sub-Events

MSCC32A Chest

Participants
David M. Naeger, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

david.naeger@ucsf.edu

LEARNING OBJECTIVES

1) Describe the classic PET/CT appearance of various types of lung cancer. 2) Compare the imaging features that are similar between different types of lung cancer.

ABSTRACT

The classic PET/CT appearance of various types of lung cancers will be reviewed. Similaries and differences between different types of lung cancer will be presented in an effort to help attendees interpret thoracic imaging with more confidence and be more helpful in interdisciplinary settings.

MSCC32B Musculoskeletal

Participants
Gary A. Ulaner, MD, PhD, New York, NY (*Presenter*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd; Research support, Novartis AG

For information about this presentation, contact:

ulanerg@mskcc.org

LEARNING OBJECTIVES

1) Demonstrate how to integrate the FDG PET and CT components of an FDG PET/CT exam to distinguish benign and malignant osseous lesions. 2) Identify common benign causes of FDG-avidity in the musculoskeletal system.

MSES32

Essentials of Non-interpretative Skills

Tuesday, Nov. 27 10:30AM - 12:00PM Room: N226

PR

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

Sub-Events

MSES32A Ethics and Code of Conduct

Participants
David M. Yousem, MD, Baltimore, MD (*Presenter*) Royalties, Reed Elsevier; Speaker, American College of Radiology; Employee, Medicolegal Consultation; ; ;

For information about this presentation, contact:

dyousem1@jhu.edu

LEARNING OBJECTIVES

1) To familiarize the attendees with the obligations and commitments inherent in the ACR and AMA Code of Ethics. 2) To present some scenarios where one's values and ethics may be challenged. 3) To assess the prevalence of sexual harassment in the Radiology field. 4) To suggest ideas for incorporating more explicit ethics education in our training.

ABSTRACT

Most physicians are unfamiliar with the Code of Conduct adopted by the AMA and most radiologists have not studied the ACR Article XI on Ethics and Discipline. Nonetheless moral issues frequently arise whether in the care of patients or in the treatment of colleagues and trainees throughout our career. Radiology also is not immune to the '#MeToo' / sexual harassment issues that are now being recognized (if not addressed) in the public sphere. This presentation will present an overview of our Code of Ethics, provide some intriguing scenarios where one's frame of values may be challenged, provide guides for navigating through moral dilemmas, and underscore some differences between LEGAL requirements versus code of conduct guidelines.

MSES32B Customer Service in Radiology

Participants
Alex Towbin, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Siemens AG; Grant, Cystic Fibrosis Foundation; Consultant, Anderson Publishing, Ltd; Advisory Board, IBM Corporation; Advisory Board, KLAS Enterprises LLC;

For information about this presentation, contact:

alexander.towbin@cchmc.org

LEARNING OBJECTIVES

1) Define customer service. 2) List the 5 dimensions of service quality. 3) Provide examples of customer service in radiology.

ABSTRACT

Radiology is a service-oriented specialty. While physicians in other specialties have direct interaction with patients, radiologist's interactions with patients are often indirect and occur after another provider has placed an order. As a result, radiology practices have had to focus on two groups, patients and ordering providers to grow their business. The purpose of this lecture is to define customer service and introduce the five dimensions of service quality. The dimensions will be highlighted through illustrative examples.

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/ Alex Towbin, MD - 2014 Honored Educator

MSES32C How to Give a PowerPoint Presentation

Participants
Eric J. Stern, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn there is no 'right way' to prepare and present educational Powerpoint lectures. 2) Learn the many simple ways to improve the effectiveness of transmitting information from the teacher to the learner. 3) Learn to enhance cognition and learning while decreasing cognitive overload and thereby becoming a memorable rather than forgettable presenter.

MSES32D Error Disclosure in Radiology

Participants
Stephen D. Brown, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

stephen.brown@childrens.harvard.edu

LEARNING OBJECTIVES

1) Explain the rationale for direct disclosure of medical errors to patients. 2) Describe recent developments in practices around disclosure and apology. 3) Appraise the relevance of these rationales and developments specifically for radiology.

ABSTRACT

Momentum has been increasing within medicine towards wider acceptance of open and transparent disclosure to patients about errors. Patients increasingly expect to be informed directly when errors occur. Normative, legal, legislative, and institutional developments have accelerated beyond the pace of dialogue and preparation within radiology for managing disclosures and apologies effectively. The purpose of this lecture to to review the rationale for disclosure of errors to patients, describe recent developments, and explain their relevance to radiology.

MSQI32

Quality Improvement Symposium: Value in Imaging 2: The Business Case for Quality

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S402AB

SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.00

Participants
Matthew S. Davenport, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

matdaven@med.umich.edu

Additional Information

RSNA will award Quality Essentials Certificates of Completion to RSNA 2018 attendees who successfully participate. Participants who achieve a score of 80% or higher on the SAM test questions will be eligible to receive the certificates.

Sub-Events

MSQI32A Why in Healthcare Do We Ignore Quality?

Participants
Matthew S. Davenport, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

matdaven@med.umich.edu

LEARNING OBJECTIVES

1) Understand why quality in healthcare has historically been ignored in the United States. 2) Learn common and unique forces in academic and community practices that help explain the current state of quality healthcare in the United States. 3) Highlight macro trends that may alter the future of healthcare in the United States.

MSQI32B Accounting and Costing Related to Quality

Participants
Lane F. Donnelly, MD, Palo Alto , CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand principles of costing estimates in medicine and the industrial approach to thinking about the costs of quality and safety. 2) To understand the differences between costs of control and costs of failure of control, also know as the hidden costs of poor quality and develop a mindset that takes the factors into consideration when budgeting.

ABSTRACT

Understanding the costs of quality are important to creating an accounting and budgeting process that reflects the total cost of quality. Adopting a total cost of quality approach tath takes into account the costs of control, or the costs to ensure high quality, as well as considering the costs of non-control, or the hidden costs of poor quality , wil lbe essentail for successful healthcare organizations in the future.

MSQI32C MACRA and the Quality Payment Program

Participants
Andrew B. Rosenkrantz, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand how the Medicare Quality Payment Program (QPP) seeks to measure the quality of physician performance. 2) To understand how the QPP relates quality to physician payments. 3) To explore strategies for radiologists to succeed under the QPP.

MSRO32

BOOST: Genitourinary Prostate (Interactive Session)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S103AB

GU OI RO

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

Participants
Daniel A. Hamstra, MD, PhD, Dearborn, MI (*Presenter*) Consultant, Augmenix, Inc
Jonathan M. Willatt, MBChB, Ann Arbor, MI (*Moderator*) Nothing to Disclose
Tristan Barrett, MBBS, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose
Brian J. Davis, MD, PhD, Rochester, MN (*Presenter*) Stockholder, Pfizer Inc; Speaker, Augenix Inc
Arvin K. George, MD , Ann Arbor, MI (*Presenter*) Nothing to Disclose
Nicole Curci, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To develop an understanding of the multidisciplinary interactions involved in the selection of patients who should undergo multiparametric prostate MRI. 2) To define the imaging features of high grade prostate cancer on MRI. 3) To describe the process whereby patients are selected for active surveillance or treatment for high grade prostate cancer. 4) To appraise a selection of lesions for categorization under the PIRADS criteria and determine how they should be followed or treated.

ABSTRACT

Multiparametric MRI for prostate cancer is now the standard of care for patients with suspected prostate cancer. The introduction of the PIRADS 2 system has enabled us to standardise the care of prostate cancer patients. Diagnosis, active surveillance, biopsy and choice of either radical prostatectomy, radiation or locoregional therapy are included in the diagnostic and treatment alogrithms. We describe the imaging features on prostate MRI which determine whether a patient is suspected of having high grade prostate cancer. We define the treatment choices and, through a cased based presentation, present a selection of cases for decision making in a tumour board scenario.

MSRO36

BOOST: Mediastinum and Pleura-Oncology Anatomy (Interactive Session)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S103CD

CH OI RO

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

FDA Discussions may include off-label uses.

Participants
Meng X. Welliver, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Mizuki Nishino, MD, MPH, Newton, MA (*Presenter*) Institutional Research Grant, Merck & Co, Inc; Institutional Research Grant, Canon Medical Systems Corporation; Institutional Research Grant, AstraZeneca PLC; Speaker, F. Hoffmann-La Roche Ltd; Consultant, DAIICHI SANKYO Group
Alexander Louie, MD, FRCPC, London, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mizuki_nishino@dfci.harvard.edu

alexander.louie@sunnybrook.ca

meng.welliver@osumc.edu

LEARNING OBJECTIVES

1) Describe the mediastinal and pleural anatomy on imaging for treatment planning and monitoring for thoracic malignancy with a focus on thymic tumors and mesothelioma. 2) Discuss the cutting-edge strategies and pitfalls for treatment planning and disease surveillance for thymic tumors and mesothelioma. 3) Understand the importance of multidisciplinary approaches to thoracic malignancy involving the mediastinum and pleura.

ABSTRACT

The purpose of this course is to provide attendees with a practical knowledge of the mediastinal and pleural anatomy and the understanding of the treatment planning strategies and pitfalls for thoracic malignancy with a focus on thymic tumors and mesothelioma, highlighting the importance of multidisciplinary approaches to these tumors.

PS31

Tuesday Morning Plenary Session

Tuesday, Nov. 27 10:30AM - 12:00PM Room: E451B

CH CT PH SQ

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: .75

Participants
Vijay M. Rao, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Bruce R. Thomadsen, PhD, Madison, WI (*Introduction*) Nothing to Disclose

Sub-Events

PS31A RSNA/AAPM Symposium: State of the Art in CT Imaging

Participants
Paul E. Kinahan, PhD, Seattle, WA (*Moderator*) Research Grant, General Electric Company; Co-founder, PET/X LLC

PS31B CT Technology - and Dose - in the 21st Century

Participants
Cynthia H. McCollough, PhD, Rochester, MN (*Presenter*) Research Grant, Siemens AG

For information about this presentation, contact:

McCollough.cynthia@mayo.edu

LEARNING OBJECTIVES

1) Identify key technological advances in x-ray computed tomography. 2) Describe new clinical applications that have been enabled by these technology advances. 3) List important technical advances that have facilitated CT dose reduction. 4) Appreciate the continued decline in CT doses since its inception. 5) Apply caution in reducing CT doses for low-contrast detection tasks.

PS31C Contemporary CT of the Indeterminate Lung Nodule: Where We Are and Why it Matters

Participants
Denise R. Aberle, MD, Los Angeles, CA (*Presenter*) Consultant, Siemens AG

LEARNING OBJECTIVES

1) To learn the current role of CT in lung cancer screening and early detection. 2) To examine current approaches to the classification of indeterminate lung nodules. 3) To understand the basis for using an atlas to standardize semantic features of lung nodules. 4) To appreciate the potential of semantic, quantitative, and machine learning approaches in nodule classification.

RCA32

3D/VR/AR Imaging: Staying on the Cutting Edge of Brain Anatomy/Pathology (Hands-on)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S401AB

IN NR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants

Komal B. Shah, MD, Houston, TX (*Presenter*) Nothing to Disclose
Maria Gule-Monroe, MD, Houston, TX (*Presenter*) Nothing to Disclose
Melissa M. Chen, MD, Houston, TX (*Presenter*) Nothing to Disclose
Jill V. Hunter, MD, Houston, TX (*Presenter*) Author with royalties, Wolters Kluwer nv
Halyna Pokhylevych, MD, Lviv, Ukraine (*Presenter*) Nothing to Disclose
Donald F. Schomer, MD, Fountain Hills, AZ (*Presenter*) Stockholder, Vertos Medical, Inc Stockholder, Sinopsys Surgical, Inc
Vinodh A. Kumar, MD, Houston, TX (*Presenter*) Nothing to Disclose

ABSTRACT

Brain Atlas/VR/AR imaging: Staying on the Cutting Edge of Brain Anatomy/Pathology This hands-on workshop will demonstrate an advanced brain atlas which fuses with a patient's MR brain imaging. Attendees will be able to navigate a patient's brain with 3D googles using Virtual Reality (VR) technology. Augmented Reality (AR) technology will also be presented. The atlas presented has extensive data related to brain anatomy, vasculature and function. It can map white fiber tracts when conventional DTI cannot be generated as a result of tumor or vasogenic edema. The atlas also takes into account tumor mass effect by deforming adjacent anatomical structures. Given its 3D capability, this tool has been used in neurosurgical pre-operative planning cases. Intraoperatively, the atlas has been successfully fused to neuronavigation systems to aid in real time surgical guidance. The atlas also has been very useful for radiation treatment planning. It supports individualized medicine, through the generation of videos related to the patient's brain tumor assisting patient education.

RCC32

RadLex: Semantics for Smart Workflows and Enterprises

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S501ABC

IN

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

Participants
Kenneth C. Wang, MD, PhD, Ellicott City, MD (*Moderator*) Co-founder, DexNote, LLC; Software support, 3D Systems, Inc

LEARNING OBJECTIVES

1) Describe the RadLex system of standard terms for radiology. 2) Access RadLex content through interactive and programmatic interfaces. 3) Identify the role of standard terminology in radiology reporting, analytics and workflows, including the use of RadLex terms in a regional lung cancer screening project. 4) Explain and utilize the RadLex Playbook and the LOINC-RSNA Radiology Playbook systems for naming and coding radiology exams.

Sub-Events

RCC32A Standard Codes for Reporting, Analytics, and Workflow

Participants
Kenneth C. Wang, MD, PhD, Ellicott City, MD (*Presenter*) Co-founder, DexNote, LLC; Software support, 3D Systems, Inc

LEARNING OBJECTIVES

1) Define the purpose of the RadLex terminology system. 2) Characterize the scope and organization of RadLex terms. 3) Access RadLex content through interactive and programmatic interfaces. 4) Explain the use of RadLex terms in radiology reporting, analytics and workflows. 5) Introduce the role of RadLex terms in standardized radiology exam codes.

RCC32B Cancer Care Ontario, Thyroid Nodule Ultrasound and LDCT Lung Cancer Screening: The Role of Terminology and Radiology Structured Reporting

Participants
David M. Kwan, BSC, Toronto, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

David.Kwan@cancercare.on.ca

LEARNING OBJECTIVES

1) Understand the motivation for using RadLex for: defining clinical elements in standardizing radiology reporting templates; facilitating clinical data retrieval for population-based research; and for integrating radiology results for cancer patients. 2) Understand the challenge associated with implementing synoptic (highly structured and coded) radiology reporting templates for radiologists. 3) Understand the use case for applying RadLex in Cancer Care Ontario Synoptic Radiology Reporting Templates for Thyroid Nodule Ultrasounds and Low Dose CT Lung Cancer Screening.

RCC32C Using RadLex for Intelligent Radiologic-pathologic Correlation

Participants
Ross W. Filice, MD, Chevy Chase, MD (*Presenter*) Co-founder, DexNote, LLC; Research Grant, NVIDIA Corporation; Advisor, BunkerHill Health, Inc

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Learn why radiology-pathology correlation is important. 2) Learn about the different techniques to correlate radiology and pathology reports. 3) Understand why RadLex can be helpful in this task. 3) Learn about how deep learning and language modeling may help refine this objective.

RCC32D The LOINC/RSNA Radiology Playbook: A Unified Terminology for Radiology Procedures

Participants
Daniel J. Vreeman, MS, Indianapolis, IN (*Presenter*) Researcher, bioMerieux SA; President, Blue Sky Premise, LLC

LEARNING OBJECTIVES

1) Explain the purpose and scope of the LOINC terminology standard. 2) Identify and select the key tools for implementing codes from the LOINC/RSNA Radiology Playbook. 3) Apply best practices for using LOINC. 4) Understand the development process for the LOINC/RSNA Radiology Playbook.

Active Handout:Daniel J. Vreeman

http://abstract.rsna.org/uploads/2018/17002189/2018 11 - LOINC RSNA Radiology Playbook RCC32D.pdf

SPCP31

The Nordic Countries Present: Radiology the Scandinavian Way, Future Potentials

Tuesday, Nov. 27 10:30AM - 12:00PM Room: E353C

ED HP OT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Sub-Events

SPCP31A Opening Remarks

SPCP31B Healthcare and Radiology in the Nordic Countries

Participants
Marianna Gardarsdottir, MD, Reykjavik, Iceland (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

marianna@landspitali.is

LEARNING OBJECTIVES

1) Understanding the form of medical education, training and health care in the Nordic Countries.

ABSTRACT

An introduction to the Nordic countries, healthcare systems and medical education will be provided. Similarities between the countries, differences and comparison with the US.

SPCP31C Mammography Screening in Denmark: Implementation of a Population Based Service Cancer Screening Program, Quality Assurance, Results, and Future Potentials

Participants
Ilse Vejborg, Copenhagen, Denmark (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To improve basic knowledge on how to implement and quality assure a population based screening programme. 2) To apply principles of critical thinking in the debate about pros and cons of mammography screening. 3) To debate future potentials in breast cancer screening.

ABSTRACT

Mammography screening aims at detecting breast cancer in its early stages and thereby to reduce breast cancer mortality. The main benefit of screening is reduction in breast cancer mortality. The main harm is overdiagnosis. In order to achieve a substantial reduction in disease specific morbidity and mortality with as few negative side effects as possible, it is necessary to build up and maintain a high standard on a professional and organizational level, not only in the screening programme as such but even concerning the ensuring diagnostic work up and treatment. In a population based screening programme every member of the target population must be known to the programme. A high participation rate and a high detection rate are necessary. Unnecessary work up should be minimized. Multidisciplinary team working, high volume readers, training and audits are essential. A continuous monitoring of the quality using target and performance indicators on variours aspects of the screening programme as well as its derived interventions is essential to obtain and maintain a high standard, as is an open mind towards new evidence based screening possibilities.

SPCP31D Education of Future Radiologists with Simulation-Based Training: Is this the way to go?

Participants
Michael Bachmann Nielsen, MD, Copenhagen, Denmark (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about how a needs assessment in radiology identified and prioritized technical procedures to include in a simulation-based curriculum. 2) To learn about the present status of simulation training in ultrasound. 3) To learn about how an ultrasound-based curriculum in ultrasound could be structured and implemented.

ABSTRACT

In a recent needs assessment in radiology in Denmark ultrasound training including biopsy came on the top of the list. The value of an ultrasound examination depends on the skill of the examiner. Mastery learning ensures that trainees all achieve the same competence level but not necessarily at the same pace. Some have seen ultrasound simulation training as a solution but a review of the literature showed the previous studies were heterogeneous in the choice of simulator, study design, participants, and outcome measures, and the level of evidence for effect was inadequate. Only recently have a standardized test of competency in abdominal ultrasound with solid validity evidence been suggested. The presentation will look at this test which is based on the EFSUMB recommendations for abdominal US and offers a pass/fail standard to facilitate mastery learning. Simulation training could be used at different levels in the specialist training, most likely the greatest benefit would be training to pass the test even before the first patient is examined. Simulation training could also be used at basic levels in medical students including hand eye

coordination if included in the medical curriculum.

URL

None

SPCP31E Future Challenges in Nordic Education in Emergency Radiology

Participants
Seppo K. Koskinen, MD, PhD, Stockholm, Sweden (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the current status and future challenges in emergency radiology training in Nordic countries.

ABSTRACT

The five Nordic countries, with a combined population of 27 million people, are a relatively homogeneous geographic region, Iceland excluded. The medical education as well as postgraduate training and health care systems resemble to a large extent each other. However, the subspecialty training varies and there is as yet no official consensus regarding the emergency radiology training. The Nordic Society of Emergency Radiology has tried to spread the best practises in emergency radiology. On the other hand, Finland has establishes a two-year subspecialty training program in three university hospitals.In thin talk, I'll briefly go thru the current status and future challenges in emergency radiology training in Nordic countries.

SPCP31F Short Presentation of the Next Nordic Congress in Radiology May 22-24, 2019 in Copenhagen, Denmark

Participants
Birthe H. Bech, MD, Copenhagen , Denmark (*Presenter*) Nothing to Disclose

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birthe.h.bech@gmail.com

LEARNING OBJECTIVES

1) To learn about upcoming Nordic Congress of Radiology 2019.

ABSTRACT

The Nordic Society of Medical Radiology welcomes you to the next Nordic congress of Radiology in Copenhagen 2019. The meeting and the venue is presented, giving an appetizer to Wonderful Copenhagen and to Nordic radiology.

URL

www.ncr2019.dk www.nordicradiology.eu

SPCP31G Closing Remarks

Participants
Vijay M. Rao, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

SSG01

Breast Imaging (Ultrasound Screening and Diagnostic Indications)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S406A

BR US

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

Participants

Donna M. Plecha, MD, Strongsville, OH (*Moderator*) Research Grant, Hologic, Inc
Jessica W. Leung, MD, Houston, TX (*Moderator*) Scientific Advisory Board, Hologic, Inc; Speakers Bureau, Hologic, Inc; Speakers Bureau, FUJIFILM Holdings Corporation

Sub-Events

SSG01-01 Performance of Screening Breast Ultrasound Over 5-Year Period

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S406A

Participants

Stamatia V. Destounis, MD, Scottsville, NY (*Presenter*) Research Grant, Hologic, Inc; Research Grant, Delphinus Medical Technologies, Inc
Amanda Santacroce, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Andrea L. Arieno, BS, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

sdestounis@ewbc.com

PURPOSE

To review and compare performance of screening ultrasound in women with dense breast tissue post adoption of state breast density mandate.

METHOD AND MATERIALS

Through a retrospective chart review, data was collected on 23,878 screening ultrasound exams performed from 2013-2017 in patients with heterogeneously dense or extremely dense breast tissue. We stratified the data by year to compare screening ultrasound performance over time. Cancer detection rate (CDR), PPV and biopsy rate were calculated for US only findings (mammographically normal). Data was collected on patient demographics, number of DBT exams performed, BI-RADS score, pathology, tumor size, and lymph node status.

RESULTS

A total of 23,878 screening ultrasound exams were performed; 691 (2.9%) in 2013, 1700 (7.1%) in 2014, 4767 (20.0%) in 2015, 7389 (30.9%) in 2016, 9339 (39.1%) in 2017. Use of BI-RADS 1 and 2 remained stable; ranging from 95.0% in 2013 to 97.1% in 2017. The use of DBT increased in the population increased, from 18.7% in 2013 to 99.3% in 2017. Cancer detection rate increased in the first 3 years, from 1.4/1000 (2013) to 3.6/1000 (2015) then decreased in 2016 to 2.4/1000, and again in 2017 to 2.2/1000. Biopsy rate steadily decreased since 2013, from 2.9% to 1.0% in 2017. PPV for biopsy initially increased substantially (5% in 2013 to 20% in 2014) and then slightly declined; 18.8% in 2015, 16.2% in 2016, and increased again to 22.3% in 2017. The assignment of BIRADS 3 decreased over time; from 2.5% of exams in 2013, to .76% in 2017.

CONCLUSION

Screening ultrasound continues to detect mammographically occult malignancy, though the rate can vary substantially, as we saw an initial increase, followed by a decrease to 2.2/1000 in 2017. This decrease could be due to the increase in use of DBT, which increases the visibility of malignancies on mammography. The biopsy rate consistently decreased, from 2.9% to 1.0%, as did assignment of BI-RADS category 3. PPV varied over time, with the highest rate over the period in 2017 (22.3%), potentially suggesting more appropriate use of biopsy in this population.

CLINICAL RELEVANCE/APPLICATION

There are 30 states with breast density legislation. As policies continue to change and center around individualized medicine, understanding the performance and value of US will be helpful for facilities as they continue to adopt improved screening practices and modalities for women with dense breast tissue.

SSG01-02 Non-Mass Lesion Detected by Breast US: Stratification of Cancer Risk for Clinical Management

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S406A

Participants

Ko Woon Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Surin Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Mi-Ri Kwon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
So Yeon Yang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
E-Ryung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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kowoon.park@samsung.com

PURPOSE

To develop a practical diagnostic prediction model by using imaging features of breast non-mass lesion (NML) detected by B-mode ultrasonography (US).

METHOD AND MATERIALS

From Dec 2011 to March 2016, B-mode US was performed in 777 NMLs in consecutive 828 patients. This retrospective study consecutively included 669 breast NMLs in 669 patients for which final diagnoses were established and mammographies obtained at the time of US examination. For each lesion, radiologists assessed BI-RADS category. For developing a diagnostic prediction model to estimate malignant risk of NMLs using a scoring, univariate and multivariate logistic regression analyses were performed to find US or mammographic features associated with malignancy in a developmental dataset (n=460). A score for each significant imaging feature was assigned and multiplied by the regression coefficient, and the risk score of malignancy for each NML was defined as the sum of individual scores. Based on area under the receiver operating characteristic curve (AUC), diagnostic performance of the prediction model was compared to the radiologist's BI-RADS classification. Later, we verified the usefulness of developed scoring model by applying into the remaining validation dataset (n=209).

RESULTS

Among 669 NMLs, 354 (52.9%) were benign and 315 (47.1%) were malignant. In the developmental dataset, the following US features, within or around the main lesion, showed significant association with malignancy: the presence of calcifications, architectural distortion, posterior acoustic shadowing or abnormal ductal change, and absence of microcysts. The following mammographic features also showed significant association with malignancy: the presence of calcifications or focal asymmetry. The predictive model's AUC was higher than the radiologist's BI-RADS classification (0.952 vs. 0.930). In the validation dataset, AUC of our prediction model was 0.961.

CONCLUSION

The prediction model using features of US and mammography may be useful in stratification of cancer risk of breast non-mass lesions.

CLINICAL RELEVANCE/APPLICATION

Cancer risk stratification for breast non-mass lesions using features of US and mammography may be useful in managing breast non-mass lesions detected by US.

SSG01-03 Decreasing Short-Term Follow-Up and Biopsies by Following BI-RADS 3 Lesions at 1 Year: A Prospective Study

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S406A

Participants
Richard G. Barr, MD, PhD, Campbell, OH (*Presenter*) Consultant, Siemens AG; Consultant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, SuperSonic Imagine; Speakers Bureau, Koninklijke Philips NV; Research Grant, Bracco Group; Speakers Bureau, Siemens AG; Consultant, Canon Medical Systems Corporation; Research Grant, Esaote SpA; Research Grant, BK Ultrasound; Research Grant, Hitachi, Ltd
Carmine Tinelli, MD, MSC, Pavia, Italy (*Abstract Co-Author*) Nothing to Disclose
Annalisa DeSilvestri, PhD, Pavia, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Supplemental US is know to detect node negative cancers not identified on screening mammography. However the large number of short-term follow-ups and low positive biopsy rate make this technique not cost effective. The majority of these are due to BI-RADS 3 lesions (B3), with an incidence of cancer in < 1%. This prospective study evaluates the effect of following B3 detected on supplemental ultrasound at 1 year.

METHOD AND MATERIALS

This HIPPA compliant, IRB approved with written informed consent study invited patients receiving a B1 or B2 screening mammogram with density 3 or 4 breast of any risk to receive a free automated volume whole breast (ABVS) ultrasound. The ABVS was performed on a Siemens S2000 using a 15cm L14-5 transducer. ABVS were read by radiologist with 20 year experience as BI-RADS category 1, 2, 3, or 0. Category 0 patients received a hand held ultrasound (HH). Patients were followed for 2 years.

RESULTS

Of 23426 screening patients, 8542(36.5%) had density 3 or 4 and were asked to participate. 2257 (26.4%) agreed to participate (50 yo mean age, range 31 to 90) (<10% high risk). The ABVS was interpreted as B1 in 1186 (52.5%), B2 in 591 (26.2%), B3 in 395 (17.5%) and B0 in 85 (3.8%). Of the 395 B3 patients, 310 had 1-year follow-up and were cancer free, 0%, 254 had 2-year follow-up and were cancer free, 0%. Of the 85 B0 patients, (recall rate of 3.8%) on HH 8 (11.3%) were B1, 51 (71.8%) were B2, 2 (2.8%) were B3, 6 (8.5%) were B4, and 4(5.6%) were B5. The B4 and 5 lesions were 2 B4A lesions were fibroadenomas,2 B4A were fibrocystic change, 2 category 4C lesions were IDC, and 4 category 5 lesions were IDC. The biopsy rate was 0.4% (10/2257) with a positive biopsy rate (PPV3) of 60.0% (6/10). The supplemental ultrasound detected 2.8/1000 additional cancers (4/1412). 5 cancers (0.28%, 5/1777) were detected in 3 yr f/u in B1 and B2 and 1 IDC (0.25%, 1/395) was identified in B3 in the contralateral breast.

CONCLUSION

Following B3 at 1 year interval decreases the recall rate (8.8% (233/2637) ACRIN 6666 to 3.8% (54/1412)) ($p<0.001$) and increases the PPV3 (8.9% (21/235)ACRIN 6666 to 60.0% (6/10))($p=0.001$) without substantial node positive cancer misses. With these improved screening characteristic, supplemental ultrasound could be cost effective.

CLINICAL RELEVANCE/APPLICATION

Following B3 at 1 year markedly reduces the recall rate and increases the PPV3 making supplemental screening more cost effective.

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/ Richard G. Barr, MD, PhD - 2017 Honored Educator

SSG01-04 A Preliminary Study of Predicting Molecular Subtypes of Breast Cancer by the Radiomics Features of Contrast-Enhanced Ultrasound

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S406A

Participants
Lei Tang, Shanghai, China (*Presenter*) Nothing to Disclose
Man Chen, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim was to analyze the quantitative features of contrast-enhanced ultrasound(CEUS) imaging of breast cancer through computer image extraction, and to explore the preoperative prognosis of the different molecular subtypes of breast cancer.

METHOD AND MATERIALS

CEUS images of 189 patients were collected from our hospital. Everyone signed informed consent before CEUS. Surgical pathology and molecular typing results were obtained in all patients. Through mapping the borders of breast cancers on the images, the entire internal area of the tumor was determined. The lesions were divided into four quadrants(Fig 1). The high perfusion within the lesion area was defined as a high brightness area. The temporal and special features of the images in different areas were extracted by the computer in a dynamic CEUS file and the time intensity curves(TIC) were drawn. From the TIC curve, the features were extracted such as wash in rate(WiR), wash out rate(WoR), rise time(RT), base intensity(BI) and peak intensity(PI) and EI(=PI-BI), so on. The parameters of the curve in each area were calculated in different molecular typing groups.

RESULTS

The patient' numbers of Luminal A, Luminal B, HER2+, and triple negative breast cancer (TNBC) of each molecular subtypes were 46, 75, 37, and 31, respectively. The extracted effective features included EI of the internal bright area, WoR of internal bright area, WoR of the internal overall area, RT of the internal overall area, and so on. The cutoff value 1.566 of WoR in the internal bright area might help to find Luminal A, with a specificity of 82.61%. When to find TNBC, the cutoff value of EI at the internal bright area was 0.3494, the sensitivity was 64.52%, and the specificity was 68.99%. When distinguishing between Her2+ and TNBC, WOR of the internal overall had a cutoff of 5.7496 and a sensitivity of 74.19%.

CONCLUSION

The radiomics features of contrast-enhanced ultrasound could contribute to preoperative prediction of breast cancer molecular subtypes. Further research needed to be larger sample, multi-center expansion.

CLINICAL RELEVANCE/APPLICATION

The radiomics features of contrast-enhanced ultrasound could contribute to preoperative prediction of breast cancer molecular subtypes, which may help to predict efficacy and to select treatment options.

SSG01-05 Sonographic Features of Radial Scars and Complex Sclerosing Lesions

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S406A

Participants
Reni S. Butler, MD, Madison, CT (*Presenter*) Nothing to Disclose
Liva Andrejeva-Wright, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Jaime L. Geisel, MD, New Haven, CT (*Abstract Co-Author*) Consultant, QView Medical, Inc
Laura S. Sheiman, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Madhavi Raghu, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Regina J. Hooley, MD, New Haven, CT (*Abstract Co-Author*) Consultant, Hologic, Inc
Liane E. Philpotts, MD, New Haven, CT (*Abstract Co-Author*) Consultant, Hologic, Inc

For information about this presentation, contact:

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PURPOSE

To assess the morphologic characteristics of radial scars (RS) and complex sclerosing lesions (CSL) when they are visualized with ultrasound (US)

METHOD AND MATERIALS

A HIPAA-compliant, IRB-approved retrospective review of core needle biopsies (CNB) performed between 1/1/2007 and 12/31/2017 was performed and filtered for RS or CSL as the primary diagnosis. Patients with a concurrent diagnosis of malignancy or with only a microscopic incidental RS were excluded. The method of detection, mammographic and sonographic features, histology at CNB and at surgical excision, if performed, were recorded for all lesions visualized with US.

RESULTS

190 lesions with a CNB diagnosis of RS or CSL were identified. 57.4% (109/190) were visible on US. Most [75.2% (82/109)] US-visible lesions were initially detected on screening mammography, followed by screening US [19.3% (21/109)], diagnostic US [2.8% (3/109)], diagnostic mammography [1.8% (2/109)], and screening MRI [0.9% (1/109)]. Among US-visible lesions, 53.2% (58/109) appeared as non-mass areas of abnormal echogenicity, 44.0% (48/109) as masses, 1.8% (2/109) as architectural distortion only, and 0.9% (1/109) as dilated hypoechoic ducts. More lesions were anti-parallel [58.7% (64/109)] compared to parallel [41.3% (45/109)]. While most were hypoechoic [64.2% (70/109)], others were isoechoic [14.7% (16/109)], hyperechoic [3.7% (4/109)], or mixed [17.4% (19/109)]. Posterior acoustic features were most often none [58.7% (64/109)], followed by shadowing [28.4% (31/109)] and enhancement [12.8% (14/109)]. Color Doppler images, available in 87 lesions, showed no vascular flow in 34.5% (30/87), adjacent flow in 34.5% (30/87), and internal flow in 31.0% (27/87). Lesions presenting as architectural distortion on mammography [50.4% (55/109)] most often appeared as non-mass areas of variable echogenicity on US [89.1% (49/55)] rather than masses [10.9% (6/55)].

CONCLUSION

RS and CSL sonographic features are variable and include non-mass areas of abnormal echogenicity. While not strictly part of the BI-RADS lexicon, subtle 'nonmass' findings may be the only US correlate in some mammographically-detected lesions, especially those presenting as architectural distortion.

CLINICAL RELEVANCE/APPLICATION

As the incidence of RS and CSL increases with tomosynthesis utilization, understanding the variety of US appearances may increase the likelihood of detecting an US correlate and facilitate biopsy.

SSG01-06 Shear-Wave Elastography of the Breast: Value of a Novel 5-Point Technical Quality Score

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S406A

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PURPOSE

To determine the value of a novel 5-point technical quality score on the diagnostic performance of shear-wave elastography (SWE) of the breast.

METHOD AND MATERIALS

This IRB-approved HIPAA-compliant study included 110 consecutive women (mean age 55.1 + 15.3 years) with 122 breast lesions who underwent SWE and ultrasound-guided biopsy from Oct. 2017 to Jan. 2018. We recorded the maximum (Emax), mean (Emean), and standard deviation (Esd) elasticity measurements for each lesion. We defined five specific SWE technical quality parameters: (1) lesion visibility on B-mode image panel, (2) red pattern (high stiffness) in the near field of the field-of-view (FOV), (3) size and location of FOV box relative to lesion, (4) heterogeneity, vertical streaks, and absence of color in tissue surrounding the lesion, (5) size and location of the region-of-interest circle on the lesion for elasticity measurements. Three blinded readers independently assessed each SWE parameter as low (score=0) or high (score=1) quality. SWE total quality score < 3.3 was classified as low and > 3.3 as high. Intra-class correlation coefficient (ICC) was used to measure inter-observer agreement for the total score and the Hanley and McNeil's method was used to compare areas under the receiver operating characteristic curve (AUC) of SWE in low vs. high-quality images.

RESULTS

Mean size of the 122 lesions was 13.9 + 10.4 mm; 64 (52%) were benign and 58 (48%) were malignant. Inter-observer agreement was good among readers (ICC 0.805). AUCs were significantly improved in the high-quality group compared to the low-quality group for Emean (0.858 vs. 0.631, p=0.009; AUC difference=0.227, 95%CI [0.056, 0.398]) and Esd (0.816 vs. 0.629, p=0.040; AUC difference=0.187, 95%CI [0.008, 0.366]). AUC for Emax also increased to 0.861 in the high-quality group compared to 0.714 in the low-quality group but without statistical significance (p=0.077; AUC difference=0.147, 95%CI [-0.015, 0.309]).

CONCLUSION

Incorporating our novel 5-point technical quality score can improve the diagnostic performance of SWE in differentiating malignant from benign breast lesions.

CLINICAL RELEVANCE/APPLICATION

A simple 5-point technical quality metric provides guidance to users during real-time acquisition and improves diagnostic performance of SWE in differentiating malignant from benign breast lesions.

SSG01-08 Can Mid-Treatment Ultrasound in Triple Negative Breast Cancer Patients Predict Residual Pathologic Disease in the Axillary Nodes?

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S406A

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PURPOSE

To determine if the number of abnormal lymph nodes visualized on mid-treatment ultrasound in triple negative breast cancer (TNBC) patients who are undergoing neoadjuvant chemotherapy associates with residual nodal disease on surgical pathology

METHOD AND MATERIALS

As part of an on-going single-institution, clinical trial of stage I-III TNBC patients, the first 106 patients who underwent surgery were included in this interim analysis. Mid-treatment was defined as the period following completion of four cycles of AC (Adriamycin and cyclophosphamide) chemotherapy and before initiating either anticipated Taxol chemotherapy or an investigational therapy. The number of abnormal nodes at mid-treatment was assessed and recorded by experienced, fellowship-trained breast radiologists. These radiologists empirically categorized lymph nodes using a binary approach of sonographically abnormal versus normal. Pathologic lymph node positive was defined as the presence of macrometastasis and micrometastasis in at least one axillary node from sentinel lymph node biopsy and/or axillary lymph node dissection as stated in the surgical pathology reports. Wilcoxon rank sum test and Fisher's exact test were used to determine statistical significance.

RESULTS

There were 26 of 106 patients (25%) who had residual nodal disease at surgery and 80 of 106 patients (75%) who had nodal pathologic complete response. The median number of abnormal nodes at mid-treatment was 3 (range 0-16 nodes) for patients who had residual nodal disease compared to 0 (range 0-12 nodes) for patients who had nodal pathologic complete response. TNBC patients with residual nodal disease on surgical pathology had significantly more abnormal nodes at mid-treatment ($p<0.0001$). More specifically, TNBC patients with at least 2 abnormal lymph nodes at mid-treatment ultrasound had a significantly higher chance of being pathologic lymph node positive at surgery ($p<0.0001$).

CONCLUSION

There is a highly significant association between the number of abnormal lymph nodes identified at mid-treatment ultrasound and the presence of residual metastatic axillary nodes at surgery in triple negative breast cancer patients.

CLINICAL RELEVANCE/APPLICATION

The number of abnormal lymph nodes at mid-treatment may be an independent predictor of residual disease in TNBC patients and may assist in identifying chemoresistant patients who could benefit from investigational therapies.

SSG01-09 Is a BI-RADS 4 or 5 Assessment Reasonable on Screening Ultrasound?

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S406A

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PURPOSE

For participants recalled for further testing, to determine the utility of a BI-RADS final assessment in determining management based on technologist-performed screening ultrasound.

METHOD AND MATERIALS

5689 women in three centers (1 academic and 2 private practice) were enrolled in an IRB-approved study of screening tomosynthesis (DBT) and technologist-performed handheld screening ultrasound (US, with orthogonal views of each finding other than simple cysts) and underwent 8151 screens (5689 yr1, 2462 yr2). Two experienced breast-imaging specialized radiologists prospectively reviewed each DBT-US set independently and in opposing order. Whenever additional imaging was recommended prior to the next annual screening, readers recorded a "final" assessment: BI-RADS 3, 4A, 4B, 4C or 5, together with recommendations, which could include immediate additional imaging and/or possible biopsy, or six-month follow-up. When US was read first and still resulted in a recall after integration with the DBT, we compared subsequent management and outcomes with the original BI-RADS assessments. We excluded technical recalls. At least targeted prior sonograms were available for 980 participants in year 1.

RESULTS

24 women were ultimately diagnosed with cancer after US recall, median patient age 55 (range 40-75). A total of 455 (5.6%) US exams prompted recall: 348/5689 (6.1%) in year 1 and 107/2462 (4.3%) in year 2. Of 209 women scored BI-RADS 3, 114 had immediate additional evaluation and 95 had 6-month follow-up; 20 (9.6%) ultimately had biopsy with 2 (1.0%) found to have cancer. Of 153 rated BI-RADS 4A on screening, 86 (56.2%) had biopsy and 2 (1.3%) proved malignant. Of 60 BI-RADS 4B, 40 (66.7%) had biopsy and 4 (6.7%) had cancer. Of 11 BI-RADS 4C, 11 (100%) had biopsy and 7 (63.6%) had cancer. Of 9 BI-RADS 5, 9 (100%) had biopsy and 9 (100%) were found to have cancer.

CONCLUSION

Malignancy and biopsy rates were lower than expected for a BI-RADS 4A or 4B assessment on technologist-performed screening US, but were reasonable for a BI-RADS 4C or 5 assessment.

CLINICAL RELEVANCE/APPLICATION

Directly scheduling biopsy based on screening US was appropriate for BI-RADS 4C and 5 assessments; 56% of 4A and 67% of 4B assessments resulted in biopsy after physician-targeted evaluation.

SSG02

Cardiac (Coronary Atherosclerosis)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S104B

CA CT VA AI

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

Participants

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Sub-Events

SSG02-01 Incremental Prognostic Value of Coronary Artery Disease-Reporting and Data System (CAD-RADS) Scores Over Coronary Artery Calcium Scores (CACS) for Major Adverse Cardiovascular Event in Stroke Patients Without Chest Pain

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S104B

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PURPOSE

The aim of this study was to investigate the prognostic value of coronary artery disease-reporting and data system (CAD-RADS) scores and determine the additional risk stratification benefit of CAD-RADS scores compared to coronary artery calcium score (CACS) and coronary artery disease (CAD) extent classifications in ischemic stroke patients without cardiac symptoms.

METHOD AND MATERIALS

From January 2013 to August 2014, 615 ischemic stroke patients who had at least one risk factor for CAD without chest pain underwent coronary computed tomography angiography (CCTA) and were included for final analysis. CT images were evaluated for CACS, extent of CAD and CAD-RADS scores. The primary endpoint was major adverse cardiovascular events (MACEs) defined as cardiovascular death, nonfatal myocardial infarction, unstable angina (UA) requiring hospitalization, revascularization and recurrent ischemic stroke event. Cox regression analyses were used to identify associations between CAD-RADS results and MACEs. C-statistics were calculated to compare discriminatory values of each model.

RESULTS

During the median follow-up period of 3.11 years, there were a total of 78 MACEs. Of 615 patients, 24.7% were classified as CAD-RADS 0, 19.3% as CAD-RADS 1, 17.6% as CAD-RADS 2, 18.5% as CAD-RADS 3, 15.6% as CAD-RADS 4A, 2.1% as CAD-RADS 4B, and 2.1% as CAD-RADS 5. CACS, CAD extent classification and CAD-RADS scores independently stratified risk of future MACEs (all $p < 0.05$). C-statistics revealed that both CAD extent classification and CAD-RADS scores improved risk stratification beyond CACS (C-index: 0.753 vs 0.698, $p < 0.001$ and 0.726 vs 0.698, $p = 0.041$, respectively).

CONCLUSION

In ischemic stroke patients without chest pain, CAD-RADS score had prognostic value for future MACE. In addition, CAD-RADS score provide additional risk-discrimination over CACS.

CLINICAL RELEVANCE/APPLICATION

CAD-RADS score provides additional risk-discrimination over CACS for the future major adverse cardiovascular events and can be recommended in the assessment of cardiovascular risk of stroke patient without chest pain.

SSG02-02 Machine Learning Outperforms CAD-RADS in Finding Optimal Prognostic Plaque Characteristics on Coronary CT Angiograms

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S104B

Participants
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PURPOSE

To use machine learning to find an optimal combination of coronary artery imaging features on CT angiography for the prediction of all cause mortality and coronary deaths, myocardial infarction and revascularization

METHOD AND MATERIALS

CT angiography was performed and risk factor data collected. Arteries were scored using CAD-RADS and 4 other published methods and compared to a score derived using machine learning. Causes of death were determined using the National Death Index. Myocardial infarction and revascularizations were discovered by follow-up letters. Prognostic results were compared using the area under the receiver operating characteristic curves.

RESULTS

7117 patients were imaged and followed for a mean of 9.0 years. There were 414 deaths from all causes, 79 attributed to coronary artery disease as the underlying or contributing cause, 51 myocardial infarctions (MI) and 231 revascularizations. The two best machine learning models were linear discriminant with diagonal covariance matrix and a classification neural network. Respective areas under the ROC curve were 0.76 and 0.77 for all cause mortality, 0.82 and 0.82 for coronary deaths or MI, and 0.87 and 0.88 for CHD or MI or revascularization. The corresponding CAD-RADS results were 0.71, 0.79 and 0.86.

CONCLUSION

Machine learning outperformed CAD-RADS for prediction of death and coronary events.

CLINICAL RELEVANCE/APPLICATION

Machine learning can be used to provide a prognostic score on coronary CT angiography that is comparable to or better than CAD-RADS.

SSG02-03 Development of a Deep Learning Algorithm for Predicting the Coronary Artery Calcium Score Using Retinal Images

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S104B

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PURPOSE

To determine if deep learning networks could be trained to estimate coronary artery calcium score (CACS) in heart CT scan from retinal images.

METHOD AND MATERIALS

All patients who obtained both ophthalmic examination and heart CT angiography at the tertiary center. Automated extraction of an OCT and retinal images was performed and linked to clinical end points from the electronic medical records. A deep neural network was trained to categorize images as either CACS<=10 (normal) or CACS>=100 (abnormal). We used the Modified VGG 11 model. We inserted one global average pooling layer instead of 2 fully-connected layers. To avoid overfitting, we had the data augmentation. At the SoftMax layer, the image that passed over the network was shown normal or abnormal binary probability value. Accuracy and Area under the receiver operating characteristic was estimated.

RESULTS

A total of 23,177 retinal images based on 15,056 examinations from 2,419 patients, who have received heart CT angiography including CACS, were extracted. At the examination level, we achieved an area under the ROC curve of 78.43% with an accuracy of 70%. At a patient level, we achieved an area under the ROC curve of 85.53% with an accuracy of 77.9%.

CONCLUSION

Using the non-invasive retinal examination including fundus photographs and OCT, deep learning networks show an impressive ability to predict the CACS, which is one of most important marker of heart disease.

CLINICAL RELEVANCE/APPLICATION

Deep-learning based screening of fundus photographs and OCT may have potential for a surrogate marker without radiation

exposure for high-risk patients with high coronary artery calcium score.

SSG02-04 Coronary Calcium Content Extracted by Machine Learning Methods from Incidental CT Scans Improves Coronary Heart Disease Prediction Accuracy

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S104B

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PURPOSE

Despite significant reductions in the last few decades, coronary heart disease (CHD) remains a significant cause of mortality. Many risk factors for CHD can be mitigated by lifestyle changes and pharmacological interventions, making risk calculation for individuals an important part of prevention. Accordingly, quantification of risk is integrated into prevailing management guidelines. Determination of coronary calcium content has been shown to allow improvement in risk calculation, but requires specialized tests that are not often performed. We present a novel algorithmic method that allows for the extraction of coronary calcium scores from incidental chest CTs performed for other indications, and demonstrate its utility in improving prediction accuracy over the American Heart Association (AHA) 2013 pooled risk model in a retrospective cohort study.

METHOD AND MATERIALS

There were 14,866 patients aged 30-74 with no prior CHD diagnosis included. CT scans and different covariates for the model were extracted in the two years prior to the index date (1 June 2012). Patients were followed-up for five years. Prediction performance results were compared between the AHA 2013 model (base model) and the same model with the novel coronary calcium score inserted as an additional predictor (augmented model). Both were logistic regression models and were trained on the sample population to allow comparison. For measures requiring a threshold, 3.5% risk over 5 years was chosen.

RESULTS

Based on the likelihood ratio test, the augmented model was superior to the base model (p-value <0.001). Similarly, the augmented model achieved superior performance for all performance measures: sensitivity increased 0.85%, specificity increased 4.9%, area under the ROC curve increased by 2.2% and there was a 4.5% categorical net reclassification improvement.

CONCLUSION

In this study, use of a novel biomarker extracted using a machine learning algorithm from incidental CT scans improves predictive accuracy compared to the commonly used model. This improvement occurs both in theoretical and practical measurements of model utility; in actual use it would translate into better clinical decisions.

CLINICAL RELEVANCE/APPLICATION

Coronary calcium content extracted via novel machine learning methods from incidental CTs significantly improves coronary heart disease prediction.

SSG02-05 Radiomics of Coronary Artery Calcium in the Framingham Heart Study

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S104B

Awards
Student Travel Stipend Award

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PURPOSE

To assess whether detailed coronary artery calcium (CAC) characterization based on radiomic feature extraction followed by machine learning improves prediction of cardiovascular (CV) events.

METHOD AND MATERIALS

Participants from the Offspring and third Generation cohorts of the community-based Framingham Heart Study who underwent chest CT between 2002 and 2005 were followed over a median of 9.1 years for cardiovascular events (CV) events (myocardial infarction, stroke, or death). Of those, 624 participants who had excellent image quality and CAC (Agatston score (AS)> 0) were randomly divided into discovery (n=318) and validation cohorts (n=306). CAC was segmented manually using 3DSlicer, and about 2000 radiomic features (based on intensity, shape, and texture of CAC) were extracted using pyRadiomics software. In the derivation cohort, we used an internal minimum redundancy maximum relevancy algorithm (without knowledge of events) to identify the 20 highest ranked features. Finally, a random forest classifier was used to optimize decision trees for prediction for CV events. The weighted predictive probabilty of events for each of the 20 features was summarized into a radiomic score. The performance of this score was tested independent in the validation cohort.

RESULTS

The discovery (66.1% men, 58.1±11.1 age) and validation cohorts (61.4% men, 59.3±11.2 age) had similar CV risk profile, median AS, and CV event rates (30/318 =9.7% and 29/306=9.5%, respectively). In adjusted multivariate analysis (for Framingham risk factors and AS), participants in the validation cohort, who had radiomic scores in the mid and upper tertiles had significantly higher risk for events as compared to the lower tertile (mid: HR= 9.3, p=0.03, upper: HR=16.5, p=0.007). The area under the curve (AUC) was higher for AS, radiomic score (RS), and combined AS/RS were 0.73, 0.76 and 0.79; respectively in the overall population. Performance was best in the subgroup with AS <300 (n=250, Figure)

CONCLUSION

This proof-of-concept study demonstrates that detailed CAC characterization based on radiomic feature extraction predicts CV events independent of traditional risk factors and AS. Further validation is necessary to determine clinical impact.

CLINICAL RELEVANCE/APPLICATION

Artificial intelligence may identify a prognostically important radiomic signature of CAC.

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/ Udo Hoffmann, MD - 2015 Honored Educator

SSG02-06 Identification of Invasive and Radionuclide Imaging Markers of Plaque Vulnerability Using Computed Tomography Radiomics

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S104B

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PURPOSE

Several invasive and radionuclide imaging markers of coronary plaque vulnerability have been described. Identification of these imaging biomarkers by a single, widely available non-invasive technique may provide an opportunity to identify vulnerable plaques and vulnerable patients in daily clinical practice. Therefore, our aim was to assess the diagnostic accuracy of coronary computed tomography angiography (CTA) derived radiomic features to identify attenuated plaque using intravascular ultrasound (IVUS), thin-cap fibroatheroma per optical coherence tomography and radionucleide uptake using sodium fluoride positron emission tomography morphologic (NaF18-PET) as compared to conventional qualitative and quantitative CT metrics.

METHOD AND MATERIALS

We analyzed 44 plaques in 25 patients using IVUS, OCT, NaF18-PET and coronary CTA. We assessed 7 conventional qualitative and quantitative plaque characteristics and calculated 935 radiomic parameters. We calculated receiver operating characteristics area under the curve (AUC) values using a 5-fold cross validation with 1000 repeats to assess diagnostic accuracy. We used the Kolmogorov-Smirnov test to compare the distribution of AUC values resulting from the cross-validations.

RESULTS

Radiomics outperformed conventional metrics to identify attenuated plaque per intravascular ultrasound, thin-cap fibroatheroma by optical coherence tomography and metabolically active plaques per sodium fluoride positron emission tomography in CT images (AUC: 0.72 vs 0.59; 0.80vs 0.66; 0.87 vs 0.65; p<0.001 all; respectively).

CONCLUSION

Computed tomography radiomics may allow the non-invasive identification of invasive and radionuclide imaging biomarkers.

CLINICAL RELEVANCE/APPLICATION

Radiomics is able to identify morphologic and metabolic high-risk plaque features currently olny identifiable using invasive and radionucleide imaging, which are both important components of plaque instability.

SSG02-07 Epicardial Fat is Increased in the HIV Population and Associated to Coronary Artery Plaque Burden

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S104B

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PURPOSE

HIV patients are exposed to a higher risk of coronary artery disease (CAD) compared to non-infected patients. The exact mechanism responsible for this increased risk is not well understood. HIV individuals are also exposed to changes in body fat distribution characterized by greater ectopic fat. These changes may play a role in promoting atherosclerosis. Epicardial fat, which is the ectopic fat related to the heart, may play a unique role because of its location near to the coronary arteries. We hypothesize that epicardial fat volume is increased in the HIV patients and correlates with total coronary plaque volume, and with low attenuation plaque volume, which is a marker of plaque vulnerability.

METHOD AND MATERIALS

This is a cross sectional study, nested in the Canadian HIV and Aging Cohort Study (CHACS), a large prospective cohort following more than 800 HIV+ and HIV- patients. Consecutive CHACS participants with low to intermediate cardiovascular risk without symptoms or past CAD were invited to undergo cardiac computed tomography (CT) and coronary plaque imaging with CT angiography. Volume measurement of epicardial fat, total atherosclerotic plaque and low-attenuation plaque were performed. Association between epicardial fat volume, coronary plaque volume and low attenuation plaque volume was assessed using multivariate linear regression.

RESULTS

A total of 246 participants underwent cardiac CT scans. 173 were HIV+ and 73 were HIV-. HIV+ patients had greater epicardial fat volume indexed to body mass index (BMI) than HIV- patients ($p = 0.03$). In the HIV infected group, epicardial fat volume was associated with duration of antiretroviral therapy use ($\beta = 1.45$, $p = 0.004$). After adjustment for traditional cardiovascular risk factors, BMI and waist circumference, epicardial fat volume was significantly associated with total plaque volume ($\beta = 1.99$, $p = 0.04$) and low attenuation plaque volume ($\beta = 0.86$, $p = 0.01$).

CONCLUSION

Epicardial fat volume is increased in the HIV participants . The association of epicardial fat volume with antiretroviral therapy duration and subclinical coronary artery plaque may suggest a potential mechanism that could explain the increased risk for CAD in the HIV population.

CLINICAL RELEVANCE/APPLICATION

Epicardial fat is increased in HIV patients and correlates with total coronary plaque volume and low attenuation plaque volume, a CT marker of plaque vulnerability.

SSG02-08 Subclinical Coronary Atherosclerosis among Individuals with HIV on Antiretroviral Therapy

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S104B

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PURPOSE

To compare coronary plaque burden and characteristics between HIV-infected and non-HIV-infected participants

METHOD AND MATERIALS

This cross-sectional study nested in a large prospective cohort was approved by the local Institutional Review Board. All subjects provided written consent. Consecutive HIV+ and HIV- participants were prospectively recruited for cardiac computed tomography (CT). Eligibility criteria were males/females, no known coronary artery disease, low/intermediate 10-yr Framingham risk score (FRS, 5-20%), no CT contraindication. Coronary calcium scoring was done with non-contrast CT, and contrast-enhanced CT for plaque (calcified vs noncalcified, volume) and lumen assessment. Imaging assessors were blinded to HIV status. Analyses used multivariate multiple linear and logistic regression models.

RESULTS

A total of 246 participants (173 HIV+ (93% males), 73 HIV- (81 % males)) were included, with similar age (mean 55 yo, p=0.69) and FRS (median 11 %, p=0.53). Diabetes (10% vs 1.4 %, p=0.01) and smoking (28% vs 14 %, p=0.02) were more frequent in HIV+ than HIV- participants, and elevated LDL cholesterol less frequent in HIV+ participants (20% vs 32%, p=0.07). Median duration of HIV infection in HIV+ participants was 18 yrs. All were on antiretroviral therapy (median 15 yrs). After adjusting for diabetes, smoking and LDL cholesterol, prevalence and plaque extent was similar between HIV+ and HIV- participants (72 % vs 69 %, p= 0.37; 2.9 ± 3.0 vs 2.7 ± 3.8 plaques/participant, p= 0.53). HIV+ participants showed more frequent noncalcified and less frequent calcified plaques than HIV- participants (0.3 ± 0.7 vs 0.1 ± 0.5, p=0.01; 1.4 ± 2.4 vs 2.0 ± 2.0 plaques/participants, p=0.006). Number of mixed plaques (1.0 ± 1.4 vs 0.6 ± 1.4 plaques/participant, p= 0.27), mean calcium score (148 vs 141, p=0.81), plaque volume (273 vs 218 mm3, p=0.91) and prevalence of >= 70% stenosis (10% vs 6%, p=0.40) were similar between HIV+ and HIV- participants.

CONCLUSION

Noncalcified plaques are more frequent in asymptomatic HIV+ individuals under antiretroviral therapy, while calcified plaques are less frequent, in comparison to HIV- individuals, after adjustment of cardiovascular risk factors.

CLINICAL RELEVANCE/APPLICATION

Noncalcified plaques are usually considered more vulnerable plaques. Our findings suggest one anatomic substrate that could explain the increased risk of myocardial infarction in the HIV population.

SSG02-09 Atherosclerosis of Coronary Arteries in HIV Patients on Routine Non-Gated CT Chest: Incidence, Characteristics, and Risk Factors

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S104B

Participants
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PURPOSE

To evaluate the incidence and risk factors of subclinical coronary artery calcification (CAC) in patients with Human Immunodeficiency Virus (HIV) infection.

METHOD AND MATERIALS

We retrospectively reviewed 143 HIV patients (M:F = 119:24; mean age, 46.4) who underwent routine non-gated CT of thorax, from May 2010 to November 2015. Each of the four main coronary arteries was identified-left main stem (LMS), left anterior descending (LAD), left circumflex (LCX), and right coronary artery (RCA)- on CT images. Calcification in each artery was categorized as absent, mild, moderate, or severe by a radiologist. A multivariate logistic regression was performed to find independent risk factors for positive CAC. Clinical and laboratory parameters reflecting the status of HIV infection, including CD4 count, viral load, duration since HIV diagnosis, and status of antiretroviral treatment.

RESULTS

Forty-one patients (28.7%) showed calcifications in one or more coronary arteries. LAD (n=38, 92.7%) was most commonly affected, followed by LCX (n=18, 43.9%) and RCA (n=13, 31.7%). CAC deposited at the proximal portion in LAD and LCX (76.3%, 77.7%, respectively) while at the mid to distal portion in RCA (61.5%). Age of CAC+ group (53.9 years) was significantly higher than that (43.4 years) of CAC- group (p < 0.001). Minimum age of HIV patient with positive CAC was 24yrs. Duration of HIV infection in CAC+ group (12.3 years) was significantly higher than that (8.6 years) in CAC- group (p<0.0344). The mean viral load was significantly lower value in CAC+ group compared to that in CAC- group (76K versus 414K, p=0.02). CAC+ group showed significantly higher CD4 cell counts than CAC- group (mean=355.9 versus 175.3, p= 0.0053). There was no significant difference in HAART status between the two groups (current HAART receivers 84.4% versus 85.7%, p=0.539). On multivariate logistic regression, age, HIV duration, and CD4 were significantly associated with CAC+ (p-values<.05)

CONCLUSION

Patients with HIV showed early onset and increased incidence of CAC and associated with higher CD4 cell counts. Duration of HIV is an independent risk factor for coronary artery calcification, in addition to age of patients.

CLINICAL RELEVANCE/APPLICATION

Awareness of increased risk of atherosclerosis development in young-age HIV-infected patients is crucial for primary prevention of future cardiovascular events.

SSG03

Chest (Lung Nodule)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S504AB

AI CH CT

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

FDA Discussions may include off-label uses.

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Sub-Events

SSG03-01 Deep Learning-Based Computer-Aided Detection System for Multiclass Multiple Lesions on Chest Radiographs: Observers' Performance Study

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S504AB

Awards
Student Travel Stipend Award

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PURPOSE

To evaluate the added value of a deep-learning based computer-aided detection (CAD) system for multiclass multiple lesions on radiographs when radiologists read chest radiographs.

METHOD AND MATERIALS

We developed new CAD system using deep learning for detecting multiple lesions with 4 different patterns (nodule/mass, interstitial opacity, pleural effusion, and pneumothorax) on chest radiograph. To train the deep learning network, 17917 images were collected in two tertiary hospitals. Numbers of normal and abnormal patients are 11000 and 6917, respectively. We labeled disease type and delineate region of interests (ROI) drawn as ground truths by two thoracic radiologists with consensus. To validate the effect of the developed CAD on observer's performance, 9 observers including 7 board-certified radiologists and two radiology residents reviewed 200 chest radiographs twice with two weeks interval. 200 chest radiographs consists of 100 normal and 100 abnormal (nodule/mass: 60, interstitial opacity: 10, pleural effusion: 10, pneumothorax: 10) chest radiographs. The diagnostic performance of the developed CAD, observers with and without CAD were evaluated and compared using jackknife free-response receiver operating characteristic (JAFROC) figure of merits (FOMs) on a per-lesion basis. The reading time for review was recorded.

RESULTS

The developed CAD showed FOMs of 0.931 for nodule/mass, 0.900 for interstitial opacity, 1 for pleural effusion, and 1 for pneumothorax. The mean FOMs of 9 observers without CAD were 0.916 for nodule/mass, 0.922 for interstitial opacity, 0.944 for pleural effusion, and 0.978 for pneumothorax. After applying the CAD, the mean FOMs of 9 observers were 0.942 for nodule/mass, 0.900 for interstitial opacity, 0.967 for pleural effusion, and 1 for pneumothorax. Except for interstitial opacity, the accuracy of three patterns with CAD increased. The mean reading time was 91.5 minutes ± 53.2 without CAD and 79.1 minutes ± 28.2 with CAD.

CONCLUSION

The deep-learning based CAD may help improve observer performance for reading chest radiograph as well as reducing reading time.

CLINICAL RELEVANCE/APPLICATION

The deep-learning based CAD has the potential to improve observer efficiency in terms of accuracy and reading and may provide preliminary interpretation for chest radiographs.

SSG03-02 A Retrospective, Multi-Center Clinical Study for Validating Increased Lesion Detection Accuracy of Radiologists When Using Computer-Aided Detection System in Reading Digital Chest X-Ray Images

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S504AB

Awards
Student Travel Stipend Award

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PURPOSE

To evaluate performance of radiologists detecting pulmonary malignant nodules assisted by deep-learning based computer-aided detection (CAD) software, compared with performance of radiologist or CAD alone.

METHOD AND MATERIALS

Each of four participating centers in three countries retrospectively collected 150 lung cancer radiographs and 50 normal radiographs. Normal x-ray images are from healthy adults, confirmed by a CT scan taken within 14 days. Each cancer x-ray image has 1 to 3 pathologically confirmed nodule(s), whose sizes are between 1 and 3 centimeters. The estimated location of each nodule was marked on x-ray image referring to the CT scan. 12 radiologists from 4 institutions with various experiences independently analyzed a set of x-ray images and marked region of interests (ROIs) on each radiograph in suspicion of a nodule. Deep learning-based computer-aided detection (CAD) software was applied to find suspicious nodules on chest radiographs. Finally, 12 radiologists reviewed whole set of images with assistance of CAD, accepting or dismissing ROIs suggested by CAD. Sensitivity and false negative per image (FPPI) of radiologist alone, CAD alone and radiologist with CAD were statistically analyzed.

RESULTS

The overall sensitivity and FPPI of the CAD system were 63.75% and 0.20, which was not statistically distinct from those of radiologists. The average sensitivity of radiologists appeared to increase significantly from 65.1% to 70.3%, after aided by the CAD software ($p<0.0001$). The average FPPI was 0.2 and 0.18, without and with CAD, respectively. The decline of FPPI was significant ($p=0.0006$). On subgroup analysis, incremental effects of CAD on nodule detection sensitivity were not affected by radiologists' experience, size, location, type (primary or metastatic) of nodules and modality of acquisition.

CONCLUSION

The average sensitivity and FPPI of our CAD system were not statically different from those of radiologists. When radiologists were assisted by the CAD, overall sensitivity increased significantly while FPPI seemed to decrease. Incremental effect of the CAD system was not affected by radiologist's experience, characteristics of a nodule or modality, which can support the potential general use of this software.

CLINICAL RELEVANCE/APPLICATION

Radiologists' performance in lung cancer nodule detection can be improved with a deep learning-based CAD system regarding both sensitivity and false positive rate.

SSG03-03 Nodule Size Measurement: Automatic or Human-Which is Better for Predicting Lung Cancer in a Brock Model?

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S504AB

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PURPOSE

To assess the impact of automated segmentation of pulmonary nodules by measuring the accuracy of the prediction of malignancy using the Brock University Cancer Prediction Model.

METHOD AND MATERIALS

Retrospective analysis was carried out of 7927 nodules (of which 314 were malignant) from 5394 patients who were scanned as part of the US NLST (mean age 62±5 years; of which 3192 were male). Following BTS guidelines, nodules <5mm in size were excluded, but all other nodules were included regardless of type, attenuation, and margin. Automatic 3D nodule segmentations were generated via a deep learned model and initiated with a single click point inside the nodule. We used the following methods for measuring nodule size: the NSLT radiologist measurements, D2D, the long axis from the automatic segmentations, D3D, and in order to characterize the nodule volumes more accurately, the volumes of the automatic segmentations, V, were converted to an equivalent linear size using the equation for a sphere. Each was tested as the size term in the standard Brock model to generate a malignancy risk and Area-Under-the-Receiver-Operating-Characteristics (AUC-ROC) curve calculated.

RESULTS

The AUC-ROC was 85.96% (95% confidence interval (CI): 84.33, 87.76) for D2D, 86.64 (95% CI: 85.04, 88.19) for D3D, and 88.17 (95% CI: 86.71, 89.82) for Dsph. The expected increase in AUC Dsph offers over D2D is 2.21 (95% CI: 1.28, 3.12).

CONCLUSION

The automatic nodule size measurements outperformed the manual radiologist measurements in predicting lung cancer as an input to the Brock model. The non-axial Dsph, which is derived from the volumetric segmentation outperforms both long axis-based methods. Assessing nodule segmentation by measuring prediction efficacy is a viable alternative to overlap measures such as DICE.

CLINICAL RELEVANCE/APPLICATION

Automatic segmentation removes the need for manual extraction of axial diameters of lung nodules. It is not subject to intra- and inter-radiologist variation thereby improving consistency.

SSG03-04 Effect of Artificial Intelligence Based Vessel Suppression and Automatic Detection of Part-Solid and Ground-Glass Nodules on Low-Dose Chest CT

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S504AB

Awards
Student Travel Stipend Award

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PURPOSE

Most studies with CAD and artificial intelligence (AI) software have focused on solid lung nodules. We assessed the effect of AI-based vessel suppression (AI-VS) and automatic detection (AI-AD) on ground glass (GGN) and part-solid lung nodules (PSN) in low-dose CT (LDCT).

METHOD AND MATERIALS

Our study included 100 LDCT examinations with mixed attenuation pulmonary nodules (average diameter>5mm) identified from the National Lung Cancer Screening Trial (NLST). These exams were not used in training or validation of the AI software (ClearRead CT, Riverain Inc.). All 100 LDCT were processed to generate three image series per case - unprocessed, AI-VS, and AI-AD series with annotated lung nodules. Two thoracic radiologists (R1: 3-year experience, R2: 27-year experience) independently assessed the unprocessed images alone, then together with AI-VS series, and finally with AI-AD. For each assessment, number of all > 5mm with location & size of dominant GGN and PSN were recorded. Descriptive statistics and student t tests were performed for data analysis.

RESULTS

On unprocessed images, R1 and R2 detected 278 nodules (123 PSN, 155 GGN) and 269 (117 PSN, 152 GGN), respectively ($p>0.05$). With addition of AI-VS images, R1 and R2 detected 290 nodules (126 PSN, 164 SSN) and 293 (132 PSN, 161 GGN), respectively, which were significantly greater than those detected without the AI-VS ($p= 0.004$). AI-VS aided in detection of solid component in 22 PSN which were deemed SSN by both readers. Conversely, AI-AD annotated only 75 PSN and 54 GGN (total 129 nodules). In 21 patients, AI-AD did not detect the dominant PSN or SSN; it detected 14 false positive nodules (vessels, atelectasis, anterior junctional line). Average respective sizes of 69-matched and detected PSN on unprocessed and AI-AD series were 15 ±7 mm and 13 ± 6 mm ($p =0.07$).

CONCLUSION

AI-VS improves detection and characterization of GGN and PSN on LDCT of the chest. Specifically, improved and easier detection of the solid component in non-solid nodules with AI-VS can avoid false down-grading of Lung-RADS category, and thus help in appropriate patient management.

CLINICAL RELEVANCE/APPLICATION

AI software can aid in improved detection and confident detection of ground-glass and part-solid lung nodules on low dose chest CT.

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/ Subba R. Digumarthy, MD - 2013 Honored EducatorBrent Little, MD - 2018 Honored Educator

SSG03-05 Evaluation of Lung Nodules with FDG PET-CT: The Value of MIP Reconstructions in Conventional Thoracic CT Images During Shallow Breathing versus Images in Deep Inspiration

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S504AB

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PURPOSE

Detection of small lung nodules is important for apropiate staging of cancer. There is controversy in literature about the value of adding a separate CT of the lungs in deep inspiration. Radiation dose is no longer an issue with the use of modern equipment because only aproximately 3 mSv are added to the usual dose. The purpose of this study was to assess the value of additional thoracic CT in deep inspiration and the use of maximum intensity projection (MIP) reconstructions in PET-CT of oncologic patients.

METHOD AND MATERIALS

186 consecutive patients (99 male and 89 female; mean age,72 years; range: 26-93 y) underwent FDG PET-CT for one of the following indications: characterization of a new detected lung nodule/mass (n=101), staging of cancer (n=31), therapy respons monitoring (n=33), suspicion of tumor relapse (n=19) and cancer of unknown origin (n=2). After PET-CT acquisition with shallow breathing, a thoracic CT in deep inspiration was performed to all patients (slide thickness: 1.25 mm). MIP of the two sets of lung images were performed. Two experienced radiologist analyzed the 4 sets of CT studies. The number of lung nodules was recorded. Lung nodule was defined as a rounded opacity smaller than 10 mm completely surrounded by lung parenchyma. The clinical relevance of the eventual discrepancies between CT studies was analized (i.e. upstaging).

RESULTS

120/186 patients presented with nodules. PET-CT with shallow breathing detected 393 nodules, and 578 when MIP images were analized. Thoracic CT with deep inspiration found 534 nodules and 905 when MIP was used. The number of detected nodules increased from free breathing to breathe hold CT in 42 patients. The detected number of nodules with breath hold technique compared with free breathing increased increased in 51 patients when MIP was used. The extradetected nodules were considered clinical relevant in 7/120 (6%) of patients because they influence patient management for example by increasing TNM staging.

CONCLUSION

According to our results the addition of deep inspiration thoracic CT with MIP reconstructions can be recommended in clinical practice because this approach yields better performance in TNM staging in oncologic patients.

CLINICAL RELEVANCE/APPLICATION

Addition of deep inspiration CT with MIP reconstructions to conventional FDG PET-CT in oncologic patients yields better performance in TNM staging.

SSG03-06 Deep Learning for Rule-Out of Unnecessary Follow-Up in Patients with Incidentally Detected, Indeterminate Pulmonary Nodules: Results on an Independent Dataset

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S504AB

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PURPOSE

To assess the follow-up rule-out accuracy of a convolutional neural network (CNN) in patients with incidentally detected, indeterminate pulmonary nodules in a multi-site, heterogeneous population.

METHOD AND MATERIALS

The US National Lung Screening Trial (NLST) dataset was manually curated and used to create a training set: each reported nodule and cancer was located, contoured and diagnostically characterised (9310 benign nodule patients; 1058 cancer patients). All patients with solid and semi-solid nodules of 6mm and above, where benign nodules and cancers could be confidently identified by clinicians (5972 patients, of which 575 were cancer patients), were selected. A CNN was trained using Deep Learning and three thresholds for benign rule-out were calculated at three levels of sensitivity: 100%, 99.5% and 99%. An independent dataset of patients with incidentally detected indeterminate pulmonary nodules was retrospectively collected from a tertiary referral centre and surrounding hospitals in the UK with a heterogeneous mix of scan parameters, manufacturers and clinical indications (610 patients, 698 nodules, 5-15mm). Diagnosis was established according to British Thoracic Society guidelines (2015). The dataset contained 50 cancers from 47 patients (7% of all nodules). Performance was evaluated by measuring the specificity at the three benign rule-out thresholds; i.e. to measure the proportion of benign nodules correctly stratified while missing no or few cancers. Overall Area-Under-the-ROC-Curve analysis (AUC) was also calculated.

RESULTS

The specificity (sensitivity) was 24% (100%), 24% (100%) and 48.6% (100%) at the three thresholds respectively. AUC was 0.93 (95%CI = 0.90-0.96).

CONCLUSION

On this independent dataset, the CNN was able to correctly classify just under half of the benign nodules whilst not misclassifying any cancers.

CLINICAL RELEVANCE/APPLICATION

Our work shows the potential of CNNs in ruling out benign pulmonary nodules and therefore reducing the need for follow up scans in a large number of patients.

SSG03-07 A Decision Analysis of Follow-Up and Treatment Algorithms for Subsolid Pulmonary Nodules

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S504AB

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PURPOSE

To use simulation modeling based on evidence from the literature to evaluate several management strategies and treatment options for patients with ground glass nodules (GGNs).

METHOD AND MATERIALS

We developed a Monte Carlo model for patients with GGNs as they underwent follow-up per Lung-RADS for up to ten years. Nodules could grow and develop solid components over time. Rates of clinically-significant malignancy were calibrated to data from the National Lung Cancer Screening Trial. We investigated modifications to the follow-up schedule and tested different treatment strategies, specifically lobectomy, radiation therapy, and no therapy.

RESULTS

Overall, 2.3% of nodules represented clinically significant malignancies, and 6.3% of nodules were treated. Only 29.8% of Lung-RADS 4B/4X nodules were clinically-significant malignancies. We compared outcomes of patients with Lung-RADS 2 nodules followed at 1-, 2-, and 3-year intervals; overall survival at 10 years of follow-up was similar, ranging from 74.7% (annual) to 73.5% (triennial). We also evaluated 10-year outcomes from Lung-RADS 4B/4X non-solid nodules treated with different modalities; at 10 years, overall survival was highest in the radiation therapy arm, at 83.9%, and lowest in the no treatment arm, at 78.1%.

CONCLUSION

Our results suggest a conservative approach to the follow-up and treatment of GGNs. The follow-up interval for GGNs can be increased to 3 years with minimal change in outcomes. Our results also favor the use of radiation therapy when a nodule has met criteria for treatment. Prospective randomized trials are needed to evaluate thresholds for management and different treatment modalities for GGNs.

CLINICAL RELEVANCE/APPLICATION

Conservative management strategies for non-solid nodules, such as triennial follow-up for Lung-RADS 2 nodules and radiation therapy instead of lobectomy for Lung-RADS 4B/4X nodules, are preferable to more aggressive treatment.

SSG03-08 A Robust Model for Prediction of Pulmonary Nodule Malignancy with CT Scans

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S504AB

Participants
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Shiyuan Liu, PhD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Pulmonary nodules could be early manifestations of lung cancer, but the morphological complexity makes it difficult to differentiate benign and malignant nodules. This paper proposes two deep learning models aiming to accurately determine the malignancy of pulmonary nodules from CT images.

METHOD AND MATERIALS

Model-1 was adapted from the winning model in Data Science Bowl 2017.. We chose ResNet as its backbone and integrated U-Net and Capsule Network architectures to enable the model to comprehensively capture multiscale features of pulmonary nodules. Model-2 took extracted features from Model-1 as input to a random forest classifier to further predict nodule malignancy, as inspired from the NoduleX model. Two datasets were adopted to validate the performance of the proposed two models. Dataset 1 contains 1061 samples (benign/malignant: 703/353) from Lung Image Database Consortium and Image Database Resource Initiative (LIDC-IDRI), and Dataset 2 consists of 1117 samples (benign/malignant: 354/763) provided by collaborating hospitals. Nodules in both datasets were biopsy or surgery proven, and pathology diagnoses were used as gold standard. We randomly selected 20% from each dataset as the testing set and used the rest 80% as the training set. We trained and tested our two models on the above two datasets respectively.

RESULTS

On Dataset 1 (LIDC-IDRI), Model-1 achieved an AUC of 0.91 in the prediction of pulmonary nodule malignancy while Model-2 achieved an AUC of 0.96. On Dataset 2, Model-1 again reached a high AUC of 0.90, which significantly outperformed the Model-2 with AUC=0.80.

CONCLUSION

Model-1 showed consistently high accuracy in pulmonary nodule malignancy prediction on both the LIDC dataset and CT scans collected from collaborating hospitals. Our two models achieved comparable results with NoduleX model which had got the state-of-the-art performance in LIDC dataset. The experimental results demonstrated that Model-1 showed more stable performance across datasets and had better model robustness. The strength of Model-1 may lie in its Capsule Network structure that could extract more universally informative features and the end-to-end deep learning architecture.

CLINICAL RELEVANCE/APPLICATION

Our proposed model can serve as a useful tool for early diagnosis of lung cancer and has the potential to be applied in clinical treatment planning.

SSG03-09 External Validation of the McWilliams Model to Predict Probability of Cancer in Pulmonary Nodules using NLST Data

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S504AB

Participants
Audrey Winter, PhD, Los Angeles, CA (*Presenter*) Nothing to Disclose
William Hsu, PhD, Los Angeles, CA (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

Lung cancer screening results in the discovery of an estimated 1.57 million screen- and incidentally-detected pulmonary nodules. Prediction models, which estimates the probability of lung cancer in pulmonary nodules detected on computed tomography (CT) can potentially aid in manage patients and minimize overdiagnosis. Thus, we performed an external validation of an existing model developed by McWilliams et al (doi:10.1056/NEJMoa1214726).

METHOD AND MATERIALS

Based on the inclusion/exclusion criteria stated by McWilliams, we identified 7,879 non-calcified nodules greater than 4 mm discovered at the baseline CT screening with at least 2 years of follow-up using data from the CT arm of the National Lung Screening Trial (NLST). We assessed model discrimination (the ability to distinguish between cancer/not cancer) and calibration (the agreement between predicted and observed probabilities). We identified differences between PanCan, the derivation dataset, and NLST. The regression coefficient and the intercept coefficient were estimated by fitting a logistic regression on NLST. We also attempted to update and recalibrate the model. Finally, we evaluated whether the addition of new covariates such as body mass index, smoking status, pack-years and asbestos improved performance.

RESULTS

While the AUC of the model was good 0.905 [0.882-0.928]), the histogram plot showed that whether a nodule was cancer/not cancer could not be well-separate (see Figure, left). The calibration plot showed that the model tended to overestimate the probability of cancer. Following methods in Steyerberg et al (doi: 10.1002/sim.1844), the updated model achieved an AUC of 0.914 [0.892-0.936] and a better calibration (see Figure, right). Emphysema ($p=0.03$) and nodule spiculation ($p<0.01$) had a significantly different effect in the NLST cohort compared to the PanCan. Among the new covariates, only the pack-year history was found to be significant ($p<0.01$).

CONCLUSION

While the model achieved high AUC, discrimination and calibration remain suboptimal, motivating our efforts to improve additional clinical, imaging, and the evolution of covariates over time that could influence performance.

CLINICAL RELEVANCE/APPLICATION

External validation is necessary to assess generalizability of a prediction model to new patients. We show how discrimination and

External validation is necessary to assess generalizability of a prediction model to new patients. We show how discrimination and calibration can be examined to assess how models can likely enter in clinical practice.

SSG04

Emergency Radiology (Brain, Head, Neck and Spine)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S403A

CT ER HN NR

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

Participants

Christopher A. Potter, MD, Boston, MA (*Moderator*) Nothing to Disclose
Savvas Nicolaou, MD, Vancouver, BC (*Moderator*) Institutional research agreement, Siemens AG

Sub-Events

SSG04-01 Spectrum of Diagnostic Errors in Cervical Spine Trauma Imaging and Their Clinical Significance

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S403A

Participants
Francesco Alessandrino, MD, Boston, MA (*Presenter*) Nothing to Disclose
Christopher M. Bono, MD, Boston, MA (*Abstract Co-Author*) Advisory Panel, UnitedHealth Group Royalties, Wolters Kluwer nv
Christopher A. Potter, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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Aaron D. Sodickson, MD,PhD, Boston, MA (*Abstract Co-Author*) Institutional research agreement, Siemens AG; Speaker, Siemens AG; Speaker, General Electric Company
Bharti Khurana, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of our study was to describe and categorize diagnostic errors in cervical spine CT interpretation (CsCT) performed for trauma and to assess their clinical significance.

METHOD AND MATERIALS

All CsCT studies with diagnostic errors that came to our attention based on clinical or imaging follow up from 2004 to 2017 were analyzed. Errors were categorized as extraspinal or spinal, osseous or soft tissue finding, according to anatomical site and level for each spinal finding. All images were reviewed by a musculoskeletal fellowship trained emergency radiologist and a spine surgeon. For each error, the spine surgeon assessed the need for 1) surgery, 2) immobilization and 3) MRI. Findings were considered clinically significant if the answer to any of the three questions was positive.

RESULTS

56 patients with CsCTs and reports containing diagnostic errors were reviewed. 12 patients (21.5%) had missed or misinterpreted finding in extraspinal location. 44 patients (78.5%) had errors localized to spine (28 fractures/dislocations, 15 intervertebral disc protrusions, 1 lytic bone lesion). The locations of missed/misinterpreted fractures were: transverse (n=8), spinous process (n=6), facet (n=4), lamina (n=2), vertebral body (n=11), C1 (n=3), occipital bone (n=1). Two dislocations were at the atlantoaxial articulation (n=2). 4 patients had missed fractures encompassing more than one anatomical location. The most common spinal fracture levels were C5 (n=7) and C7 (n=6). In 4 patients, additional contiguous (n=2) or noncontiguous (n=2) fractures were missed. Responses to the three questions were positive in 3, 25, and 16 patients, respectively. All fractures were considered clinically significant, including 3 patients who would have required surgical stabilization (2 atlantoaxial dislocations and 1 facet fracture). None of the intervertebral disc protrusions were reported to alter the management by the surgeon.

CONCLUSION

65.9% of our patients in our series with diagnostic errors localized to spine on CsCTs were considered clinically significant, potentially altering therapeutic and diagnostic management. Transverse process fractures were the most common clinically significant missed/misinterpreted finding.

CLINICAL RELEVANCE/APPLICATION

Radiologists should be aware of commonly missed injuries on CsCT and their clinical significance so they can adjust their search pattern and improve the accuracy of their reports.

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/ Bharti Khurana, MD - 2014 Honored EducatorBharti Khurana, MD - 2018 Honored EducatorAaron D. Sodickson, MD,PhD - 2014 Honored EducatorAaron D. Sodickson, MD,PhD - 2017 Honored EducatorAaron D. Sodickson, MD,PhD - 2018 Honored Educator

SSG04-02 Diagnostic Value of Prevertebral Soft Tissue Thickening on Cervical Spine CT in Acute Trauma, Using MRI as the Reference Standard

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S403A

Participants
James S. Kho, MBBCh, Brighton, United Kingdom (*Presenter*) Nothing to Disclose
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PURPOSE

Population normal values of prevertebral soft tissue (PVST) thickness on CT have been established but there is little previously published research examining whether an abnormal PVST thickness on CT has diagnostic value as a sign of cervical spine injury. This study aims to evaluate whether an abnormal PVST on CT is a predictor of anterior column soft tissue injury on cervical spine MRI.

METHOD AND MATERIALS

The radiology information system(RIS) at a tertiary trauma centre was searched for Emergency Department patients over 18 years of age who had a CT of the cervical spine for trauma from 1st January 2017 onwards, which was followed by a cervical spine MRI within 7 days. Exclusion criteria include previous spinal surgery and intubated patients. 40 consecutive patients meeting inclusion and exclusion criteria were selected. For each CT study, PVST thickness on CT at levels C1 to C7 were measured, and the PVST thickness was categorised as normal or abnormal based on previously published normal values by Rojas et al in 2009. The corresponding MRI images and reports were reviewed for anterior column soft tissue injury (prevertebral haematoma or anterior longitudinal ligament injury). The performance of abnormal PVST thickness on CT as a predictor of MRI findings of anterior column soft tissue injury was evaluated and diagnostic odds ratio, sensitivity and specificity were calculated.

RESULTS

Prevertebral soft tissue thickening on CT is strongly associated with findings of anterior column soft tissue injury on MRI ($p = 0.0002$), with a diagnostic odds ratio of 32.7, specificity of 93% and sensitivity of 70%.

CONCLUSION

Prevertebral soft tissue thickness should be evaluated on cervical spine CTs as it is a useful radiological sign of anterior column soft tissue injury.

CLINICAL RELEVANCE/APPLICATION

When reporting cervical spine CTs, anterior column soft tissue injury should be strongly suspected if there is prevertebral soft tissue thickening.

SSG04-03 Spinal Trauma in DISH: Is MRI Essential After the Detection of Vertebral Fractures on CT?

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S403A

Awards
Student Travel Stipend Award

Participants
Nandish Shah, MD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

1. To assess the incidence of posterior column involvement on CT and MRI in patients with diffuse idiopathic skeletal hyperostosis (DISH) and known anterior/middle column injury on CT. 2. To evaluate the utility of performing MRI in DISH patients with isolated anterior/middle column fractures and no neurological deficit.

METHOD AND MATERIALS

Records of 177 consecutive patients older than 50 years of age admitted between 2008 and 2017 for a traumatic spinal fracture and a diagnosis of DISH were reviewed. Only fractures involving an ankylosed region of the spine were included. Patients with fractures involving a non-ankylosed spine segment and history of prior spine surgery were excluded. Age, gender, mechanism of trauma, fracture type, spine CT and MRI imaging findings, surgical intervention, neurologic deficit, complications, and in-hospital mortality were collected from the medical records.

RESULTS

26% (47/177) of patients had hyperextension injuries; overall, 59% (106/177) had either non-displaced or minimally displaced fractures. 116/177 (66%) patients had fractures isolated to the anterior/middle column. 22/177 patients had fractures isolated to the posterior column only and 39/117 patients had fractures involving both the anterior/middle and posterior columns. 97 patients in our cohort underwent MRI after a fracture was detected on CT. 75 of the 97 patients had fractures isolated to the anterior/middle column. Of these 75, 26 had disruption of the posterior ligamentous complex (PLC), and only 4 of the 26 patients had no neurologic deficit. 28 of the 97 patients had either spinal cord injury or epidural hematoma and 27/28 of these patients presented with neurological deficit. The one patient that did not present with neurologic deficit had a tiny dorsal epidural hematoma without spinal cord injury or disruption of the PLC and was managed conservatively.

CONCLUSION

1. 49% of patients in our cohort (87/177) had either a posterior column fracture on CT or disruption of the PLC on MRI. 2. In DISH patients with isolated anterior/middle column fractures and no neurologic deficit, MRI did not provide additional information that would change management in most cases (85%).

CLINICAL RELEVANCE/APPLICATION

In most DISH patients with anterior/middle column fractures only and no neurologic deficit, spine CT alone is sufficient for management without the additional time and money spent on MRI.

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/ Bharti Khurana, MD - 2014 Honored EducatorBharti Khurana, MD - 2018 Honored Educator

SSG04-04 Incidence and Patterns of Cervical Spine Injuries on CT: A Study in a Level I Trauma Center

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S403A

Participants
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PURPOSE

Though spinal fractures constitute a minority of all trauma, the financial burden imposed is very significant especially cervical spine trauma. The pattern of cervical spine injuries in the setting of trauma in general population is unknown at the moment in United States with very few papers addressing the issue. We reviewed entire spectrum of cervical spine injuries and demonstrated correlation between various demographics, clinical presentation with radiological appearance of the injury.

METHOD AND MATERIALS

We performed retrospective analysis of 13,500 patients who underwent imaging for cervical spine trauma at a level I trauma center. Out of this database we selected 934 patients who had a positive CT scan. Each patient was then analyzed by reviewing the medical records and correlation was sought between demographic, clinical and imaging features.

RESULTS

In our study, the peak incidence of cervical spine trauma was in the age group of 21-30 years followed by 31-40 years with a male:female ratio of 2.1. Major cause of injury in the study population was motor vehicle accidents (66.1%), followed by fall from height of less than 8 feet (12.2%). For fractures of vertebral bodies, we identified 440 injury levels, with C1 and C2 being the most frequent fractured as compared to the subaxial spine. Incidence of C2 fractures (40.9%) was higher as compared to C1 (23.2%). Body and lateral mass fracture incidence was marginally higher as compared to odontoid fractures. C7 (11.3%) was the most fractured vertebral body in the subaxial spine followed by C6 (8%) and C5. Highest number of vertebral body fractures were due to compression injury. 924 injury levels were identified for vertebral body process with transverse process fractures (38.6%) being the most common.

CONCLUSION

Spinal trauma is on the rise and it helps to understand the frequency and pattern of injuries in cervical spine to guide us for better management of these patients.

CLINICAL RELEVANCE/APPLICATION

To understand the distribution and pattern of injuries in cervical spine on a plain CT in the setting of trauma to improve delivery of healthcare.

SSG04-05 The Combination of SWI and DTI in Evaluating the Severity of Traumatic Brain Injury

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S403A

Participants
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PURPOSE

To explore the diagnostic value of SWI and DTI on different severity's traumatic brain injury(TBI).

METHOD AND MATERIALS

Totally 60 TBI patients (including 20 mild TBI patients, 20 moderate TBI patients and 20 severe TBI patients) and 20 health volunteer underwent SWI, DTI and conventional MRI examination. The numbers of involving regions, numbers and areas of hemorrhagic lesions detected by SWI, and FA values of 37 brain regions (including knee, body, splenium of corpus callosum, cingulate bundle, et al.) were compared between each two groups. The correlation analysis between GCS scores and the number of involving regions, number of hemorrhagic lesions, areas of hemorrhagic lesions detected by SWI, and FA values of each region were performed.

RESULTS

The differences of involving regions' number, lesions' number, lesion's areas detected by SWI between each two groups were statistically significant ($P<0.05$). Severe TBI group got the maximum number of involving regions, lesions, and the largest areas. Followed by moderate group and mild group. Among the 37 regions, totally 30 regions differ in FA values between the four groups ($P<0.05$). And among these 30 regions, 18 regions' FA values, for example corpus callosum region, gradually reduce as the severity of TBI aggravate. The GCS scores are highly negatively correlated with the number of involving regions, number of lesions, areas of lesions detected by SWI, but are positively correlated with 30 regions' FA values. The descending order of relevance is hemorrhagic lesions' areas($r=-0.932$), lesions' number($r=-0.911$), involving regions' number($r=-0.900$), FA values of right cingulum($r=0.872$), right anterior limb of internal capsule($r=0.801$), left cingulum ($r=0.787$), the splenium of corpus callosum($r=0.775$), the body of corpus callosum ($r=0.765$), et al.

CONCLUSION

The clinical applications of SWI and DTI is valuable in diagnosing different severity's TBI.

CLINICAL RELEVANCE/APPLICATION

SWI and DTI are effective in evaluating the severity of traumatic brain injury

SSG04-06 Iodine Maps on Follow-Up DECT: Prognostic Value in Patients with Cerebral Hemorrhagic Contusions in Moderate to Severe Head Trauma

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S403A

Participants
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PURPOSE

We aimed to retrospectively determine if the quantitative data derived from Iodine Maps of follow-up head DECT can predict the 6-month mortality and unfavorable outcome scores in patients with cerebral contusions as derived from IMPACT model.

METHOD AND MATERIALS

This study was HIPAA compliant and institutional review board approved. Informed consent was waived. We retrospectively analyzed admission and 6-hour follow-up CT studies in 69 patients with hemorrhagic contusion(s). We incorporated the previously described powerful conventional CT outcome predictors related to the dominant lesion and new variables derived from Iodine Maps in our evaluation. After performing univariate analysis, the independent predictors were determined by using regression analysis.

RESULTS

CT variables with significance on univariate analysis were, hematoma volume at admission (Spearman's rho=0.38, $p=0.03$ for mortality; Spearman's rho=0.36, $p=0.04$ for unfavorable outcome), hematoma volume on follow-up (Spearman's rho=0.42, $p=0.001$ for mortality; Spearman's rho=0.38, $p=0.004$ for unfavorable outcome), enhancing penumbra volume (Spearman's rho=0.47, $p=0.0003$ for mortality; Spearman's rho=0.43, $p=0.001$ for unfavorable outcome), iodine concentration (Spearman's rho=0.32, $p=0.02$ for mortality; Spearman's rho=0.3, $p=0.03$ for unfavorable outcome), iodine content in penumbra (Spearman's rho=0.5, $p=0.0002$ for mortality; Spearman's rho=0.45, $p=0.001$ for unfavorable outcome), iodine content in contusion (Spearman's rho=0.5, $p = 0.0002$ for mortality; Spearman's rho=0.44, $p=0.001$ for unfavorable outcome). There was no correlation between the fractional hemorrhagic progression of contusion (%HPC) and the outcomes. Enhancing penumbra volume, and iodine content in penumbra were the independent predictors of both the outcome scores on regression analysis (B=10.9, $p=0.002$; B=9.22, $p=0.02$ for mortality; B=13.1, $p=0.003$; B=11.4, $p=0.02$ for unfavorable outcome).

CONCLUSION

Enhancing penumbra volume, and iodine content in penumbra may be more accurate for predicting outcomes in patients with cerebral contusions, than the previously identified predictor variables of hematoma volumes and %HPC.

CLINICAL RELEVANCE/APPLICATION

Quantitative iodine based CT variables derived from extravasated iodine into the contusions may improve the accuracy of the existing prediction models.

SSG04-07 Supplementing Screening Criteria Yields Increased BCVI Incidence, with Subsequent Imaging Showing Markedly Increased Risk for Ischemic Stroke

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S403A

Participants
Frank Bensch, MD, PhD, Helsinki, Finland (*Presenter*) Nothing to Disclose
Elina Varjonen, MD, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose
Seppo K. Koskinen, MD, PhD, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Blunt cerebrovascular injuries (BCVI) are uncommon, but can have severe consequences such as ischemic stroke. Detection of BCVI requires an angiogram of the cervical arteries, commonly by CT angiography (CTA). CTA screening criteria for BCVI based on clinical findings and trauma mechanism have improved detection. Denver criteria for screening are most commonly used in absence of a clear consensus. Since clinical findings are often inconclusive, many patients do not meet any of these criteria. The aim of this study was to analyze the effect of augmented Denver criteria on BCVI incidence, as well as to determine the relative risk for ischemic stroke.

METHOD AND MATERIALS

For a single level one trauma center, Denver screening criteria for BCVI were augmented by including any high-energy trauma, cervical spine fracture, and major chest injury. All acute blunt trauma WBCT studies over a period of 38 months were reviewed retrospectively for distribution and grade of BCVI by two board-certified radiologists blinded to initial results. Non-CTA studies were excluded and any disagreements settled by consensus. Any subsequent cerebral imaging studies were reviewed for ischemic lesions appearing at a later phase.

RESULTS

1544 WBCT studies included 374 CTA (m/f=271/103; mean age 41.5 years). Most common mechanisms of injury were MVA (51.5%) and fall from a height (22.3%). We found 72 BCVI in 56 patients (15.0%), with 13 (23.2%) multiple lesions. The internal carotid artery (ICA) was affected in 49 (68.1%) and the vertebral artery (VA) in 23 (31.9%) of cases. Most common injury grades were Biffl I and II in both ICA and VA, with C2 as the most common level. Gender (p=0.1482) and age (p=0.611) had no impact on BCVI incidence. Interobserver agreement was substantial (Kappa=0.674). Subsequent imaging of 215 patients revealed cerebral ischemic stroke in 19.6% of BCVI and 3.5% of the remaining cases. Fisher's exact test shows this difference to be highly significant (p<.0001) with an OR of 9.77 (95% CI; 3.3-28.7).

CONCLUSION

Augmenting Denver screening criteria yielded an almost threefold incidence for BCVI in blunt trauma than expected (15.0%), which emphasizes the need for more liberal screening protocols. The markedly elevated relative risk for ischemic stroke following BCVI with an OR of 9.77 underlines the urgency of this proposal.

CLINICAL RELEVANCE/APPLICATION

Supplementing screening criteria for BCVI might markedly improve patient outcome.

SSG04-08 Frequency of Acute Findings in Head CT Scans Performed in the Emergency Department

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S403A

Participants
Evgeni Druskin, Ramat Gan, Israel (*Presenter*) Nothing to Disclose
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Eyal Zimlichman, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Head CT is the most common CT scan conducted in the ED. The aims of this study were to evaluate the frequency of acute findings on head CTs conducted in the ED in different age groups, and to analyze head CT referral indications.

METHOD AND MATERIALS

Institutional review board (IRB) approval was granted for this study. Informed consent was waived by the IRB committee. The records of one tertiary care hospital's ED were retrospectively reviewed for consecutive adult patients who underwent head CT during a time frame of 40 days from January 1st 2017. CT interpretations were obtained and checked for demographics, referral indications and CT findings. Findings were divided into three groups: Acute findings, chronic findings and normal head CT. The cohort was divided into groups according to age: young adults (aged 19-40), adults (aged 41-65) and elderly (over 65 years old). Associations between referral indications and acute findings were calculated.

RESULTS

During the study's time frame, 12,958 adult patients presented to our ED. 1,621 of them (12.5%) underwent a head CT (young adults 221/1621=14.4%, adults 404/1,621= 26.3%, and elderly 913/1,621=59.4%). Acute findings were found in 15% of the patients and the frequency increased with age (young adults 12.2%, adults 13.6%, elderly 17.2%, p=0.027). Chronic findings were found in 24% of the patients (young adults 5.9%, adults 18.3%, elderly 30.6%, p<0.001). The distribution of acute findings for the entire cohort was: brain hemorrhage 32.6%, brain infarct 27.6%, SOL 23.0%, fractures 8.4%, sinusitis 11.3% and hydrocephalus 9.2%. Brain hemorrhage was the most common finding in young adults (29.2%) and in the elderly (36.3%), while SOL was the most common in the adult group (36.4%). The top three referral indications were neurological signs (19.7%), trauma (15.6%) and headache (12.3%). Headache was the most common indication in young adults (25.1%) and neurological signs were the most common in the adults and elderly groups (20.6%, 20.0%, respectively). Seizures were associated with acute findings (p=0.024, OR=1.917) and dizziness with absence of acute findings (p=0.022, OR=0.528).

CONCLUSION

Acute findings are found in 15% of head CT scans performed in the ED. The frequency of acute and chronic findings increases with age.

CLINICAL RELEVANCE/APPLICATION

The increasing amount of head CTs and the relatively low yield of this test, requires the implementation of decision protocols.

SSG04-09 Evaluation of the Big-5 CT-Protocol: Diagnostic of Ischemic Stroke Including Origins

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S403A

Participants
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PURPOSE

Approximately 20-40% of ischemic strokes are caused by a cardio genetic embolic disease. Evidence of the embolic origin cannot become clearly defined. The goal of this study was the implementation of an extended stroke protocol (Big-5, see Fig. 1) for evaluation of thrombo-embolic sources, detection of pulmonary artery embolism, carotid artery stenosis and acute aortic syndrome in one initial exam.

METHOD AND MATERIALS

Imaging was performed using a high-end CT in the ER (Revolution CT, GE Healthcare). All patients (n=208) received an unenhanced brain scan for hemorrhage exclusion. Subsequently a combined ECG-gated/non-ECG-gated scan (caudo-cranial) for the assessment of heart, aortic arch, carotid arteries and brain vessels. Consecutively 40 s after CM injection another ECG-gated acquisition in diastolic phase covering the left atrial appendage and left atrium. Finally, a dynamic neuro perfusion scan was performed. All patients had no contraindication for CM or any known iodine allergy. Image quality of left atrium appendage was scaled with a 5-tier Likert-scale by 2 radiologists.

RESULTS

Excluded were 48 patients due to external causes (motion artifacts, IC, etc.). In 60/160 patients a pathological finding, in 54 (34%) patients morphological change consistent with acute stroke was detected. Cardiogenic thrombus sources could be found in 8/160 cases, 6 in the left atrial appendage and 2 on the aortic valve. One type A aortic dissection was documented. In 3/54 patients with acute stroke a cardiac source of thrombus, in 18 cases a severe stenosis or occlusion of carotid vessels and in 20 cases extensive thrombotic plaques of aortic arch or carotids and in 13 patients an intracranial arterial thrombus could be found. Image quality of left atrium appendage was significantly better in venous phase compared with CTA arterial phase (141 vs. 107 cases as good or very good, $p<0.001$).

CONCLUSION

Big5 provides extensional clinical information for patients with acute ischemic stroke compared to the traditional CT stroke examination protocol.

CLINICAL RELEVANCE/APPLICATION

Concomitant pathologies including pulmonary artery embolism, carotid artery stenosis and acute aortic syndrome could make the initial clinical assessment difficult and can be excluded. There is higher prevalence of pathologic findings in carotid vessels than in detection of intracardial thrombus.

SSG05

Gastrointestinal (Advanced Liver MR Imaging Techniques)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S503AB

GI MR

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

FDA Discussions may include off-label uses.

Participants

Kathryn J. Fowler, MD, San Diego, CA (*Moderator*) Nothing to Disclose
Elmar M. Merkle, MD, Basel, Switzerland (*Moderator*) Speakers Bureau, Siemens AG Research Grant, Bayer AG Research Grant, Guerbet SA Research Grant, Bracco Group Research Grant, Siemens AG
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Sub-Events

SSG05-01 Correcting for Tumor Volume-Related Statistical Measurement Error in Motion Corrected Image Sets, Improves Sensitivity of the ADC to Detect Significant Changes in a Multicenter Study of Colorectal Liver Metastases

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S503AB

Awards

Student Travel Stipend Award

Participants
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PURPOSE

We compare reproducibility (CoV) of the Apparent Diffusion Coefficient (ADC) histogram for a standard Diffusion Weighted Imging (DWI) protocol against methods that correct for respiratory motion artifact and account for tumour volume, in order to assess the feasability of such methods to improve sensitivity of ADC in a multicentre setting.

METHOD AND MATERIALS

Data was acquired from 2 different 1.5 Tesla (T) vendors located at 3 centres. Test and retest images were acquired within 7 days. Two DWI acquisition protocols were used, A (standard) and B (allows for retrospective motion correction). Protocol B data was motion corrected using a previously published retrospective method. Similarly, a previously published model that estimates tumor volume related statistical error was applied (defined as S). The suitability of the model to describe this data set distribution was tested using Chi-squared ($\chi 2$) goodness of fit. Histogram analysis of reproducibility was calculated with a 5% level of significance for each method, A, B and S. The within-patient coefficient of variance (CoV) compared ADC reproducibility between methods for all the chosen histogram metrics (mean, median, 5th, 20th, 95th percentiles). Upper 95% limits of agreement (LoA) were calculated to define thresholds for detecting a statistically significant percentage change in ADC (ΔADC%).

RESULTS

15 patients (5 per site) were scanned. Although an improvement in sensitivity (CoV) was observed after motion correction (4.4% (A) vs. 3.2% (B) for mean ADC), no significant improvement was observed for the ADC histogram. Correcting for tumour size (S) in motion corrected data (B) significantly ($p<0.05$) improved CoV estimates (1.5% for mean ADC). The 95% LoA for ΔADC% narrowed from 12.7% (A) to 8.9% (B) to 1.9% (S). Sensitivity for the 20th percentile improved the most (20% to 2.4% 95% LoA)

CONCLUSION

This study demonstrates the feasibility of applying methods to improve ADC histogram sensitivity in a multicentre setting. Accounting for tumour volume and motion artifact improves estimates of reproducibility to within 1.5% (CoV for mean ADC),The 20th percentile demonstrated the largest improvement in sensitivity.

CLINICAL RELEVANCE/APPLICATION

Considering statistical error related to individual tumour volumes, and correcting for motion artifact, improves the sensitivity of the ADC to detect a significant post treatment response, in patients with colorectal liver metastases.

SSG05-02 Impact of Gadoxetate-Disodium vs. Gadoterate-Meglumine on Quantitative Respiratory and Hemodynamic Metrics Viewed through the Lens of a Compressed-Sensed MR Imaging Sequence

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S503AB

Participants
Carl Glessgen, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose
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PURPOSE

To primarily test whether any contrast administration leads to respiratory irregularities. Secondarily, to quantify respiratory anomalies during the injection cycle comparing gadoxetate with gadoterate meglumine, and to assess whether utilization of free-breathing acquisition schemes using compressed sensing, parallel imaging and golden-angle radial sampling (GRASP) may yield additional quantitative information helpful in correcting imaging anomalies through respiratory gating.

METHOD AND MATERIALS

This prospective, IRB approved study examined a population of 497 patients; 338 received gadoxetate, 159 received gadoterate. All underwent GRASP imaging (TR/TE=4/2ms,ST=3.5, 0.56x0.56cm, temporal resolution=10s). Consecutive acquisitions during 250sec allowed dynamic imaging; each imaging was initiated 20 seconds prior to injection. Quantitative assessment evaluated (1)aortic enhancement (ROI in abdominal aorta), (2)respiratory translation of liver (ROI in liver dome) and (3)K-space based detection of plethysmographic excursion of diaphragm. (1)allows determination of individual contrast phases and hemodynamic metrics. (2)enables quantification of respiratory dynamics through changes in hepatic intensity; (3) enables extraction of plethysmographic signal strength curves and calculation of individual respiratory parameters.

RESULTS

Hemodynamic metrics did not differ between the 2 administered contrast agents (p>0.05). Both agents showed a mean signal drop of the hepatic ROI, with significantly higher (-52,3%vs-37,2%, p=0.003) and steeper (-.0211vs-.0165 ; p< 0.001) values for gadoxetate. Patients receiving gadoxetate had decreased breathing amplitude during entire examination (0.37 vs. 0.43, p<0.001), and specifically during pre-bolus and early arterial phases (0.32 vs. 0.42, p = 0.018). Enabling intrinsically inherent respiratory gating led to no significant differences in hepatic translation between the 2 patient populations.

CONCLUSION

Injection of any type of contrast agent potentially leads to respiratory irregularities with differing intensities and time point of maximum occurrence. Intrinsically enabled respiratory gating through the GRASP methodology compensated for any respiratory irregularities.

CLINICAL RELEVANCE/APPLICATION

Gadoxetate is an essential diagnostic tool for hepatobiliary phase MR imaging, GRASP methodology allows to compensate for any respiratory irregularities.

SSG05-03 Modified CAIPIRINHA-VIBE Without View-Sharing: Excellent Sequence to Detect HCC Without Motion Artifact on Multi-Arterial Gadoxetic Acid-Enhanced Liver MRI

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S503AB

Participants
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PURPOSE

To evaluate the diagnostic performance of the modified CAIPIRINHA-VIBE without view-sharing and compare it with the CAIPIRINHA-DIXON-TWIST-VIBE with view-sharing on multi-arterial gadoxetic acid-enhanced MRI in the assessment of HCC

METHOD AND MATERIALS

We retrospectively identified 65pathologically confirmed hepatic tumors(<=3cm) in 65patients(51men,14women;mean age,60.9years) with cirrhosis or chronic hepatitis who underwent multi-arterial gadoxetic acid-enhanced MRI between June 2016 and March 2018.All patients underwent triple-arterial-phase imaging using the modified CAIPIRINA-VIBE without view-sharing(n=33)or the CAIPIRINHA-DIXON-TWIST-VIBE with view-sharing(n=32).We analyzed images to compare the diagnostic performance of two sequences for HCC, with categorization by LIRAD.We assessed the motion artifacts at triple-arterial phase of two sequences.The diagnostic performance for HCC and the incidence of motion artifacts were compared between two sequences using Fisher's exact test.

RESULTS

Among 65 patients, 33patients with 33pathologic proven liver nodules(28HCCs,3cholangiocarcinomas,1cHCC-CC and 1FNH) underwent triple-arterial-phase image using modified CAIPIRINA-VIBE without view-sharing,and remaining 32 patients with

32pathologic proven nodules(27HCCs, 4cholangiocarcinomas, and 1adenoma) underwent triple-arterial-phase image using CAIPIRINHA-DIXON-TWIST-VIBE with view-sharing.The sensitivity for detecting arterial enhancement in HCC was significantly improved in the group using the modified CAIPIRINA-VIBE without view-sharing(96.4%;95% C.I.,76.39 to 99.9),compared to the group using CAIPIRINHA-DIXON-TWIST-VIBE with view-sharing(74.7%; 95% C.I.,47.7 to 91.8)(p=0.025).Detection of motion artifact in triple-arterial-phase was significantly decreased in the group using modified CAIPIRINA-VIBE without view-sharing(2/33), compared to the group using CAIPIRINHA-DIXON-TWIST-VIBE with view-sharing(9/32)(p=0.023)

CONCLUSION

The modified CAIPIRINA-VIBE without view-sharing can improve the diagnostic performance of multi-arterial-phase of gadoxetic acid-enhanced MRI in the evaluation of HCC without motion artifact, compared to CAIPIRINHA-DIXON-TWIST-VIBE with view-sharing.

CLINICAL RELEVANCE/APPLICATION

Multi-arterial phase using modified CAIPIRINA-VIBE without view-sharing can overcome motion artifacts in multi-arterial phase using CAIPIRINHA-DIXON-TWIST-VIBE with view-sharing, resulting in provide optimal arterial phase imaging.

SSG05-04 Quantification of Hepatic Steatosis and Iron Overload at 3.0 Tesla: Comparison of Qualitative T1 Two-Point DIXON and Quantitative T2* Corrected Multi-Echo DIXON with MR Spectroscopy as the Reference Standard

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S503AB

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To compare the qualitative 3D T1 VIBE two-point Dixon technique (First look Dixon) with Inline Liver Segmentation and quantitative T1 independent T2* corrected volumetric multiecho Dixon proton density fat fraction (PDFF) using HISTO (STEAM spectroscopy sequence) as a reference for evaluation of liver fat and iron content at 3.0 T.

METHOD AND MATERIALS

Retrospective, HIPAA compliant, IRB approved study included 435 patients with known or suspected liver disease. Two-point DIXON, multi-echo DIXON and MR spectroscopy (HISTO) sequences were performed for each patient at 3.0 Tesla.The two-point DIXON sequence qualitatively assigned each patient to one of four categories: 'normal', 'fat', 'iron', 'fat and iron deposition'. A cut off of 5% fat fraction on multi-echo DIXON and HISTO was used to differentiate presence or absence of hepatic steatosis. The results of two-point DIXON and multi-echo DIXON were compared using HISTO as the reference standard.For iron overload, qualitative results from Two-point DIXON were compared with multi-echo DIXON using R2* cutoff values of 70 sec-1 for minimal iron overload and 110 sec-1 for mild iron overload.

RESULTS

PDFF using multi-echo DIXON showed sensitivity of 0.80, specificity of 0.85, with PPV of 0.83, and NPV of 0.83. This technique failed in 18 patients (4.1%) due to fat/water swap. The two-point DIXON technique showed sensitivity of 0.97 and specificity of 0.56, PPV of 0.65, and NPV of 0.95 for presence of hepatic steatosis. Two point DIXON had 0% failure rate.The percentage of patients qualitatively classified as 'iron deposition' by two-point DIXON is 28% among patients with R2* value greater than 70 ms-1, and 75% among patients with R2* value greater than 110 ms-1.

CONCLUSION

Compared with quantitative PDFF from multi-echo DIXON, qualitative fat evaluation from two-point DIXON was more sensitive but less specific for detection of hepatic steatosis. Two-point DIXON detected the presence of iron overload in most patients with mild iron overload, but not minimal iron overload.

CLINICAL RELEVANCE/APPLICATION

Two-point DIXON and R2* multi-echo DIXON are complimentary in evaluation of hepatic steatosis. Multi-echo DIXON has a higher failure rate due to fat-water swap.

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

SSG05-05 Optimal Simultaneous Multislice Diffusion-Weighted Imaging of Liver: Measurement of Different Breathing Schemes in Comparison to Standard Sequences

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S503AB

Participants
Yigang Pei, MD, Changsha, China (*Presenter*) Nothing to Disclose

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PURPOSE

To obtain the optimal Simultaneous Multislice (SMS) - accelerated diffusion- weighted imaging (DWI) of liver by systematically estimating the reproducibility of apparent diffusion coefficient (ADC), signal-to-noise ratio (SNR) and image quality of different breathing schemes(DBS) in Comparison to Standard DWI Sequences in healthy volunteers.

METHOD AND MATERIALS

In this institutional review board-approved prospective study, DWIs (b=50,300,600 sec/mm2) of the liver were performed in 23 volunteers at 3.0 T MRI using three SMS accelerated DWI sequences with respiratory-triggered (RT-SMS), free breathing (FB-SMS) and breath-hold (BH-SMS), and three Standard DWI (STD) sequences with three DBS techniques (RT-STD, FB-STD,BH-STD) served as reference. Reduction of scan time by SMS-acceleration was measured. Three representative sections-superior, central, and inferior-were selected on right liver lobes respectively, three regions of interest were drawn on each selected section. ADCs and SNRs were measured and image quality were assessed on SMS and STD with three DBS. Qualitative and quantitative parameters were compared using Bland-Altman method, Friedman test and Dunn-Bonferroni post-hoc method with P-values < 0.05 considered statistically significant.

RESULTS

SMS-DWI provided diagnostic image quality with three DBS with a obviously reduction of scan time for each slice scan(1.8 vs. 4.0 sec in RT, 2.3 vs. 4.1sec in FB, 1.1 vs. 1.7 sec in BH). Overall image quality did not significantly differ between STD and SMS sequences acquisition (median RT-STD: 5.0, FB-STD: 4.5, BH-STD :5.0; RT-SMS: 4.75; FB -SMS: 4.5; BH-SMS: 4.75; P>0.0.5). SNR in the right hepatic lobe was comparable between the six tested sequences. RT-SMS have a greater SNR ADC value than RT-STD (82.3 ± 13.2 ×10-6mm2/s vs. 42.2 ± 8.6×10-6 mm2/s; P < 0.001),but FB- SMS and BH-SMS were lower in FB-STD and BH-STD respectively (FB: 56.5 ± 8.7 ×10-6mm2/s vs. 61.3 ± 12.4×10-6 mm2/s; P= 0.035; HB: 71.5 ± 6.7 ×10-6mm2/s vs. 74.5 ± 5.4×10-6 mm2/s; P =0.257).

CONCLUSION

SMS-acceleration provides considerable scan time reduction for hepatic DWI with equivalent image quality compared to the STD technique. In DBS-SMS, RT-SMS as optimal SMS sequence is recommended for liver DW imaging because of its SNR and excellent image quality, good ADC reproducibility and shorter acquisition time.

CLINICAL RELEVANCE/APPLICATION

RT-SMS should be recommended for liver DW imaging.

SSG05-06 Intravoxel Incoherent Motion Diffusion-Weighted Imaging for Preoperative Assessment of Microvascular Invasion in Hepatocellular Carcinoma

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S503AB

Participants
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PURPOSE

To prospectively evaluate the potential role of Intravoxel incoherent motion diffusion-weighted imaging and conventional radiologic features for preoperative prediction of MVI of HCC.

METHOD AND MATERIALS

115 patients with 135 newly diagnosed HCCs between January 2016 and April 2017 were evaluated. For all examinations, studies were carried out by using a 3.0 T MR system (Discovery MR 750, GE Healthcare, Milwaukee, USA). IVIM was performed by using an echo-planner imaging sequence with respiratory gating, twelve b values of 0, 10, 20, 40, 80, 100, 150, 200, 400, 600, 800 and 1000 sec/mm2 (with number of excitations of 1, 6, 4, 2, 2, 2, 1, 1, 2, 4, 6 and 6, respectively) were obtained. All the IVIM images were analyzed by two independent radiologists independently. Freehand region of interest (ROI) was used to outline the tumor on the original IVIM image (b=400 sec/mm2), and try to avoid the necrosis and hemorrhage The ADC, ADCslow, ADCfast and f values were automatically calculated. Univariate and multivariate logistic regression analyses were used to screen the independent risk factors of MVI, receiver operating characteristics (ROC) curves were drawn and to determine the optimal cut-off value. A P value less than 0.05 was considered to indicate a statistical significance.

RESULTS

Features significantly related to MVI of HCC at univariate analysis were reduced ADC (odds ratio, 0.341, 95% CI: 0.211-0.552; P<0.001) and ADCslow (odds ratio, 0.141, 95% CI: 0.067-0.299; P<0.001). At multivariate analysis, only ADCslow was the independent risk factor for MVI of HCC. The mean ADCslow value for MVI of HCC showed an area under ROC curves of 0.815 (95% CI: 0.740-0.877) with the optimal cutoff value of 0.868.

CONCLUSION

The results of the preliminary study have demonstrated that the decreased ADCslow value was independent risk factor for predicting MVI of HCC.

CLINICAL RELEVANCE/APPLICATION

1. IVIM can be used to predict the MVI of HCC.2. The result of ADCslow measurement with an optimal cutoff point of 0.868 was preliminary, and the decreased ADCslow should be considered when developing a treatment strategy for HCC.

SSG05-07 Cross Vendor Validation of Multi-point Dixon MRI for Fat Detection: A Phantom Study

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S503AB

Participants
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PURPOSE

The amount of visceral adipose is increasingly recognized to impact a wide variety of disease processes. We assessed multi-point Dixon pulse sequence in multiple platforms for accuracy and reproducibility.

METHOD AND MATERIALS

7 fat-water phantom sets (0%, 10%, 20%, 40%, 60% and 100% fat) were created and analyzed at on one MRI system (3T Siemens Skyra). 6 phantom sets were distributed to Visceral Adiposity and Physical Fitness in CKD study sites that used 2 Siemens 3T Skyra, 1 Siemens 3T Prisma, 1 Siemens 1.5T Avanto, 1 GE Discovery 3T MR750, and 1 Philips 3T Ingenia. Phantoms were scanned using commercially available 6 point Dixon sequences once for quality assurance at study initiation and subsequently during every subject exam over the 24 months of the study. Summary statistics include cross-sectional accuracy (by weight), short term test-retest reproducibility, and long term test-retest reproducibility for the entire study, for each site, for each manufacturer and for each system type.

RESULTS

391 patients were scanned and phantoms were evaluable in 361 (92%). 99 phantoms were scanned on Siemens 1.5, 115 Siemens 3T, 60 Philips 3T, 87 GE 3T. Average measured fat % (±s.d.) for 100% phantom was 96.2 (±2.8), for 35% phantom was 36.9 (±5.0), for 16% phantom was 18.6 (±5.0), for 10% phantom was 9.9 (±4.3) and for 0% phantom was 2.6 (±3.1). Average % error across all phantom percents for each platform was: 2.7% Siemens 1.5, 2.1% Siemens 3, 3.8% Philips, 1.9% GE.

CONCLUSION

6 point Dixon MRI is highly accurate in quantifying fat percent irrespective of vendor or magnet strength.

CLINICAL RELEVANCE/APPLICATION

6-point Dixon can be used to quantify body fat accurately on multiple vendors.

SSG05-08 Pre-Operative Prediction of Hepatocellular Carcinoma Recurrence After Hepatectomy Using Intravoxel Incoherent Motion (IVIM)

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S503AB

Participants
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PURPOSE

To investigated the diagnostic performance of intravoxel incoherent motion (IVIM)-diffusion-weighted imaging in predicting posthepatectomy recurrence in hepatitis B virus (HBV)-infected adults with hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

With institutional review board approval and informed consent requirement waiver, we retrospectively identified 157 patients who underwent 3.0T IVIM-based diffusion-weighted imaging within one month before hepatectomy for HCC between 2014-2017. HCC with clean margins was confirmed in each hepatectomy specimen. IVIM derived-parameters including apparent diffusion coefficient (ADC), diffusion coefficient (D), pseudodiffusion coefficient (D*), and perfusion fraction (f) were obtained. Regions of interest (ROIs) were drawn manually to encompass as much of the lesion as possible in the maximum tumor cross section and placed at least 5 mm far away from the margin of the lesion and avoided necrosis and hemorrhage. Image analysis was performed independently by two abdominal radiologists who were blinded to pathologic and follow-up. Disagreements were adjudicated in consensus. Pathology was reviewed for each resected HCC by a hepatopathologist. Tumor recurrence was determined by clinical and imaging follow up. The cut-off values of IVIM parameters were determined by receiver operating characteristic (ROC) analysis. IVIM parameters and clinical factors were analyzed the potential predictors for postthepatectomy recurrence using Cox proportional hazards model.

RESULTS

The optimal cut-off values of ADC, D, D*, and f for predicting recurrence of HCC were 0.858 × 10-3 mm2/s, 0.985 × 10-3 mm2/s, 12.5 × 10-3 mm2/s, and 23.4%, respectively. Lower ADC, D, and f values were associated with poor histologic differentiation of HCC (P < 0.001 - 0.001) and the f value was related to microvascular invasion (P = 0.0017). The D value [hazard ratio (HR), 0.190; P = 0.023], age (HR, 0.328; P = 0.034), A-fetoprotein (AFP) (HR, 2.079; P = 0.013) were independently predicted tumor recurrence after hepatectomy resection.

CONCLUSION

In HBV-infected adults with HCC, D value, age and AFP independently predicted tumor recurrence.

CLINICAL RELEVANCE/APPLICATION

Although preoperative IVIM are independent predictors of posthepatectomy recurrence. This finding needs to be further confirmed in the future.

SSG05-09 Compressed Sensing Reconstruction of High Resolution Hepatobiliary Phase Imaging at Gadoxetic Acid-Enhanced Liver MRI: A Feasibility Study

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S503AB

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To evaluate the clinical feasibility of high resolution (HR) hepatobiliary phase (HBP) imaging using compressed sensing (CS) reconstruction of gadoxetic acid-enhanced liver MRI (Gd-EOB-MRI)

METHOD AND MATERIALS

This retrospective study included 136 patients who underwent Gd-EOB-MRI at one of two 3T scanners (Ingenia or Ingenia CX, Philips) including three breath-hold HBP sequences: i) standard HBP using mDixon-3D-fast field echo (FFE) (S-HBP), ii) HR HBP using mDixon-3D-FFE (HR-HBP), and iii) HR HBP using CS reconstruction (CS-HR-HBP). Acquired resolutions were i) 1.2x1.3x3.0 mm and ii-iii) 1.0x1.0x1.5 mm). HBP images were obtained with either protocol A (Ingenia CX) using acceleration factors (AFs) for S-HBP, HR-HBP and CS-HR-HBP of 2.8, 6.14 and 6.4, and acquisition times of 13.1, 12.4, and 12.9 sec for S-HBP, HR-HBP, and CS-HR-HBP (n=58), or protocol B (Ingenia) using AFs of 2.8, 3.4 and 6.4 and acquisition times of 15.3, 17.2, and 14.2 sec (n=78), respectively. Image quality and diagnostic performance in detecting solid focal liver lesions (FLLs) were compared among the sequences.

RESULTS

Using protocol A with similar acquisition times between CS-HR-HBP, S-HBP, and HR-HBP, CS-HR-HBP showed significantly better overall image quality and lesion conspicuity than the other sequences (Ps <0.05). Using protocol B with a shorter acquisition time in CS-HR-HBP than in S-HBP or HR-HBP, CS-HR-HBP showed comparable results in overall image quality and lesion conspicuity to the other sequences (Ps>0.05), albeit with more severe unzip artifacts than S-HBP (P=0.003). Moreover, the performance of CS-HR-HBP in detecting solid FLLs using protocol A, was better than S-HBP (reader-averaged figures-of-merit (FOM); 0.92 vs. 0.82, P=0.02), while CS-HR-HBP using protocol B was equivalent to S-HBP or HR-HBP (0.86 vs. 0.80 or 0.90; Ps=0.06, 0.23, respectively).

CONCLUSION

CS-HR-HBP was demonstrated to be feasible, providing better image quality and higher performance in detecting solid FLLs at similar acquisition times to S-HBP and HR-HBP. When using shorter acquisition times for CS-HR-HBP, its performance in detecting solid FLLs was comparable to S-HBP and HR-HBP.

CLINICAL RELEVANCE/APPLICATION

Compressed sensing can provide higher resolution and/or faster imaging acquisition, potentially aiding patients who have difficulty sustaining a breath-hold during the entire nonaccelerated imaging.

SSG06

Informatics (Artificial Intelligence in Radiology: No Pixels or Fake Pixels)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: N230B

AI IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Luciano M. Prevedello, MD, MPH, Dublin, OH (*Moderator*) Nothing to Disclose
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Sub-Events

SSG06-01 Deep Learning for the Automatic Detection of Urgent Radiology Findings from Free-Text Radiology Reports

Tuesday, Nov. 27 10:30AM - 10:40AM Room: N230B

Participants
Yuhao Zhang, Stanford, CA (*Presenter*) Nothing to Disclose
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PURPOSE

Reliably identifying and communicating urgent radiology findings are crucial to the diagnosis and treatment of diseases. We describe a deep learning algorithm to automatically detect urgent radiology findings from free-text reports and evaluate its performance on a multi-institutional corpus.

METHOD AND MATERIALS

Radiology reports of 156,992 studies from Nov. 2017 to Feb. 2018 were collected from 3 hospitals. These reports were categorized by experts using 4 levels of acuity (1=normal, 2=routine, 3=priority and 4=critical). Reports also received a binary label as requiring follow-up or not. We randomly stratified the reports into a 70% training, a 10% validation, and a 20% test set. For classification we developed a 2-layer long short-term memory (LSTM) network followed by a term weighting layer. We then use the weighted sum of the LSTM states as a vector representation of the report to get the probabilistic estimate of the urgency level. To enable knowledge transfer from a larger corpus, we trained word vectors with the GloVe algorithm on 4.5 million reports and use them to initialize the word vectors used in our network. Additionally, the term weighting layer provided interpretable information about which words were weighted most heavily towards the decision.

RESULTS

We evaluate our algorithm on 3 tasks: (1) binary classification of the reports into urgent (categories 3-4) vs. non-urgent (categories 1-2) findings; (2) binary classification into follow-up vs. non-follow-up recommended; and (3) 4-way classification for acuity categories 1-4. Results for task 1, 2, and 3 are AUC=0.951, AUC=0.961, and micro-averaged F1=0.846, respectively. In comparison, a baseline naive Bayes classifier with hand-tuned lexical features achieves 0.911, 0.915, and 0.773 for the 3 tasks. Task 3 F1 drops to 0.833 when we initialize the word vectors randomly, suggesting that some knowledge was transferred from the larger corpus. Term weighting results showed the network placed a high weight on 'no abnormalities' for normal studies or 'large effusion' for priority studies.

CONCLUSION

Deep learning algorithms can reliably detect urgent radiology findings from free-text radiology reports and provide highly interpretable results.

CLINICAL RELEVANCE/APPLICATION

Automatic detection of urgent radiology findings with natural language processing and deep learning is a useful technique for

improving clinical radiology workflow.

SSG06-02 Automated Determination of Radiology Reports Requiring Urgent Communication Using Intelligent Word Embeddings

Tuesday, Nov. 27 10:40AM - 10:50AM Room: N230B

Awards

Trainee Research Prize - Medical Student

Participants
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Hari Trivedi, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
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CONCLUSION

The model performed extremely well at the task of detecting urgent findings in radiology reports. This model can be further tested in real clinical workflow to further assess its value as a detection tool.

Background

Radiology exams can reveal findings that require the immediate attention of clinicians. Radiologists are responsible for ensuring communication of urgent findings because it may affect patient safety and management. Leveraging Natural Language Processing (NLP) and machine learning (ML) techniques, we developed a model that can predict the likelihood that a radiology report contains findings that require urgent communication.

Evaluation

80,649 radiology reports from a variety of modalities and body parts were extracted from a single institution. Reports were labeled as containing urgent findings if the impression included phrases like 'results communicated to'; these phrases were then removed from the reports to blind the model to ground-truth. Feature selection followed the 'Intelligent Word Embeddings' model: applying standard tokenization, performing negation and phrase identification, using RadLex for synonym detection, and training fastText document embeddings on the processed reports. A variety of different classifiers (convolutional neural network, support vector machine, random forests, and multi-layer perceptions (MLP)) were trained on the document embedding vectors. The accuracies of the classifiers were compared on an internal test set of 8,779 reports and an external test set from a different hospital of 20,208 reports.

Discussion

The linear bag-of-words MLP was the best performing model, achieving an ROC-AUC of 0.94 on validation data, which corresponded to 84% accuracy at 90% sensitivity and an F1 score of 0.87. The model also achieved ROC-AUCs of 0.90 and 0.87 on the internal and external test data, respectively. A web version of the model is also provided for real-time and crowdsourced review: bit.ly/2Ikhce1

SSG06-03 Rule-Based Natural Language Processing Algorithm for Automated Parsing of Clinical Radiology Reports

Tuesday, Nov. 27 10:50AM - 11:00AM Room: N230B

Participants
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PURPOSE

Clinical radiology reports are usually written in free-form text rather in a structured format. In this work, we develop and validate rule based natural language processing (NLP) algorithm to parse these reports into structured data consumable by other information systems.

METHOD AND MATERIALS

Anonymized clinical radiology reports of 290,155 (development dataset) and 1,779 (Q2k dataset) head CT scans were used to develop and validate the algorithms. Target findings were intracranial hemorrhage and its subtypes, intraparenchymal, intraventricular, subdural, extradural and subarachnoid hemorrhages, skull fracture, midline shift and mass effect. Rules based on keywords and regular expressions were constructed to account for the variations in reporting of the these findings in development dataset. Additionally, grammar rules were created to identify the negations in a sentence. To validate the results of this rule based algorithm, we established gold standards of Q2k dataset by manually going through them. We measure sensitivity and specificity of the algorithm for each finding against this gold standard.

RESULTS

Average sensitivity and specificity of the algorithm across the target findings on Q2k dataset are 0.9841 and 0.9956 respectively.

Least performing finding was subdural hemorrhage with sensitivity of 0.9318 (95% CI 0.8134-0.9857) and specificity of 0.9965 (95% CI 0.9925-0.9987) while skull fracture was inferred perfectly with sensitivity of 1 (95% CI 0.9745-1.000) and specificity of 1 (95% CI 0.9977-1.000). A previous similar study on head CT reports, but with machine learning based NLP algorithms, reported average sensitivity and specificity of 0.9025 and 0.9172 across findings.

CONCLUSION

In this work, we showed that rule based NLP algorithms can identify the findings from free text clinical radiology reports with very high accuracies. Their performance is superior to that of machine learning based NLP algorithms which require annotation of reports instead of rule creation.

CLINICAL RELEVANCE/APPLICATION

This algorithm can be used to retrieve studies with desired findings from a PACS for research or educational purposes, or to train AI algorithms.

SSG06-05 Restoration of Motion-corrupted MR Images Using Deep Adversarial Networks

Tuesday, Nov. 27 11:10AM - 11:20AM Room: N230B

Participants
Karim Armanious, MSc, Stuttgart, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

Motion artifacts are a frequent source of image quality deterioration in MRI. Existing motion correction strategies mostly focus on prospective compensation of motion artifacts during acquisition. Currently, strategies for retrospective correction of acquired MR images are very limited. The purpose of this work is to implement and evaluate a framework for retrospective restoration of motion-corrupted MR images using deep adversarial networks.

METHOD AND MATERIALS

Our proposed framework consists of two main components trained simultaneously. The first component is a multi-scale deep architecture consisting of 70 convolutional layers for high-resolution image restoration of MR images.The second component is a convolutional neural network (CNN), which classifies the output of the first multi-scale network as realistic or not. The training of the network is done in the adversarial fashion of generative-adversarial networks, where competition between the two components drives the multi-scale network to improve its performance until a detailed motion-free MR image is acquired. The framework was trained on a dataset of 1500 T1 weighted MR images of the head and pelvis regions from 11 volunteers. Image data were paired such that a motion-free and a motion-corrupted image were acquired. Evaluation of the trained model was carried out on a separate dataset of 600 MR images from 4 patients. The quality of the motion corrected images was attested quantitatively in comparison to MR images without motion correction using the SSIM metric. Additionally, qualitative performance was rated by 2 radiologists using a 4-point score (4: best).

RESULTS

The developed framework achieved state-of-the-art results on MR motion correction for rigid motion artifacts. Motion-corrected images achieved an average score of 2.9 by radiologists in comparison to 1.2 for images without motion correction and to 3.7 for motion-free MR images. In addition, SSIM score of motion corrected images has improved by 27.3 % indicating a remarkable reduction of artifacts.

CONCLUSION

Motion artifacts can be retrospectively corrected using a deep adversarial framework, enabling a high-resolution restoration of MR images.

CLINICAL RELEVANCE/APPLICATION

This project enables the extraction of valuable information from motion-corrupted MR images. This can be used to enhance the accuracy of post-processing tasks, such as segmentation and organ volume estimation.

SSG06-06 Predicting Exam Cancellations Using Machine Learning: Towards Optimized Radiology Scheduling

Tuesday, Nov. 27 11:20AM - 11:30AM Room: N230B

Participants
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PURPOSE

The capacity of a radiology department is constrained by the number of imaging slots, which is related to the availability of imaging equipment. However, while slots may be filled in advance, last minute cancellations and no-shows may result in underutilization that could have otherwise accommodated additional patients. We evaluated the use of a machine learning approach called gradient boosting trees that were trained on scheduling and medical record data to predict whether an exam would be canceled.

METHOD AND MATERIALS

Using data from 150,000 past scheduled exams during a 2 year time period, we examined whether each exam was completed or canceled. Metadata about an exam such as its description, modality, anatomical region, duration, site/location, patient demographics (age, gender, associated diagnostic codes), and timestamps (date of scheduling, exam completion) were used as inputs to the model. For each cancellation, we recorded the date and reason. A gradient boosting is a machine learning method that generates a set of decision trees from training data by minimizing the average value of a loss function and incrementally expanding the model. A final prediction is generated based on the collective sum of each tree's prediction. A five-fold cross-validation was used to train and test the model. A random sample of 6,000 exams was set aside from each training set to tune the model hyperparameters.

RESULTS

A total of 44,928 exams (30%) were canceled, many of which are provider-initiated (e.g., erroneous order). Of the canceled exams, 13,962 (31%) were canceled by the patient (in advance or no-show). The average area under the curve across all of the folds was 0.742 +/- 0.004. The most predictive features included patient age, day/time of the scheduled exam, location, and whether the exam was an x-ray or ultrasound.

CONCLUSION

We demonstrate a prediction model with a limited set of clinical and exam variables is still capable of yielding meaningful predictions. We are exploring other factors such as the distance of the patient to the imaging site, weather and traffic, prior history of cancellations, and payor as ways to improve the model's accuracy.

CLINICAL RELEVANCE/APPLICATION

A model to predict exam cancellations may assist departments with identifying and avoiding such occurrences through outreach (e.g., proactive reminders) and mitigation of underlying issues (e.g., difficulty coming to the site, denial by payors).

SSG06-07 Generative Adversarial Neural Networks in the Creation of Synthetic Chest Radiographs: Can We Fool the Experts?

Tuesday, Nov. 27 11:30AM - 11:40AM Room: N230B

Participants
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PURPOSE

Generative Adversarial Neural Networks (GANs), are a form of unsupervised machine learning, utilizing competitive neural networks, which can synthesize realistic images unique from training data. GANs can theoretically allow a near limitless supply of unique and HIPAA compliant cases, which could be used for both computer and human training. The purpose of this study was to determine if chest radiographs synthesized from a GAN could fool radiologists.

METHOD AND MATERIALS

A GAN was trained using a sliced Wasserstein distance criterion, with modifications to suppress variance in the estimate of the sliced Wasserstein distance. Training data is the NIH Chest X-ray8 dataset, using 60,000 images. All frontal radiographic views were used regardless of findings. Synthetic radiographs, 512x512 pixels, were created in PNG format. De novo real/acquired chest radiograph images and synthetic images were randomly assorted into testing sets consisting of pairs of one real and one synthetic image, with the same resolution. These images were then presented to 12 ABR-certified radiologists, with a median experience of 10-15 years. The radiologists were then asked to distinguish between synthetic and real images using a two-alternative forced choice, with random timers between 2-10 seconds. Subjects were presented with as many pairs as they were willing to judge.

RESULTS

GAN training took approximately 70 hours on an NVIDIA P100. The generation of a synthetic image takes on average 2ms on an NVIDIA Titan-X. Overall, expert readers were able to detect the synthetic image in 61% of over 1300 pairs viewed (chance is 50%; this corresponds to a sensitivity of 61% and a specificity of 39%). There is significant variation between subjects, with some subjects reliably able to identify real images quite accurately (3 % of GAN images identified as real) and others reliably detecting GAN images as real (85%).

CONCLUSION

Current GAN methods can generate unique realistic chest radiographs in arbitrary quantities. These radiographs can pass as real images, when presented to radiologists.

CLINICAL RELEVANCE/APPLICATION

Current applications include anonymizing datasets and training images for humans and machines. Improvements could allow generating images guaranteed to contain a particular disease, to show a rare disease state, enhance image quality, create unique views, or to show possible future disease states implied by a current radiograph.

SSG06-08 Realistic CT Images Generation Using Condition Generative Adversarial Network (cGAN) for Accurate Segmentation of Hemorrhagic Stroke

Tuesday, Nov. 27 11:40AM - 11:50AM Room: N230B

Participants
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PURPOSE

Investigate the quality of synthetic brain CT images generated using a cGAN, and their use as augmentation data for accurate detection and dilineation of hemorrhagic stroke.

METHOD AND MATERIALS

Well labeled intracranial hemorrhage on 33391 CT images from 2647 patients consisting of 5 subtypes: intraparenchymal, intraventricular, subarachnoid, epidural and subdural hemorrhages were obtained. Existing GAN implementation on tensorflow framework and images of 256 x 256 were used. Images from 80% of patients were used for training and 20% set aside for testing. Segmented ground truth images were used as the condition to steer the generation process. 2.5%, 10% and 50% of original training data were trained for 10, 50, 100 and 200 epochs each. Because evaluating generated images using a single traditional metric did not reflect the quality of images well, we used a combination of metrics. FCN Scores, Clarity (based on average blurriness) and a classifier that distinguishes between generated images and original images at various thresholds were used. FCN scores were obtained by evaluating the dice similarity coefficients (DSC) of generated images on an existing segmentation algorithm specifically trained only on the original dataset. The best GAN model chosen was then used to generate additional images as training to improve a fully convolutional neural network (FCN) for segmentation.

RESULTS

Using 2.5% of original data, generated images helped to increase sensitivity by 16.7% and DSC by 38%. The increase using 10% of original data was 56.5% and 28.8% for sensitivity and DSC respectively. Whereas using 50% of original data, the increase was 26.7% and 22.6% for sensitivity and DSC respectively.

CONCLUSION

Conditional GANs were effective in generating realistic images that increased detection and delineation performance compared to model trained with just original data. Both dice coefficients and sensitivity increased with the usage of synthetic CT images as augmentation.

CLINICAL RELEVANCE/APPLICATION

Realistic synthetic images generated from accurate labels could help studies and medical tools that rely on access to labeled medical images for training and validation.

SSG06-09 Self PET Attenuation Correction Using Conditional Generative Adversarial Networks

Tuesday, Nov. 27 11:50AM - 12:00PM Room: N230B

Participants
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PURPOSE

Current methods for PET attenuation correction rely on the existence of an attenuation map generated by a second imaging modality which is mostly CT. In certain situations, CT is not available and attenuation correction is performed by estimating an attenuation map using MRI or by importing externally acquired CT images. In this work, we present and evaluate a framework for self attenuation correction of PET data using conditional Generative Adversarial Networks (cGAN) which does not require an accompanying modality.

METHOD AND MATERIALS

The principle idea of the proposed method is to generate an artificial CT image only based on non-corrected PET data. This CT image can then be used for subsequent PET attenuation correction. Our method is based on a cGAN trained on a dataset of corresponding PET/CT brain images from 38 patients. The cGAN consists of three separate convolutional neural networks (CNNs). The first network translates an uncorrected PET image into a synthetic corresponding CT image. The two remaining networks compare the low and high-frequency components respectively between the synthetically generated CT images and the ground-truth CT images. As a result, the generator network is able to match the global structure as well as the texture and style of the desired output. The proposed method was evaluated on a dataset of PET/CT images of the head region from 8 patients. Quantitative comparison between synthetic and ground truth CT images was carried out using the Structural SIMilarity (SSIM) index. In addition, qualitative performance to judge the clinical fidelity of the synthetic CT images was rated by 2 radiologists using a 4-point score (4: best).

RESULTS

The developed method succeeded in translating uncorrected input PET images into highly realistic synthetic CT images. The image quality of synthetic CT images received an average score of 3.1 by radiologists in comparison to 3.7 for real images. Quantitative correlation between our synthetic CT images and corresponding ground truth CT images is indicated by an SSIM score of 0.914.

CONCLUSION

Attenuation correction of PET images without further image modalities is feasible and could be achieved by utilizing cGANs.

CLINICAL RELEVANCE/APPLICATION

The proposed method can be used for fast and reliable attenuation correction of PET data in situations where no CT can be acquired for this purpose. An extension to whole body imaging is conceivable.

SSG07

Molecular Imaging (Oncology)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S504CD

MI

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

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSG07-01 Patient Derived Xenograft Model for Ultrasound Molecular Imaging Applications in Renal Cell Carcinoma

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S504CD

Participants
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PURPOSE

To develop a reliable in vivo model to assess by ultrasound and MRI imaging tumor development and local molecular expressions

METHOD AND MATERIALS

The model used is a patient derived xenograft: an 8 mm tumor core is taken from fresh renal cell carcinoma (RCC) at the time of surgery. The tissue sample is cut into 300 µm homogenous slices with a dedicated device (Krumdieck, Alabama Research & Development). Each slice is grafted into the kidney capsule on immunodeficient mice (RAG2-/-γc-/-) in order to develop a cohort from the same tumor. The grafted tumor is then monitored by ultrasound imaging (Aplio, Toshiba and VEVO2100, Visualsonics) and 7T MRI (Bruker spectrometer). Once the tumor is detected, a first 7T is made to accurately measure the tumor volume and ultrasound molecular imaging series are performed. US molecular imaging is based on antibody -related contrast agents (MicroMarker™, Visualsonics). The antibodies selected for our RCC study are VEGFR1 and FSHR. The targeted signal enhancement is quantified and compared to the signal of the non-targeted microbubbles 10 minutes after the injection. Ultrasound imaging is performed the same week as MRI (T0), then at 1week, 2 weeks and one month on two groups placebo versus sunitinib. Before sacrifice of animals, a second MRI is also performed.

RESULTS

Slices of tumors from 7 patients were removed and implanted on mice. To date, 5 cohorts from 3 different patients have been treated and imaged by ultrasound and MRI. Ultrasound examinations with non-targeted microbubbles validated the lack of specificity of these agents over time for both the placebo and sunitinib groups. On the other hand, the quantification of VEGFR1 and FSHR showed a decrease in the expression of these biomarkers in the sunitinib group, particularly at 1 week and 2 weeks compared to the placebo group. According to the cohorts, the decreases observed are of the order of a factor between 2 to 17.

CONCLUSION

Xenografts derived from patient samples are more realistic models for molecular imaging studies. These first results are encouraging for the follow-up of biomarkers of interest in oncology.

CLINICAL RELEVANCE/APPLICATION

Robust and realistic preclinical models are essential for better-adapted clinical trials and the identification of biomarkers that can guide therapeutic strategies.

SSG07-02 Human Somatostatin Receptor type-2 (hSSTR2) Mutant Muted in Altering T-Cell Signaling and Function Enables Visualization of T-cell Trafficking

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S504CD

Participants
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Vikas Kundra, MD, PhD, Houston, TX (*Presenter*) Institutional license agreement, Introgen Therapeutics, Inc; Research Grant, General Electric Company

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PURPOSE

Adoptive T-cell therapies have shown great promise in patients, but are limited by clinically translatable methods for following their trafficking in vivo. Reporters (enzymes, transporters, receptors) can alter T-cell cellular milieu and function. We evaluated whether a hSSTR2 mutant reporter is signaling deficient in T-cells and can serve to image these cells in vivo.

CONCLUSION

A hSSTR2 mutant muted in altering OT1 T-cell signaling or function can serve as an in vivo reporter of T-cells trafficking.

CLINICAL RELEVANCE/APPLICATION

Findings suggest that the hSSTR2-based mutant reporter muted in signaling has potential for clinical translation for following adoptive T-cell therapy without affecting T-cell function.

SSG07-03 Out of Sight, Out of Mind: The Detection Rate and Impact on Management Intent of 68Ga-PSMA-HBED-CC PET/CT in Prostate Cancer - Results from a Brazilian Center

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S504CD

Participants
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PURPOSE

The aim of this study was to evaluate the detection rate and the role of PSMA PET/CT on management intent in patients with primary or recurrent prostate cancer.

METHOD AND MATERIALS

A retrospective study of 251 patients who underwent PSMA PET/CT imaging for primary staging and for biochemical recurrence between June and December 2017 was performed. All patients were submitted to the same imaging protocol and were reviewed together by a nuclear medicine physician and a radiologist with at least five years of experience. We conducted a retrospective survey of referring physicians who completed one questionnaire to indicate the initial treatment plan without PSMA PET/CT information and after the scan to denote intended management changes.

RESULTS

Overall 173 PSMA PET-CT studies were performed for biochemical relapse (69%) and 78 (31%) for primary staging. Median total PSA was 9,63 ng/ml (0,099-259,0 ng/ml). The median Gleason-score was 7 (range 4-10). The overall percentage of positive PSMA PET-CT among patients was 70%. In 38 patients (15,1%) no abnormal findings were observed. The average maximum standardized uptake value (SUV) was 16,7 (range 1,8 - 107,3). PSMA PET/CT revealed unsuspected disease in the prostate bed in 12,4% of patients, locoregional lymph nodes in 34,7% (57% were up to 1 cm), and distant metastatic disease in 16,3%. Considering PSA ranges, 3 % of patients had positive scans with PSA up to 0.2, 22% with PSA from 0.2-1.0, 12% with PSA from 1.0-2.0, and 63% positivity with PSA above 2.0 ng/ml. Overall, PSMA PET/CT scanning led to 38.2% change in planned management. The impact was greater in the biochemical failure group (47% change in management intent, most these consisted of conversion from systemic treatment to focal treatment) than in patients undergoing primary staging (19%).

CONCLUSION

The early and accurate detection of prostate cancer disease is important to ensure timely management and appropriate individualized treatment. Currently, conventional imaging has limitations particularly in early disease detection in biochemical failure patients, especially at PSA level < 2.0 ng/mL. PSMA-PET/CT has high diagnostic accuracy for small lymph node, especially at low PSA levels.

CLINICAL RELEVANCE/APPLICATION

68Ga-PSMA-HBED-CC PET/CT is superior to conventional imaging methods, especially at low PSA levels (under 2.0 ng/mL), for early detection of metastases, thereby significantly impacting on appropriate treatment.

SSG07-04 PSMA-Directed Biopsies: Initial Experience from Ongoing Clinical Trial

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S504CD

Participants
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PURPOSE

To evaluate the histological correlates of PSMA PET/CT findings in a mixed cohort of high risk, biochemically recurrent (BCR), and metastatic prostate cancer (PCa) patients.

METHOD AND MATERIALS

Patients enrolled on a clinical trial to evaluate PSMA PET/CT imaging in PCa undergo 18F-DCFPyL PET/CT imaging, along with multiparametric MRI (mpMRI) for patients negative for metastases on conventional imaging (CIM) or 18F-NaF PET/CT for patients with suspicious findings for metastatic disease on CIM. PSMA PET/CT imaging was prospectively interpreted by an experienced nuclear medicine physician. When feasible, patients underwent a core-needle biopsy by image-guidance (CT or US) of regions suspicious for metastases by study imaging. For patients undergoing CT-guided biopsy, biopsy targeting localization was confirmed by anatomical registration with PSMA PET/CT imaging.

RESULTS

Samples were obtained from 18 patients, including 12 patients with negative CIM (5 high-risk [median PSA 18.87], 7 BCR [median PSA 2.08 ng/ml]) and 6 patients with positive CIM (2 high-risk, 4 metastatic [median PSA 12.16 ng/ml]). Twenty-two lesions were sampled from bone (N=11), lymph nodes (N=9), or other soft tissue areas (N=2). PSMA PET/CT findings in these lesions were prospectively interpreted as negative (N=4), indeterminate (N=4), or positive (N=14). PSMA negative or indeterminate lesions were not found to harbor metastatic PCa, with 5/8 samples demonstrating non-cancerous pathologies including fibrous dysplasia, reactive node, and lung carcinoma. Of 14 PSMA-positive samples, 11 were confirmed metastatic PCa, 2 demonstrated an alternative pathology (focal fibrosis in bone and necrosis/inflammation in a node), and one was negative (hematopoietic bone). Patients with solitary findings outside of prostate area were less likely to harbor metastatic PCa ($p=0.05$). SUVmax was higher in cancer sites (median 30, range 3.7-77, $p=0.01$); however, SUVmax differed in non-cancerous DCFPyL-avid nodal sites (SUVmax<3) compared to non-cancerous DCFPyL-avid bone sites (SUVmax range 2.5-6.7).

CONCLUSION

Preliminary findings of this ongoing study demonstrates an elevated frequency of non-cancerous benign pathologies with differential DCFPyL uptake based on anatomical locations.

CLINICAL RELEVANCE/APPLICATION

Non-specific PSMA uptake has been noted in several recent studies, further pathological validation and characterization of imaging signatures is warranted.

SSG07-05 Correlation Between Diffusion-weighted MRI and Proliferative Activity ki-67 Expression in Cervical Cancer Cells

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S504CD

Participants
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PURPOSE

To investigate the changes of ADC value and rADC value of diffusion-weighted magnetic resonance imaging (DWI) in patients with cervical cancer with different differentiation degrees and their correlation with proliferative activity ki-67 of cervical cancer cells.

METHOD AND MATERIALS

Forty patients with cervical cancer were diagnosed by pathology. All the patients underwent MR examination and diffusion-weighted imaging before operation, and Ki-67 immunohistochemical staining was performed during the operation.The expression of ki-67 in cervical cancer patients with different differentiation degrees was analyzed by means of ANOVA. Pearson correlation analysis was used to analyze the correlation between Ki-67 and ADC and rADC values.The statistical analysis of data by SPSS 20.0 software has statistical significance ($P < 0.05$).

RESULTS

The ADC value and rADC value of low differentiation group were lower than that of high differentiation group, the difference was statistically significant ($P < 0.05$).There was no significant difference between the low differentiation group and the middle differentiation group ($P > 0.05$).With the degree of differentiation, the expression of Ki-67 increased gradually.With the increase of Ki-67 expression degree, the ADC value and rADC value decreased, and the difference was statistically significant ($P < 0.05$). After the correlation test, it was found that there was a negative correlation between ADCs value and Ki-67 expression degree ($P < 0.05$).

CONCLUSION

The measurement of DWI value in cervical carcinoma is helpful to evaluate and differentiate the pathological grade of cervical cancer and has the potential as a noninvasive method to evaluate the degree of tumor proliferation.

CLINICAL RELEVANCE/APPLICATION

The grade of cervical cancer was distinguished by the correlation between DWI and ki-67

SSG07-06 PET Proliferation Imaging Biomarkers for Monitoring Treatment Response of Combined Cyclin-Dependent Kinase Inhibitors and Endocrine Therapy in Breast Cancer: Comparison of FLT and ISO-1 Radiotracers

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S504CD

Participants
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Robert Mach, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
David A. Mankoff, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Koninklijke Philips NV; Consultant, General Electric Company; Advisory Board, RefleXion Medical Inc; Consultant, Blue Earth Diagnostics Ltd; Research Funded, Siemens AG; Advisory Board, ImaginAb, Inc; Spouse, Owner, Trevarx
Amy Clark, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Cell cycle targeted therapeutics such as CDK4/6 inhibitors (CDK4/6i) in combination with endocrine therapy are the emerging standard of care for treating metastatic ER+ breast cancer (BC). These agents target cell cycle at two independent checkpoints, therefore PET probes reflecting different facets of proliferation, seem promising for identifying patients that might benefit from addition of CDK4/6i. In this study, we compared the ability of 18F-FLT (reflecting S-phase changes) and 18F-ISO1 (reflecting proliferation), for predicting response from combination therapy with CDK4/6i (palbociclib [PD]) and ER antagonist (fulvestrant [F]).

METHOD AND MATERIALS

Six BC cell lines with different ER status and sensitivity to PD were treated with PD and/or F. Cell proliferation assay, flow-cytometric cell cycle analyses, Ki-67, and TMEM-97 western-blot were performed after 24hrs, 72hrs, and 6days. These data were correlated to FLT uptake and ISO-1 analogue ligand-binding. Subsequently, SCID mice bearing MCF7 tumors were used for in-vitro investigation and randomly assigned to PD, F, or PD+F groups. FLT and ISO-1 micro-PET/CT were performed, on days 0, 3, and 14 of treatment. Changes in tumor to muscle uptake ratios (T/M) for each tracer was quantified and correlated to changes in cell-cycle.

RESULTS

PD resulted in a remarkable decrease in FLT accumulation at all time points, correlating with decrease in S-phase. In contrast, change in binding of ISO-1 was delayed and only prolonged combination therapy in ER+ cells (MCF7 & MDA134) resulted in significant reduction ($p<0.01$), correlating with G0 arrest. On day 3 of MCF-7 xenograft treatment, FLT T/M significantly decreased in treated mice ($p<0.005$), without change in ISO1 uptake. On day 14, we noticed significant decrease in ISO-1 T/M in combination therapy group ($p<0.05$). Changes in FLT and ISO1 uptake correlated with S-phase depletion and G0-arrest, respectively, as an indication of contribution of PD and F in treatment response.

CONCLUSION

FLT and ISO-1 PET/CT assess different aspects of proliferation after PD and F treatment. Our data suggest that FLT is more sensitive in evaluating changes in tumor proliferation and provides a prediction of both early and late treatment changes, whereas ISO-1 is more predictive for late response.

CLINICAL RELEVANCE/APPLICATION

Combination of FLT and ISO-1 PET imaging might serve as a clinically translatable approach to guide dual-targeted therapy of ER+ BC.

Honored Educators

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SSG07-07 MR Imaging of Zinc Depletion in Prostate Cancer

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S504CD

Participants
Yue Yuan, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Of all soft tissues, the normal prostate has the highest mobile zinc content, but this level decreases dramatically during malignant transformation. We aimed to use iCEST (ion chemical exchange saturation transfer) 19F MRI as a non-invasive means to probe zinc depletion in prostate cancer.

METHOD AND MATERIALS

For in vitro validation studies, normal (RWPE1), ZIP1 zinc transporter-downregulated (RWPE2), and malignant (DU145 and LNCaP) human prostate cells were incubated with 75 µM $ZnSO_4$ and induced to secrete zinc using glucose stimulation. Following the addition of 2.5 mM TF-BAPTA, 19F-derivative of BAPTA which is a fluorescent dye indicator for zinc, the supernatant was assessed with 1H and 19F iCEST MRI at 17.6 T. For in vivo studies, 1E6 cancer cells were injected into the prostate of 6-8 weeks old immunodeficient NSG mice and allowed to grow for 21 days. Immediately after i.p. injection of 80 µL of 20% w/v D-glucose and injection of 0.15 g/kg bw TF-BAPTA into the anterior prostate through a catheter, iCEST MR images were collected at 17.6T using a modified RARE sequence with a FOV=2.6×2.6 cm, 3 mm slice thickness, and a resolution of 0.8x0.8 mm.

RESULTS

In vitro, the strongest iCEST signal was observed for glucose-stimulated RWPE1 cells with a normal zinc transporter level. In normal prostate cells with a downregulated ZIP1 zinc transporter (RWPE2), a weaker iCEST signal was observed. No signal could be observed for DU145 and LNCaP prostate cancer cells. In vivo, the strongest iCEST signal was observed for the normal prostate following i.p. glucose stimulation (Fig. 1). Both the normal prostate without glucose stimulation and the two orthotopic tumor models with glucose stimulation showed much weaker iCEST signal.

CONCLUSION

Using iCEST MRI, differences in glucose-induced zinc secretion between normal and malignant prostate cells can be readily detected, both in vitro and in vivo.

CLINICAL RELEVANCE/APPLICATION

Monitoring the conversion of normal prostate cells into malignant cells using iCEST 19F MRI may be further developed to diagnose prostate cancer in its earliest stages.

SSG07-08 A Novel Treatment for Neuroendocrine Tumors Hepatic Metastases with Combination Everolimus and Trans-Arterial Chemo-Embolization (E-TACE): Role of 68Ga-DOTATATE in Conjunction with CT for Tumor Load Assessment

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S504CD

Participants
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PURPOSE

Both TACE and Everolimus are widely used for treatment of metastatic NETs. The standard protocol is to hold Everolimus 2-4 weeks prior to and following TACE. Combining both therapies has shown therapeutic benefit in a preclinical study. RECIST 1.1 is the basic treatment response assessment criteria used, yet is limited. The aim of our study was to investigate the additive value of functional imaging using 68Ga-DOTATATE PET/CT in conjunction to contrast CT in the assessment of viable tumor volume

METHOD AND MATERIALS

We retrospectively reviewed all patients who received concurrent E-TACE between September 2016 and April 2018. Only patients who underwent baseline pre-and post-TACE 68Ga-DOTATATE PET/CT were included in our study. As part of our institutional protocol, 10 mg of Everolimus/1-2 days started $\geq$ 1 month prior to TACE. RECIST 1.1 criteria were followed. Quantitative analysis of PET/CT images were performed and multiple parameters were collected including SUVmax, SUVmean, SUVpeak, binding tumor volume (BTV), and tumor binding index (TBI)

RESULTS

Among the 23 patients who underwent concurrent E-TACE therapy, 5 met our inclusion criteria. Based on RECIST, all 5 cases showed stable disease on contrast CT. Quantitative analysis of PET/CT showed significant difference between the baseline and post-treatment scans in all tested quantitative parameters (p-value < 0.05). The pre/post-treatment mean %difference in SUVmax, SUVpeak, and TBI were -49% + -16.7%, -52.5% + 0.2%, and -71% + 21.6%, respectively. A subset analysis of 2 cases that underwent embolization of one lobe was performed, comparing the quantitative parameters between the TACE treated and non-treated lobes. There was significant difference between the reduction in TBI after combined E-TACE treatment in the TACE treated versus non-TACE treated lobe in the same patient (-71% + 21.6% versus -25% + 14%, p-value <0.0001)

CONCLUSION

E-TACE combination resulted in reduction of liver metastatic tumor load, which was significantly better than Everolimus alone. Adding functional imaging with 68Ga-DOTATATE PET/CT to the standard follow up with contrast CT has the potential to improve treatment response assessment and overcome the limitation of RECIST

CLINICAL RELEVANCE/APPLICATION

68Ga-DOTATATE PET/CT has potential to improve treatment response assessment and overcome limitation of size based RECIST criteria.

Honored Educators

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SSG07-09 Detecting and Grading Solid Tumor Using ADC as a Marker of Cellularity: Fact or Fiction?

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S504CD

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Decreased ADC derived by diffusion MRI has been the most widely accepted clinical imaging biomarker of tumor cellularity in various types of cancer. However, complex microenvironment surrounding tumor foci confounds ADC measurements sometimes failing to reflect tumor cellularity. We have developed a novel diffusion histology imaging (DHI) to characterize tissue structural changes resulting from various pathologies associated with solid tumors. DHI-derived restricted isotropic diffusion ameliorates confounding factors such as vasogenic edema, necrosis, and fibrotic structures, accurately assessing tumor cellularity quantifying signal fraction resulting from cellularity.

METHOD AND MATERIALS

Brain tumor specimens were examined using a 4.7T MR scanner with a homemade surface coil. Breast cancer and prostate cancer patients were examined on a 3T MR scanner with an 8-channel phased-array receive coil. DWI data with 99 (fixed specimens) or 25 (in vivo) diffusion encoding directions was processed using DHI multi-tensor modeling.

RESULTS

Decreased ADC in the adult anaplastic ependymoma (Fig. 1A) misidentified inflammation as tumors. In pediatric primitive neuroectodermal tumor (Fig. 1B), the ADC values of tumor did not consistently decrease as expected missing majority of histology-identified tumors. In contrast, DHI-restricted fraction map accurately delineated the H&E identified increase of tumor cellularity. In invasive ductal carcinoma, DHI more accurately identified increased cellularity revealed by H&E than ADC (Fig. 1C). In prostate cancer (Fig. 1D), ADC overestimated cancer lesion due to the coexisting BPH and inflammation. DHI correctly detected inflammation (highly-restricted isotropic diffusion), tumor (restricted isotropic diffusion), stromal BPH (anisotropic diffusion) and normal prostate tissues (non-restricted isotropic diffusion).

CONCLUSION

Despite its wide use in detecting increased cellularity associated with solid tumor growth, ADC is inconsistent to reflect tumor cellularity as demonstrated in various tumors as shown herein. DHI-restricted fraction accurately reflects tumor cellularity in adult and pediatric brain tumors, breast cancer, and prostate cancer.

CLINICAL RELEVANCE/APPLICATION

Our findings caution the continuing use of decreased ADC as the biomarker of increased tumor cellularity. We propose a better imaging method, such as DHI, more accurately detecting solid tumors will improve patient management.

SSG08

Musculoskeletal (Machine Learning and Artificial Intelligence)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S102CD

AI CT IN MK

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

FDA Discussions may include off-label uses.

Participants
Martin Torriani, MD, Lincoln, MA (*Moderator*) Nothing to Disclose
Bao H. Do, MD, Stanford, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSG08-01 SpineNet: Automated Vertebra and Disc Gradings Using Deep Learning

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S102CD

Participants
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PURPOSE

To assess the performance of an fully automated deep learning method in producing radiological gradings of spinal MRI in the context of management of chronic back pain

METHOD AND MATERIALS

A dataset comprising images of 12,018 individual discs from 2009 patients were retrospetively collected from 6 different referrral centers in the UK, Hungary, Slovenia and Italy in a previous EU project (Genodisc). The primary selection for recruitment to Genodisc was "patients who seek secondary care for their back pain or spinal problem" and were sourced from routine clinical management. The MRI machines and protocols varied between the sites but included at least one standard T2 sagittal MRI acquisition which, for consistency, was used for all of the results reported here, though the system is capable of using the T1 and axial images also. The scans were annotated with the following radiological scores by a single experienced spinal radiologist: Pfirrmann grade, disc narrowing, endplate defects, marrow changes, spondylolisthesis and central canal stenosis. To test the radiologist's intra-rater variability, they repeated their grading on a subset of 200 patients randomly interdispersed throughout the entire dataset. For training, the dataset was split into a 80:10:10 train:validation:test sets on a per patient basis (not per disc). This resulted in 1806 patients (10,836 discs) for training and 203 patients (1,224 discs) for testing. A multi-class Convolutional Neural Network (CNN) was trained using Deep Learning to predict all of the gradings. Accuracy was measured by comparing the output of the system to the radiologist annotations using class-balanced accuracy. Multi-way cross-validation was used to test the efficacy and repeatability of the system.

RESULTS

The average class balanced accuracy for the SpineNet system was 86.3% (+/- 0.3). This compares favourably to the radiologists intra-rater repeatability of 82.5%.

CONCLUSION

The SpineNet system can produce accurate and repeatable gradings for a range of spinal MRI radiological gradings used in chronic back-pain clinical management and research. Such gradings may be used to augment the radiologist report, improve consistency and communication with the referring physician.

CLINICAL RELEVANCE/APPLICATION

Quantitative gradings of spinal degeneration may be a useful adjunct to routine qualitative report of spinal MRI and improve communication with the referring phyician.

SSG08-02 Can a Machine Diagnose an Anterior Cruciate Ligament Tear? Fully-Automated Detection System Using Deep Learning

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S102CD

Participants
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Humberto G. Rosas, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
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Ali Guermazi, MD, PhD, Boston, MA (*Abstract Co-Author*) Shareholder, Boston Imaging Core Lab, LLC ; Research Consultant, Merck

KGaA ; Research Consultant, sanofi-aventis Group ; Research Consultant, TissueGene, Inc; Research Consultant, OrthoTrophix, Inc; Research Consultant, AstraZeneca PLC ; Research Consultant, General Electric Company ; Research Consultant, Pfizer Inc
Richard Kijowski, MD, Madison, WI (*Presenter*) Research support, General Electric Company; Consultant, Boston Imaging Core Lab, LLC

For information about this presentation, contact:

N/A

PURPOSE

To investigate the use of a deep learning (DL) approach to create a fully-automated prediction model for detecting anterior cruciate ligament (ACL) tears of the knee joint.

METHOD AND MATERIALS

The propsed deep learning approach consisted of two neural networks connected in a cascaded fashion to create a fully-automated processing pipeline. The first network performed rapid segmentation of the intercondylar notch on two to three consecutive image slices, while the second classification network evaluated structural abnormalities within the segmented anatomic region. Sagittal proton density-weighted fast spin-echo (PD-FSE) and fat-suppressed T2-weighted fast spin-echo (T2-FSE) sequences were acquired using the same 3T scanner on the knees of 200 subjects (100 subjects with a torn ACL and 100 subjects with an intact ACL at subsequently performed knee arthroscopy). The DL method was trained to detect ACL tears using both the PD-FSE and T2-FSE images on 100 randomly chosen subjects and evaluated on the remaining 100 subjects. Diagnostic performance of the DL method was assessed with receiver operation characteristic (ROC) and area under curve (AUC) analysis using arthroscopy as the reference standard. The diagnostic performance of a musculoskeletal radiology fellow and an experienced fellowship-trained musculoskeletal radiologist for detecting ACL tears in the same subject poulation was also calculated.

RESULTS

For the fellow and radiologist, the sensitivity (95%CI) for detecting ACL tears was 94% (81%-99%) and 97% (86%-100%) respectively, while the specificity (95%CI) was 98% (92%-100%) and 98% (92%-100%) respectively. In comparison, the sensitivity (95%CI) and specificity (95%CI) for the DL method for detecting ACL tears at the optimal threshold by the Youden index was 89% (74%-97%) and 98% (92%-100%) respectively. The AUC (95%CI) for the DL method was 0.942 (0.876-0.979, $p<0.001$), indicating high overall diagnostic performance.

CONCLUSION

A fully-automated DL approach showed high diagnostic performance for detecting surgically confirmed ACL tears, but its sensitivity was slightly lower than human readers indicating the need for larger training datasets to maximize diagnostic performance.

CLINICAL RELEVANCE/APPLICATION

A fully-automated DL approach trained on a small image dataset shows promise for detecting ACL tears but requires further optimization to achieve diagnostic performance comparable to human readers.

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SSG08-03 Deep Learning For CT Spine Fracture Detection

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S102CD

Awards
Student Travel Stipend Award

Participants
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Peter Chang, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate a multi-step deep learning tool, based on convolutional neural networks (CNN), for fully-automated localization of vertebral bodies and detection of fracture on CT.

METHOD AND MATERIALS

After IRB approval, an institutional database was queried to identify patients with cervical, thoracic or lumbar CT obtained between January 2016 and 2017. For each patient, sagittal bone reconstructions were used to manually generate bounding cubes for each vertebral body. Additionally, all levels with a vertebral body fracture were identified. Final annotations were confirmed through visual inspection by a board-certified radiologist. A 3D mask R-CNN architecture based on a feature pyramid backbone was used to regress bounding cube locations for each vertebrae (Figure 1A). Subsequently, each vertebrae was cropped, resampled and used as input into a second 3D residual CNN for detection of fracture (Figure 1B). The 34-layer residual CNN architecture was implemented with bottleneck layers and all-convolutional design (no pooling). Performance was assessed on per vertebrae and per patient levels.

RESULTS

A total of 440 patients were included in this study, 88 of which had at least one vertebral body fracture. Overall, 174 of 3,206 individual levels contained a fracture. Accuracy, AUC, sensitivity, specificity, PPV and NPV were 0.961, 0.956, 0.845, 0.967, 0.590, 0.991 (per-vertebrae) and 0.859, 0.836, 0.875, 0.823, 0.558, 0.963 (per-patient). Combined, serial inference for the 3D mask R-CNN followed by the 3D residual CNN required 2.19 seconds per patient on a single GPU workstation.

CONCLUSION

A custom deep learning based tool is accurate for detection of vertebral body fracture. Given the potential subtle appearance of fractures and high resolution of CT spine imaging, a two-part serial architecture was required to integrate complimentary large field-of-view (vertebral body localization) and small field-of-view (fracture detection) information needed for this task.

CLINICAL RELEVANCE/APPLICATION

A high-performing deep learning tool for CT spine fracture detection can be used for rapid triage in the acute trauma setting, optimizing radiology workflow and expediting patient care.

SSG08-04 Automatic Detection of Distal Radius Fractures in X-Ray Images using Deep Learning

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S102CD

Participants
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PURPOSE

The aim of this study was to evaluate the diagnostic performance of a multi-purpose, deep-learning based image analysis software for the detection of wrist fractures.

METHOD AND MATERIALS

In this retrospective study, patients with suspected wrist fractures on X-ray imaging studies ordered by the ER department between 2016 and 2017 were included. After applying exclusion criteria (e.g. presence of osteosynthesis material), the remaining X-ray images were labeled for the presence of radius fractures. In uncertain cases, CT studies were consulted, excluding cases missing CT confirmation. The cases were randomly split into training and test set (85% and 15%, respectively). A multi-purpose image analysis software was trained for the decision whether a distal radius fracture was present on the X-ray image. Training data was augmented (e.g. by horizontal flipping, shifting, rotating, scaling). The test set was subsequently processed by the trained system. Performance was measured as area under the ROC curve (AUC) from the score the software assigned to each image. Sensitivity and specificity were calculated at the optimal threshold as indicated by Youden's index. Finally, the test set was evaluated by an attending radiologist and a radiology resident with 16 and 2 years of experience, respectively.

RESULTS

The included images featured 171 cases with fractures and 562 controls, amounting to 733 X-ray images of 277 different patients. The training and evaluation set consisted of 573 and 160 X-ray images, respectively. The diagnostic performance of the trained software on the test set of 160 X-ray images was excellent with an AUC of 0.91 (95%-CI 0.85-0.95). It therefore performed comparable to a radiology resident (AUC 0.87, $p=0.25$) but worse than the attending radiologist (AUC 0.98, $p<0.01$). Sensitivity and specificity of the software at the optimal threshold were calculated to be 88.5% and 89.9%, respectively. Heatmaps drawn as an image overlay by the software indicated areas suspicious for defects as useful visual feedback. The interreader agreement of the human readers was substantial with a Cohen's kappa of 0.71 (95%-CI 0.60-0.82).

CONCLUSION

The software was able to detect wrist fractures with high sensitivity and specificity, using only a small dataset for training. It performed on a par with the radiology resident reader.

CLINICAL RELEVANCE/APPLICATION

Deep-learing based software is useful for the detection of wrist fractures.

SSG08-05 Multi-Tissue Segmentation for Body Composition Using a Deep Convolutional Neural Network

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S102CD

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To develop and test a deep convolutional neural network (CNN) to automatically segment abdominal CT images for body composition measures. We hypothesized that a deep CNN would achieve high accuracy using a limited training dataset and data augmentation.

METHOD AND MATERIALS

We manually segmented single-slice CT images obtained at the level of L4 (80kV, 70mAs, 10mm slice thickness, 50cm field of view) in 160 subjects for determination of body composition. Manual segmentation was performed on 512x512 pixel images to label 6 classes: background, muscle, bone, bowel/solid organs, visceral and subcutaneous fat. Twenty cases were segregated for a test dataset. The remaining 140 underwent a processing pipeline of histogram equalization followed by data augmentation (N=2,000), which included random deformations, horizontal mirroring, Poisson noise, cropping and magnification. We trained our model from scratch on Keras/Tensorflow using an 80/20 training/validation split and a U-Net architecture (8 batch size, 50 epochs, dropout 0.3, initial learning rate 0.0001, softmax). Testing was performed to obtain the Dice (F1) score as a parameter to compare the similarity between manual vs. CNN-based multi-class segmentation.

RESULTS

The overall mean Dice score was 96% (median 97%, range, 94-98). Mean Dice scores for each class were: background 98% (median 98%, range, 96-99), bone 87% (86%, 83-92), subcutaneous fat 94% (96%, 87-98), muscle 91% (91%, 84-97), bowel/solid organs 89% (90%, 83-94), and visceral fat 81% (88%, 45-93). Visceral fat demonstrated the broadest accuracy range, which may derive from its more variable quantity and morphology, representing an important focus to improve algorithm performance.

CONCLUSION

Our results show overall accurate automated abdominal CT segmentation for body composition using a deep CNN algorithm, trained on a limited dataset with data augmentation. While segmentation accuracy was generally high for most classes (>81%), improvement of algorithm performance will focus on strategies to increase visceral fat segmentation accuracy. This workflow may serve as a basis for future models aimed at automated segmentation of entire abdominal CT studies for body composition.

CLINICAL RELEVANCE/APPLICATION

Deep CNN algorithms for tissue segmentation are promising methods to obtain body composition measurements, and may allow efficient and automatic data extraction in opportunistic and population studies.

SSG08-06 End to End Solution for Complete Thigh Muscle Semantic Segmentation from Musculoskeletal CT using Deep Learning

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S102CD

Participants
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N/A

PURPOSE

The goal is to develop and validate a 2.5D deep learning neural network (DLNN) to automatically classify thigh muscle into 10 classes and evaluate its classification accuracy over 2D DLNN.

METHOD AND MATERIALS

The clinical dataset consists of 48 thigh volume(TV) cropped from 24 anonymized non-contrast CT DICOM of lower extremities. Cropped volumes were aligned with femur axis and resample in 2mm voxel spacing. To reduce the annotation workload, final expert ground truth annotation was created by editing the predicted labels of muscle by a newly developed stacked U-Net DLNN. Stacked U-Net produces relatively higher segmentation accuracy on smaller muscles even when it is trained with small number annotated datasets. Proposed 2.5D DLNN consists of three 2D U-Net(optimizer: Adam, lr=1e-4,decay=1e-3) trained with axial, coronal and sagittal muscle slices respectively. A voting algorithm was used to combine the output of 2D U-Nets to create final segmentation. 2.5D U-Net was trained on PC(Intel Xeon 2.20GHz 128GB, NVIDIA Tesla P100-SXM2-16GB) with 38 TV(Epoch:100, Batch:32) and the remaining 10 TV were used to evaluate segmentation accuracy of 10 classes within Thigh. The result segmentation of both left and right thigh were de-cropped to original CT volume space. Finally, segmentation accuracies were compared between proposed DLNN and 2D U-Net(axial).

RESULTS

Average segmentation DSC score accuracy of all classes with 2.5D U-Net as 91.18% and Housdorff distance(HD) as 17mm. We found DSC score for 2D U-Net was 2.9% lower and HD was more than four times higher than the that of 2.5D U-Net.

CONCLUSION

Successfully implemented end-to-end solution for complete automatic classification with reasonable accuracy of thigh muscle into 10 classes . The same could be easily extend to muscle segmentation of any other body parts (lower limb, arm, shoulder etc.). To date, there is no other study of deep machine learning algorithm used except our study for CT based semantic muscle segmentation.

CLINICAL RELEVANCE/APPLICATION

Muscle segmentation functionality on PACS may improve visibility and can enable automatic quantitative evaluation of muscle atrophy with the disease progression. Change in volume or shapes of muscles will enable therapeutic interventions to be targeted to the affected regions only.

SSG08-07 A Deep-Learning System for Fully-Automated Muscle Assessment on Abdominal CT for Opportunistic Detection of Sarcopenia

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S102CD

Participants
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PURPOSE

Central sarcopenia is a risk factor for mortality in multiple cancers, liver transplantation, cirrhosis, and trauma, and represents a topic of interest in multiple medical and surgical specialties to help guide patient management. We have created a fully-automated deep-learning system to opportunistically analyze truncal musculature for sarcopenia detection on CT scans obtained as part of the patient's routine clinical care

METHOD AND MATERIALS

First, individual lumbar vertebral bodies are segmented to separate bone from soft tissue, and create reference anatomic levels for muscle analysis, via thresholding, morphologic operations, and aggregated intensity profiles. Next, muscle groups at reference vertebral levels are segmented on axial images by a holistically nested neural network through image-to-image training and classification. There are varying reference level and muscle group standards for sarcopenia determination in different medical and surgical specialties. To accommodate this, the system performs analysis for multiple muscle groups and vertebral levels. Segmentation accuracy was assessed via Dice Similarity Coefficient, a measure of overlap between manual and automated segmentations. The system was trained on contrast enhanced portal venous phase CTs of 51 patients and tested on 51 cases (average age 67 (range 59-81), 53 F, 49 M). For demonstration here, the system was designed to calculate sarcopenia via the standard cutoff value for L3 SMI (skeletal muscle index: L3 axial muscle area cm2/patient ht m2) of < 3.62cm2/m2 for women and <4.93 cm2/m2 for men, as proposed by international consensus of cancer cachexia

RESULTS

The Dice coefficients for the psoas, paraspinous, and total abdominal muscle groups in the training and testing sets were 0.953 +/- 0.015 and 0.938 +/- 0.028, respectively at the level of the third lumbar vertebra. The mean normalized L3MI was 5.02 +/- 1.45 cm2/m2 for women and 6.18 +/- 1.83 cm2/m2 for men. Sarcopenia was present in 15.4% (8/52) of women and 13.3% (6/45) of men

CONCLUSION

This fully-automated system can robustly detect, accurately segment, and generate quantitative statistics for multiple abdominal wall muscle groups at multiple lumbar vertebral levels on CT scans

CLINICAL RELEVANCE/APPLICATION

Automated quantification of sarcopenia may guide patient management in pre-treatment risk assessment and surgical planning, and act as a platform to facilitate large scale clinical trials

SSG08-08 Machine-Learning-Based Discovery of Sexual Dimorphism of Hand and Wrist Radiographs

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S102CD

Participants
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PURPOSE

Skeletal sexual dimorphism develops mostly in the pelvis during puberty. Although prior work has shown higher second-to-fourth digit ratio and smaller carpal bones in women compared to men, the distributions of these measures substantially overlap for women and men. We aim to create a machine-learning algorithm to distinguish sex from hand and wrist radiographs and evaluate its performance by comparing it to radiologists'.

METHOD AND MATERIALS

We compiled a dataset of 10,607 (5,148 male and 5,459 female) radiographs of hand and wrist from a cohort of patients, ranging from 5 years to 80 years of age. A total of 7,461 radiographs were used for training, and 1,573 images separate from the training data were randomly selected for validation. Images from the remaining 1,573 cases were reserved for testing. The images were labeled solely with the sex of the subject. We fine-tuned an ImageNet-pretrained VGG16 convolutional neural network (CNN) on our training dataset. The best CNN, selected based on the validation loss, then provided automated prediction of sex, which was compared to the sex in the medical record. To compare the performance with human radiologists, we randomly selected 50 cases for which the CNN correctly predicted sex. Two radiologists independently read the hand and wrist radiographs and predicted sex for these 50 cases. The radiologists were blinded to clinical information of the patients but were allowed to use reference such as the Greulich and Pyle atlas while reading the radiographs.

RESULTS

Of the 1,573 radiographs tested, the algorithm predicted sex correctly with 95.4% accuracy (95.2% in female and 95.7% in male).

The two radiologists showed 58% (45.8% in female and 69.2% in male) and 46% (50% in female and 57.7% in male) accuracy. The class activation maps (CAM) showed that the CNN mostly focused on 2nd and 3rd metacarpal base or 4th and 5th metacarpal head in women, and radioulnar/radiocarpal joint or 2nd, 3rd, and 4th metacarpophalangeal joints in men.

CONCLUSION

We developed an algorithm that accurately distinguishes men and women from hand and wrist radiographs in children as well as in adults.

CLINICAL RELEVANCE/APPLICATION

The current study shows the discovery of previously unrecognized radiologic features using machine learning. It could be used in screening of disorders affecting sexual development.

SSG08-09 Automated Radiograph Based Preoperative Measurements in FAI Patients Utilizing Deep Learning

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S102CD

Participants
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PURPOSE

Utilize deep learning to obtain preoperative measurements from radiographs in patients with femoroacetabular impingement.

METHOD AND MATERIALS

A retrospective study of patients with femoroacetabular impingement was performed. 181 unique patients who underwent CT scan of the hip for preoperative measurement of alpha angle (AA), acetabular version (AV), femoral version (FV) and lateral center edge (LCE) were identified. The training set consisted of 1084 radiographs. This was made up of available preoperative false profile, Dunn, frog leg and AP radiographs (n=419) and augmented with digitally reconstructed radiographs (DRRs) generated from the CT scans at different views (n=665). A novel convolutional neural network (CNN) based on a DenseNet architecture with 54 hidden layers and a regression head was trained on 256x256 input images to predict LCE measurement. For testing AA, AV, and FV measurements, both a regression output and a binary classifier for normal and abnormal ranges were tested. Parameters were tuned based on a 20% validation group generated from the training set. The sequestered testing set consisted of 95 preoperative radiographs at various views and corresponding measurements from accompanying CT scans.

RESULTS

Overall mean absolute error (MAE) and standard deviation of the error for LCE measurement was 3.2° ± 2.3°. Performance of the network was best on false profile views of the hip (3.0° ± 2.2°) but this difference was not statistically significant. AA, AV and FV prediction performance was evaluated, however the performance of the network was not predictive in the current implementation.

CONCLUSION

Deep learning techniques applied to radiographs can be used for quantitative measurement of LCE. With further modification and additional examples, quantitative measurement of AA, AV and FV may be possible.

CLINICAL RELEVANCE/APPLICATION

An accurate, automated system designed to obtain FAI measurements from radiographs can obviate the need for CT and has the potential to decrease healthcare costs, decrease patient exposure to radiation and increase radiologist efficiency.

SSG09

Nuclear Medicine (Gastrointestinal Oncology Nuclear Imaging)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S505AB

CT GI MR NM OI

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

FDA Discussions may include off-label uses.

Participants
Peter L. Choyke, MD, Rockville, MD (*Moderator*) Nothing to Disclose
Jacob G. Dubroff, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSG09-01 Dynamic PET Perfusion Imaging (DPPI) of Esophageal Cancer to Characterize Angiogenicity: A Phase I Study to Explore this Potential Imaging Biomarker Enabled by Ultra-Fast Digital PET

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S505AB

Participants
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PURPOSE

While PET perfusion imaging using dynamic acquisitions has a long history, its use in clinical practice outside of cardiovascular applications remains negligible. This Phase I study assesses the feasibility of dynamic PET perfusion imaging as an alternative methodology to contrast enhanced MRI in esophageal cancer using next-generation digital PET technology with substantially improved TOF timing resolution and reduced dead time.

METHOD AND MATERIALS

FDG PET/CT was performed prior to radiation therapy of advanced esophageal cancer in 12 patients using a next-generation digital photon counting system (Vereos Philips, dPET). Prior phantom and preclinical experiments established the following protocol. Dynamic PET Perfusion Imaging (DPPI) was performed at the time of bolus injection of 5 mCi FDG over a volume of interest for 10 min. PET events were recorded in continuous list mode acquisition and reconstructed using frame rates from 1 sec/fr to 15 sec/fr. A count density adaptive reconstruction approach was previously developed. Data analysis were performed using Intellispace Discovery (Philips) workspace. The reconstructed dynamic PET images were assessed in blinded review by three experienced PET readers. Descriptive statistics were calculated for data analysis.

RESULTS

All dynamic PET acquisitions were successfully acquired and reconstructed according to protocol. Frame rates of 10 sec led to high quality uptake time curves of the well delineated esophageal cancer. Count density adaptive reconstruction was essential to minimize noise. 2mm voxel length (HD) reconstruction was found to be beneficial. The first 2 min duration of the dynamic series were found to be the most relevant and also sufficient for the perfusion assessment. Uptake time curves were found analogous to characteristic findings in DCE-MRI.

CONCLUSION

Dynamic PET Perfusion Imaging (DPPI) of esophageal cancer was achievable using frame rates of 10 sec with acceptable quality for quantitative and visual assessment even at the low FDG dose of 5 mCi. A short table time of 5 min appears to be sufficient combined with the dPET's low dose capabilities making clinical utilization feasible.

CLINICAL RELEVANCE/APPLICATION

Dynamic PET perfusion imaging has the potential to be an alternative methodology to DCE-MRI or CT for assessment of perfusion of esophageal cancer for therapy planning and response assessment.

SSG09-02 Focal Liver Uptake on 18F-FDG PET/CT without CT Correlate: Utility of MRI Evaluation in Patients with Known Malignancy

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S505AB

Participants
Tetsuro Araki, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

There is insufficient evidence to guide management of focal FDG uptake in the liver without CT correlate. This study aims to assess the utility of MRI for evaluation of focal FDG uptake on PET/CT without CT correlate in patients with known malignancy.

METHOD AND MATERIALS

In this IRB-approved, HIPAA compliant retrospective study, between 2005 and 2012, out of 1851 patients who underwent FDG-PET/CT, we identified 36 patients with known malignancy (19 women, 17 men; mean age, 56.1 years) who had focal hepatic uptake on PET/CT without CT correlate and had follow-up MRI within 100 days for assessment of the uptake. Two radiologists reviewed the PET/CT images in consensus blinded to the area of uptake noting SUVmax of the lesion and background liver. MR images were then reviewed to look for the presence of focal lesion corresponding to the uptake. When a focal lesion was present, the size, signal intensity and enhancement characteristics and follow-up imaging were documented. Statistical analysis was performed to determine correlation between intensity of FDG uptake and presence of focal lesion.

RESULTS

A total of 50 sites of focal hepatic uptake without CT correlate were identified. Median SUVmax was 4.1 (range 2.1-10.1) and median SUVmax ratio of hepatic lesion/normal parenchyma was 1.3 (range 0.98-2.6). MRI confirmed focal lesion in 26/50 sites (52%). Median lesion size was 13 mm (range 3-30 mm). Among 26 hepatic lesions noted on MR imaging, 77% (20/26) were diagnosed as metastatic disease (6 with pathological confirmation, 14 based on follow-up image findings). Other 6 lesions were diagnosed as benign, including 3 with pathological diagnosis of nodular regenerative hyperplasia (n=2) and heterogenous hepatic steatosis (n=1). There was no significant difference in the SUVmax of hepatic lesions (3.85 vs. 4.2, p=0.5) and the SUVmax ratio (1.32 vs. 1.31, p=0.97) between the groups with and without MRI correlate.

CONCLUSION

More than half of focal areas of uptake on PET/CT without CT correlate had a focal lesion on MRI in our study, and more than three-quarters of these MRI lesions were hepatic metastases, regardless of SUVmax values.

CLINICAL RELEVANCE/APPLICATION

In patients with known malignancy, focal FDG uptake in the liver without CT correlate warrants further assessment with MRI regardless of SUVmax as it is likely to be metastasis.

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/ Sreeharsha Tirumani, MBBS, MD - 2016 Honored EducatorNikhil H. Ramaiya, MD - 2017 Honored EducatorAtul B. Shinagare, MD - 2017 Honored Educator

SSG09-03 Focal Colonic Tracer Uptake in 18F-FDG PET/CT Scans: Does the Combined Analysis of Morphological Changes and PET Improve Lesion Characterization?

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S505AB

Participants
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PURPOSE

To evaluate the impact of morphological information derived from contrast enhanced CT on the characterization of incidental, focal colonic uptake in 18F-fluordesoxyglucose positron emission tomography / computed tomography (18F-FDG PET/CT) examinations.

METHOD AND MATERIALS

In this retrospective study, 125 patients (female: n=53, male: n=72, mean age 62.9y) that underwent 18F-FDG PET/CT and colonoscopy (mean time between colonoscopy and PET: 52±58d) were included. By two readers, PET/CT examinations were assessed for incidental, focal colonic tracer uptake in comparison to the background. Focal tracer uptake was correlated with morphological changes of the colonic wall such as focal thickening, polypous shape or focal contrast media uptake. Discrepancies were resolved in a consensus reading. Then, colonoscopy reports were evaluated for precancerous (oligo-tubular adenoma, serrated adenoma, sessile adenoma and tubulo-villous adenoma) and cancerous lesions verified by histopathology, serving as a reference standard. Imaging findings were then compared to the reference standard to calculate sensitivity, specificity as well as positive (PPV) and negative predictive values (NPV) for focal tracer uptake in PET alone as well as focal tracer uptake in PET and morphological changes in contrast enhanced CT in the detection of precancerous and cancerous lesions.

RESULTS

In 38.4% (48/125) of all patients, focal tracer uptake was observed in 67 lesions. In the corresponding colonoscopy reports, a total of 10 cancerous and 26 precancerous lesions were found. In PET, two cancerous lesions and 10 precancerous lesions were missed, resulting in a sensitivity, specificity, PPV and NPV of 51%, 68%, 29% and 84% for focal tracer uptake in PET alone. By correlation focal tracer uptake with morphological changes in contrast enhanced CT, a sensitivity, specificity, PPV and NPV of 48%; 79%; 37,5%; 86% for precancerous and cancerous lesions could be observed.

CONCLUSION

Focal colonic tracer uptake has a low specificity and sensitivity for precancerous and cancerous lesions. By analyzing additional morphological changes in contrast enhanced CT imaging in 18F-FDG PET/CT examinations, the specificity can be increased without sacrificing sensitivity.

CLINICAL RELEVANCE/APPLICATION

Morphological changes in 18F-FDG-PET/CT examinations help to decide, which patients with focal tracer uptake will profit from additional colonoscopy.

SSG09-04 Clinical Workflow of PET/MR for Primary Staging of Rectal Cancer

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S505AB

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PURPOSE

analyze the clinical workflow of a PET/MR for rectal cancer staging, regarding MR imaging protocol, total scan time, prevalence and distribution of metastasis.

METHOD AND MATERIALS

55 patients with rectal adenocarcinoma were submitted to whole-body PET/MR for primary staging. MR sequences and total scan time were recorded. One reader analyzed the MR (blinded to PET findings) for locoregional staging. Another reader (blinded to the high-resolution MR of the pelvis) analyzed the PET/MR according to T, N and M staging. A third blinded reader analyzed only the liver MRI. Standard of reference was biopsy when feasible or imaging follow-up.

RESULTS

PET/MR workflow consisted of a dedicated pelvic MR, including high-resolution T2w and DWI, followed by whole-body PET/MR from head to mid thigh, ending with a T2w and DWI of the liver. Any dedicated MR sequence was used for the thorax. The mean total acquisition time of PET/MR was 64 minutes, ranging from 53 to 90 minutes. The PET acquisition time was on average 17 minutes, ranging from 12 to 25 minutes and the only-MR time was 52 minutes on average, including the dedicated pelvic and the liver sequences. One patient has not completed the exam due to claustrophoby and one patient was recalled due to low imaging quality (movement artifacts). For primary lesion detection, PET and DWI were positive in 54 out of 55 patients (one patient was negative even at MR). Metastatic disease was observed by PET/MR in 21 (38.2%) patients, mainly in the liver (12/21, 57.1%) non-regional lymph node (10/21, 47.6%), lungs (7/21, 33.3%) and peritoneum (1/21, 4.8%). Liver DWI detected 64 lesions in 12 patients and PET detected 62 lesions in the same 12 patients. Any brain metastasis was found.

CONCLUSION

PET/MR for rectal cancer staging is feasible, with a tolerable scan time and showing a high incidence of synchronic metastasis. DWI of the liver and of the rectum could be omitted in a staging/detection setting. PET coverage could start from skull base instead of vertex. Optimization of MR protocol would decrease scan time and allow the inclusion of other MR sequences.

CLINICAL RELEVANCE/APPLICATION

PET/MR for rectal cancer may be used clinically as a one-stop-shop imaging tool for whole-body staging.

SSG09-05 PET/MR for Staging Rectal Cancer: A Comparison to Conventional Staging with Pelvic MR and Thoracoabdominal CT

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S505AB

Participants
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PURPOSE

To compare the detection rate of metastatic lesions on PET/MR versus conventional staging (pelvic MR and thoracoabdominal CT) in rectal cancer patients referred for primary staging.

METHOD AND MATERIALS

Ninety-five patients with biopsy proven rectal adenocarcinoma were submitted to whole-body PET/MR for primary staging in addition to conventional staging with pelvic MR and thoracoabdominal contrast-enhanced CT (ceCT). One reader analyzed the MR (blinded to PET findings) regarding locoregional staging. Another reader (also blinded to the high-resolution part of pelvic MR) analyzed the PET/MR about T-, N- and M-stage. A third blinded reader assessed the M-stage by ceCT. Standard of reference was biopsy when feasible or imaging follow-up. Lesions were cateogrized as positive, negative or indeterminate.

RESULTS

On a lesion-based analysis, PET/MR detected 24.5% more positive metastatic lesions than conventional imaging (305 vs. 254 lesions). The higher detection rate on PET/MR was observed for non-regional lymph nodes (73 vs. 37 lesions). On a patient-based, PET/MR was positive in 38 out of 95 patients (40%), while conventional staging in 24 out of 95 patients (25.3%). PET/MR was indeterminate in 7 patients (7.4%), which 1 was positive on CT (non-regional lymph nodes, later confirmed to be sarcoidosis), while conventional imaging was in 30 patients (31.6%), which 10 were positive on PET/MR, mainly for non-regional lymph nodes and liver.

CONCLUSION

For rectal cancer staging, PET/MR presents not only a higher detection rate of metastatic lesions than conventional imaging (pelvic MR and thoracoabdominal ceCT), but also clarifies the etiology indeterminate lesions.

CLINICAL RELEVANCE/APPLICATION

PET/MR might be preferred for whole-body staging of rectal cancer patients, with a higher detection rate and potential clinical impact.

SSG09-06 Diagnostic Performance of PET/MR in Identifying High-Risk Primary Rectal Cancer Patients

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S505AB

Participants
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PURPOSE

to assess the diagnostic performance of PET and MR parameters to identify high-risk rectal cancer patients.

METHOD AND MATERIALS

fifty-three patients with biopsy proven rectal adenocarcinoma were submitted to whole-body PET/MR for primary staging. One reader analyzed the MR (blinded to PET findings) regarding T stage, mesorectal fascia involvement, extramural vascular invasion, and presence of locoregiona nodal disease. Another reader (also blinded to the high-resolution part of pelvic MR) measured the semiquantitative PET parameters using a dedicated software (PETVCAR, GE Healthcare) and assessed the M stage. Standard of reference was biopsy when feasible or imaging follow-up. Mann-Whitney test was performed to compare PET parameters between high and low-risk patients. ROC analysis was also used to define the diagnostic perfomance of PET parameters in identifying the tumor risk.

RESULTS

PET-volumetric parameters, namely TLG and MTV, performed better than SUVmax and mean to distinguish low and high-risk patients. MTV (48.9 vs. 18.4, p = 0.006) and TLG (629.4 vs. 190.4, p = 0.008), but not SUVmax (23.4 vs. 19.2, p = 0.306) or SUVmean (11.7 vs. 9.9, p = 0.285) were significantly higher in high-risk patients. Patients with advanced T stage, positive regional node and metastatic disease also presented significantly higher MTV and TLG values. No difference was found in any PET parameters in patients according to the involvement of mesorectal fascia and presence of EMVI. The AUC to distinguish low and high-risk patients was 77.9% (p = 0.006) for MTV and 77.0% (p = 0.008) for TLG and the best cut-off value (sensitivity of 83.7% and specificity of 70%) of MTV and TLG to detect high-risk patients was 16.1 and 172.8, respectively.

CONCLUSION

In addition to MR adverse risk factors, the volumetric-based PET parameters (MTV and TLG) allow the identification of high-risk patients, which could tailor therapy management.

CLINICAL RELEVANCE/APPLICATION

PET/MR provides morphologic and metabolic parameters to identify high-risk rectal cancer patients that need more detailed staging in a whole-body setting. The volumetric-based PET parameters (MTV and/or TLG) might be included in clinical reports instead of SUVmax.

SSG09-07 PET/MR Characterization of Mucinous versus Nonmucinous Components of Rectal Adenocarcinoma: A Comparison of Tumor Metabolism and Cellularity

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S505AB

Participants
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PURPOSE

to analyze the relation of mucinous component of rectal adenocarcinoma to FDG avidity and diffusion restriction.

METHOD AND MATERIALS

ninety-four patients with biopsy proven rectal adenocarcinoma were submitted to whole-body PET/MR for primary staging. One reader analyzed the MR (blinded to PET findings) regarding locoregional staging, including the presence of mucinous component. Another reader (also blinded to the high-resolution part of pelvic MR) analyzed the PET/MR according to T, N and M staging. Two different readers drawn in consensus the volume of interest (VOI) larger than 0.5 cmCubed of the mucinous component (MC) and the non-mucinous component (NMC) of the primary tumor on high-resolution T2w sequence and propagated the VOI to PET, DWI and ADC. SUVmax, SUVmean, TLG, MTV, ADCmax, ADCmean and ADCmin values were recorded and compared using Mann-Whitney test.

RESULTS

Seventeen patients (18.1%) presented MC on MRI. The SUVmax and SUVmean of the NMC were significantly higher than of the MC (16.7 vs. 7.4, p = 0.002 and 13.4 vs. 5.4, p = 0.001). Any of the ADC values was significantly different between MC and NMC groups.. Among the 17 patients with MC, 16 (94.1%) were at least mrT3b, 15 (88.2%) presented positive extramural vascular invasion, 14 (82.4%) had involvement of mesorectal fascia, 13 (76.5%) were N-positive and 8 (47.1%) presented distant metastasis, reinforcing the correlation of MC and tumor risk.

CONCLUSION

The MC identified on PET/MR presents lower glycolytic metabolism than the NMC and is associated with high tumor risk. Tumor cellularity was not different between MC and NMC.

CLINICAL RELEVANCE/APPLICATION

PET/MR enables a conspicuous correlation of mucinous component and tumor metabolism. Imaging readers should be aware of this pattern, recognizing that both primary and metastatic disease of mucinous tumors present low FDG uptake.

SSG09-08 Comparative Accuracy of Qualitative and Quantitative 18F-FDG PET/CT Analysis in Detection of Lymph Node Metastasis from Anal Cancer

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S505AB

Awards
Student Travel Stipend Award

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PURPOSE

To evaluate the diagnostic performance of qualitative and quantitative FDG PET combined with CT in detection of regional and distant lymph node metastases in patients with anal cancer

METHOD AND MATERIALS

In this IRB approved retrospective study between January 2000 and December 2017, a total of 29 patients (F/M;17/12), mean age 59.9±13.7 (15-95) with anal cancer who had staging PET/CT and pathological analysis of suspicious lymph nodes were included for qualitative and quantitative analysis. For qualitative analysis, the positive lymph nodes were defined as uptake close to or higher than the liver background. For quantitative study, lymph nodes were contoured using the 3D region of interest (ROI) to determine the maximum standard uptake value (SUVmax) and metabolic tumor volume (MTV). Receiver operating characteristic (ROC) curves were analyzed to extract the optimal cut-off values of SUVmax, lesion to background (L/B) ratio, short axis diameter (SAD) and MTV of the lymph nodes. Histopathologic analysis was the reference standard.

RESULTS

A total of 29 lymph nodes (25 inguinal, 2 external iliac, 1 internal iliac and 1 paraaortic nodes) in 29 patients on PET/CT were included for analysis. For qualitative visual analysis, PET/CT interpreted 27 patients as positive for the presence of nodal metastases with sensitivity, specificity and accuracy of 1, 0.25 and 0.79. The optimal cut-off values of SUVmax and L/B ratio were 2.51 and 1.13 with sensitivity and specificity of 0.91, 0.75 and area under the ROC curve (AUC) of 0.863 (95%CI:0.685,0.962) for SUVmax and 0.887 (95%CI:0.714,0.974) for L/B ratio. Using a best discriminative cut-off value 1.5 cm for SAD and 3.53 cm3 for MTV, the sensitivity and specificity were 0.81 and 1 with AUC of 0.952 (95%CI:0.803,0.997) for SAD and 0.935 (95% CI:0.777,0.993) for MTV. If we used the optimal cut-off value of either SUVmax or SAD, the sensitivity will increase to 0.95 (95%CI:0.76,0.99) with a specificity of 0.75 (95%CI:0.35,0.97).

CONCLUSION

Quantitative analysis of lymph node metastases in patients with anal cancer obtained with SUVmax, L/B ratio, nodal size and MTV are more specific and accurate than those performed with qualitative analysis but slightly less sensitive.

CLINICAL RELEVANCE/APPLICATION

The presence of nodal metastasis is crucial for treatment planning. Inguinal nodes with gross nodal involvement will receive a booster dose. Distant metastasis will change the chemotherapy regimen.

SSG09-09 68Ga-DOTATATE PET/CT as a Predictive Marker for 177Lu-DOTATATE Therapy

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S505AB

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PURPOSE

Lutetium-177 (177Lu)-DOTATATE has shown significant promise in patients with somatostatin receptor positive neuroendocrine tumors (NETs). Here we report our preliminary experience with the use of 68Ga-DOTATATE PET/CT as a predictive marker for outcomes with 177Lu-DOTATATE therapy.

METHOD AND MATERIALS

Fifteen patients with progressive metastatic NETs were enrolled at our institution on the Expanded Access Program for 177Lu-DOTATATE. Pre-treatment 68Ga-DOTATATE PET/CT scans were performed in all patients. A retrospective analysis of these PET/CT scans was performed for tumor burden. Indices measured include maximal SUV uptake (SUVmax) and total SUV uptake (SUVtotal), which is the sum of 68Ga-DOTATATE uptake by all the lesions in one patient's PET scan. Tumor burden is the sum of all tumor volumes. These measurements were correlated with progression-free survival.

RESULTS

Of the 15 enrolled patients, six completed all four 177Lu-DOTATATE infusions, and 9 patients completed 3 or fewer infusions. Median progression-free survival is 80% at 12 months from the date of enrollment. The pre-treatment 68Ga-DOTATATE PET/CT demonstrated well-differentiated NETs and wide-spread metastases in all 15 patients, with liver, lymph nodes and bone being the most common sites. Our data showed a larger tumor burden (1824 ml vs. 748 ml) and higher SUVtotal (636 thousand vs. 186 thousand) in deceased patients vs. patients with stable disease, while SUVmax had the opposite trend (36.5 vs. 51.0).

CONCLUSION

It may be possible to metrics from the pre-therapy 68Ga-DOTATATE PET/CT to predict outcomes of 177Lu-DOTATATE in patients with metastatic NET. While the results are encouraging, larger cohorts are needed to establish 68Ga-DOTATATE PET/CT based predictive factors for progression-free survival.

CLINICAL RELEVANCE/APPLICATION

68Ga-DOTATATE PET/CT could serve as a clinical predictor for response to 177Lu-DOTATATE.

SSG10

Neuroradiology (Brain Tumors: Looking Beyond the Obvious)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: E353A

MR NR

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

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSG10-01 Improves Diagnostic Value of Pseudoprogression in Early Post-Treatment Glioblastomas: Multiparametric Radiomics Analysis with Diffusion- and Perfusion-Weighted MRI

Tuesday, Nov. 27 10:30AM - 10:40AM Room: E353A

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PURPOSE

Diagnosis of pseudoprogression (PsP) is a challenging issue for glioblastoma patients in their early post-treatment state. We developed a multiparametric radiomics model using diffusion- and perfusion-weighted MRI and externally validated to facilitate the diagnosis.

METHOD AND MATERIALS

Patients with glioblastomas within 3 months followed by Stupp protocols were reviewed and 61 consecutive patients exhibiting enlarging contrast enhancing masses on MRI were enrolled (PsP = 26). 6472 multiparametric radiomic features were extracted from post-contrast T1-weighted, FLAIR images, ADC and CBV maps. Imaging features were selected using the least absolute shrinkage and selection operator logistic regression model and redundant features were removed. The performance of radiomics model was calculated using the area under the receiver operating characteristics curve (AUROC) and compared with histogram parameters of ADC (ADC10) and CBV (CBV90). To improve validity, the multiparametric radiomics model was tested in an external data set with histopathologic confirmation (n = 34).

RESULTS

Twelve significant radiomic features (1 from post-contrast T1-weighted, 2 from FLAIR, 2 from ADC, and 7 from CBV maps) were selected to construct the radiomics model. The multiparametric radiomics model (AUROC 0.90, 95% confidence interval [CI] 0.82-0.98) showed significantly better diagnostic performance of pseudoprogression than any single parameter of ADC10 (AUROC 0.70, CI 0.46-0.76) or CBV90 (AUROC 0.61, CI 0.66-0.88), and outperformed than a conventional radiomics model using post-contrast T1-weighted and FLAIR only (AUROC 0.76, CI 0.63-0.88). The multiparametric radiomics model also showed better diagnostic performance in the external validation (AUROC 0.85, CI 0.71, 0.99) than single parameters (AUROC 0.43-0.50) and a conventional radiomics model (AUROC 0.74, CI 0.67-0.97).

CONCLUSION

The multiparametric radiomics model improved diagnostic performance for diagnosing pseudoprogression in glioblastoma patients in their early post-treatment state and showed robustness in multi-center setting.

CLINICAL RELEVANCE/APPLICATION

Pseudoprogression is a diagnostic challenge in neuroradiology, especially in their early post-treatment state of less than 3 months followed by Stupp protocols for glioblastoma patients. Multiparametric radiomics model has good generalizability with improved diagnostic performance, which augments the role of diffusion and perfusion MRI.

SSG10-02 Immune Checkpoint Inhibitors Against Glioblastoma: Imaging Assessment of Therapy Response

Tuesday, Nov. 27 10:40AM - 10:50AM Room: E353A

Participants
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PURPOSE

Immunotherapeutic strategies are increasingly pursued as upfront and salvage therapies in glioblastoma. Early results with vaccine trials have shown a subset of patients achieve radiographic response, develop stable disease, or have enhanced survival despite early worsening of imaging findings. Here, we assess the imaging findings and outcomes in a cohort of glioblastoma patients treated with immune checkpoint inhibitors.

METHOD AND MATERIALS

We analyzed MR imaging from twenty-nine patients with newly-diagnosed or recurrent glioblastoma treated with immune checkpoint inhibitors. Morphologic and physiologic MR imaging characteristics including diffusion and perfusion imaging were evaluated and clinical outcomes were assessed. Relevant histopathology from sampled tissue was also evaluated.

RESULTS

The majority (20, 69%) of patients on immune checkpoint inhibitors developed early radiographic progression of disease within six months of starting therapy. Of those, seventeen (59%) developed definitive progressive disease radiographically or clinically at follow-up. Eight patients underwent re-resection with pathologic confirmation of progression or treatment related changes. Progressive disease was related to increasing volume of FLAIR signal abnormality, decreased normalized apparent diffusion coefficient, and increased cerebral blood flow ($p<0.05$). Patients with recurrent glioblastoma developed marked early progression with significantly shorter progression free survival compared to newly diagnosed glioblastoma ($p=0.02$). While commonly observed imaging patterns of progression included disseminated leptomeningeal and subependymal disease, particularly in cortex and subventricular zone positive tumors, no significant survival difference was found when stratifying by tumor location.

CONCLUSION

In this retrospective study, glioblastoma treated with immune checkpoint inhibitors was often found to demonstrate early radiographic progression of disease with unique patterns of progression. These findings provide an initial insight into the imaging of glioblastoma treated with immune checkpoint inhibitors and highlight the role of imaging in patient selection and therapeutic response assessment.

CLINICAL RELEVANCE/APPLICATION

Immunotherapy is expected to play an ever-expanding role in glioblastoma treatment. Familiarity with radiographic findings following immunotherapy for glioblastoma is paramount for patient care.

SSG10-03 Virtual and Augmented Reality Helps in Pre-Operative Planning of Brain Tumors

Tuesday, Nov. 27 10:50AM - 11:00AM Room: E353A

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PURPOSE

To compare virtual reality (VR) and augmented reality (AR) in the pre-operative planning of complex glioma cases.

METHOD AND MATERIALS

After obtaining IRB approval, the clinical MRI exams of 1,250 cases of adult cerebral hemispheric gliomas of all histologic types were examined and characterized. Complex cases were evaluated in 3D with VR and AR using Anatom-e (Houston, TX).

RESULTS

We found that VR which works with a computer screen and a headset in a closed 'purely virtual' environment is a robust technology. It was helpful in pre-operative planning,which included mapping out the gyral anatomy, arteries, veins, as well as tumor infiltration patterns. However, at this time, this technology can only be used by a single user. AR technology is rapidly evolving. AR uses a clear goggle system which allows the user to see his/her 'real' environment and overlays holographic images onto the patients MR imaging. When used, we found AR was superior to VR in anatomy and tumor display. AR is also capable of being shared by multiple viewers, which is of value in communicating with the surgeon and consultation with other colleagues in real time. However, AR is currently not stable enough for consistent use in clinical cases. AR has the potential to be used intraoperatively, by fusing holographic images to the patient's own brain during surgery.

CONCLUSION

Both VR and AR are innovative alternatives to analyse complex glioma cases for pre-operative planning. At this time, VR is superior to AR, as it is better established and a stable platform. However, as technology advances, AR will likely overtake VR for pre-operative planning of brain tumors.

CLINICAL RELEVANCE/APPLICATION

Continued development of technologies such as VR and AR are needed to advance neuroimaging and surgical planning.

SSG10-04 Simultaneous Permeability Measurements Using Dynamic Susceptibility Contrast Imaging Enhances Differential Diagnosis of Primary Central Nervous System Lymphoma from Glioblastoma

Tuesday, Nov. 27 11:00AM - 11:10AM Room: E353A

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PURPOSE

Simultaneous perfusion and permeability measurements become feasible with tissue-residue function based leakage correction in dynamic susceptibility contrast MRI (DSC MRI). We aimed to test whether estimates of adding permeability parameters obtained from single short acquisition of DSC-MRI improves diagnostic performance for distinguishing primary central nervous system lymphoma (PCNSL) from glioblastomas.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. Total 145 patients with pathologically proven glioblastomas (n=89) and PCNSL (n=56) were enrolled. Two post-processing methods were used to calculate leakage corrected cerebral blood volume (CBV), using Weisskoff-Boxerman method (normalized CBV, nCBV) and tissue residue function-based method (CBVres). Vascular permeability parameter of extraction fraction (EF) was further calculated with the latter. Diagnostic performance to distinguish PCNSL from glioblastoma was calculated for CBVs and adding EF, using the area-under-the curve from the receiver operating characteristics curve (AUROC) and cross-validated with boot-strapping.

RESULTS

PCNSL demonstrated significantly higher EF (10.49 ± 6.89 %) and lower CBVs (nCBV, 3.13 ± 1.33; CBVres 3.23±2.51 relative units) compared to glioblastoma (EF, 4.30 ± 2.4 %; nCBV, 6.01 ± 4.1; CBVres, 6.45 ± 3.54 relative units, P < .001). Combined perfusion and permeability measurements significantly improved diagnostic performance (AUROC, 0.89; 95% confidence interval 0.84-0.94) to any single parameter of nCBV (AUROC 0.78, 0.71- 0.85, P =0.02) and CBVres (AUROC 0.80, 0.73-0.86, P<0.001), and performed better than EF (AUROC 0.83, 0.75-0.86).

CONCLUSION

Simultaneous perfusion and permeability measurement on single DSC MRI acquisition improved diagnostic performance in differentiating PCNSL from glioblastoma.

CLINICAL RELEVANCE/APPLICATION

Obtaining permeability parameters for brain tumor evaluation requires double gadolinium contrast injection, long imaging acquisition time and complex post-processing methods. Our results suggests that simultaneous perfusion and permeability parameters derived from a single DSC-MRI acquisition provided useful biomarker and improved diagnosis for differentiating PCNSL from glioblastomas.

SSG10-05 Arterial Spin Labeling for Glioma Grade Discrimination: Correlations with IDH1 Genotype and 1p/19q Status

Tuesday, Nov. 27 11:10AM - 11:20AM Room: E353A

Participants
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PURPOSE

To evaluate the diagnostic efficacy of perfusion values derived from arterial spin labeling (ASL) to grade gliomas. In addition, the correlation between perfusion parameters and isocitrate dehydrogenase 1 (IDH1) genotypes and 1p/19q status of gliomas were assessed.

METHOD AND MATERIALS

The institutional review board approved this retrospective study. From October 2015 to January 2018, a total of 53 cases of supratentorial gliomas in adults who received ASL magnetic resonance imaging were included. The cerebral blood flow (CBF) images derived from ASL and the anatomical maps were normalized to the Montreal Neurological Institute coordinate system and then matched. Both qualitative and quantitative analyses of CBF were performed. The mean and maximum CBF were obtained from the whole solid part and the largest perfusion area of the tumor, respectively. The relative values were calculated by dividing the CBF value of the contralateral grey matter area. The pathological results were diagnosed according to the 2016 WHO criteria.

RESULTS

Perfusion in the high-grade group was significantly higher than that in the low-grade group. The maximum CBF, the relative mean

CBF, and the maximum CBF, all showed statistical differences between the low and high-grade groups. Among all the parameters, relative maximum CBF showed the best diagnostic efficacy, with a cutoff value of 1.59, which yielded a sensitivity and specificity of 81% and 75%, respectively. The CBF qualitative analysis showed that the IDH1 mutant group tended to have lower perfusion than the IDH1 wild-type group, with a Phi and Cramer's V coefficient of 0.266. In the sample containing only diffuse astrocytoma, anaplastic astrocytoma, and glioblastoma, the relative mean and maximum CBF were significantly different between the IDH1 mutant and wild-type groups, and correlation analysis found that the Phi and Cramer's V coefficient was 0.395. There was no significant association between 1p/19q codeletion and the perfusion parameters.

CONCLUSION

ASL can offer accurate perfusion values to grade gliomas. There was a mild correlation between IDH1 genotypes and perfusion, and no significant association between 1p/19q status and perfusion of gliomas.

CLINICAL RELEVANCE/APPLICATION

The association between perfusion values from ASL and pathological grades and genotypes of gliomas might enhance the role of MR imaging in the clinical management and prognostic evaluation of gliomas.

SSG10-06 Diagnostic Performance of 2-hydroxyglutarate Magnetic Resonance Spectroscopy for Prediction of Isocitrate Dehydrogenase (IDH) Mutant Glioma: A Systemic Review and Meta-Analysis

Tuesday, Nov. 27 11:20AM - 11:30AM Room: E353A

Participants
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Ho Sung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We aimed to investigate the diagnostic performance of 2-hydroxyglutarate (2HG) magnetic resonance spectroscopy (MRS) for prediction of isocitrate dehydrogenase (IDH) mutant glioma.

METHOD AND MATERIALS

A systematic literature search of Ovid-MEDLINE and EMBASE was performed to identify original articles investigating the diagnostic performance of 2HG MRS for prediction of IDH mutant glioma up to March 20th, 2018. The pooled sensitivity and pooled specificity and their 95% CIs were calculated using a bivariate random-effects model and the coupled forest plot was obtained. Meta-regression was performed to explain the effects of heterogeneity.

RESULTS

Fourteen original articles in a total of 460 patients were included. IDH mutant gliomas consistently showed a significantly higher accumulation of 2HG compared to IDH wild-type gliomas. The pooled sensitivity and specificity for the diagnostic performance of 2HG MRS for prediction of IDH mutant glioma were 95% (95% CI, 85-98%) and 91% (95% CI, 83-96%), respectively. The area under the HSROC curve was 0.96 (95% CI, 0.94-0.98), which suggests high diagnostic performance. The Higgins I2 statistic demonstrated that heterogeneity was present in the sensitivity (I2 = 50.69%) whereas no heterogeneity was noted in the specificity (I2 = 30.37%). In meta-regression, MRS sequence and TE were associated with study heterogeneity. Among the studies using PRESS, studies using long TE (97 ms) showed higher sensitivity (92% [95% CI, 85-99%]) and specificity (97% [95% CI, 92-100%]) compared to studies using short TE (30-35 ms) (sensitivity of 90% [95% CI, 79-100%], specificity of 88% [95% CI, 83-93%]) ($p < 0.01$).

CONCLUSION

2HG MRS demonstrated excellent diagnostic performance for prediction of IDH mutant glioma

CLINICAL RELEVANCE/APPLICATION

Further validation and applying 2HG MRS to daily practice would be critical in glioma management.

SSG10-07 Preoperative Determination of Isocitrate Dehydrogenase Mutation in Gliomas Using Multiparametric MRI

Tuesday, Nov. 27 11:30AM - 11:40AM Room: E353A

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PURPOSE

To predict preoperatively IDH1 mutant status in gliomas using a multiiparametric approach based on tumor volume, presence of 2-hydroxyglutarate (2-HG), dynamic contrast-enhanced (DCE) and intravoxel-incoherant motion(IVIM) derived parameters.

METHOD AND MATERIALS

Patients with a suspicion of a glioma were prospectively enrolled before surgical resection. Each patient underwent a conventional MR examination with the addition of a spectral editing MRS (MEGA-PRESS), DCE-MR and IVIM. Parameters for the MEGA-PRESS sequence were: TR=2000ms, TE=60ms, 64 acquistions, voxel size=8cm3, duration=4.5min. 2-HG of the substracted MEGA-PRESS spectra was analyzed using jMRUI v5.2. ROIs were manually drawn around the whole tumour volumes on conventional MR images and superimposed onto the IVIM and DCE-derived parametric maps to measure volume transfer constant (Ktrans), fractional volume of blood plasma in tissue (Vp), apparent diffusion coefficient (D), pseudodiffusion coefficient (D*), and perfusion fraction(f). Sensitivity and specificity for the prediction of IDH status were calculated using immunohistochemistry as the gold standard.

RESULTS

A total of 45 patients were enrolled: 10 patients with IDH+ gliomas (4 Grade II, 6 Grade III); 35 patients with IDH- gliomas (1 Grade I, 5 Grade III, 29 Grade IV). IDH+ gliomas showed lower enhancing and necrotic volumes but higher non-enhancing volumes. IDH+ gliomas had lower values for Ktrans and Vp. There was no statistically significant difference in the IVIM parameters between the two groups. For differentitation between IDH- and IDH+ gliomas, sensitivity and specificity were 33% and 95% respectively for 2-HG measured from MRS, 89% and 71% respectively from enhancing tumour volume using a cut-off<3640mm3, 89% and 93% for mean Ktrans using a cut-off<0.004min-1, 89% and 64% for mean Vp using a cut-off<0.083%.

CONCLUSION

IDH+ gliomas showed higher non-enhancing tumour volume and lower Ktrans and Vp than IDH- gliomas. The majority of our patients were high grade gliomas, which are less likely to be IDH+. This may have led to the finding that IDH-tumours appeared to have higher vascularity.

CLINICAL RELEVANCE/APPLICATION

IDH status in patients with suspected gliomas can be predicted preoperatively using a multiparametric method combining conventional MRI, MRS and perfusion imaging.

SSG10-08 Glioblastoma versus Cerebral Metastases: Differentiation Using a Radiomic Evaluation on Post-Contrast 3DT1 MR Images

Tuesday, Nov. 27 11:40AM - 11:50AM Room: E353A

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PURPOSE

To evaluate the diagnostic performance of magnetic resonance (MR) texture analysis in differentiating glioblastoma (GBM) from cerebral metastases (MET) on post-contrast 3 dimensional T1 weighted sequences (3DT1).

METHOD AND MATERIALS

140 patients (70 individuals with GBM > 2cm diagnosed between January 2013 and March 2018 and 70 with cerebral MET > 2cm diagnosed between August 2010 and March 2018) were enrolled in this retrospective bicentric study. All patients had post-contrast 3DT1 sequence acquired on 3T MRI (GE Discovery 750w) with the same protocol. Segmentation of all tumoral lesions was performed semi-automatically on Olea Medical software and 42 radiomic features were computed using LIFEx freeware. As a part of radiomics analysis, texture analysis is a method of extracting quantitative features that evaluate specifically the spatial arrangement of gray levels in a volume to obtain more information about tumor heterogeneity. Patients were separated in training and validation sets for statistical analysis. Univariate analysis was first performed to select the most informative radiomic features. A multivariate regression was then realized to construct and validate a model predicting lesion type. Area under ROC curves (AUC) and p-values from Wilcoxon's test were calculated to evaluate the performance of each classifier.

RESULTS

According to univariate analysis realized on the training set (GBM: N = 46, MET: N = 46), 6 textural features were statistically significant (p<0.00001, for 3 features; p<0.001, for 3 features). The mean AUC of the multivariate radiomics classifier combining 3 textural features from gray level zone-length and co-occurrence matrices was 0.854 (95% CI 0.77-0.93). These results are to be confirmed on the validation set which is still in process.

CONCLUSION

Texture analysis on post-contrast 3DT1 MR images is useful to differentiate cerebral MET and GBM. The implementation of this method for automatic characterization of tumoral lesions in clinical software would have a strong impact in the management of patients.

CLINICAL RELEVANCE/APPLICATION

Glioblastoma and cerebral metastases are the most frequent malignant brain tumors. Texture analysis is an objective tool to differentiate these 2 diseases which have different therapeutic strategies.

SSG10-09 Deep Learning-Based Analysis of Quantitative MRI Features to Identify IDH-Mutant Glioblastoma Multiform

Tuesday, Nov. 27 11:50AM - 12:00PM Room: E353A

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PURPOSE

Glioblastoma multiforme (GBM) is the most common primary brain tumor in adults and carries a poor prognosis with a median survival of less than 2 years. Recent studies have shown that GBMs harboring mutations in isocitrate dehydrogenase (IDH) are associated with improved survival, and may benefit from maximal resection including the non-enhancing tumor component. Unfortunately, IDH status is sometimes only available after resection. The purpose of this study is to evaluate quantitative MRI based imaging features that can be used to identify IDH-mutant GBMs on preoperative imaging.

METHOD AND MATERIALS

We analyzed preoperative MR images from 13 patients with pathologically proven IDH-mutant GBMs and 99 patients with IDH-wildtype GBMs. The MRI protocol included T1, T2, FLAIR, and post-contrast T1 images, in addition to 55-direction diffusion tensor imaging. A convolutional neural network-based deep learning algorithm was used to generate automated volumetric segmentation of the three key components of GBM that are seen on MRI: enhancing tumor core, non-enhancing tumor, and necrosis. Tumor compartment volume fractions and DTI parameter values were compared between IDH-mutant and wildtype GBMs.

RESULTS

IDH-mutant GBMs demonstrated lower enhancing tumor fraction compared to wildtype GBMs, as well as lower volume ratios of enhancing to non-enhancing tumor and enhancing tumor to necrosis ($p < 0.05$ with Bonferroni correction). IDH-mutant GBMs also had higher average apparent diffusion coefficient within the necrotic region, consistent with the clinical observation that these tumors often have heterogeneous and/or cystic non-enhancing components; however, this difference was not significant after Bonferroni correction.

CONCLUSION

In this small retrospective study, IDH-mutant GBMs demonstrated statistically significant differences in enhancing tumor fraction compared to IDH-wildtype GBMs. These findings are in line with the theory that IDH-mutant GBMs represent secondary GBMs that develop from lower grade gliomas. Our work suggests that deep-learning based quantitative image analysis may be useful for distinguishing IDH-mutant GBMs on preoperative imaging.

CLINICAL RELEVANCE/APPLICATION

IDH-mutant GBMs are associated with increased survival and may benefit from maximal resection. Analysis of unique imaging features may help radiologists identify this tumor type on preoperative MRI.

SSG11

Neuroradiology (Molecular Neuroimaging: From Diffusion to Beyond)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: E351

MR MI NR

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

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSG11-01 Subtype Diagnosis in Sporadic Creutzfeldt-Jakob Disease with Diffusion Magnetic Resonance Imaging: A Study of 706 Patients with Definite Pathology

Tuesday, Nov. 27 10:30AM - 10:40AM Room: E351

Participants
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PURPOSE

The two aims of this study are i) to measure DWI diagnostic reliability and compare it with that of CSF tests (i.e. RT-QuIC, 14-3-3 and tau); ii) to build a decision algorithm to diagnose sCJD subtypes using the MRI lesion profile obtained by DWI without and with codon 129 polymorphism (obtained with a blood test).

METHOD AND MATERIALS

A total of 1212 patients were recruited in this prospective study as part of a MRI consulting program. At autopsy the diagnosis of sporadic Creutzfeldt-Jakob disease (sCJD) was confirmed in 556 and ruled out in 150 patients. 506 patients were excluded because they are still alive or were lost to follow-up. A neuroradiologist blind to the diagnosis scored the DWI. A semi-quantitative method based on a four-point (0-3) ordinal scale was implemented to grade the hyperintensities of the DWI in 12 specific brain regions.To assess the inter-rater reliability (IRR) of the scoring system, other two neuroradiologists blind to final diagnosis scored DWI of 150 subjects. We measured the DWI diagnostic reliability in 706 patients, then we compared it with those of CSF tests in a subset of 399 patients (339 sCJD and 60 non prion) that had undergone MRI, 14-3-3 and tau tests. To predict the sCJD subtype with the MRI lesion profile, we built an algorithm in the form of a decision tree.

RESULTS

The overall diagnostic reliability of DWI in 706 patients was 0.94 sensitivity and 0.97 specificity. The IRR among the three neuroradiologists was excellent (above 0.80) in 10 over 12 brain regions. Furthermore, in the subset of 399 patients the sensitivity and specificity of DWI (0.94 and 0.97) surpassed those of 14-3-3 (0.84 and 0.34) and tau (0.87 and 0.63). The decision algorithm produced 9 distinct MRI phenotypes that characterized the five sCJD pure subtypes. Key steps in the algorithm are the presence of DWI hyperintensity in the neocortex, striatum, thalamus and cerebellum. The accuracy in predicting the correct subtype was about 0.62 and increased to 0.90 if the codon 129 polymorphism was considered.

CONCLUSION

Diagnostic reliability of MRI for the early diagnosis of sCJD is excellent. The study also provides the neurologists with a diagnostic algorithm for subtype identification at the patient's bedside.

CLINICAL RELEVANCE/APPLICATION

Diffusion MRI is an excellent test for diagnosis of sCJD. Subtype diagnosis with MRI may help to determine prognosis and direct therapies when they will become available.

SSG11-02 Comparative Analysis of Diffusion Kurtosis Imaging, Diffusion Tensor Imaging, and Diffusion

Weighted Imaging in Grading and Assessing Cellular Proliferation of Meningiomas

Tuesday, Nov. 27 10:40AM - 10:50AM Room: E351

Participants
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PURPOSE

To prospectively evaluate and compare diffusion kurtosis imaging (DKI), DTI and DWI metrics in determining the grade and cellular proliferation of meningiomas.

METHOD AND MATERIALS

Consecutive 96 patients with histopathologically confirmed meningiomas were included in this study. Mean kurtosis (MK), radial kurtosis (Kr), axial kurtosis (Ka), fractional anisotropy (FA), mean diffusivity (MD), and ADC were semi-automatically obtained in the solid components of tumors. Each normalized diffusion value was compared between high-grade meningiomas (HGMs) and low-grade meningiomas (LGMs) by using the Mann-Whitney U test. Receiver operating characteristic, multiple logistic regression, and Pearson correlation analysis were used for statistical evaluations.

RESULTS

DKI metrics (MK, Kr, and Ka) were significantly higher in HGMs than in LGMs ($P <= .001$). MD and ADC were significantly lower in HGMs than in LGMs ($P < .003$, and $= .002$). MK had significantly greater area under curve values than MD and FA in differentiating HGMs from LGMs ($P = .038$, and .002). MK was the only variable that could be used to independently differentiate HGMs and LGMs ($P < .001$). Significant correlations were found between Ki-67 labeling index and kurtosis metrics ($P < .001$), as well as for MD and ADC ($P = .004$, and .007).

CONCLUSION

In conclusion, diffusion techniques, including DKI, DTI and DWI, were useful in grading meningiomas. Moreover, MK demonstrated a better diagnostic efficiency than DTI metrics and was most closely associated with the grade of meningiomas. In addition, diffusion metrics showed great potentials in reflecting the cellular proliferation of meningiomas.

CLINICAL RELEVANCE/APPLICATION

Compared with other diffusion metrics, MK may serve as an optimal parameter for evaluating and predicting the grade of meningiomas. Moreover, diffusion metrics may potentially reflect the cellular proliferation.

SSG11-03 Event-Based Model of Diffusion MRI Shows that sCJD Strains Have Similar Epicenter but Different Lesion Propagation in the Brain

Tuesday, Nov. 27 10:50AM - 11:00AM Room: E351

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PURPOSE

Sporadic Creutzfeldt-Jakob (sCJD) is a very heterogeneous prion disease with five subtypes or strains that have different clinical presentation and survival times. We tested the hypothesis that different subtypes have different path of lesion propagation in the brain. This study aimed at modeling the DWI signal abnormalities spreading in 5 pure strains, in order to determine the epicenter (starting point) and the sequence of propagation of prion lesions in 12 brain regions.

METHOD AND MATERIALS

We considered a novel data-driven model, the event-based model (EBM), recently introduced to study the evolution of Alzheimer's and Huntington's diseases. The EBM describes the disease progression as a sequence of events, defined as the switching from a normal to an abnormal state for a biomarker of a patient. Considering a set of 12 events related to the appearance of DWI hyperintensity in 12 specific brain regions, the EBM finds the most likely sequence of DWI abnormalities given the observed DWI measurements of the subjects. A neuroradiologist blind to the pathological diagnosis visually scored the DWI of 306 patients with definite autopsy diagnosis of sCJD subtype and 123 patients with rule-out diagnosis of prion disease. An ordinal scale (0-3) was implemented to visually score the images and grade the DWI hyperintensities in 12 brain regions. Patients with 5 sCJD pure subtypes were included: MM/MV1 (n=89), MM/MV2C (n=42), MV2K (n=22), VV1 (n=15) and VV2 (n=49). The EBM sequences were based on cross-sectional data and their longitudinal consistency was validated comparing the stages at follow-ups with the baseline.

RESULTS

Results showed that the 5 sCJD strains have different sequence of lesion propagation. The anterior cingulate cortex was affected very early in all strains. Then, three propagation trajectories emerged from the orderings: neocortex is affected before striatum in MM/V1 and MM/V2C; striatum is affected before neocortex in VV2 and MV2K; limbic regions are affected before neocortex and striatum in VV1.

CONCLUSION

The EBM is a good model to determine DWI signal abnormality propagation in the brain. The 5 main sCJD strains share the epicenter but have a different path of lesion propagation in the brain.

CLINICAL RELEVANCE/APPLICATION

EBM provided for the first time data-driven models of spreading of DWI signal hyperintensities in sCJD subtypes. This result may have an impact on patient management and clinical trials.

SSG11-04 Q-Space Trajectory Imaging to Untangle the Source of Microstructural Abnormalities in Schizophrenia Subjects

Tuesday, Nov. 27 11:00AM - 11:10AM Room: E351

Participants
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PURPOSE

To untangle the microstructural sources of white matter abnormalities that are commonly identified in schizophrenia patients by using q-space trajectory imaging (QTI) that separates abnormalities into three microstructural domains: orientation coherence (Cc), size variance (CMD) and microscopic anisotropy (Cμ).

METHOD AND MATERIALS

QTI was measured with tensor-valued diffusion encoding (b-tensors), using non-conventional gradient waveforms, on a 3T MAGNETOM Prisma scanner (Siemens Healthcare GmbH). b-tensors were shaped as sticks, planes and spheres (b=0, 50, 250, 500, 1000, and 2000 s/mm2), totaling 95 volumes. Resolution was 2x2x4 mm3, 35 slices, TE=145ms, TR=6500ms, in 12:54 minutes. Participants were 21 inpatient subjects suffering from SZ (4F/17M; mean age 34.9), and 18 controls (4F/14M; mean age 32.6). All participants provided informed consent, and the study was approved by the local institutional review board. The QTI analysis yielded four measures: Cμ , Cc, CMD and macroscopic anisotropy (CM) which is proportional to Diffusion Tensor Imaging (DTI) Fractional Anisotropy (FA). Images were registered to MNI space and FA was used to extract the white matter skeleton, on which the four measures were projected, averaged and group compared using a general linear model with age and gender as covariates.

RESULTS

Significantly lower FA (p=0.038) in SZ subjects was explained by a significant decrease in microscopic anisotropy, Cμ. Differences in orientation coherence, Cc, were not significant (p=0.445), and an increase in size variance, CMD, did not reach significance threshold (p=0.115).

CONCLUSION

We disentangle DTI's FA differences into three domains, showing that the reduction of FA is best explained by a reduction of microscopic anisotropy in white matter rather than increased orientation dispersion, or size variability. Since microscopic anisotropy describes the shapes of microenvironments, regardless of orientation (e.g., dispersion), macroscopic arrangement (e.g., crossing fibers), and size variability (e.g., partial volume) our results suggest that in this population of SZ patients the microstructural shape of white matter is altered, which supports an interpretation of axonal degeneration or demyelination.

CLINICAL RELEVANCE/APPLICATION

Untangling microstructural abnormalities helps identifying underlying pathologies in brain disorders with potentially co-occurring pathologies such as schizophrenia.

SSG11-05 Diffusion Tensor Imaging of Human Optic Nerve Observes Gaze Evoked Changes

Tuesday, Nov. 27 11:10AM - 11:20AM Room: E351

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PURPOSE

Several disorders affect the optic nerve (ON) that are potentially life- and sight threatening. Disorders such as papilledema and ischemic optic neuropathy result in changes to the peripapillary basement membrane caused by ON abnormalities; changes are known to vary with eye position. DTI allows for non-invasive in vivo assessment of ON structural integrity, providing useful information in the manifestation, progression and recovery of several disorders. This information may detect pathological changes earlier than established methods such as optical coherence tomography (OCT).

METHOD AND MATERIALS

Eight healthy participants were recruited for this IRB approved study on a Siemens Prisma 3T magnet using a single channel loop coil placed over the left eye. A zoom-RESOLVE DTI acquisition was developed to image the ON. The total acquisition time was ~2 min for 20 diffusion directions with b = 800s/mm2. Each subject was imaged with visual fixation at three locations; primary position, ~20° abduction and ~20° adduction. Three repetitions were acquired at each gaze with ~30 sec rest between scans. Structural bSSFP images with 0.8mm3 isotropic resolution were acquired at each visual fixation for planning of each DTI acquisition. DTI data was processed using DSI studio to calculate RD, AD and FA maps. ON regions of interest were automatically calculated for each DTI acquisition using a previously developed method by Spees et al.

RESULTS

Compared to primary, abduction resulted in 15.5%, 10.6%, 12.9% and 0.7% increases in RD, AD, MD and FA respectively. Adduction compared to primary position resulted in 16.6%, 8.8%, 14.3% and 1.7% increases in RD, AD, MD and FA respectively. Compared to abduction, adduction resulted in 1.0%, -1.6%, 1.2% and 1.7% increases in RD, AD, MD and FA respectively.

CONCLUSION

A zoom-RESOLVE DTI method was used to investigate gaze evoked changes in ON DTI parameters. Previous MRI of the ON suggested that the ON sheath is the principal load bearing structure in adduction. This study suggests that some of this strain is also transferred to the ON itself. Gaze evoked changes in diffusion characteristics have the potential to assess diseases that affect the ON.

CLINICAL RELEVANCE/APPLICATION

Gaze evoked changes in diffusion characteristics have the potential to assess diseases that affect the optic nerve before the manifestation of ocular anatomical changes observed in OCT.

SSG11-06 Multi-Center Study Demonstrates Radiomic Texture Features Derived from MR Perfusion Images Predict Pseudoprogression from True Progression in Glioblastoma Patients

Tuesday, Nov. 27 11:20AM - 11:30AM Room: E351

Awards
Student Travel Stipend Award

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PURPOSE

To differentiate between pseudoprogression and true progression in patients with glioblastoma using MR perfusion radiomic texture analysis (TA)

METHOD AND MATERIALS

98 patients with pathologically-proven diagnosis of GBM were retrospectively included in this IRB approved HIPAA compliant study. All patients underwent DSC and DCE Perfusion MRI as part of their routine clinical care. Images were analyzed using Nordic ICE 2.3 (NordicNeuroLab) ; rCBV and ktrans maps were obtained. Subsequently, 3D slicer 4.3.1(http://www.slicer.org) was used to segment the entire tumor on the different processed maps to create a volume of interest (VOI) for Radiomic TA. Multiple invariant texture features where then extracted from each VOI. 310 invariant texture features were applied to each map. Radiomic texture features selection was performed using Maximum Relevance Minimum Redundancy (mRMR) feature selection method to narrow down the feature count to the top few hundred features. Two different supervised learning algorithms were evaluated in this analysis for classification and predictive model building, namely Support Vector Machine (SVM) and decision tree algorithm (C5.0). Cross validation was performed using the Leave One Out Cross Validation (LOOCV) approach for the SVM method, and k-fold cross validation (k=10) for the C5.0 method to see if the best model obtained had high accuracy, sensitivity and specificity to descriminate between pseudoprogression and true progression patients

RESULTS

We achieved an accuracy of 90.82% (AUC 89.10%, sensitivity 91.36%, specificity 88.24%, p-value 0.017), when using 60 out of 620 radiomic features obtained from both Ktrans and rCBV pharmacokinetic maps coupled with SVM,Variance and sum entropy were the two most significant radiomic features that discriminated between pseudoprogression and true progression.

CONCLUSION

Radiomic TA derived from perfusion images can be helpful in determining true versus pseudoprogression in GBM. Further, this study illustrates successful application of radiomic TA as an advanced processing step for different MRI perfusion maps (DCE, DSC)

CLINICAL RELEVANCE/APPLICATION

MR perfusion radiomics texture analysis (TA) as a potential noninvasive imaging surrogate to differentiate between True and pseudo progression in glioblastoma

SSG11-07 Reproducibility of Hadamard Encoded Multi-Delay 3D pCASL

Tuesday, Nov. 27 11:30AM - 11:40AM Room: E351

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PURPOSE

Arterial spin labeling (ASL) can be confounded by varying arterial transit times (ATT) across the brain and with disease. In this study, a Hadamard encoding scheme was used to acquire multiple post-labeling delays (PLD), which were used to estimate ATT and corrected CBF. The goal of this study was to assess the reproducibility of this sequence in a set of normal volunteers to be able to apply it to clinical patients.

METHOD AND MATERIALS

Imaging was performed on 31 healthy male subjects at 4 time points (TPs) over 45 days. An 'enhanced' 3D pCASL (eASL) sequence was acquired with seven delays (1.0-3.3s) using Hadamard encoding. A long (4.0s) labeling block was divided into 7 sub-boluses with control and label sub-boluses corresponding to the Hadamard matrix. Images for each delay were extracted using a linear combination of the eight images. T1-weighted anatomical images were acquired for registration. Uncorrected flow (Flow) was obtained by averaging the delay images. ATT and corrected flow (cFlow) were also computed. Mean gray matter reproducibility was analyzed using the within and between subject coefficient of variation (wCV and bCV) and the repeatability coefficient (RC).

RESULTS

Mean cFlow was significantly higher than Flow (56.3±6.9 vs. 47.5±6.9 mL/100g/min, p<10-6). Mean ATT was 1335±62 ms. wCV was significantly lower for cFlow compared to Flow (0.079±0.038 vs. 0.089±0.047, p=0.005) and for TD (0.029±0.015) compared to Flow and cFlow (p<10-7). bCV followed a similar trend, but was higher compared to wCV (0.142±0.018, 0.121±0.011, 0.046±0.010 for Flow, cFlow, and TD respectively). The RC, normalized to the mean, was 0.300, 0.255, and 0.092 for Flow, cFlow, and ATT respectively.

CONCLUSION

wCV was less than 10% for the majority of subjects, and was lower than bCV indicating eASL is a robust tool for measuring changes in CBF and ATT over time. Corrected CBF was more reproducible compared to uncorrected CBF. ATT was very repeatable with wCV and bCV less than 5 percent.

CLINICAL RELEVANCE/APPLICATION

Corrected CBF and ATT can be measured with eASL in the same scan time as traditional ASL acquisitions. These metrics are stable across time allowing for changes over time to be reliably evaluated.

SSG11-08 Multi-Shell-Multi-tissue Gray Matter-Based Spatial Statistics: A Framework for Voxel-Wise Gray Matter Microstructure Analysis

Tuesday, Nov. 27 11:40AM - 11:50AM Room: E351

Awards
Student Travel Stipend Award

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PURPOSE

Indices derived from emerging multi-shell diffusion weighted-based modeling techniques (e.g., NODDI) can be used to assess gray matter (GM) microstructure. Accurate tissue segmentation and between-subject registration are critical steps for optimal voxel-wise/vertex-wise analysis of these indices to localize changes related to brain development and disease. Most current methods rely on tissue segmentation of structural images followed by fine registration between diffusion-weighted and structural images, which suffer from poor between-modality registration. In this study, we used multi-shell multi-tissue constrained spherical deconvolution (MSMT-CSD, for accurate single-step tissue segmentation of diffusion images) followed by GM-based spatial statistics (GBSS, for between subject registration) and present example results from voxel-wise heritability analysis on Human Connectome Project (HCP) data.

METHOD AND MATERIALS

After quality control, data from 689 healthy adult participants in HCP (S900-release) with the complete set of multi-shell diffusion-weighted MRI were used. Orientation dispersion (ODI) and neurite density indices (NDI) were generated using the NODDI toolbox for all brain voxels. Diffusion-weighted images were segmented using MSMT-CSD (MRtrix). GBSS was performed to generate skeletonized maps of GM neuritic indices. Voxel-wise heritability analyses were performed using the Fast and Powerful Heritability Inference (FPHI) toolbox with threshold-free clustering. To further scrutinize GM regions with highly significant heritability, hard-threshold-based clustering was performed at uncorrected-$P<0.01$.

RESULTS

GM-ODI showed high heritability across the cortex, hippocampi, and amygdalae (FWE-$P<0.0001$), with both amygdalae surviving secondary more conservative clustering. In contrast, no significant GM-NDI heritability was observed.

CONCLUSION

We demonstrated successful implementation of a new framework for voxel-wise analysis of gray matter microstructure. Across the "healthy GM" spectrum, GM-ODI is significantly affected by genetic factors. Our results suggest that GM-ODI can serve as a candidate in studies of neural endophenotypes underlying the heritable pathology of brain disorders and GM-NDI may be considered as an environmentally-modifiable treatment target for neuropsychiatric traits.

CLINICAL RELEVANCE/APPLICATION

MSMT-GBSS can improve localization of gray matter microstructural variations in health and disease.

SSG11-09 Intrinsic Diffusivity Encoding of Arterial Labeled Spins (IDEALS) for Whole Brain Water Permeability Mapping with MRI

Tuesday, Nov. 27 11:50AM - 12:00PM Room: E351

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Blood-brain barrier (BBB) disruption has been linked to multiple neurological diseases and psychiatric disorders. Water molecules are several times smaller than most exogenous contrast agents and transcapillary water exchange is mainly facilitated by active, transcellular transport mechanisms. As such, BBB water permeability, extraction fraction (Ew) and permeability-surface area product (PSw), could provide a more sensitive assessment of BBB dysfunction. Here we propose a novel MRI-based approach, Intrinsic Diffusivity Encoding of Arterial Labeled Spins (IDEALS), to non-invasively map whole-brain BBB water permeability.

METHOD AND MATERIALS

In IDEALS, intra and extravascular labeled water after pCASL preparation are separated by the intrinsic diffusion sensitivity of the segmented 3D-GRASE acquisition that manifests as a point spread function (PSF) in the image domain. The PSFs differ for intra and extravascular labeled spins and are highly dependent on the segmentation scheme. The PSFs were estimated using augmented extended phase graphs and the extravascular signal fraction was estimated by deconvolution. Two post-labeling delay (PLD) values were adopted. A PLD of 2sec was used to estimate cerebral blood flow (CBF), Ew after T1 correction of the extravascular signal fraction, and PSw according to the Renkin-Crone equation. A PLD of 1sec was used to calculate the arterial transit time (ATT). Ten healthy participants were recruited for this IRB approved study. All studies were performed on a Siemens 3T MRI. Total acquisition time was 15min for 4 sets of ASL images; 2 PLDs and 2 segmentation schemes.

RESULTS

Gray matter averages were 1.39sec, 55.7mL/100g/min, 85.8%, and 112.9mL/100g/min for ATT, CBF, Ew, and PSw respectively. White matter averages were 1.47sec, 41.3mL/100g/min, 87.4%, and 84.5mL/100g/min for ATT, CBF, Ew, and PSw respectively. Both Ew and PSw values are in good agreement with PET-based measurements.

CONCLUSION

Encouraging initial results using IDEALS was reported in this study. This novel approach provides whole-brain BBB water permeability maps at comparatively high spatial and temporal resolutions without a MRI contrast agent.

CLINICAL RELEVANCE/APPLICATION

BBB breakdown has been hypothesized as a key mechanism in neurological and psychiatric diseases. The proposed noninvasive method, IDEALS, allows for repeated measurement of BBB integrity without the potential side effects of gadolinium-based contrast agents.

SSG12

Physics (CT: Radiation Dose)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S404CD

CT PH SQ

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

Participants
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Sub-Events

SSG12-01 Radiation Dose from Cone Beam CT in SPECT/CT Examinations

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S404CD

Participants
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CONCLUSION

The CBCT scan may result in higher radiation dose, even exceeding the dose from conventional MDCT scan. Using lower x-ray tube current allowed 3.8-fold dose reduction without clinically significant degradation of image quality. The DLP method provided good estimate of patient effective dose.

Background

Hybrid imaging modalities provide anatomic and functional information improving diagnostic accuracy but also increase patient radiation dose. Combining a cone beam CT (CBCT) with SPECT may result in high radiation exposure due to lack of tube current modulation. The purpose of our investigation was to assess radiation dose for clinical CBCT protocols as part of SPECT/CT examinations and to evaluate dose reduction options.

Discussion

Effective doses calculated from the measurements were 4.21 mSv and 1.11 mSv for 20 mA and 5 mA respectively. The DLP method resulted in very similar values with the differences of 0.05% at 20 mA and 4.76% at 5 mA. With lower tube current image noise was increased by 35%. That was found acceptable for localization and attenuation correction of SPECT data.

SSG12-02 Strategy and Results for Characterization of Dose Outliers in CT Dose Monitoring: Analysis Across 84683 Patient Studies

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S404CD

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PURPOSE

The Joint Commission mandates monitoring of individual patient doses from CT and investigation of outliers. The mechanics of this process was left for the institution to determine. This study presents a novel strategy to identify and characterize dose outliers in a large academic medical center.

METHOD AND MATERIALS

With IRB approval, for the calendar year of 2016, 84,683 CT exams were recorded in an in-house dose monitoring program. For each protocol using AEC, radiation dose and patient diameter was fitted to an exponential relationship. The dose value from the fitting for a patient was considered to be ideal for the given diameter. A patient with higher than 99%ile dose for his/her diameter was flagged as a dose outlier. To streamline the severity of over-dosing and thus prioritizing the investigation of outliers, a dose deviation index (DDI) was calculated for each outlier as the ratio of received dose and ideal dose minus one. All outliers were investigated by two senior CT technologists by carefully examining the techniques and images. The CT physicist then categorized the found reasons and tagged each outlier with all reasons applicable to that case.

RESULTS

Over 50% of the dose outliers had a DDI between 1-2. A total of 18 different reason categories were identified. Out of the 661 dose outliers, about half were due to multiple accession number grouped together due to dose values extracted from screenshot of the dose reports, a problem resolved when radiation dose structure report can be used in the dose monitoring report. Another common reason for high dose (25%) was correlated with use of high kV, rotation time, or both with extra-large patients. Wrong positioning including patients unable to raise their arms (13%) was the third common issue.

CONCLUSION

A strategy was devised to survey patient CT dose and characterize the dose outliers. The identified categories are representative reasons of high radiation dose in CT imaging, and can be used as reference reasons for the community. The tagged data set can further be used as a training set for machine learning algorithm to automatically characterize the outliers in the future.

CLINICAL RELEVANCE/APPLICATION

A strategy was devised to survey large scale patient CT dose, identifying dose outliers, and characterize the outliers. The identified categories are representative reasons of high radiation dose in CT imaging, and can be used as reference reasons for the community.

SSG12-03 A Data-Centric Strategy for Developing CT Dose and Noise Reference Levels from Clinical Patient Populations

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S404CD

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PURPOSE

To develop a data-centric strategy solution for developing CT dose and noise reference levels across large clinical patient populations and in CT scanners.

METHOD AND MATERIALS

This IRB-exempt study evaluated CT abdominopelvic (AP)-related examinations performed in 2017 by 22 scanners from two vendors with 11 models in 3 site hospitals. An in-house developed informatics system automatically extracted protocol information, patient size (cross-sectional diameter), dose, and in vivo noise magnitude within images. Protocol nomenclature categorization was performed using a decision tree machine learning algorithm. Four reference patient size intervals were identified: 13-20, 20-30, 30-40, and 40-50 cm. Noise Reference Level (NRL), Noise Reference Range (NRR), Dose Reference Level (DoRL), and Dose Reference Range (DoRR) were defined for each size range as the median and interquartile interval of noise and dose, respectively.

RESULTS

60,000 CT AP studies with 64 different convolution kernels for patients ages 0-70 and sizes 13-48 cm were identified. NRLs ranged between 15.8 to 18.4 HU with NRRs for the four size ranges were the following: 13.2-24.7,12.6-22.5,12.5-23.2, and 12.1-22.8 HU. DoRLs ranged within 11.9-16.1 mGy. The four DoRRs were 9.5-21.4,7.9-17.3,9.9-21.3, and 10.8-23.2mGy.

CONCLUSION

This study offers the first even data-crunching solution for developing CT dose and noise reference levels using clinical patient data. New reference levels and ranges simultaneously consider image noise and radiation dose information across patient populations. The new metrics enables prospective optimization of clinical practice to maximize the imaging benefit and patient safety.

CLINICAL RELEVANCE/APPLICATION

A new solution is introduced for simultaneously defining image quality and dose reference levels across different patient body habitus. The methodology enables prospective optimization of clinical practice to maximize the imaging benefit and patient safety.

SSG12-04 Does the Dose Reduction Associated with a Percentage Increase of a CT Statistical Iterative Algorithm Maintain the Detectability of Low-Contrast Details? A Phantom Study

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S404CD

Participants
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PURPOSE

To verify if the dose reduction combined with increasing percentages of the ASIR-V algorithm was associated with a maintenance of detectability of low contrast details in the abdominal area.

METHOD AND MATERIALS

An anthropomorphic chest and abdomen phantom containing a liver equivalent insert with details of 10 HU relative contrast was repeatedly scanned with a GE Revolution CT equipment. Given a fixed level of noise index (18 HU combined with a thickness of 1.25 mm), the images were acquired without iterative algorithm and with percentages of ASIR-V of 30%, 50% and 70%. The correspondent dose reductions determined by the tube current modulation system were 48%, 67% and 83%, respectively. The same images were then reconstructed using only FBP, at an ASIR-V percentage of 0%. Five radiologists evaluated randomized image data sets with and without details, scoring the lesion presence on a five-point diagnostic confidence scale and the area under the roc curve (AUC) was calculated as figure of merit. The human observer results were then compared with AUC obtained with a Channelized Hoteling Observer (CHO). CNR values were also measured.

RESULTS

For human observer, AUC values were in the range 0.90-0.93 for images acquired without ASIR-V and with percentages of 30% and 50%, whereas with ASIR-V at 70% the AUC decreased significantly to 0.81. Diagnostic accuracy for FBP reconstructed images were always inferior to ASIR-V images, with an AUC decrease between 6 and 9%. The behaviour of the CHO was coherent with human observer results, with lower AUC differences between FBP and ASIR-V images (from 2 to 6 %). CNR values were stable for the different ASIR-V percentages, confirming the right functionality of the current modulation system, whereas progressively decrease with dose for FBP reconstructed images.

CONCLUSION

The iterative ASIR-V algorithm maintained low contrast detectability and the diagnostic accuracy up to a dose reduction of 67%, consequent to the application of a 50% level with automatic tube current modulation. At further dose reductions with greater iterative percentages, a significant decrease of detectability and diagnostic accuracy was observed.

CLINICAL RELEVANCE/APPLICATION

Prior to define the iterative level combined with dose reduction in a clinical protocol, the maintenance of low contrast detectability must be verified with ROC studies done with human or model observers.

SSG12-05 Effective Dose for Computed Tomography in Large, Clinical Populations

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S404CD

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Effective dose can efficiently integrate multiple organ dose values into a singular scalar value of radiation dose. The effective dose can also be calculated using dose length product (DLP) to effective dose conversion coefficients. The purpose of this study was to compare the results from these two methods across a large clinical population.

METHOD AND MATERIALS

This IRB-approved study included 579 chest and 247 abdominopelvic exams from two scanners. The organ doses were estimated based on an established Monte Carlo method. Each patient was matched to an XCAT anthropomorphic phantom of the same anatomical height. Precomputed Monte Carlo data were then applied along with adjustments for tube current modulation and patient size. A bias correction factor was also applied to each organ dose to calibrate the organ doses to validated ground truth dose values. The effective dose of each exam was calculated using both dose-length-product based (EDk) and organ-dose-based (EDOD) methods. The EDk was estimated by extracting the DLP and DLP-to-effective dose conversion coefficients defined by ICRP 102. The EDOD was derived using the patient-informed organ doses from the exam using ICRP 103 weighting factors. The EDk was compared to EDOD and CTDIvol.

RESULTS

For the abdominopelvic protocol, EDk was > EDOD by 80.2±48.7% on average (min: -28%; max: 235%; median: 75%). For the chest protocol, EDk was > EDOD by 64.1±33.1% on average (min: -18%; max: 191%; median: 60%). EDk was highly influenced by mean CTDIvol (abdominopelvic: R=0.9692, chest: R=0.9557). EDk was higher than EDOD, especially for larger patients (abdominopelvic: 9.6%, 66.2%, and 115.6% higher; chest: 30.2%, 77.9%, and 116.2% higher on average for patients with 22, 30, and 35 cm water equivalent diameters, respectively). This can be attributed to the contribution of doses absorbed by remainder tissue in EDk calculations.

CONCLUSION

In this work, we compared the effective dose calculated using DLP-based methods versus those based on organ dose. The result showed that DLP methods may over-estimate effective dose, especially for larger patients

CLINICAL RELEVANCE/APPLICATION

This clinical cohort study showed the substantial differences of effective dose estimated using DLP vs. organ-dose-based methods. This effect is more prominent for larger patients. The study indicates that radiation dose monitoring and reporting could benefit from accurate and robust organ dose estimation.

SSG12-06 Addressing Limitations of the ACR DIR Patient Size Measurement Method

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S404CD

Participants
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PURPOSE

AAPM Reports 204/220 reported the relationship between patient size surrogates and normalized dose coefficients (NDC) needed for size-specific dose estimates (SSDE). When localizer radiographs are used to calculate SSDE then a magnification correction should be applied. In this study, we demonstrate a new patient-model based magnification correction on patient data. We also discuss limitations to thresholding based size measurements for bariatric and pediatric patients.

METHOD AND MATERIALS

We analyzed 573 patient scans obtained from a clinical CT system under IRB approval. There were 229 adult abdomen, 284 adult chest, 48 pediatric abdomen, and 12 pediatric chest exams. We extracted LAT and AP dimensions from CT localizers using the ACR DIR method and a connected component analysis to extract gold standard LAT and AP dimensions from axial CT images. We extracted table height from the DICOM header. We applied the model-based magnification correction to the AP and LAT dimensions from the localizers. We used the equation from AAPM Report 204 to calculate the NDC. 'Gold' standard NDC values were derived using effective diameter measurements from axial CT images. We plot the NDC for our model-based correction and ACR DIR method as a function of the gold standard NDC values.

RESULTS

NDC estimates for the model-based approach have excellent correlation (R2 = 0.92) with the gold standard approach. On average, effective diameter for the ACR DIR and model-based methods are 8.0% and 1.0% greater than the gold standard, respectively. Outlier cases were noted caused by patient truncation, arms down or devices on patients. ACR DIR size extraction method failed for small patients due to the CT couch being included in the size measurement and bariatric patients were underestimated as some of their anatomy was classified as belonging to the CT couch and thresholded away.

CONCLUSION

The model-based magnification method gives an accurate estimate of effective diameter needed for calculating NDC to achieve accurate SSDE. We discuss errors associated with threshold based size methods for very small and very large patients.

CLINICAL RELEVANCE/APPLICATION

We demonstrate how thresholding based size methods, like those used by the ACR DIR fail for very small and very large patients.

SSG12-07 Characterization of Radiation Risk across a Clinical CT Patient Population: Comparison across 12 Risks Metrics

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S404CD

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PURPOSE

Ascertaining radiological procedure radiation burden is essential for justification, optimization, and personalization of the procedure. While the exact radiation risk for an individual exam is unknowable, various risk-related figures have been used as surrogates, e.g., device output metrics such as CTDI, DLP, SSDE, and hypothetical constructs such as Effective Dose (ED) and Risk Index (RI) that take into account specific organ risks, age, and gender factors. Purpose of this study was to compare how twelve different radiation risk metrics characterize the radiation burden across a set of clinical CT examinations differently.

METHOD AND MATERIALS

This IRB-approved study included 265 abdominopelvic exams with contrast. Organ doses were estimated using Monte Carlo methods. The following risk metrics were calculated using previously validated methods: CTDIvol, DLP, SSDE, DLP-based ED (EDk), organ-dose-based ED (EDOD), dose to a defining organ (ODD to stomach), organ-dose-based RI (RI), and RI for a reference 20 y.o. patient (RIr). Additional metrics of ODD,0, ED0, and RI0 were calculated for a reference patient (ICRP 110). Lastly, inspired by the ICRP, an adjusted ED (ED') was computed as the product of RI/RIr and EDOD. A linear regression was applied to each metric dependency to the patient water equivalent diameter (WED). Fit slopes (FS) and relative interquartile ranges (rIQR) at 30 cm reference WED were calculated and normalized to those of RI, which was assumed to be the actual patient risk closest surrogate.

RESULTS

Results showed significant differences between the metrics. EDOD exhibited closest concordance with RI, followed by ODD. Normalized FS ranged between 0.99 (ED') to 2.24 (DLP), and normalized rIQR ranged between 0.30 (DLP) to 4.03 (ED').

CONCLUSION

Different risk metrics lead to different characterization of population risk, particularly risk overestimation for large patients and underestimation for small patients. Furthermore, the risk variability across a population is underestimated for most variables except ED', which exhibits more variability and radiation risk individualization. Care should be exercised in drawing risk predictions from unrepresentative risk metrics applied to a population.

CLINICAL RELEVANCE/APPLICATION

Different risk metrics can lead to different risk predictions. There is a need to standardize risk metrology for proper justification and optimization of radiological procedures.

SSG12-08 Effect of Simulated Micro-Dose (mD) CT on the Performance of Neural Network Convolution (NNC) Deep-Learning (DL) In Radiation Dose Reduction in Chest CT

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S404CD

Participants
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PURPOSE

Radiation dose reduction in chest CT is highly demanded since current radiation dose is high for lung cancer screening. Our purpose was to investigate the effect of simulated mDCT images on the training and performance of our 3D NNC DL for radiation dose reduction in chest CT.

METHOD AND MATERIALS

We developed anatomy-specific (AS) NNC models employing volume-based neural network regression in a convolutional manner to convert mDCT to higher-dose (HD)-like CT. We trained 3 AS NNC models with soft-gating layers with 3 anatomic areas under two training protocols. In our first protocol, we trained our NNC with an anthropomorphic chest phantom (Kyoto Kagaku, Kyoto, Japan) by utilizing real mDCT (120kVp, 10mAs, 0.37mSv) images as input and HDCT (120kVp, 550mAs, 34.9mSv) as "teaching" images. In a second protocol, we trained our NNC with simulated mDCT and HDCT from our diagnostic CT database of 20 patients. Our mDCT simulation consisted of forward-projection of HDCT, addition of photon and electric noise to the sinogram image, filtered back-projection of the noise component, and addition of the noise image to the original HDCT. Through training, our NNC learned to convert lower-dose CT to HD-like CT, where noise and artifacts are substantially reduced; thus, term "virtual" HD (VHD) CT. To compare our NNC models under two different protocols, we collected mD (120 kVp, 5 mAs, 0.2 mSv) and full-dose (120 kVp, 50 mAs, 2.0 mSv) CT of 50 clinical cases including 30 cases with nodules.

RESULTS

Our VHD technology converted mDCT to "virtual" HDCT where noise and artifacts were reduced substantially, while anatomic structures and pathologies were preserved. Our NNCs trained with real mDCT and simulated mDCT improved the contrast-to-noise-ratio (CNR) of mDCT of clinical cases from 4.1±3.9 dB to 21.5±4.9 dB and 22.7±5.0 dB, respectively, which were higher than that of "gold-standard" full-dose CT (CNR: 13.4±5.1 dB). Difference between the 2 models was not statistically significant (t-test; $P=0.1$).

CONCLUSION

Our 2 NNC models, using real and simulated mDCT images for training, achieved a similar dose reduction performance of 90% and converted mDCT of 50 clinical cases to VHDCT that have higher image quality than "gold-standard" full-dose CT.

CLINICAL RELEVANCE/APPLICATION

Substantial reduction of radiation dose in CT by our new VHD technology would potentially make mDCT screening possible, and it would be beneficial to screening population.

SSG12-09 Radiation Doses from the Dual-Layer Spectral Detector CT at Different Patient Sizes: Comparison with a Conventional CT Scanner

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S404CD

Participants
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PURPOSE

To compare the radiation doses from the dual-layer spectral detector CT (SDCT) and a conventional CT scanner at different patient sizes.

METHOD AND MATERIALS

In this retrospective IRB-approved study, consecutive patients scanned on the SDCT scanner (IQon, Philips, Cleveland, USA) with chest CT (PE protocol) and abdominal CT (routine single portal venous phase) protocols from were included. A comparison group of patients scanned using the same matched protocols in a conventional 256- slice scanner (Brilliance iCT, Philips, Cleveland, USA) was selected. The radiation doses (CTDIvol) and the size (WED- Water equivalent diameter) was extracted using Radimetrics software (Bayer, Whippany NJ, USA). The radiation doses of the two scanners for these two protocols were compared by log transformation of the CTDIvol and using linear regression model to measure the differences in log (CTDI) on average when interacting with WED. The percentage difference between iQon and iCT was also calculated. Each variable was estimated using Maximum likelihood method and tested against the hypothesis of being zero (no effect). P value of less than 0.05 was considered as statistically significant. SAS 9.4(SAS Institute Inc., Cary, NC) was used for all analysis.

RESULTS

The study included 482 abdominal CTs (mean patient size 306.4 ± 38.3 mm (182.4 - 442.2 mm)) and 215 chest CTs (296.3 ± 34.1 mm (207.4 - 388.4 mm)) performed in IQon and 741 abdominal CTs (303.1 ± 44 mm (156.8 - 450.1 mm)) and 323 chest CT (299.6 ± 42.3 mm (205.5 - 408.2 mm)) in iCT. For the abdominal CTs, the mean CTDI for IQon was 12.0 ± 6.0(3.1 - 50.8) and for iCT was 11.7 ± 6.7 (2.8 - 44.5). For the chest CTs, the mean CTDI for IQon was 11.7 ± 6.2 (4.0-43.1) and for iCT was 6.3 ± 3.0 (3.9-57.0). The intercept was lower for iQon than that for the conventional CT (p<.0001). However, iQon has a higher slope (p<.0001). As a result, the percent difference in CTDvol between iQon and the conventional CT increased when the patient size increased.

CONCLUSION

With matched abdominal and chest CT protocols, the SDCT had lower CTDIvol than the conventional CT at small patient sizes, but slightly higher radiation dose than conventional CT at large patient sizes.

CLINICAL RELEVANCE/APPLICATION

Understanding the size-based variability of radiation dose from the SDCT will help in optimizing the dose and utilize the technique appropriately.

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/ Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator

SSG13

Physics (CAD/Machine Learning)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S404AB

AI IN PH

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

Participants
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Sub-Events

SSG13-01 Deep Learning-Based Automatic Chest PA Screening System for Various Devices and Hospitals

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S404AB

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PURPOSE

To ensure generalization performance in various hospitals, we developed a deep learning based automatic Chest PA screening System which can detect 5 class findings and performs well on various devices. Its performance was evaluated by using FROC and FOM in various devices.

METHOD AND MATERIALS

Our system can detect 5 class findings which are nodule, consolidation, pleural effusion, interstitial opacity, pneumothorax. We used chest radiographs(PA view) collected from 2013 to 2015 at two hospitals. There were 18,869 labeled CRs comprised of 11,181 normal and 1,943 nodule, 1,293 consolidation, 1,867 pleural effusion, 1,406 interstitial opacity, 1,179 pneumothorax CRs. All abnormal CRs were clinically confirmed by CT scans. Thus, we could collected elaborate segmentation label data. Furthermore, our data were acquired in various devices, the first hospital has x-ray detectors from 3 manufacturers(GE, FUJI, Canon), and the other has devices from 2 manufacturers(Philips, LISTEM). We used only data from the first hospital for training and then used all data of other hospital as test data.

RESULTS

In the test dataset, our screening performance showed AUC of 0.99, with an sensitivity, specificity of 97.6%, 97.9%, respectively. For each class findings, Our system achieved FROC and FP per scan of 81.2% / 0.72, 84.4% / 1.41, 83.1% / 0.35, 85.7% / 1.45, 91.6% / 0.78 for nodule, consolidation, pleural effusion, interstitial opacity, pneumothorax, respectively. In FOM performance, sensitivity is 84.7%, 91.5%, 93.7%, 97.9%, 97.2%.

CONCLUSION

Our screening system demonstrated reliable performance in various devices and multi hospitals. It also showed competitive results in detecting location and classification of 5 class findings.

CLINICAL RELEVANCE/APPLICATION

Our system demonstrates reliable performance on various devices on multiple findings using CAD.

SSG13-02 Curriculum Learning from Patch to Image for Pulmonary Abnormal Pattern Screening in Chest-PA X-Ray: Intra- and Extra-Validation on Multi-Center Datasets

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S404AB

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PURPOSE

To propose and validate a computer aided detection (CAD) for detecting 5 kinds of pulmonary abnormalities in chest-PA X-ray using multicenter data with a curriculum learning strategy to train entire images after training lesion-specified image patches to guide the CAD toward better local minima.

METHOD AND MATERIALS

Chest-PA X-rays collected from two hospitals, which consisted of 10137 healthy subjects and 3244 patients including 944, 550, 280, 1364, and 331 patients with nodule (ND), consolidation (CS), interstitial opacity (IO), pleural effusion (PE) and pneumothorax (PT) from XXX (X1), and 1035 healthy subjects and 4404 patients including 1189, 853, 1009, 998 and 944 patients with ND, CS, IO, PE and PT from YYY (Y1), respectively. 60% and 20% of X1 dataset were used for training and validation. 20% of X1 and Y1 datasets were used for test. Every abnormality lesion was manually drawn by expert thoracic radiologists. Using these regions, image patches were used to specifically train the regional patterns of abnormalities. Entire images were used to fine-tune the network subsequently. Modified resnet-50 architecture for multi-label problem was used to train weak supervisions. To assess the effectiveness of our approach, we compared it with or without this strategy using six-measures including area under the curve (AUC), accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value.

RESULTS

Both models converged well and weights were extracted at the minimum loss on validation set. With curriculum learning, the AUC in X1 test set was 93.2, 88.6, 97.7, 99.5, 96.6% for ND, CS, IO, PE, and PT, respectively. Compared to the model without this strategy, performance improvement was achieved in all metrics, and PPV showed the largest improvement of 11.3% and 4.6% for X1 and Y1.

CONCLUSION

The proposed curriculum learning strategy successfully showed the outperforming results compared with baseline through multicenter validation, which could be used in case of the smaller dataset with complex task.

CLINICAL RELEVANCE/APPLICATION

This curriculum learning strategy could be useful in case of computer-aided detection (CAD) on the smaller dataset with complex task such as CAD on abnormalities of chest-PA X-ray.

SSG13-03 Data Augmentation via Synthetic Mammograms for Improved Training of a Deep Learning Breast Mass Detection Algorithm

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S404AB

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PURPOSE

To evaluate whether training data augmentation using synthetic mammograms may improve the performance of a deep learning system for mass detection.

METHOD AND MATERIALS

Synthetic mammograms were generated from procedurally generated compressed breast phantoms containing masses. The anthropomorphic phantoms were modeled for four different breast density categories, and the masses were modeled with different sizes, shapes and margins. MC-GPU, a Monte Carlo-based x-ray transport simulation code that generates clinically-realistic radiographic projection images, was used to project the 3D phantoms into synthetic mammograms. A total of 530 mammograms with 677 masses were generated. We used Faster R-CNN for our deep learning network with pre-training from ImageNet using ResNet-101 architecture. From the Curated Breast Imaging Subset of Digital Database for Screening Mammography (CBIS-DDSM) data set, we used 573 mammograms (607 masses) for training, and 170 mammograms (177 masses) for testing, all of which contained masses. We compared the detection performance of the Faster R-CNN when the network was trained using only the CBIS-DDSM training images, and when the network was augmented with the 530 synthetic mammograms. FROC analysis was performed to compare performances with and without the synthetic mammograms.

RESULTS

When trained on the CBIS-DDSM data set alone, the Faster R-CNN detected 68.4% (121/177) of the masses on the test set. With the augmented training set, the test set detection prescreening sensitivity was 83.6% (148/177). The difference between the two FROC curves was statistically significant using JAFROC ($p = 0.005$). At 1 false positive per image (FP/image), the test set detection sensitivity was 60.5% (107/177) when trained on CBIS-DDSM alone, and was 68.9% (122/177) when trained with the augmented data set. The difference was statistically significant using McNemar's test ($p = 0.001$).

CONCLUSION

Our study demonstrates that it is possible to generate high quality synthetic mammograms using procedurally generated breast

Our study demonstrates that it is possible to generate high quality synthetic mammograms using procedurally generated breast phantoms and Monte Carlo simulation, that can be used to enlarge the training data set and improve the performance of deep learning systems for mass detection on mammograms.

CLINICAL RELEVANCE/APPLICATION

Training data set can be a limiting factor for deep learning applied to medical imaging tasks. This study shows our synthetic mammograms are useful for data augmentation in computer-aided detection.

SSG13-04 Comparison of Transfer Learning and Deep Feature Extraction Strategies for Breast Cancer Classification in Mammography Using Deep Neural Networks

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S404AB

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PURPOSE

To study the differences between using a pre-trained deep convolutional neural network (DCNN) as feature extractor and a fine-tuned DCNN using transfer learning for classification of malignant and benign masses in mammography.

METHOD AND MATERIALS

3,578 mass lesions from 3,411 mammograms were collected with IRB approval. Three DCNN structures: AlexNet, InceptionV1 (GoogLeNet) and VGG16 that had success in ImageNet classification were used in this study. All the DCNNs were pretrained on ImageNet data for a 1000-class object classification task and then applied to mammographic mass classification. When used as a feature extractor, the features from the first fully connected layers (*FF*) were extracted and a random forest classifier (RF-*FF*) is trained. Under the transfer learning paradigm, two transfer strategies: freezing up to the first convolutional layer (*CF*) and freezing up to the last convolutional layer (*CL*) were studied, which led to four mammography-trained classifiers: mDCNN-*CF* and mDCNN-*CL* with DCNN classifier (consisting of fully connected layers and softmax) and random forest classifier using *FF* features. All the strategies were validated in a 4-fold cross-validation approach while keeping all the views from the same patient together in the same fold. The experiments were repeated ten times with different random stochastic initializations.

RESULTS

ImageNet-trained feature extractor RF-*FF* obtained mean AUCs of 0.77, 0.58 and 0.74 for AlexNet, InceptionV1 and VGG16, respectively. Mammography fine-tuned mDCNN-*CF* and mDCNN-*CL* reached mean AUCs of 0.83 and 0.79, respectively, as the best among the three structures. mDCNN-*CF*-RF-*FF* and mDCNN-*CL*-RF-*FF* also reached similar AUCs of 0.83 and 0.79, respectively. The fine-tuned mDCNNs achieved higher accuracy than without transfer learning.

CONCLUSION

Although DCNN trained with images from a different domain may be used as a deep feature extractor for medical imaging, transfer learning in the target domain has significant advantages where some of the deeper layers can be fine-tuned for the target task. In transfer learning, replacing the DCNN classifier with an external classifier like the random forest classifier does not improve the classifier performance.

CLINICAL RELEVANCE/APPLICATION

With the prolific usage of deep learning in medical imaging, it is important to understand the effectiveness of the features extracted by different DCNN structures with and without transfer learning.

SSG13-05 Detecting Mal-Positioned Endotracheal (ET) Tubes in Portable Chest X-Ray (CXR) Images: Comparing Deep Learning Models with Hand-Engineered Approach on Carina Detection

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S404AB

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PURPOSE

Comparing performances in detecting carina location from deep learning and hand-engineered approaches

METHOD AND MATERIALS

ET tubes are the most commonly used tubes for ICU patents. Mal-positioned ET tubes may lead to collapsed lungs. The ET tube tip placement relative to carina location in a CXR image is used to determine if an ET tube is properly positioned. However, the carina, a ridge of cartilage in the trachea that occurs between the division of the two main bronchi, can be hard to detect on CXR images. Our previously developed hand-engineered approach includes the detection of lungs, spine and aortic arch to identify an initial ROI. Carina location is detected using template matching and feature analysis within the ROI. In this study, we investigate convolutional neural networks (CNN) based models, i.e., the faster R-CNN and U-Net, to detect carina locations. The R-CNN was trained with initial weights from a pre-trained model. U-Net was trained from scratch. Both models were trained on 994 portable CXR images, validated on 136 images, and tested on 212 images. The carina location (x,y) on each image was identified by an experienced radiologist for the 212 testing images and by a trained scientist for the rest of images. The carina detection accuracy was measured by the distance between the human-identified and computer detected locations in terms of <=5mm, 10 mm and beyond.

Each image has only one detection from each approach; detections beyond 10 mm from the truth are regarded as a miss or FP detection.

RESULTS

R-CNN yielded sensitivities of 92% (98%) and 60% (88%) and 58% (87%) for <=5 (10) mm on the training, validation and testing data, respectively . U-Net yielded sensitivities of 94% (94%), 64% (85%) and 67% (89%) for <=5 (10) mm on the training, validation and testing data, respectively. Our hand-engineered approach yielded a sensitivity of 52% (74%) for <=5 (10) mm on the same 212 testing images. The CNN based models yielded a similar performance in detecting carina location measured within 10 mm of truth with more than 10% improvement on average than that of the hand-engineered approach.

CONCLUSION

Use of CNN based models substantially improved carina detection accuracy and performance robustness.

CLINICAL RELEVANCE/APPLICATION

Accurate detection of carina locations in CXR images can help timely detection of mal-positioned ET tubes, thus improving the care and treatment management for critically ill patients in ICU.

SSG13-06 Classification of Glioblastoma Using Machine Learning and Delta-Radiomic Signature Derived from Dynamic Susceptibility Enhanced MRI

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S404AB

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PURPOSE

Glioblastoma (GBM) is the most aggressive cancer with poor prognosis due to its heterogeneity. The purpose of this study is to improve the tissue characterization of these highly heterogeneous tumors using delta-radiomic signature of dynamic susceptibility contrast enhanced (DSC) MR images, which are commonly used to derive blood perfusion parameters to the tumor, with machine learning approaches.

METHOD AND MATERIALS

Multiparametric magnetic resonance (MR) images of 25 patients with histo-pathologically confirmed 13 high and 12 low grade GBM were taken using a standard brain tumor imaging protocol. All DSC images were registered to FLAIR images. The tumor contours from FLAIR images and its contralateral regions of the normal tissue were used to extract delta-radiomic features from each DSC image over the entire volume of DSC time course images before applying feature selection methods. The most informative and non-redundant features (signature) were selected to train a random forest to differentiate high-grade (HG) and low-grade (LG) tumors while feature correlation limits were applied to remove redundancies. Then a leave-one-out cross-validation random forest was applied to the dataset to classify GBMs. To evaluate the performance of our proposed classification method, overall prediction accuracy, confidence, sensitivity and specificity were calculated.

RESULTS

Analysis of the predictions showed that our method consistently predicted the tumor grade of 24 out of 25 patients correctly (0.96). Based on the leave-one-out cross-validation, the mean prediction accuracy was 0.95 ± 0.10 for HG and 0.85 ± 0.25 for LG. The area under the receiver operating characteristic curve (AUC) was 0.94.

CONCLUSION

Our method performed well in classifying high and low grade GBMs based on the DSC MRI data. This study shows that delta-radiomic features of DSC MRI are correlated with GBM grades and may be use to improve imaging characterizing of gliomas. The performance of our method in interrogating DSC MRI data will be explored further using combined spatial and temporal delta-radiomic features.

CLINICAL RELEVANCE/APPLICATION

This study explores the new computational approach of delta-radiomic signature and machine learning to extract additional information from clinically applied DSC MR images to better classify GBMs.

SSG13-07 U-Net-Based Deep-Learning Bladder Segmentation in CT Urography

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S404AB

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PURPOSE

To develop a U-Net based deep learning approach (U-DL) for bladder segmentation in CT urography (CTU) as a critical component for computer-aided diagnosis (CAD) of bladder cancer and treatment planning.

METHOD AND MATERIALS

Bladder segmentation in CTU remains a challenge because the bladder often contains regions filled with intravenous contrast and without contrast. We previously developed a bladder segmentation method using deep-learning convolution neural network (DL-CNN) and level sets within an user-input bounding box. However, some cases with poor image quality or with advanced bladder cancer spreading into the neighboring organs caused inaccurate segmentation. We have newly developed an automated U-DL method to identify the bladder boundary in CTU cases. The entire CTU slice containing bladder is used as input to the U-DL without the need for a bounding box. The output of U-DL is the corresponding bladder likelihood mask of the slice. No level set is used as a post-processing step. We trained the U-DL with a mini-batched stochastic gradient descent algorithm by minimizing a binary cross-entropy cost function using 7629 bladder slices from 81 CTU cases. The segmentation performance was evaluated using 92 independent test cases. 3D hand-segmented contours were obtained as reference standard for all cases. The segmentation accuracy was evaluated relative to the reference standard in terms of the average volume intersection ratio (AVI), average percent volume error (AVE), average absolute volume error (AAVE), average minimum distance (AMD), and the Jaccard index (JI).

RESULTS

For the independent test set, the AVI, AVE, AAVE, AMD, and JI for segmentation with U-DL were 93.0±9.8%, -3.0±13.9%, 8.9%±11.1%, 2.7±2.0 mm, 85.1%±10.9%, respectively. With DL-CNN and level sets, the corresponding values were 81.9%±12.1%, 10.2%±16.2%, 14.0%±13.0%, 3.6±2.0 mm, and 76.2%±11.8%, respectively. The improvement for all measures were statistically significant ($p<0.001$).

CONCLUSION

Compared to the previous method using DL-CNN and level sets, the U-DL is more accurate and does not depend on an user-input bounding box. Further work is underway to improve the U-DL as a fully automated method for segmentation of the bladder.

CLINICAL RELEVANCE/APPLICATION

Bladder segmentation is a crucial step for detection of bladder cancer and wall thickening in CAD and for treatment planning. This study developed a highly accurate method for bladder segmentation.

SSG13-08 Automated Detection of Hemorrhage and Fracture Regions in Head and Neck CT of the Trauma Patient in Emergency Rooms Using 3D Convolutional Neural Networks with Strong and Weak Labels

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S404AB

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PURPOSE

To purpose and validate detection of hemorrhage and fracture using 3D convolutional neural network (CNN) with weak supervision in head and neck CT of brain trauma patient in emergency rooms.

METHOD AND MATERIALS

Brain CT images were acquired from 1785 healthy subjects and 2661 patients including 2451 and 1122 patients with hemorrhage including EDH, ICH and SDH and fracture, respectively. Weakly labeled data could lead to training failure due to high complexity and dimensionality problems. To solve of this problem, we used additional 169 patient's data with information of areas of fracture and hemorrhage were labeled. Using this hard labeled data, 3D patch images were extracted and trained before training weak supervision. After that, the network was fine-tuned using weak supervision with a relatively large amount of data. 3D CNN architecture was designed based on VGGNet-16 and global average pooling was performed before the prediction layer to extract the class activation map. Two independent networks were used to train and detect hemorrhages and fractures individually and evaluated in terms of accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

RESULTS

Our proposed method performance for hemorrhage detection showed 87.7%, 87.7%, and 87.6% and fracture detection showed 80.5%, 69.5%, and 87.8% for accuracy, sensitivity, and specificity. In addition, PPV and NPV of hemorrhage detection and fracture detection were 91.5%, 82.5% and 79.0%, 81.3%, respectively.

CONCLUSION

We proposed fully automated detection system using deep learning networks for brain injury patients in emergency rooms. The system helps to radiologists and physicians in emergency rooms reducing the diagnosis time and human errors. The automated detection system could be applied in various kinds of other abnormal detection with strong and week labels.

CLINICAL RELEVANCE/APPLICATION

This study could be used for CAD on hemorrhage and fracture in head and neck CT of brain trauma patient in emergency rooms.

SSG13-09 Quantitative MRI Radiomics in the Task of Distinguishing Between Malignant and Benign Breast Lesions in a Large Clinical Dataset from China

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S404AB

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PURPOSE

To evaluate the potential of quantitative MRI radiomics in the task of distinguishing between malignant and benign breast lesions in a large clinical dataset from China.

METHOD AND MATERIALS

Our research involved a clinical DCE-MRI database of 600 breast cases retrospectively acquired under a HIPAA-compliant with a waiver of consent IRB protocol. The average ages of the 300 benign and 300 malignant patients were 41.8 and 47.2 years with a standard deviation of 9.5 and 9.6 years, respectively. Characteristics of the breast cancers included clinical and histopathologic findings on axillary lymph nodes and tumors. Once each lesion was indicated to our radiomics workstation, the machine learning algorithm automatically segmented and extracted radiomic features on the primary lesion, including those from six categories: size, shape, morphology, enhancement texture, kinetics, and enhancement-variance kinetics. The selected feature subset was input to a Bayesian artificial neural network (BANN) classifier and underwent leave-one-case-out cross validation. Area under the receiver operating characteristic (ROC) curve (AUC) served as the figure of merit in the task of distinguishing between malignant and benign breast lesions.

RESULTS

In the task of distinguishing between malignant and benign breast lesions, the analyses of each radiomic feature demonstrated AUC values ranging from 0.53 (se = 0.02) to 0.78 (se = 0.02). A subset of features that characterize lesion irregularity, margin sharpness, textural and kinetics were selected. The resulting radiomic lesion signature from the BANN classifier yielded an AUC value of 0.88 (se = 0.01).

CONCLUSION

Quantitative MRI radiomics demonstrated promising classification performance in distinguishing between malignant and benign breast lesions in a large clinical dataset from China.

CLINICAL RELEVANCE/APPLICATION

Our computerized radiomic analysis method has potential to aid clinicians in improving breast cancer diagnosis and patient management.

SSG14

Physics (CT: New Techniques)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S405AB

CT PH

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

FDA Discussions may include off-label uses.

Participants
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Dianna D. Cody, PhD, Houston, TX (*Moderator*) In-kind support, General Electric Company; Reviewer, ACR CT accreditation program; Researcher, Gammex, Inc

Sub-Events

SSG14-01 Imaging Arterial Vasa Vasorum Proliferation as an Early Marker of Atherosclerosis Using High Resolution Photon-Counting CT

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S405AB

Awards
Trainee Research Prize - Fellow

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PURPOSE

To detect vasa vasorum (VV) proliferation in arterial walls as an early marker of atherosclerosis using a whole-body photon counting detector (PCD) CT system.

METHOD AND MATERIALS

A swine carotid model of enhanced vasa vasorum (the micro vessels in artery walls) was developed in an anesthetized animal, by injecting autologous blood into the left carotid wall in multiple locations caudal to the bifurcation to mimic early stage atherosclerosis. The right carotid artery (control) was exposed but was not injected. The animal was allowed to recover, and six weeks later re-anesthetized and scanned using the PCD-CT system. Four locations caudal to the carotid bifurcation were scanned using the ultra-high resolution (UHR) PCD-CT acquisition mode and a 40mL contrast bolus (Omnipaque) followed by a 30mL saline chaser. Axial acquisitions (140kV, 342 mAs) were performed at 20 time points (1s rotation, 3s cycle time) allowing CT number measurements in arterial lumen and wall for peak enhancement and recirculation phases. The PCD-CT energy thresholds were set to be 30 and 70 keV. PCD-CT images were reconstructed using a quantitative sharp kernel(Q65). To reduce image noise, a multi-energy non-local means denoising algorithm was applied to the PCD-CT images. Arterial lumen-wall boundaries in the 30-140 keV images were identified using half-max CT number thresholding, and wall CT number enhancement was calculated using an annular ROI placed in the segmented arterial wall. The animal model of increased VV was validated using microfil-enhanced micro-CT (µCT) of excised carotids from the same animal.

RESULTS

Baseline corrected wall-lumen ratio integrated over the arterial recirculation phase showed a significantly higher value ($p = 0.0036$, unpaired t-test) for the left common carotid with enhanced vasa vasorum measured over a length of 22.5mm. Images from contrast-enhanced µCT showed VV proliferation in the excised left carotid, while the right carotid showed normal VV density.

CONCLUSION

We have demonstrated in vivo quantification of vasa vasorum proliferation in the carotid arteries of an animal model using contrast-enhanced PCD-CT. The findings were compared to ex vivo µCT of the carotids.

CLINICAL RELEVANCE/APPLICATION

Vasa vasorum proliferation precedes atherosclerosis and its detection could enable early diagnosis prior to irreversible consequences occur from vulnerable plauque, stenosis, infarction or stroke.

SSG14-03 High-Pitch Coronary CT Angiography in Revolution CT During Free Breathing versus Breath Holding in Patients with Unlimited Heart Rates

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S405AB

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PURPOSE

To explore the feasibility of coronary CT angiography (CCTA) using free breathing and evaluate the image quality CCTA in free breathing patients when compared to breath holding patients.

METHOD AND MATERIALS

60 patients with suspected coronary heart disease were randomly divided into two groups for CCTA scans: group A (n=30) were performed during breath-holding ,and the remaining 30 during free-breathing (group B).No heart rate control was performed before examination. The heart rate during planning was 57-113bpm in group A and 48-124bpm in group B .The basic information for the two groups was statistically the same.A coefficient of 25 mgl/kg/s was applied for all patients.CT value in Aortic sinus (AS), right coronary artery (RCA), left anterior descending (LAD), left circumflex (LCX), and pericardial fat and standard deviation (SD) in AS and fat were measured. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) for AS were calculated. We compared the differences in the heart rates during the planning and scanning period between two methods.Image quality of every coronary artery segment according to the American Heart Association 15-segment model with at least 1.0mm diameter was evaluated using 5-point grading scales(1: non diagnostic-5:excellent).Two experienced Radiologists also independently reviewed image quality of each coronary artery segment.

RESULTS

There was no statistical difference between the demographic data of the two groups. The subjective image quality scores for coronary artery image were 4.49±0.41(A) and 4.33±0.36(B).With breath-holding,91.7% of the coronary artery segments were evaluable with image quality scores of 4 and 5 compared to 89.5% with free breathing group(P>0.05).The CT Value in AS ,SNR,CNR with RCA were significantly(P<0.05) lower with group B,But CT numbers in LAD, LCX, RCA, as well as CNR between the two groups were not statistically different (P>0.05). The mean difference between the heart rates before and during scanning for group A was(1.74±1.86) bpm,and group B was (1.30±1.25) bpm,the two groups were not statistically different (P>0.05).

CONCLUSION

Free-breathing CCTA is feasible using 256-MDCT scanner without heart rate control, and aquire high quality image .

CLINICAL RELEVANCE/APPLICATION

Free-breathing CCTA is feasible using 256-MDCT scanner without heart rate control, and aquire high quality image .

SSG14-04 Early Investigation on CT Thermometry as a Tool to Monitor the Ablation Zone During Thermal Ablation Therapy

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S405AB

Participants
April Griffith, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose
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PURPOSE

Percutaneous thermal ablation, such as microwave or radiofrequency ablation, is a clinical treatment for cancer that utilizes directed heating to induce cell death. Currently, there is no accurate way to evaluate the ablation zone, which can lead to incomplete ablation and thereby precipitate local recurrence of cancer. Since temperature affects mass density and since CT can measure changes in mass density, CT could be used to monitor the ablation zone. In this study, we test the hypothesis that a reliable, clinically significant decrease in attenuation can be seen in water heated from body temperature (36°C) to the temperature at which cell death occurs (above 55°C).

METHOD AND MATERIALS

Four bottles of water stacked in a 2 x 2 arrangement were heated to 75°C and then passively cooled to 30°C. The temperature within each bottle was monitored using independent thermometers (1°C accuracy). CT scans (120 kV, routine abdominal protocol) were taken after every 2°C drop until the desired temperature range was covered. A representative central slice passing through the four bottles was chosen. The mean attenuation coefficient in an 81 x 81 region-of-interest was evaluated within each bottle and plotted against temperature at time of acquisition.

RESULTS

At 73°C (the temperature measured during the initial CT scan), the attenuation of water was -24.6 ± 0.4 Hounsfield Units (HU). As the water cooled to 33°C (the temperature measured during the last scan), the attenuation increased to -5.0 ± 0.6 HU. The measurements were consistent across all 4 bottles. A linear model was fitted to all measurements ($R^2 = 0.98$). The model demonstrates an 11.52 HU change between 36°C and 60°C (95% confidence interval: [11.21-11.84], based on the Student distribution with 88 degrees of freedom).

CONCLUSION

Our study shows that there is a measurable decrease in CT attenuation between body temperature and 55°C, the temperature at which cell death occurs. This observed 11.5 HU change in attenuation can be clinically differentiated by radiologists at a reasonable radiation dose, indicating that parenchymal changes due to heating could be measured using CT.

CLINICAL RELEVANCE/APPLICATION

In thermal ablation, directed heating is used to treat pathology, especially malignancy. Reliable evaluation of the ablation zone using CT thermometry will allow more accurate cancer treatment.

SSG14-05 Effectiveness of Metal Artefact Reduction Algorithm in a New Generation Spectral CT

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S405AB

Participants
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PURPOSE

The purpose of this study was to quantify the effectiveness of metal artefact reduction (MAR) algorithm in restoring the CT image quality with the new generation spectral CT scanner, and compared the results with those of an older generation CT scanner

METHOD AND MATERIALS

We retrospectively reviewed clinical data of twelve patients with pedicle screw fixation of fractured vertebrae or degenerated intervertebral disc. Institutional review committee approval and written informed consents from patients were obtained. All patients underwent CT scan during the first hospital admission and three weeks thereafter to evaluate the position of the pedicle screws. The initial CT examination was carried out using GE Discovery CT750 HD with 80/140kVp, 0.5s rotation and 0.986 pitch. The follow-up scan was performed at 0.5s rotation and 0.992 pitch using a new generation spectral CT (Revolution CT, GE Healthcare). Virtual monochromatic images (VMIs) were reconstructed at energy levels of 63, 68, 74, 88, and 105 keV. Artefact index (AI=v(Ns2-Nm2) was assessed by region of interest (ROI) measurements in position of the strongest artefact (Ns) and in a muscle structure without artefact (Nm) (noise in HU units). The subjective image quality was assessed by two experienced radiologists independently. The CTDIvol and dose length product (DLP) were recorded. All quantitative analysis was based on the mean value of parameter calculated from five VMIs.

RESULTS

Metal artefact index and radiation dose was significantly reduced in the new generation spectral CT (AI 18.27±7.09, CTDI 11.89±0.89, DLP 212.50±36.96) compared with that in older generation CT (AI 51.98±28.77, CTDI 17.51±1.63,DLP 276.69±42.11, $p<0.05$ for all). There was high agreement between two radiologists (kappa=0.682). Subjective image quality analysis showed significantly higher score at new generation CT scanner (3.82±0.68,3.85±0.66) than older generation CT scanner (2.12±0.76),(2.00±0.74).

CONCLUSION

The MAR algorithm in the new generation spectral CT allows for a significant reduction of metal artefacts and improved subjective image quality in patients with pedicle screw.

CLINICAL RELEVANCE/APPLICATION

Pedicle screw with high atomic number are widely used in orthopedic surgery and can produce severe metal artefact. The present study demonstrated that MAR algorithm in a new generation spectral CT was effective in reducing artefacts arising from pedicle screw.

SSG14-07 Improvement of Image quality in Low-Dose Computed Tomography Using a Deep Learning Based Denoising Algorithm

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S405AB

Participants
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PURPOSE

To assess the image quality of low dose (LD) computed tomography (CT) using a deep learning based denoising algorithm (DLA) compared with filtered back projection (FBP) and advanced modeled iterative reconstruction (ADMIRE).

METHOD AND MATERIALS

Our institutional review board approved this retrospective study. A total of 50 patients underwent routine dose (RD) abdominal CT using FBP. CT images at 50%, 25%, and 13% dose levels of RD were simulated from RD CT images and reconstructed using FBP. We trained the DLA using the simulated LD CT images as input data and the RD CT images as the ground truth. To assess the image quality, we included five patients who underwent abdominal LD CT and additionally performed CT scan for the CTP 528 module of Catphan. CT images were reconstructed using FBP and ADMIRE (LD-FBP and LD-ADMIRE images). LD-FBP images were processed using DLA (LD-DLA images). We compared the mean image noise levels of LD-DLA, LD-ADMIRE and LD-FBA images in the liver, subcutaneous fat, paraspinal muscles and aorta drawing elliptical region-of-interests. Modulation transfer function (MTF) was measured at the images of CTP 528 module to assess the spatial resolution.

RESULTS

Mean image noises in LD-DLA images were significantly lower than LD-FBP images ($p<0.05$ for all) and similar compared with LD-ADMIRE images ($p>0.05$ for all). MTFs (mm-1) of 10% contrast were 0.629, 0.629 and 0.635 in LD-DLA, LD-ADMIRE and LD-FBP images, respectively.

CONCLUSION

The LD-DLA images showed the less noise than LD-FBP images and comparable noise to LD-ADMIRE images while preserving the spatial resolution.

CLINICAL RELEVANCE/APPLICATION

Deep learning based denoising algorithm could improve the image quality of low dose computed tomography and be a new way to reduce radiation dose.

SSG14-08 Potential Application of Photon Counting CT in Cerebrovascular Imaging

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S405AB

Participants
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PURPOSE

The goal of this work was to study the potential benefit of photon counting CT (PCCT) in imaging the cerebral vasculature. The scientific rationale was that compared with the current cerebral CT angiography (CCTA) technology, PCCT could provide better performance for cerebrovascular imaging tasks due to 1) improved energy weighting scheme applied to the photon signal and 2) significantly relaxed noise-spatial resolution tradeoff offered by the photon counting detector (PCD).

METHOD AND MATERIALS

An in-house experimental PCCT was constructed using a 51 cm CdTe-based PCD with a native pixel size of 100 μm. A customized angiographic CT head phantom containing contrast-enhanced healthy cerebral artery models (diameters ranging from 0.5 to 4.0 mm) was scanned by both the PCCT and a clinical MDCT with a clinical CCTA protocol. Radiation dose, beam collimation (20 mm), kV (100), reconstruction pixel size (0.4 mm) and slice thickness (1.25 mm) were matched between the two systems. MIP images were generated based on the instruction of the clinical CCTA protocol. CNR was measured at both proximal and distal branches of ICA and MCA. In addition, axial- and z-MTFs were measured for the two CT systems.

RESULTS

The CTDIvol and effective dose of the two systems were matched at 35 mGy and 1.23 mSv, respectively. Based on the measured axial MTF of MDCT, the reconstruction kernel of PCCT was adjusted until the axial spatial resolution of the two CT systems was matched; under this condition, the CNR of the proximal arteries (diameter 4.0 mm) was 44.7 ± 12.2 in MDCT and was 87.5 ± 22 ($p=0.0003$) in PCCT. For the distal and smaller artery branches (0.5 mm) the CNR was 11.3 ± 6.3 for CCTA and 17.3 ± 6.1 for PCCT ($p=0.013$). 10% MTF along z was 1.1 lp/mm for MDCT and 2.1 lp/mm for PCCT. The MDCT MIP demonstrated artifactural stenosis in a healthy angular artery due to partial volume effect; in contrast, the PCCT MIP provided more accurate and clearer rendering of all the arteries evaluated.

CONCLUSION

With matched dose and axial spatial resolution, PCCT provides higher vessel CNR, better z resolution, and reduced partial volume artifact, which suggests its promising application in cerebrovascular imaging.

CLINICAL RELEVANCE/APPLICATION

PCCT has the potential to address two major challenges in clinical CCTA: 1) limited CNR and spatial resolution of MDCT in imaging small or partially enhanced vessels; 2) distortions of true artery information due to image artifacts.

SSG15

Radiation Oncology (CNS Malignancies)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S403B

BQ MR NR OI RO

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

Participants
Hui-Kuo G. Shu, MD, PhD, Atlanta, GA (*Moderator*) Speakers Bureau, Varian Medical Systems, Inc; Stockholder, Medtronic plc; Stockholder, Apple Inc; Stockholder, ICON plc; Stockholder, Raytheon
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Sub-Events

SSG15-01 Decoding IDH Genotype in Grade-II and -III Gliomas Using Machine Learning with Protein-based Amide Proton Transfer-Weighted (APTw) and Magnetization Transfer (MT) MRI

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S403B

Participants
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PURPOSE

The 2016 WHO includes molecular markers, such as isocitrate dehydrogenase (IDH) mutation status, to classify diffuse gliomas. This reveals an unmet radiographic need-the ability to identify genetic biomarkers preoperatively, with methods such as MRI. This study aimed to evaluate the power of machine learning based on endogenous mobile protein-based APTw and semi-solid macromolecule-based MT MRI features in classifying IDH1/2 mutation status.

METHOD AND MATERIALS

105 patients with grade-II or -III gliomas with pre-operational routine and APTw MR images, and lab test reports of IDH mutation status were retrospectively recruited. 391 radiomics features were extracted from the tumor ROIs on APTw, MT, and structural MR images. The support vector machine (SVM) method was implemented (A). 70, 25 and 10 cases were randomly assigned to the training set, validation set, and test set. 10-fold cross-validation was used for tuning parameter (γ) selection. The dimensionality of all features is reduced using principal component analysis (PCA). Leave-one-out cross-validation was applied to estimate the classification performance of the models. The alpha level of all tests was set at $P < 0.05$.

RESULTS

43 vs. 62 patients were confirmed as IDH-wildtype or IDH-mutant, respectively. Demographic and clinical characteristics showed no significant difference between the training set and validation set. The IDH-wildtype cohort showed significant higher age and higher WHO grade compared with IDH mutant group. Thus, age and WHO grade were added to SVM classifier. An accuracy of 95.2% in the test set was achieved to predict IDH genotype. The 10 features (age, grade, APTw_mean, APTw_10th percentile, APTw_25th percentile, MT_75th percentile, etc.) that contributed most to the model are presented (B).

CONCLUSION

Our SVM model presented here achieved an accuracy of 95.2% in the test set. The findings support the use of textures extracted from APTw and MT MRI to aid the accurate diagnostic classification of IDH genotype.

CLINICAL RELEVANCE/APPLICATION

The textures extracted from APTw and MT MRI could be used in the accurate diagnostic classification of IDH genotype in patients with WHO grade-II and -III gliomas.

SSG15-02 Identifying Recurrent Tumor in Post-treatment Glioblastomas with Volumetric Amide Proton Transfer-Weighted (APTw) Image Metrics as Biomarkers

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S403B

Participants
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PURPOSE

Post-treatment glioblastomas are biologically complex and often demonstrate highly variable imaging characteristics. Currently

Post-treatment glioblastomas are biologically complex and often demonstrate highly variable imaging characteristics. Currently, patients with suspected recurrent tumor are often referred for repeat surgery to obtain pathologic confirmation due to the lack of reliable imaging modalities. APTw-MRI is a novel molecular imaging technique that generates contrast primarily based on endogenous cellular proteins. Here, we assessed whether volumetric APTw-MRI metrics could identify recurrent tumor in a heterogeneous background in patients with suspected recurrent glioblastoma.

METHOD AND MATERIALS

31 patients with suspected recurrent glioblastoma were enrolled. MRI sequences included T1w, T2w, FLAIR, Gd-T1w, and volumetric APTw sequences. Diagnosis was made by the RANO criteria and pathological results. Volumes of interest (VOIs) were drawn by a neuroradiologist and a research scientist separately. Three ratios of the volumes of Gd-enhancement, abnormal FLAIR intensity, and APTw hyperintensity were recorded: VGd/VFLAIR, VAPT/VFLAIR, and VAPT/VGd. APTw histogram parameters, including mean, mode, and percentiles, calculated from both VOIs on Gd-T1w and FLAIR images (Fig. 1A, B).

CONCLUSION

Volumetric APTw image metrics are valuable predictors of tumor recurrence in patients with suspected recurrent glioblastoma treated with standard chemoradiation.

CLINICAL RELEVANCE/APPLICATION

APTw-MRI is totally noninvasive and now commercially available, and the results can be readily translated into improved diagnostics for patients with suspected recurrent brain tumors.

SSG15-03 Evaluation of Early Acute Radiation-Induced Brain Injury: Hybrid Multifunctional MR Imaging Based Study

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S403B

Participants
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PURPOSE

Accidental or deliberate radiation injury is a serious threat to humans that requires prompt accurate diagnosis and assessment. At present, there is no effective imaging method to evaluate the extent of acute radiation brain injury at early stage. We use DCE, IVIM-MRI and 1H-MRS to noninvasively evaluate acute radiation-induced brain injury.

METHOD AND MATERIALS

SD rats were divided into five groups and four groups received a single radiation treatment to the whole brain. The different extent of brain injury was created by exposure different radiation dose, 10, 20, 30, 40Gy respectively. DCE, IVIM-MRI and MRS was performed on day 5 post radiation injury.The correlation between parameters and radiation dose grade was analyzed using Spearman's rank correlation coefficients. ROC analysis of each MRI parameter was carried to differentiate the extent of radiation exposure. Immunohistochemistry, western blot and transmission electron microscopy were used to determine radiation-induced histopathological changes of neurons and glial cells.

RESULTS

For DCE, Ktrans, Ve, Vp and AUC increased significantly with the radiation dose increase. For IVIM, S0, f and D* also increased significantly with the radiation dose increase. For Ktrans, Ve and AUC in DCE and S0, f and D* in IVIM, the value in 30Gy group was significantly higher than other groups ($P<0.05$). The ratio of NAA/Cr in the 30Gy group was significantly lower than other groups and the ratio of NAA/Cho was increase from 10Gy to 20Gy group, but decreased significantly in the 30Gy group ($P<0.05$). VEGF and caspase-3 expression in the cortex was increased with the irradiation dose increasing from10 Gy to 30 Gy ($P<0.05$). Astrocyte population elevated with radiation dose increase ($P<0.05$).MBP staining did not show differences among the sham-radiation and every radiation groups ($P>0.05$). ROC analysis demonstrated that DCE and IVIM parameters are more effective for diagnosing the 30Gy group, but lower for the 10Gy and 20Gy groups.

CONCLUSION

Hybrid multifunctional MRI parameters can non-invasively evaluate acute radiation-induced brain injury at early stage, especially high dose radiation exposure.

CLINICAL RELEVANCE/APPLICATION

In the event of acute radiation exposure accidents, radiation damage can be detected non-invasively by MR imaging markers and used to determine the extent of brain injury without the need for invasive histopathological analysis.

SSG15-04 Glioma Survival Prediction with the Combined Analysis of Multi-Modal MRI, Histopathology, and Patient Characteristics by Supervised Machine Learning

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S403B

Participants
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PURPOSE

To establish a survival prediction model for gliomas based on multi-modal MRI, ex vivo histopathology and patient characteristics.

METHOD AND MATERIALS

102 patients with pathologically confirmed WHO I-IV gliomas and complete survival information were retrospectively included. All patients received fluid attenuated inversion recovery, contrast enhanced T1-weighted image, three dimensional pseudo-continuous arterial spin labeling, intravoxel incoherent motion diffusion-weighted images (IVIM-DWI) and dynamic contrast enhanced MRI (DCE-MRI) before surgery. After surgery, histopathology-derived ex vivo features according to WHO 2016, such as tumor grade, histology, isocitrate dehydrogenase mutation status and the methylation of oxygen 6-methylguanine-DNA methyltransferase promoter have been acquired. The histogram and textural features were extracted from tumor volume of interests in each parametric map derived from multi-modal MRI. As for feature selection, pearson correlation and single factor cox regression were utilized to identify relevant features for predicting 2-year overall survival. The multi-factor cox model based on the histopathology and patient characteristics (partial-feature) or their combinations with multi-modal MRI features (full-feature) were established, respectively. Three approaches such as likelihood ratio, Wald and Score (log-rank) test were used to verify the two predictive models.

RESULTS

The predictive model based on the full-feature performed better than that based on partial-feature. The most contributing features to predict overall survival were tumor location, patient age, textural features from DCE-MRI and IVIM-DWI. The likelihood ratio of the full-feature model was 98.23 ($p<0.0001$),while that of the partial-feature one was 62.48 ($p<0.0001$). The hazard ratio of selected image features derived from DCE-MRI and IVIM-DWI were 0.51 ($p = 0.0003$) and -2.37 ($p = 0.0002$) respectively.

CONCLUSION

Survival prediction of glioma patients based on full features containing multi-modal MRI, histopathology and patient characteristics is more accurate than that without multi-modal MRI.

CLINICAL RELEVANCE/APPLICATION

While survival is associated with molecular biomarkers, diagnostic work-up of patients with suspected glioma mainly done by using multi-modal MRI holds great potentials in glioma characterization.

SSG15-05 Clinical Impact of Time Interval Between Gross Total and Subtotal Resection of Glioblastoma and Radiotherapy Using a Large National Database

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S403B

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Glioblastoma (GBM) is the most common primary malignant brain tumor in adults and standard of care treatment includes maximal safe surgical resection followed by adjuvant radiotherapy (RT) and chemotherapy. The optimal time interval between surgery and the initiation of adjuvant therapy remains unclear.

METHOD AND MATERIALS

The NCDB was queried for adult patients with diagnostic codes for GBM diagnosed from 2004 to 2015 who were treated with RT following surgical resection. Time interval between surgery and the start of RT were grouped into a. <= 4 weeks, b. 4.1-6 weeks, c. 6.1-8 weeks, and d. >8 weeks. Overall survival (OS) was estimated using Kaplan-Meier and log-rank test methods. Univariate (UVA) and multivariable (MVA) modeling with Cox regression analysis was used to determine predictors of OS.

RESULTS

A total of 46,012 patients, with a median age of 61 years (range 18-90 years) met inclusion criteria. Median time interval from resection to RT was 29 days (range 1-620 days). A total of 11,480 patients underwent a gross total resection (GTR) and 13,608 underwent a subtotal resection or biopsy (STR). Median survival was significantly different between time interval groups: 13.9, 15.2, 14.4, and 14.7 months, groups a-d respectively (p<0.0001). Using all variables significant on UVA, the following variables were associated with better OS on MVA: higher KPS, lower age, female gender, black ethnicity, methylated status, unifocal disease, and treatment initiation of RT >4 weeks. When separated by resection status, these variables remained significant; however patients with GTR initiated on RT >8 weeks had worse survival (HR 1.23, p=0.007) whereas patient's with STR did not.

CONCLUSION

Consistent with prior smaller series, this large retrospective analysis of the NCDB suggests that patients with newly diagnosed GBM who start RT within four weeks of surgical resection have worse outcomes. In terms of prolonged delay from surgery to RT, patients with GTR had worse OS if they initiated RT after 8 weeks whereas patients with STR did not. This finding should be considered in the future designs of clinical trials.

CLINICAL RELEVANCE/APPLICATION

This study aims to use the National Cancer Database (NCDB) to identify predictors for and clinical impact of time from surgical resection to initiation of RT in patients with newly diagnosed GBM.

SSG15-06 Assessment of the Alpha/Beta Ratio of the Optic Pathway

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S403B

Participants
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PURPOSE

Hypofractionation has been recently considered an alternative to improve stereotactic radiosurgery of lesions in close proximity of the optic pathways. To estimate the intrinsic benefit from fractionation versus single dose radiosurgery for peri-optic lesions, the value of the alpha/beta ratio of the optic pathways has to be taken into account. Most studies expect and use an alpha/beta ratio of 2 Gy, or even 3 Gy, for the visual system. So far, to our knowledge, only 3 alpha/beta ratios have been published: In 1992 Goldsmith and Larson published an alpha/beta ratio of 3.06 Gy, which means that there would be no benefit of hypofractionation for most benign lesions. In 1994 Jiang estimated a ratio of 1.6 Gy based on relatively few data from a single center study. In 2010 Vernimmen derived a negative value of -0.6 Gy, and remarked that a negative value is not permitted by the LQ model.

METHOD AND MATERIALS

The alpha/beta ratio of the optic pathways was estimated from a meta analysis of 388 studies published since 2000. We included 27 studies with fraction numbers between 1 and 31, considering the following inclusion criteria: frequency of radiation induced optical neuropathy RION between > 0 %, and < 10 %, follow up of at least 12 months, no tumor progression, no prior radiation, detailed dosimetric analysis for the visual system. Clinical data provided from our center were added, including 54 hypofractionated Gamma Knife Radiosurgery regimens (4 treatments with 5 sessions, 45 treatments with 4 sessions, and 5 treatments with 3 sessions) and 106 single session treatments of different lesions close to the optic pathways.

RESULTS

The FE plot method revealed an alpha/beta ratio of the optic system of 1.11 Gy, confidence interval [0.39 - 3.59]. There is still not enough data in order to distinguish between alpha/beta ratios of the optic chiasm, the nerves and the tracts.

CONCLUSION

A significant intrinsic benefit from hypofractionation can be expected not only for malignant tumors located in the sellar region but for benign lesions as well, because of the very low alpha/beta ratio of the optic system of 1.11 Gy.

CLINICAL RELEVANCE/APPLICATION

The knowledge of the alpha/beta ratio of the optic system helps to optimize fractionation regimens for peri-optical tumors, facilitating dose restraints, BED and single fraction equivalent doses.

SSG15-07 Repeat Whole Brain Radiation Therapy Using a Pulsed Reduced Dose Rate Technique

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S403B

Participants
Sara Kelm, Wauwatosa, WI (*Presenter*) Nothing to Disclose
Vanica Guignard, Wauwatosa, WI (*Abstract Co-Author*) Nothing to Disclose
Maikel Botros, MD, Wauwatosa, WI (*Abstract Co-Author*) Nothing to Disclose
Benjamin Gillingham, Wauwatosa, WI (*Abstract Co-Author*) Nothing to Disclose
Joseph A. Bovi, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose
Christopher J. Schultz, MD, Milwaukee, WI (*Abstract Co-Author*) Medical Advisory Board, Prism Clinical Imaging, Inc
Jennifer Connelly, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose
Malika L. Siker, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Limited salvage options exist for patients with multiple recurrent brain metastases previously treated with whole brain radiation therapy (WBRT). Pulsed reduced dose rate radiation therapy (PRDR) is a unique irradiation strategy that lowers the effective dose rate, potentially decreasing toxicity to normal tissue by allowing for sublethal damage repair. PRDR is safe and effective in patients with gliomas receiving partial brain re-irradiation. To our knowledge, this technique has not been reported before in patients with brain metastases who have received repeat WBRT with PRDR. We report our early outcomes.

METHOD AND MATERIALS

We conducted a retrospective review of patients with brain metastases who received repeat WBRT with PRDR at the time of clinical and/or radiographic progression. PRDR treatments were delivered with a series of 0.20 Gy pulses given over a 3-minute period. Patients were treated with parallel-opposed whole brain lateral fields with dose prescribed to isocenter.

RESULTS

We identified 26 patients who received WBRT with PRDR since 2012. We excluded 4 patients as 2 patients had no prior WBRT and 2 expired during treatment due to extracranial disease. Primary histology included breast cancer, melanoma, NSCLC, non-seminomatous testicular cancer, SCLC and sarcoma. Initial WBRT dose regimens included 30 Gy in 10 fractions, 37.5 Gy in 15 fractions, and 39.6 Gy in 18 fractions. KPS was 70-100 for all patients at time of first WBRT. Median time to progression after first WBRT was 7.7 months at which time patients underwent repeat WBRT with PRDR. Patients received daily fractions of 2 - 3 Gy to a total dose of 20 Gy - 30 Gy. KPS at repeat irradiation was 70-100. With a mean follow-up of 7.1 months, mean time to intracranial progression after repeat WBRT with PRDR was 4.7 months. Four patients had intracranial disease control after repeat WBRT with PRDR for > 6 months and 1 patient is still alive at the time of this review. No acute grade 3 toxicities were seen as a result of reirradiation based on CTCAE v4.03. Grade 1/2 toxicities included fatigue, anorexia, and alopecia.

CONCLUSION

To our knowledge, this is the first report of repeat WBRT with PRDR. This technique appears to be a safe and feasible option for patients with multiple brain metastases who previously received WBRT.

CLINICAL RELEVANCE/APPLICATION

Future prospective studies using this technique are being considered to determine use as salvage therapy.

SSG15-08 Whole Ventricular Irradiation and Neoadjuvant Chemotherapy for Pure Intracranial Germinoma: A Comparison of Three Dose-Sparing Techniques

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S403B

Awards
Trainee Research Prize - Medical Student

Participants
Jason D. Nosrati, BA, Grand Rapids, MI (*Presenter*) Nothing to Disclose
Kenneth Wong, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Arthur Olch, PHD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

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Jnosrati@live.com

PURPOSE

Radiation therapy (RT) plays a major role in the management of pure CNS germinoma, a disease most commonly seen in children 10-19 years of age. Awareness of late effects of RT has led to a shift in the focus of research to maintaining high cure rates with treatments such as chemotherapy with whole ventricular irradiation (WVI). In the present study, we evaluate three brain-sparing treatment techniques for pure intracranial germinomas with dose-volume analysis of normal brain structures.

METHOD AND MATERIALS

Four patients with intracranial germinomas were treated with chemotherapy followed by 22.5 Gy WVI with simultaneous integrated boost (SIB) to the primary site to 30 Gy. Tumor locations include suprasellar, pineal, or both locations. The SIB plans were replanned with the Japanese (24 Gy WVI only) and current Children's Oncology Group (COG) treatment paradigms (18 Gy WVI with primary site boost to 30 Gy). Target volumes were contoured from registered diagnostic MRIs and included the whole ventricular volume (WVV) and boost volume. Organs at risk (OAR) included hippocampi, temporal lobes, whole brain, and brain-WVPTV. V12, V18, and V20 were recorded for each of these structures, and dose-volume metrics were recorded for all 12 plans. PTV dose-volume coverage and OAR sparing were compared.

RESULTS

For the SIB protocol, the mean total brain V12, V18, and V20 were 59%, 34%, and 28%, respectively; the COG protocol values were 48%, 27%, and 20%; and the WVI values were 57%, 33%, and 28%. Analyzed across 4 patients with varying WVV and boost volumes, the WVI plan giving 24 Gy to the WVV without boost did not result in lower OAR dose-volume metrics yet underdosed the primary by 6 Gy compared to the other two treatment methods. The COG paradigm further reduced the dose to normal brain by reducing the WVPTV dose to 18 Gy while maintaining the 30 Gy boost PTV dose.

CONCLUSION

The WVI treatment plan may not reduce neurocognitive deficits yet potentially risks failure to control the primary site. The COG plan may result in even better neurocognitive outcomes than the SIB treatment, but whether there is an increase in ventricular failures remains to be seen.

CLINICAL RELEVANCE/APPLICATION

Minimization of cognitive late effects during treatment planning for CNS Germinoma is not enhanced by omission of a boost dose to

30 Gy to the primary tumor.

SSG15-09 Biomechanical Model-Based Deformable Image Registration for Glioma Patients

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S403B

Participants
Molly McCulloch, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Brian Anderson, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Samantha M. Buszek, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Karine Al Feghali, MD, Beirut, Lebanon (*Abstract Co-Author*) Nothing to Disclose
Hesham Elhalawani, MD, MSc, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Guillaume Cazoulat, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Caroline Chung, MD, FRCPC, Houston, TX (*Abstract Co-Author*) Research Grant, Elekta AB; Research Grant, RaySearch Laboratories AB; Advisory Board, RaySearch Laboratories AB; Advisory Board, Novocure Ltd
Kristy K. Brock, PhD, Houston, TX (*Presenter*) License agreement, RaySearch Laboratories AB

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PURPOSE

Assessment of treatment response for gliomas requires alignment of pre- and post-radiotherapy (RT) images. Large deformations in gross tumor volume (GTV) and surrounding brain can occur due to edema and tumor or surgical cavity growth or shrinkage. These large shifts can propose challenges in aligning serial images. The purpose of this study is to evaluate the accuracy of biomechanical model-based deformable image registration (DIR) driven by modeling the GTV volumetric response.

METHOD AND MATERIALS

Serial MR images of 10 glioma patients from post-surgery/pre-RT and post-RT were imported into an RT treatment planning system for analysis. GTV, ventricles, right and left hippocampi, brainstem and optic chiasm were delineated on each image. Automated rigid registration (RR) was performed between the pre- and post-RT MR images, followed by a biomechanical model-based DIR with boundary conditions on the GTV. Normal tissue contours were propagated from the pre-RT MR to the post-RT MR. The accuracy of the DIR method was evaluated using dice similarity coefficient (DSC) for each propagated contour.

RESULTS

The DSC was calculated between each propagated and original contour on the post-RT MR for both RR and DIR. Rigid registration was sufficient for 9 out of 10 patients in this limited cohort, as they did not have significant GTV or brain changes. In one patient with a large tumor (55 cm3), we qualitatively noted normal tissue shifts and tumor response due to treatment. In this patient, the use of DIR improved DSC for the ventricles from 0.56 to 0.74, left hippocampus from 0.36 to 0.48, and right hippocampus from 0.68 to 0.71.

CONCLUSION

In cases demonstrating therapeutic response of the tumor, biomechanical model-based DIR improves alignment compared to RR alone. This method was particularly beneficial for one patient in this limited cohort. Additional patients are needed to further evaluate impact and accuracy. These models will also aid in tracking the delivered dose and incorporating delivered dose into an adaptive protocol for glioma patients.

CLINICAL RELEVANCE/APPLICATION

For patients with therapeutic response to glioma, biomechanical model-based DIR is beneficial in alignment of normal tissues during RT, potentially aiding in tracking delivered dose.

RCA33

Case Review: Introduction to LI-RADS - Bring Your Own Device (Hands-on)

Tuesday, Nov. 27 12:30PM - 2:00PM Room: S404CD

GI

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

FDA Discussions may include off-label uses.

Participants
Ania Z. Kielar, MD, Shanty Bay, ON (*Moderator*) Research Grant, General Electric Company
Kathryn J. Fowler, MD, San Diego, CA (*Presenter*) Nothing to Disclose
Robert M. Marks, MD, San Diego, CA (*Presenter*) Nothing to Disclose
James T. Lee, MD, Lexington, KY (*Presenter*) Nothing to Disclose
Venkateswar R. Surabhi, MD, Houston, TX (*Presenter*) Nothing to Disclose
Cynthia S. Santillan, MD, San Diego, CA (*Presenter*) Consultant, Robarts Clinical Trials, Inc
Aya Kamaya, MD, Stanford, CA (*Presenter*) Nothing to Disclose
Yuko Kono, MD, PhD, San Diego, CA (*Presenter*) Equipment support, Canon Medical Systems Corporation; Equipment support, General Electric Company; Contrast agent support, Lantheus Medical Imaging, Inc; Contrast agent support, Bracco Group
Alice W. Fung, MD, Portland, OR (*Presenter*) Nothing to Disclose
Eleanor L. Ormsby, MD, Davis, CA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Implement newest LI-RADS categories when assessing liver observations in patients at risk for developing hepatocellular carcinoma (HCC). 2) Review LI-RADS major and ancillary features and apply them in a hands on interactive environment. 3) Demonstrate proficiency with assigning LI-RADS categories for assessing response of observations to locoregional treatment. 4) Present newest LI-RADS and concurrent AASLD updates.

ABSTRACT

Participants will review cases on their own devices and answer questions. The cases will then be reviewed by the presenters. Note: this activity is best done on a laptop or tablet. Although phones will work, their small size limits optimal image view. In this 1.5-hour Hands-On Workshop, participants will have the opportunity to review up to 15 cases of patients at risk for HCC across multiple modalities (e.g. MRI, CT and ultrasound). Participants will be asked to characterize observations based upon the most current version of LI-RADS. The workshop will be led by world-renown experts in the field, all of them members of the LI-RADS steering committee and/or members of a LI-RADS working group. The course will begin with a short 20-minute didactic lecture, highlighting key concepts of LI-RADS and updating attendees on the most current version. Thereafter, workshop attendees will have time to evaluate each case independently, with support faculty available throughout the room to answer individual questions. At set intervals, cases will be reviewed, highlighting pearls for accurate use of LI-RADS. Throughout the workshop, focus will be placed upon the correct assignment of LI-RADS categories based upon 1) recognition of major imaging features, 2) working through the diagnostic algorithm and 3) appropriately applying ancillary imaging features. Attendees will be given tips and tools to help with integration of LI-RADS into daily practice.

Active Handout:James T. Lee

http://abstract.rsna.org/uploads/2018/17002587/2018 RSNA LI-RADS Hands-On Workshop RCA33.pdf

RCB33

Case Review: Lung-RADS - Bring Your Own Device (Hands-on)

Tuesday, Nov. 27 12:30PM - 2:00PM Room: S503AB

CH OI

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Ella A. Kazerooni, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Elizabeth Lee, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Jared D. Christensen, MD, Durham, NC (*Presenter*) Advisory Board, Riverain Technologies, LLC
Maria D. Martin, MD, Madison, WI (*Presenter*) Nothing to Disclose
Brett M. Elicker, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe patient risk factors for lung cancer and current requirements for patients to be eligible for lung cancer screening based on the coverage decision outlined by the Centers for Medicare and Medicaid Services. 2) Explain the rational for each category used in Lung-RADS. 3) Apply Lung-RADS to case examples and recommend appropriate follow up.

ABSTRACT

Participants will review cases on their own devices and answer questions. The cases will then be reviewed by the presenters. Note: this activity is best done on a laptop or tablet. Although phones will work, their small size limits optimal image view. Lung-RADS was established in 2014 as a means to standardized reporting and management in high-risk patients undergoing screening for lung cancer with low dose CT. This workshop will begin with an approximately 20 minute review of the National Lung Screening Trial (NLST) and other supporting evidence for the efficacy of screening, recommendations for screening as per the U.S. Preventative Services Task Force and the coverage decision by the Centers for Medicare and Medicaid Services. Additionally, concepts regarding the structure and rational for Lung-RADS will be highlighted. After a didactic portion, participants will review cases independently on their own devices. Faculty support will be available throughout the room to answer individual questions. Following this, cases will be reviewed by the presenters in order to highlight key concepts in the use of Lung-RADS. This session will focus on the application of Lung-RADS including: recognizing important imaging features and applying findings to assign the correct Lung-RADS category. Attendees will be given tips and tools to help with use of Lung-RADS and requirements for establishments of a lung cancer screening program.

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/ Ella A. Kazerooni, MD - 2014 Honored Educator

RCC33

Secure Image Sharing for Education and Patient Care in Radiology

Tuesday, Nov. 27 12:30PM - 2:00PM Room: S501ABC

ED IN

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

FDA Discussions may include off-label uses.

Participants
Erik R. Ranschaert, MD,PhD, Tilburg, Netherlands (*Moderator*) Officer, Diagnose.me; Medical Advisory Board, MedicalPHIT;
Erik R. Ranschaert, MD,PhD, Tilburg, Netherlands (*Presenter*) Officer, Diagnose.me; Medical Advisory Board, MedicalPHIT;
Saad Ranginwala, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Peter M. Van Ooijen, MSc, PhD, Groningen, Netherlands (*Presenter*) Advisory Board, MedicalPHIT

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LEARNING OBJECTIVES

1) Learn about the advantages of using mobile devices for sharing radiological images, both for education and patient care. 2) Know about the risks involved in sharing personal data when using public messaging services like WhatsApp. 3) Learn about the strategies and techniques to share medical images safely and securely. 4) Know about the existing regulations for protection of privacy and personal data.

MSRP31

RSNA Resident and Fellow Symposium 2018: Transition to Early Career (Interactive Session)

Tuesday, Nov. 27 1:00PM - 4:00PM Room: E451A

ED PR

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credit: 0

Sub-Events

MSRP31A Welcome: Membership Benefits for Trainees

Tuesday, Nov. 27 1:00PM - 1:10PM Room: E451A

Participants
Courtney M. Tomblinson, MD, Nashville, TN (*Presenter*) Nothing to Disclose
David C. Gimarc, MD, Madison, WI (*Presenter*) Nothing to Disclose

MSRP31B Job Market Update

Tuesday, Nov. 27 1:15PM - 1:35PM Room: E451A

Participants
David C. Gimarc, MD, Madison, WI (*Presenter*) Nothing to Disclose
Jay R. Parikh, MD, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To present an overview of the 2018 Human Resources Commission Report. 2) Systematic approach to help land a job after residency / fellowship. 3) Private practice positions - questions to consider. 4) Academic positions - questions to consider.

ABSTRACT

Landing a job after residency or fellowship can be challenging. The 2018 ACR Human Resources Commission Report will be reviewed to gain an overview of the current job market. A systematic approach to help residents and fellows land a job will be described. Considerations for both private practice and academic positions will be presented.

MSRP31C Changes in Radiology Marketplace

Tuesday, Nov. 27 1:40PM - 2:00PM Room: E451A

Participants
Eric R. Smith, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose
Richard E. Heller III, MD, Chicago, IL (*Presenter*) Nothing to Disclose

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richard.heller@radpartners.com

LEARNING OBJECTIVES

1) List the major factors contributing to consolidation across health care. 2) Identify the contributing factors to consolidation of radiology practices. 3) Describe the various practice ownership models.

MSRP31D Personal Finance for Radiology Residents

Tuesday, Nov. 27 2:05PM - 2:25PM Room: E451A

Participants
Casey Reed, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
Seetharam C. Chadalavada, MD,MS, Cincinnati, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Establishing your financial goals. 2) Risk Management. 3) Asset Management. 4) Professional versus Personal Advising. 5) Common mistakes.

ABSTRACT

Managing personal finances, we will focus on tips or advice for radiology residents as they transition to attendings.

MSRP31E Transition to Early Career

Tuesday, Nov. 27 2:30PM - 2:50PM Room: E451A

Participants
David H. Ballard, MD, Ballwin, MO (*Presenter*) Nothing to Disclose

Nisha Mehta, MD, Charlotte, NC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the various practice models, and analyze these based on changing physician demographics. 2) Identify evolving trends in radiology practices and examine the impact of consolidation and private equity on career options. 3) Establish the importance of self-care and work-life balance. 4) Define physician burnout and introduce the concept of career longevity. 5) Develop effective negotiation skills.

MSRP31F Q&A

Tuesday, Nov. 27 2:50PM - 3:00PM Room: E451A

MSRP31G Career Transition Panel

Tuesday, Nov. 27 3:00PM - 3:45PM Room: E451A

Participants
David M. Theriot, MD, Atlanta, GA (*Moderator*) Nothing to Disclose
Lauren P. Golding, MD, Winston Salem, NC (*Presenter*) Nothing to Disclose
Jordan S. Gross, MD, Nashville, TN (*Presenter*) Nothing to Disclose
Richard E. Heller III, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Lucy B. Spalluto, MD, Nashville, TN (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Discuss advantages and disadvantages of different career pathways within radiology. 2) Specifically address the challenges and benefits associated with transitioning from one practice style to another. 3) Address questions and concerns of trainees pertaining to practice type and career transitions during question and answer session.

MSRP31H Q&A Closing Remarks

Tuesday, Nov. 27 3:45PM - 4:00PM Room: E451A

Participants
Courtney M. Tomblinson, MD, Nashville, TN (*Presenter*) Nothing to Disclose

MSAS33

Building the Management 'A Team' (Sponsored by the Associated Sciences Consortium) (Interactive Session)

Tuesday, Nov. 27 1:30PM - 3:00PM Room: S105AB

LM

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

Participants
Patricia Kroken, Albuquerque, NM (*Moderator*) Nothing to Disclose

Sub-Events

MSAS33A Managing at the Tip of the Spear: Radiology Practices Face Turbulent Times

Participants
Robert Still, Fairfax, VA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

bob.still@rbma.org

LEARNING OBJECTIVES

1) Identify the essential communication skills physician practice managers and physician leaders need to possess. 2) Examine several physician practice environments that foster a synergistic team: Radiologist/Practice Administrator/Hospital administrator. 3) Detect weaknesses in their radiology practices that may hinder positive management focus. 4) Develop new pathways to positive management initiatives within a rapidly changing radiology business model.

ABSTRACT

This session will provide an overview and specific strategies to create a synergistic leadership team between a radiologist, a radiology practice administrator or CEO and a hospital radiology department administrator. Participants will be able to return to their practice leadership positions with practical and time tested leadership strategies for success.

MSAS33B Partnering with Your Administrator to Lead Enterprise Initiatives: How to Be at the Table and Not on the Menu

Participants
Chris Tomlinson, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Christopher.tomlinson@jefferson.edu

LEARNING OBJECTIVES

1) Identify opportunities for radiology to lead initiatives across the healthcare enterprise. 2) Position radiology as an enabler for risk based payer contracts (appropriate use, utilization management). 3) Enable radiology to be at the table for enterprise decision making by enabling areas outside of radiology to be successful. 4) Provide examples of areas to show enterprise leadership.

MSCC33

Case-based Review of Nuclear Medicine: PET/CT Workshop-Abdomen/Pelvis & Pediatrics PET/CT (In Conjunction with SNMMI) (Interactive Session)

Tuesday, Nov. 27 1:30PM - 3:00PM Room: E450B

CT GI GU NM PD

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

FDA Discussions may include off-label uses.

Participants
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Director*) Nothing to Disclose
Katherine A. Zukotynski, MD, Ancaster, ON (*Director*) Nothing to Disclose
Terence Z. Wong, MD, PhD, Chapel Hill, NC (*Moderator*) Consultant, Lucerno Dynamics, LLC;

Sub-Events

MSCC33A Abdomen/Pelvis I

Participants
Don C. Yoo, MD, E Greenwich, RI (*Presenter*) Consultant, Endocyte, Inc

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dyoo@lifespan.org

LEARNING OBJECTIVES

1) Review Challenging and Instructive cases which will help with interpretation of PET/CT scans in the abdomen and pelvis.

ABSTRACT

For oncologic studies, F18-FDG is an outstanding tracer with wide applications. However, there are many normal variants and pitfalls which can make interpretation challenging. Appropriate clinical history can help avoid mistakes. Having patients fill out a questionnaire form can provide helpful information and if possible directly interviewing the patients for relevant pertinent clinical information can also be valuable. Discussing a complicated PET/CT scan with the referring physician can also yield valuable information and improve interpretation. This review will discuss challenging cases, physiologic variants and pitfalls seen in the abdomen and pelvis when interpreting PET/CT scans concentrating on genitourinary and gastrointestinal cases.

MSCC33B Abdomen/Pelvis II

Participants
Esma A. Akin, MD, Washington, DC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review the current applications of PET-CT in gynecologic disease and bladder cancer.

ABSTRACT

FDG PET-CT is an effective tool in initial assesment andtreatment follow up of various genitourinary and gynecological tumors. This session aims to highlight the utility of PET-CT in gynecological disroders as well as tumors of the bladder. An updated review of the current applications of PET-CT in gynecologic disease as well as bladder cancer will be presented.Pitfalls and variants that may challenge image interpretation will also be highlighted.

MSCC33C Pediatrics

Participants
Helen R. Nadel, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To be able to identify optimal PET/CT imaging parameters for children. 2) To be able to describe PET/CT patterns of disease in pediatrics. 3) To be able to compare PET/CT with PET/MR imaging in children.

MSES33

Essentials of Neuro Imaging

Tuesday, Nov. 27 1:30PM - 3:00PM Room: S100AB

MR NR

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

Sub-Events

MSES33A WHO Classification of CNS Neoplasms: Update 2018

Participants
Anne G. Osborn, MD, Salt Lake Cty, UT (*Presenter*) Author, Reed Elsevier;

For information about this presentation, contact:

anne.osborn@hsc.utah.edu

LEARNING OBJECTIVES

1) Learn why and how molecular data is more important than morphology in glioma diagnosis and stratification of patients for different risk-based treatments. 2) Be able to list newly-canonized tumor entities and recognize the unique imaging pattern of a new ganglion cell tumor, MVNT.

ABSTRACT

The 2016 World Health Organization (WHO) '4-Plus' Classification of CNS Neoplasms represents a radical departure from prior editions, the most recent of which was published in 2007. Recently-published updates to the 2016 schema have resulted in additional significant interim changes that will be summarized. Molecular data is now more important for diagnosis and patient treatment than histopathologic features. 'Master' molecules such as isocitrate dehydrogenase (IDH) have been identified as the result of early 'driver' events in tumorigenesis. We will summarize why IDH status is the key to glioma diagnosis and prognosis. We will delineate what's new and what's out as of 2016, emphasizing that identical neoplasms in children and adults differ genetically even though they are morphologically indistinguishable. Finally, participants will learn to recognize the unique imaging pattern of a new ganglion cell tumor, multinodular and vacuolating neuronal tumor (MVNT) which has been recently defined as a benign-behaving clonal neoplasm defined by specific genetic alterations.

MSES33B Phakomatoses

Participants
James G. Smirniotopoulos, MD, Silver Spring, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

james.smirniotopoulos@nih.gov

LEARNING OBJECTIVES

1) Describe why NF-1 is truly 'Neurofibromatosis'. 2) Describe the three neoplasms caused by the chromosome 22 mutation of NF-2. 3) Explain why Tuberous Sclerosis is a disorder of neuronal migration. 4) Define the vascular malformation of Sturge-Weber Syndrome Describe the features of VHL.

ABSTRACT

Phakomatoses are complex multi-system disorders, originally described as 'neuro-cutaneous'. NF-1 mutation cause neurofibromas, pigmentation, and optic gliomas. NF-2 causes Schwannoma, meningioma, and ependymoma. Tuberou Sclerosis, a disorder of migration and maturation, causes cortical tubers and subependymal nodules. Sturge-Weber is a capillary-venous malformation of the brain and skin. VHL causes multiple hemangioblastomas and complex visceral lesions (cysts and neoplasms).

Active Handout:James G. Smirniotopoulos

http://abstract.rsna.org/uploads/2018/18000948/Phakomatoses Smirniotopoulos RSNA MSES33B.pdf

MSES33C Spectrum of Prenatal and Postnatal MRI Findings of Central Nervous System Malformations

Participants
Eduardo Portela de Oliveira, MD , Ottawa, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the normal CNS embryology. 2) Identify the main MRI findings of CNS malformations and the diagnostic imaging approach to these anomalies. 3) Apply a practical embryological classification of the main CNS malformations.

ABSTRACT

Prenatal magnetic resonance imaging (MRI) is a complementary tool in the presence of an abnormal screening prenatal ultrasound (US) or in fetuses at increased risk for underlying central nervous system (CNS) malformations. There are, in many cases, overlap and presence of multiple neuronal malformations simultaneously. Knowledge of normal CNS embryology facilitates the classification and the diagnostic imaging approach to these anomalies. After reviewing thispresentation, radiologists should be able to recognize the prenatal and postnatal MRI features of the major CNS malformations as well as their embryological origin.

MSES33D Metastatic CNS Disease

Participants
Spyros S. Kollias, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Spyros.Kollias@usz.ch

LEARNING OBJECTIVES

1) Describe the various imaging manifestations of metastatic CNS disease. 2) Familiarization with the spectrum of differential diagnosis. 3) Apply a systematic work up for reaching the correct diagnosis. 4) Appraise the most appropriate advanced MR techniques for the differential diagnosis.

ABSTRACT

Metastases are among the most common mass lesions in the brain. 20%-25% of systemic malignancies show metastases in the CNS, and 15% of them present with neurological symptoms before the diagnosis of the systemic cancer. Chest radiography should be included in the work-up of any brain mass lesion (40%-60% have an abnormal chest x-Ray suggestive of bronchogenic primary or other metastases to the lung). Additional imaging modalities such as CT, PET, and bone scanning are used to stage the systemic disease. Metastases to the brain, skull, dura, and leptomeninges may have variable, and often nonspecific, apperance. In the absence of typical tumefactive lesions, mimics in neuroimaging may include MS, pyogenic abscess, toxoplasmosis, cysticercosis, sarcoidosis, tuberculosis, fungal infections, and others. CT underestimates the number of brain lesions even when contrast is used. Magnetization transfer, perfusion and diffusion imaging and MR spectroscopym can potentially ddifferentiate between metastatic lesion from multifocal glioma or lymphoma. When the diagnosis of brain metastasis is raised a thorough assessment of history, physical examination, and a minimal work-up can provide important clues on the nature of the lesion (i.e., neoplastic, vascular, inflammatory, or infectious). Decisions should be based on adequat clinical judjment, a high index of suspicion for alternative diagnoses, and concordance among diffeent examinations. Biopsy or surgical resection is indicated when the diagnosis of brain neoplasm is not confidently excluded.

Active Handout:Spyros Sotirios Kollias

http://abstract.rsna.org/uploads/2018/18000950/METS Chicago handout MSES33D.pdf

MSQI33

Quality Improvement Symposium: Value in Imaging 3: The Importance of Effective Communication

Tuesday, Nov. 27 1:30PM - 3:00PM Room: S402AB

LM SQ

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

Participants
David B. Larson, MD, MBA, Stanford, CA (*Moderator*) Grant, Siemens AG ; Grant, Koninklijke Philips NV

Additional Information

RSNA will award Quality Essentials Certificates of Completion to RSNA 2018 attendees who successfully participate. Participants who achieve a score of 80% or higher on the SAM test questions will be eligible to receive the certificates.

Sub-Events

MSQI33A Creating a Culture that Fosters Communication

Participants
Amber L. Liles, MD , Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the relationship between communication and culture. 2) Identify frequent communication barriers in the workplace. 3) Describe how effective communication can improve engagement, alignment, and productivity. 4) Apply principles of effective communication to further develop your culture of communication.

MSQI33B Communication Across Authority Gradients

Participants
Bettina Siewert, MD, Boston, MA (*Presenter*) Reviewer, Wolters Kluwer nv

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LEARNING OBJECTIVES

1) Describe human factor barriers to safety event reporting. 2) Apply specific techniques to facilitate communication across barriers. 3) Identify opportunities for cultural change.

Active Handout:Bettina Siewert

http://abstract.rsna.org/uploads/2018/18000363/Hand-out Communication across authority gradients MSQI33B.pdf

MSQI33C Optimizing Communication with Referring Providers

Participants
David B. Larson, MD, MBA, Stanford, CA (*Presenter*) Grant, Siemens AG ; Grant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Understand the concept of media richness in communication, including both conveyance and convergence. 2) Recognize aspects of radiology in which effective communication is critical. 3) Become familiar with key principles of effective communication in the diagnostic process.

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/ David B. Larson, MD - 2014 Honored EducatorDavid B. Larson, MD - 2018 Honored Educator

MSQI33D Optimizing Communication with Patients

Participants
Olga R. Brook, MD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Learn about strategies that improve communication between radiologists and patients.

MSRO33

BOOST: Gastrointestinal Hepatobiliary-Science Session with Keynote

Tuesday, Nov. 27 1:30PM - 2:30PM Room: S103AB

GI RO OI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Tarita O. Thomas, MD, PhD, Chicago, IL (*Moderator*) Nothing to Disclose
Michael F. Bassetti, MD, Madison, WI (*Moderator*) Research Grant, Merck KGaA; Research Grant, AstraZeneca PLC;

Sub-Events

MSRO33-01 Invited Speaker:

Tuesday, Nov. 27 1:30PM - 1:40PM Room: S103AB

Participants
Michael F. Bassetti, MD, Madison, WI (*Presenter*) Research Grant, Merck KGaA; Research Grant, AstraZeneca PLC;

MSRO33-02 Imaging Response Assessment and Outcomes in Hepatocellular Carcinoma after Stereotactic Body Radiotherapy: iRECIST as a Potential Substitute for Traditional Criteria

Tuesday, Nov. 27 1:40PM - 1:50PM Room: S103AB

Participants
Federica Vernuccio, MD, Palermo, Italy (*Presenter*) Research support, Siemens AG
Devon J. Godfrey, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Hannah Vernia, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Mathias Meyer, Durham, NC (*Abstract Co-Author*) Researcher, Siemens AG; Researcher, Bracco Group
Donna Niedzwiecki, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Manisha Palta, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Daniele Marin, MD, Durham, NC (*Abstract Co-Author*) Research support, Siemens AG

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PURPOSE

To compare imaging response assessment criteria in hepatocellular carcinoma (HCC) treated with stereotactic body radiotherapy (SBRT), and to determine which of these criteria better predicts patient survival.

METHOD AND MATERIALS

In this multicenter retrospective IRB-approved, HIPAA-compliant study, we included 56 HCC lesions (mean size 3.1 cm±1.4) treated with SBRT in 45 patients (age 66.73±7.61; 32 M; 13 F) between 2009 -2017. All patients underwent diagnostic CT/MR imaging within 6 weeks pre-SBRT and at least once 1-6 months post-SBRT. Tumor response on pre- and post-SBRT CT/MR over all assessments was determined using RECIST (response Evaluation Criteria in Solid Tumors) version 1.1, iRECIST (immune-RECIST), WHO (World Health Organization), mRECIST (modified RECIST) and EASL (European Association for the Study of Liver) criteria. Each response criteria was used to classify lesions as responders (i.e. local control: stable disease, partial or complete response) or nonresponders (progressive disease). McNemar's test was used to compare proportions of responders by each method vs RECIST 1.1 assuming independence of lesions. The Kaplan-Meier method was used to estimate 1-year overal survival (OS) from SBRT by each method.

RESULTS

Median follow-up was 19 months (3-29 months). Lesion response rates were 80.4% (n=45) by RECIST 1.1, 94.6% (n=53) by iRECIST, 67.9% (n=36) by WHO, 76.8% (n=43) by mRECIST, 71.4% (n=40) by EASL. Compared to RECIST 1.1, lesion response rate was significanly higher with iRECIST (p=0.005) and lower with WHO (p=0.02). Pseudoprogression occurred in 3 lesions (5%) with RECIST 1.1, 0 (0%) with iRECIST, 5 (9%) with WHO, 4 (7%) with mRECIST, and 7 (12.5%) with EASL. The largest difference in 1-year OS was observed for RECIST 1.1 with longer survival in responders (85%, 90% CI:72-93%) vs non-responders (67%, 90% CI: 35-86%). No differences were found for mRECIST, WHO or EASL. Too few events occurred to assess OS for iRECIST.

CONCLUSION

SBRT is an effective local treatment for HCC. RECIST 1.1 identifies patients with better outcomes; yet iRECIST appears to be promising in overcoming pseudoprogression. Further analysis of association between RECIST 1.1, iRECIST and outcomes are needed.

CLINICAL RELEVANCE/APPLICATION

Response assessment of HCC after SBRT by RECIST 1.1 may be superior to other imaging criteria; however, pseudoprogression occurs with all of these criteria, except with iRECIST.

MSRO33-03 Stereotactic Body Radiotherapy (SBRT) Utilized as a Bridge to Orthotopic Liver Transplant (OLT) in Patients with Hepatocellular Carcinoma (HCC) and Severe Hepatic Cirrhosis

Tuesday, Nov. 27 1:50PM - 2:00PM Room: S103AB

Participants
Steven D. Gresswell, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Rachel Tobillo, Boca Raton, FL (*Presenter*) Nothing to Disclose
Shaakir Hasan, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Tadahiro Uemura, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Lorenzo Machado, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Ngoc Thai, MD,PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Alexander V. Kirichenko, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To report outcomes on SBRT as a bridging treatment to OLT for patients with HCC and Child-Pugh (CP) score >=8 hepatic cirrhosis.

METHOD AND MATERIALS

Twelve patients, 17 HCC lesions, within Milan criteria for liver transplant who completed liver SBRT prior to OLT from 2010-2017 were retrospectively analyzed. 4D-CT and SPECT imaging were used to facilitate functional treatment planning.

RESULTS

The median age was 60 years (range 48-69 yrs), with a median CP 9 (range 8-11) and MELD-Na 14 (range 9-24). Main cause of cirrhosis was hepatitis C. Three patients required downsizing to be listed within Milan criteria for transplant. The median SBRT dose was 40 Gy in 5 fractions (range 30-50 Gy in 4-6 fractions). The median tumor max dimension was 2.3 cm (range 1.3-5.2 cm). The median PTV size was 37.5 cc (range 9-164 cc). Two patients had a prior TACE. The median time from SBRT to OLT was 5 mos (range 2-10 mos). All patients in the study received planned SBRT prior to OLT. One patient succumbed to progression of hepatic cirrhosis before OLT. The median follow-up and survival was 40 mos (range 3-70 mos) and 46 mos (range 3-70 mos), respectively. Local control was 100%. One patient progressed distantly at 38 mos, with no patients recurring in the liver. The median decrease in size of the HCC lesion was 60%, with five lesions having complete radiographic response by mRECIST criteria. Out of 5 patients who had elevated pretreatment AFP, 4 normalized by 6 mos. Five patients out of the 11 transplanted (45%) had a pathologic complete response on explanted liver. Acute toxicities (CTCAE v4.03) were two Grade 1 gastrointestinal and six Grade <=2 fatigue. No patients were diagnosed with RILD, however 4 patients had grade <=2 elevation of their liver enzymes. The median time to progression of CP > 2 was 9.7 mos (range 7 days-10 mos) while MELD-Na progression leading to an increased 3-month mortality was not met before OLT.

CONCLUSION

Based on our retrospective study we suggest, that SBRT with functional treatment planning can be used safely as a bridging treatment to OLT in select patients with severe cirrhosis meeting Milan criteria for liver transplant

CLINICAL RELEVANCE/APPLICATION

This paper demonstrates promising efficacy and toxicity results in one of the largest series of select patients with severe (Child Pugh $\geq$ 8) cirrhosis treated with SBRT with functional treatment planning for tumor downsizing prior to OLT.

MSRO33-04 Liver Radiomics Using Sulfur Colloid SPECT/CT for Survival Prediction in Primary Liver Cancer Patients Treated with Radiation Therapy

Tuesday, Nov. 27 2:00PM - 2:10PM Room: S103AB

Participants
Stephanie K. Schaub, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Landon Wootton, PHD, 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, Canon Medical Systems Corporation; Research Grant, Siemens AG
Stephen R. Bowen, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Art Chaovalitwongse, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Paul E. Kinahan, PhD, Seattle, WA (*Abstract Co-Author*) Research Grant, General Electric Company; Co-founder, PET/X LLC
Tobias R. Chapman, MD, Boston, MA (*Abstract Co-Author*) Consultant, Medtronic plc;
Smith Apisarnthanarax, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Matthew J. Nyflot, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

A critical need in radiotherapy (RT) for primary liver cancer patients is to accurately predict those at risk for toxicity and mortality. We hypothesize that radiomic signatures of the uninvolved liver extracted from pre-treatment functional liver imaging with [99mTc]sulfur colloid (SC) SPECT/CT can improve overall survival (OS) prediction compared with clinical factors alone.

METHOD AND MATERIALS

We retrospectively reviewed 48 primary liver cancer patients with underlying cirrhosis treated with RT for clinical data, including Child-Pugh (CP) score and gross tumor volume (GTV). 30 radiomic features were extracted from pretreatment SC SPECT/CT of the uninvolved liver (histogram, Haralick, neighborhood difference, and zone size features). Cox models were used for univariate and multivariate analysis of OS. Univariate p-values were not adjusted for multiple comparisons. The LASSO was used to construct multivariate models (<=4 variables). Initial model performance was estimated by the apparent c-index (Capp) and models were internally validated with the .632 bootstrap (C.632).

RESULTS

Twelve patients (25%) had CP-B8+ cirrhosis, and median GTV was 10 cc3 [1.2-1573]. 18 died over median follow-up of 13 months. The strongest univariate predictors of OS were GTV (hazard ratio (HR) 2.6, $p<0.001$) and CP score (HR 1.7, $p=0.027$), and 9 radiomic features had $p<0.05$ after adjusting for the strongest predictor (GTV). Multivariate LASSO-Cox performance was Capp=0.75 for GTV, 0.64 for CP score, 0.65 for radiomics, and 0.83 for GTV+CP+radiomics. After internal validation, GTV (C.632 =0.76) and CP models (C.632 =0.64) retained predictive accuracy. However, the radiomics model was not predictive (C.632=0.55, $p=0.34$) and the GTV+CP+radiomics model was not superior to GTV alone (C.632=0.76, $p=0.82$).

CONCLUSION

Tumor volume, and to a lesser extent CP score, appear to predict overall survival in primary liver cancer patients. Univariate analysis suggested radiomic features of SC SPECT/CT may provide complementary information beyond GTV and CP score; however, their inclusion did not improve model performance. Prospective validation in a clinical trial is underway.

CLINICAL RELEVANCE/APPLICATION

SC SPECT/CT functional liver radiomics may complement clinical factors to predict survival in primary liver cancer patients for precision radiotherapy that improves outcomes and reduces toxicity.

MSRO33-05 Robotic Stereotactic Radiotherapy for Liver-only Oligometastastic Colorectal Cancer: Single Center Experience

Tuesday, Nov. 27 2:10PM - 2:20PM Room: S103AB

Participants
Lorenzo Livi, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Pierluigi Bonomo, Florence, Italy (*Presenter*) Nothing to Disclose
Marco Vernaleone, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Vanessa Di Cataldo, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Giulio Francolini, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
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Emanuela Olmetto, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesca Terziani, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Icro Meattini, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Laura Masi, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To report on the safety and clinical benefit of robotic stereotactic body radiotherapy for liver-only oligometastatic colorectal cancer.

METHOD AND MATERIALS

Robotic stereotactic radiotherapy (SBRT) with Cyberknife was applied to oligometastatic colorectal cancer patients defined as having 1-4 liver metastases and absent or controlled extrahepatic disease. The intended prescription dose was 37,5 Gy in 3 fractions, prescribed to the 70% isodose line to cover 95% of the PTV, and adapted if risk-related. Liver - implanted fiducials allowed for tumor tracking during delivery. Treatment efficacy was estimated by clinical benefit rate (CBR), progression free survival (PFS) and overall survival (OS). Toxicity was graded according to CTCAE v. 4.03. Regression analysis was performed to establish whether any correlation could be found between treatment efficacy and biologically effective dose (BED), number of metastatic lesions, number of treated lesions, site of primary tumor, presence of extrahepatic disease and number of lines of systemic treatment.

RESULTS

Between 2012 and 2017, 38 patients (66 lesions) were irradiated. The median delivered biological effective maximum dose (maxBED10) was 142 Gy. At a median follow-up of 11.8 months (range 3.2-58.8), the 1 and 2-year OS were 67.3% and 44.1%, respectively.Local relapse or distant progression occurred in 28 (77,8%) patients, with a 1 and 2-year PFS of 19.3% and 12.2%, respectively. The CBR was 71,4%, with no significant association with max BED10. Age at SBRT > 76 ys and presence of extrahepatic disease had a significant impact on PFS, the latter confirmed at univariate and multivariate analyses. In addition, extrahepatic disease and number of metastatic lesions > 3 had a significant impact on OS, both of which significant at univariate analysis. Mean time of local or distant progression was 4,7 months (SD 3.7). No acute grade 3 gastrointestinal (GI) toxicity was observed.

CONCLUSION

Our results underline the importance of patients' selection to identify the oligo-metastatic scenario most likely to benefit from SBRT. Prospective studies are needed to further assess the role of SBRT among loco-regional treatment options for liver metastases from colorectal cancer.

CLINICAL RELEVANCE/APPLICATION

Our retrospective single center experience adds to the limited available evidence on the promising efficacy and tolerability of SBRT for liver metastases from oligometastatic colorectal cancer

MSRO33-06 Preliminary Clinical Study of Biliary Tract Irradiation Stent for Hilar Cholangiocarcinoma with Malignant Obstructive Jaundice

Tuesday, Nov. 27 2:20PM - 2:30PM Room: S103AB

Participants

Ju Gong, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To evaluate the efficacy and safety of biliary stent loaded with 125I seeds in treatment of hilar cholangiocarcinoma with malignant obstructive jaundice.

METHOD AND MATERIALS

Totally 43 patients with malignant obstructive jaundice caused by cholangiocarcinoma were included. All the paitents were underwent percutaneous transhepatic puncture ,of, the left and right side branch of the bile duct. In the hilar stenosis, the biliary stent with 125I seeds were implanted, and the biliary drainage tube had been kept in 3 to 5 days after procedures. The drainage tube was removed and the puncture road was closed after the patency of stents were confirmed by cholangiography. The changes of liver function before and after procedures were recorded, and the survival time was observed.

RESULTS

Five biliary stents loaded with 125I seeds were implanted in typeI (n=5), 36 in type II (n=18), 8 in typeIII (n=4) and 25 in typeIV (n=16). The Serum total bilirubin and direct bilirubin of paitents before procedures were (145.5 ±65.3) μmol/L and (124.7±35.0) μmol/L respectively, and (65.9±29.4) μmol/L and (35.5±15.1) μmol/L respectively after procedures. Compared with preoperative, the alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, C-reactive protein and gamma glutamic transaminase decreased significantly (all $P<0.05$); and the lactate dehydrogenase increased significantly ($P=1.05$). The median survival time was 13 months (3.0 to 22.5 months). The serious complications such as biliary puncture, pancreatitis, severe biliary tract infection or biliary bleeding were not occurred.

CONCLUSION

Biliary stent loaded with 125I seeds is an effective therapy to alleviate symptoms of jaundice and prolong the survival time of patients with malignant obstructive jaundice caused by hilar cholangiocarcinoma.

CLINICAL RELEVANCE/APPLICATION

To evaluate the efficacy and safety of biliary stent loaded with 125I seeds in treatment of hilar cholangiocarcinoma with malignant obstructive jaundice.

MSRO37

BOOST: Lung, Mediastinum and Pleura

Tuesday, Nov. 27 1:30PM - 2:30PM Room: S103CD

BQ CH CT NM OI RO

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Meng X. Welliver, MD, Columbus, OH (*Moderator*) Nothing to Disclose
Tracy M. Sherertz, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

Sub-Events

MSRO37-01 Dynamic Perfusion Area-Detector CT versus Dynamic Perfusion MR Imaging versus FDG-PET/CT: Capability for Therapeutic Outcome Prediction in Small Cell Lung Cancer Patients with Limited Disease

Tuesday, Nov. 27 1:30PM - 1:40PM Room: S103CD

Participants
Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Presenter*) Research Grant, Canon Medical Systems Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Fuji Pharma Co, Ltd; Research Grant, Guerbet SA;
Yasuko Fujisawa, MS, Otawara, Japan (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation
Masao Yui, Otawara, Japan (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation
Yuji Kishida, MD,PhD, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Shinichiro Seki, Kobe, Japan (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation
Takeshi Yoshikawa, MD, Kobe, Japan (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation
Noriyuki Negi, RT, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Katsusuke Kyotani, RT,MSc, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Takamichi Murakami, MD, PhD, Osakasayama, Japan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To directly compare the capability for therapeutic outcome prediction among dynamics contrast-enhanced (CE-) perfusion area-detector CT (ADCT) and CE-perfusion MR imaging (MRI) assessed by same mathematical method and FDG-PET/CT in small cell lung cancer (SCLC) patients assessed as limited disease (LD).

METHOD AND MATERIALS

Forty-three consecutive pathologically diagnosed SCLC patients assessed as LD (25 male, 18 female; mean age 67 year old) underwent FDG-PET/CT, dynamic CE-perfusion ADCT and MRI, chemoradiotherapy, and follow-up examination. In each patient, therapeutic outcomes were assessed as therapeutic effect based on RECIST guideline, disease free interval and overall survival. Then, all patients were divided into two groups as follows: 1) responder (CR+PR: n=33) and 2) non-responder (SD+PD: n=10) groups. In each patient, total perfusion (TP) and tumor perfusions from pulmonary (TPP) and systemic (TPS) circulations calculated by dual-input maximum slope method from dynamic CE-perfusion ADCT and MRI data and SUVmax on PET/CT were assessed at targeted lesions. Then, final values were determined as average values from all targeted lesion, and compared between two groups by Student's t-test. To compare the capability for distinguishing two groups, all indexes as having significant difference were assessed by ROC analysis. Finally, disease free and overall survivals between responders and non-responders assessed by each index were compared by Kaplan-Meier method followed by log-rank test.

RESULTS

There were significant difference of all indexes except TPP determined by each method ($p<0.05$). Area under the curves (Azs) of TPS (ADCT: Az=0.92, MRI: Az=0.92) were significantly larger than that of SUVmax (Az=0.73, $p<0.05$). Disease free survivals of responder were significantly longer than that of non-responder by TP (ADCT: p=0.006, MRI: p=0.02) and TPS (ADCT: p=0.001, MRI: p=0.02). Overall survivals of responder were also significantly longer than that of non-responder by TP (ADCT: $p<0.0001$, MRI: p=0.0003,) and TPS (ADCT: p=0.001, MRI: p=0.001).

CONCLUSION

Dynamic CE-perfusion ADCT and MRI have better potential for predicting therapeutic outcome than FDG-PET/CT in small cell lung cancer patients with limited disease.

CLINICAL RELEVANCE/APPLICATION

Dynamic CE-perfusion ADCT and MRI have better potential to predict therapeutic outcome than FDG-PET/CT in small cell lung cancer patients with limited disease.

MSRO37-02 Modern Treatment Patterns and Overall Survival of Non-Small Cell Lung Cancer Patients Receiving Palliative Radiation Therapy for Brain Metastases at Diagnosis

Tuesday, Nov. 27 1:40PM - 1:50PM Room: S103CD

Awards
Student Travel Stipend Award

Participants
Pamela Samson, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Benjamin W. Fischer-Valuck, MD, MS, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Prashant Gabani, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Michael C. Roach, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Jeffrey D. Bradley, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Cliff G. Robinson, MD, Saint Louis, MO (*Abstract Co-Author*) Investigator, Varian Medical Systems, Inc; Research funded, Varian Medical Systems, Inc; Speakers Bureau, Varian Medical Systems, Inc; Research funded, Elekta AB; Travel support, Merit Medical Systems, Inc; Speakers Bureau, ViewRay, Inc; Stockholder, Radialogica, LLC
Christopher D. Abraham, MD, Manchester, MO (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Non-small cell lung cancer (NSCLC) is one of the most common malignancies associated with brain metastases (BM) at diagnosis. Recent randomized trials have shown equivalent survival outcomes and improved neurocognitive outcomes with stereotactic radiosurgery (SRS) compared to whole brain radiation therapy (WBRT). We reviewed the NCDB to identify trends of RT for NSCLC patients with BM.

METHOD AND MATERIALS

11,299 NSCLC patients with BM at diagnosis and treated with palliative brain RT between 2010 and 2014 were identified in the NCDB. Patients receiving "stereotactic radiosurgery, NOS," "LINAC radiosurgery," or "gamma knife radiosurgery," or received external-beam RT with fraction size >=6 Gy were included in the SRS cohort. The WBRT cohort included all patients receiving RT to the brain in >=5 fractions. Patient characteristics were correlated with treatment received using multivariable logistic regression. Kaplan-Meier was used to compare overall survival (OS) between these two groups and Cox Proportional Hazards modeling (CPHM) to identify variables associated with OS.

RESULTS

9,680 (85.7%) patients were included in the WBRT group and 1,619 (14.3%) patients in the SRS group. Median dose in the WBRT was 3000 cGy and 2200 cGy in the SRS group. The frequency of SRS increased from 9.9% in 2010 to 19.6% in 2014. On MVA, variables associated with increased likelihood of receiving SRS included: increasing age (OR 1.01, 95% CI 1.01-1.02; P<0.0001), most recent year (2014) of diagnosis (OR 2.14, 1.78-2.56; P<0.0001), treatment at an academic facility (OR 3.21, 2.51-4.10; P<0.0001), private insurance (OR 2.25, 1.62-3.11), income in zip code >$63,000 (OR 1.33, 1.13-1.56; P=0.001), living >20 miles from treatment facility (OR 1.19, 1.03-1.37; P=0.016), and receipt of chemotherapy (OR: 2.48, 2.12-2.88; P<0.0001). WBRT patients had median OS of 4.1 months (95% CI, 4.0-4.3) vs. 8.9 months (8.2-9.7) for SRS patients (P<0.0001). On CPHM, factors independently associated with improved OS included receipt of SRS, chemotherapy, treatment at an academic center, and private insurance (P<0.02 for all).

CONCLUSION

Our analysis reveals that WBRT remains the most common palliative treatment for BM in NSCLC. SRS use is increasing and has nearly doubled between 2010 and 2014. In this study, SRS was associated with increased OS although there are biases in the selection of patients who receive SRS.

CLINICAL RELEVANCE/APPLICATION

SRS use for NSCLC patients with BM at the time of diagnosis is increasing, and is independently associated with improved OS.

MSRO37-03 Quantification of Radiation Pneumonitis in Lung Cancer Patients Receiving Proton or Photon Radiotherapy Using FDG-PET/CT

Tuesday, Nov. 27 1:50PM - 2:00PM Room: S103CD

Awards
Trainee Research Prize - Fellow

Participants
Pegah Jahangiri, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Kamyar Pournazari, MD,MSc, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Charles B. Simone II, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Drew A. Torigian, MD, MA, Philadelphia, PA (*Abstract Co-Author*) Co-founder, Quantitative Radiology Solutions LLC
Abass Alavi, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

This study assessed the feasibility of FDG-PET/CT to quantify radiation-induced pneumonitis in ipsilateral and contralateral lungs of patients with locally advanced non-small cell lung cancer (NSCLC) who received proton, photon, or combined proton-photon radiotherapy (RT).

METHOD AND MATERIALS

39 consecutive patients (53.8% female, median age 67y) with predominantly stage IIIA (62%) or IIIB (31%) NSCLC underwent FDG-PET/CT before and after proton or photon RT. Regions of interest (ROIs) were drawn manually along the margins of the lung parenchyma on PET/CT images. Lung mean standardized uptake value (SUVmean), global lung glycolysis (GLG), and lung volume were measured. Partial volume correction (PVC) of PET-based parameters was then performed. To quantify tumor metabolic response to RT, metabolically active tumor volume (MTV), tumor SUV, and total lesion glycolysis (TLG) were measured. Total lesion glycolysis was then subtracted from GLG to calculate global lung parenchymal glycolysis (GLPG). Parameters of FDG-PET/CT scans before and after RT were compared using two-tailed paired t-tests.

RESULTS

Among the 9 patients who received photon RT, there was a significant increase in PVC-GLPG of ipsilateral ($p < 0.001$) and in GLG of contralateral ($p = 0.036$) lungs. Also, in the subset of 9 patients who received combination of proton-photon RT, there was a statistically significant increase in PVC-GLPG in only the ipsilateral lung ($p < 0.001$). In contrast, among the 21 patients treated exclusively with proton RT, no significant increase in PVC-SUVmean ($p=0.114$) or in PVC-GLPG ($p=0.453$) were observed in ipsilateral lungs. Also, there were no significant increase in SUVmean ($p=0.841$) or in GLG ($p=0.241$) of contralateral lungs of patients who received exclusively proton RT.

CONCLUSION

We identified significant increases in PVC-SUV and PVC-GLPG in patients who received photon RT (either alone or in combination with proton RT) that were not identified in patients who received only proton RT. These observations suggest less induction of inflammatory response in both ipsilateral and contralateral lungs of patients treated with proton compared to photon or combined proton-photon RT, suggesting a mechanism by which proton therapy reduces radiation-induced pneumonitis.

CLINICAL RELEVANCE/APPLICATION

Proton RT induces less inflammatory response in both the ipsilateral and contralateral lungs of patients compared to photon or combined proton-photon RT.

MSRO37-04 Differentiating EGFR Mutation Status in Non-Small Cell Lung Cancer Using Imaging Features From PET/CT

Tuesday, Nov. 27 2:00PM - 2:10PM Room: S103CD

Participants
Mengmeng Jiang, Shanghai, China (*Presenter*) Nothing to Disclose
Yiqian Zhang, MS, Shanghai, China (*Abstract Co-Author*) Employee, Shanghai United Imaging Healthcare Co, Ltd
Min Ji, Shanghai, China (*Abstract Co-Author*) Employee, Shanghai United Imaging Healthcare Co, Ltd
Junshen Xu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Jiyong Wang, MSc, Jiading, China (*Abstract Co-Author*) Researcher, Shanghai United Imaging Healthcare Co, Ltd
Nan-Jie Gong, Houston, TX (*Abstract Co-Author*) Employee, UIH America, Inc
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PURPOSE

In this study, we investigated whether epidermal growth factor receptor (EGFR) mutation status in non-small cell lung cancer (NSCLC) can be assessed from quantitative as well as qualitative features extracted from both CT and PET.

METHOD AND MATERIALS

Eighty patients with stage II and III NSCLC and a confirmed EGFR mutation status (30 patients were positive and 50 were negative for EGFR mutation), who underwent PET/CT between January 2017 to December 2017, were included in this study. We extracted 514 quantitative features from PET/CT (257 for PET and 257 for CT) and 12 qualitative features from CT. Principal component analysis (PCA) was applied for feature selection. We selected principal components retaining 95% of the variability from all features. We then rebuilt the original features using the selected principal components and the original features were selected that correlated by at least 99% to the rebuilt features. Finally, 5 qualitative features, 24 quantitative features for CT as well as 10 quantitative features for PET were selected. A predictive model of EGFR mutation in terms of selected features using generalized linear regression with lasso regularization. The regularization parameter was selected through a 10-fold cross validation. All statistical analysis were performed in R software version 3.4.4.

RESULTS

With the total of 39 features selected which were significantly associated with EGFR mutation status, a predictive model for associating image features with EGFR positive/negative was built. We estimated the performance of the model using the area under the receiver operating characteristic curve (AUC). The result revealed an AUC=0.74.

CONCLUSION

By combing the PET-CT images together with first generation gene testing data, we investigate the relationship between image features and EGFR mutation status and built a radiogenomics model which can predict whether the patients have EGFR mutation or not from a certain number of qualitative features as well as quantitative features.

CLINICAL RELEVANCE/APPLICATION

A non-invasive method from image features to predict gene mutation status correlated with NSCLC and further advancing the role of imaging in precision medicine.

MSRO37-05 Stereotactic Body Radiotherapy for Centrally Located Non-Small Cell Lung Cancer: Single Center Experience

Tuesday, Nov. 27 2:10PM - 2:20PM Room: S103CD

Participants

Lorenzo Livi, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Pierluigi Bonomo, Florence, Italy (*Presenter*) Nothing to Disclose
Vieri Scotti, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

By definition, centrally located lung tumors are identified as a lesion located within 2 cm or touching the zone of the proximal bronchial tree or tumors immediately adjacent to the mediastinal or pericardial pleura. In these cases, the use of stereotactic body radiotherapy (SBRT) is debated due to the potential risk of severe toxicity. Currently, no high-level evidence is available to support its use.

METHOD AND MATERIALS

Between 2010 an 2015, 40 patients were treated with SBRT for 45 centrally located lesions. SBRT was delivered through either a LINAC-based intensity modulated radiotherapy (IMRT) technique or a robotic technique with Cyberknife. The prescribed total dose varied between 26 and 60 Gy delivered in 1 or 8 fractions, respectively, with median BED10 of 69 Gy (range 37,5-105 Gy). Overall Survival (OS) and Progression Free Survival (PFS) were reported using Kaplan-Meier method. Treatment-related toxicity was evaluated according to CTCAE version 4.0

RESULTS

The median age of the cohort was 62 years (48-86). The majority of treated lesions were secondary hilar or mediastinal lymphadenopathies (31/45, 69%), while unresectable primary tumors represented the remaining 14 cases (14/45, 31%). The most commonly used technique was VMAT for 21 lesions (47%), followed by Cyberknife for 14 (31%) and step and shoot IMRT for 10 targets (22%), respectively. The predominant NSCLC histology was adenocarcinoma (32/45, 71%). The median longest tumor diameter was 31 mm (range 10-60 mm). At a median follow-up of 14.5 months, OS and PFS were 86.5%, 55.6%, 49.4% and 48.6%, 24.1% and 12% at 1, 2 and 3 years, respectively. According to RECIST 1.1 criteria, a clinical benefit was achieved for 23 patients (57.5%) with a complete or partial response or stable disease in 4 (10%), 15 (37.5%) and 4 (10%) patients, respectively. Consistent with previous experiences using the same fractionation regimens, SBRT was well tolerated, with no G3/G4 toxicities: the most severe side effect was G2 esophagitis in 5/40 patients (12.5%).

CONCLUSION

In accordance with standardized risk-dose prescriptions, the use of SBRT for centrally located NSCLC was confirmed to be a safe and effective strategy. Prospective studies are warranted to support its use with high level evidence.

CLINICAL RELEVANCE/APPLICATION

Our single-center experience adds to the limited available evidence on the feasibility and clinical benefit of SBRT for centrally located NSCLC

MSRO37-06 Evaluation of the Tumor Response Using FDG-PET/CT Scans in Non-Small Cell Lung Cancer Patients Treated with Proton or Photon Radiotherapy

Tuesday, Nov. 27 2:20PM - 2:30PM Room: S103CD

Participants
Pegah Jahangiri, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Kamyar Pournazari, MD,MSc, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Charles B. Simone II, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Drew A. Torigian, MD, MA, Philadelphia, PA (*Abstract Co-Author*) Co-founder, Quantitative Radiology Solutions LLC
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PURPOSE

Lung cancer is one the leading causes of death worldwide. Radiation therapy (RT) is a major treatment option for lung cancer, including for unresectable locally advanced non-small cell lung cancer (LA-NSCLC). The aim of this study was to evaluate the response of the primary lung tumor to proton versus photon RT using 18F-fluorodeoxyglucose (FDG)-PET/CT in patients with LA-NSCLC.

METHOD AND MATERIALS

Thirty-nine consecutive patients who underwent FDG-PET/CT imaging pre- and post- proton or photon RT were assessed. Patients were predominantly female (53.8%) with a median age of 67 years and with predominantly stage IIIA (62%). An adaptive contrast-oriented thresholding algorithm was applied to measure metabolically active tumor volumes, uncorrected SUV, partial volume corrected SUV and total lesion glycolysis. Parameters of FDG-PET/CT scans before and after RT were compared using two-tailed paired t-tests.

RESULTS

Among the 9 patients who received photon RT and the 9 patients who received a combination of proton-photon RT, there was a significant decrease in PVC-TLG. Interestingly, among the 21 patients treated exclusively with proton RT, all tumor parameters including MTV, SUVmax, uncorrected SUVmean, PVC-SUVmean, uncorrected TLG, and PVC-TLG after treatment decreased significantly (all $p < 0.001$). The decreases in PVC-TLG and tumor PVC-SUVmean were more obvious than non-PVC ones (ΔPVC-TLG -357.26 cc versus ΔTLG -252.92 cc; ΔPVC-SUVmean -16.2 versus ΔSUVmean -10.19).

CONCLUSION

Adaptive contrast-oriented thresholding algorithm is a promising method to quantify whole tumor glycolysis in LA-NSCLC, and our findings demonstrates that proton RT is as effective as photon RT metabolically in inducing tumor response of LA-NSCLC.

CLINICAL RELEVANCE/APPLICATION

Proton RT, which is much safer, is as effective as photon RT in treatment of LA-NSCLC.

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VSIO31

Interventional Oncology Series: Basic Science and Imaging

Tuesday, Nov. 27 1:30PM - 6:00PM Room: S405AB

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ARRT Category A+ Credits: 5.00
AMA PRA Category 1 Credits ™: 4.25

FDA Discussions may include off-label uses.

Participants
S. Nahum Goldberg, MD, Ein Kerem, Israel (*Moderator*) Consultant, AngioDynamics, Inc; Consultant, Cosman Medical, Inc; Consultant, XACT Robotics;
Muneeb Ahmed, MD, Boston, MA (*Moderator*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc

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LEARNING OBJECTIVES

1) Characterize the most important cutting-edge advances of interventional oncologic techniques. 2) Gain a better understanding of the intraprocedural and follow-up imaging techniques that facilitate successful state of the art interventional oncologic practice. 3) Gain awareness of the extent of potentially beneficial and harmful systemic effects of "focal" interventional oncologic therapy. 4) Learn how immuno-oncologic techniques can be combined with both percutaneous and transcatheter interventional oncologic therapies to potentially achieve better clinical outcomes.

ABSTRACT

The first half of the session will has been organized into a thematic unit entitled: ""Interventional Oncology: Progress, Challenges and Opportunities" and will provide a series of seven lectures by leaders in the field each dedicated to discussing advances in the key aspects that comprise interventional oncologic practice. These include lectures on ablation devices, transcatheter therapies, and combination therapy, as well as the latest methods of using imaging for both guidance and navigation, and follow up. Additionally, there will be dedicated lectures addressing the ever expanding role of bio-markers for stratification and prognosis and the potential roles that IO may serve in the future oncologic platforms. This portion of the program will be concluded with a panel discussion entitled: "Which factors will most drive future progress ?". The second half of the session has been organized into a thematic unit entitled: "Immuno-oncology and IO - the next frontier ?" and will be dedicated to gaining an appreciation of how interventional oncologic practice can be further stimulated by leveraging advances from the rapidly growing discipline of immuno-oncology. First, a tailored overview will be provided as a "Practical primer of immuno-oncology for the radiologic community". This will be followed by two lectures highlighting how these advances can be best used in clinical practice with both percutaneous ablation and transcatheter chemo- and radio- embolic therapies - including the potential role of IO therapies for inducing abscopal effects. Finally, the potentially negative systemic effects of IO therapies including hypoxia and inflammation that can lead to tumorigenesis and proposed solutions to reduce these unwanted effects will be discussed.The session will further include selected complementary abstract presentations that highlight innovative research in these thematic areas.

Sub-Events

VSIO31-01 Ablation Devices

Tuesday, Nov. 27 1:30PM - 1:50PM Room: S405AB

Participants
Alison R. Gillams, MBChB, London, United Kingdom (*Presenter*) Speaker, Endocare, Inc

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LEARNING OBJECTIVES

1) To learn the distinct features of the commonly used ablation technologies. 2) To consider the advantages and disadvantages of the different devices. 3) To consider some examples of the optimal choice of device in certain clinical situations.

VSIO31-02 Hepatic Radiofrequency Ablation: Are Periablational Hepatocytes Bystanders or Active Participants in Post-Ablation Tumorigenesis?

Tuesday, Nov. 27 1:50PM - 2:00PM Room: S405AB

Participants
Aurelia Markezana, MSc, Jerusalem, Israel (*Presenter*) Nothing to Disclose
Elina Zorde Khvalevsky, PhD, Jerusalem, Israel (*Abstract Co-Author*) Nothing to Disclose
Muneeb Ahmed, MD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc
Svetlana Gourovich, BSC, Jerusalem, Israel (*Abstract Co-Author*) Nothing to Disclose

Eithan Galun, MD, PhD, Jerusalem, Israel (*Abstract Co-Author*) Nothing to Disclose
S. Nahum Goldberg, MD, Ein Kerem, Israel (*Abstract Co-Author*) Consultant, AngioDynamics, Inc; Consultant, Cosman Medical, Inc; Consultant, XACT Robotics;

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PURPOSE

To identify whether heated hepatocytes play a role in the activation of pro-tumorigenic pathways induced post-radiofrequency ablation (RFA).

METHOD AND MATERIALS

Primary hepatocytes isolated from 8 C57BL/6 mice were subject to moderate hyperthermic doses routinely achieved in the periablational rim. Purified hepatocytes were heated in-vitro to 45°C for 5min in a water bath and incubated thereafter at 37°C for 3hr. R3230 (rat breast carcinoma), CT26 and MC38 (Mouse colon carcinoma) and Bnl.CL2 (mouse HCC) cell lines (n=1.5x104) were incubated in cell culture wells with 50% heated hepatocyte medium or unheated hepatocyte medium as control. Tumor cells were stained with crystal violet 24-72hr after 37°C incubation to assess the extent of cell proliferation. Tumor cell growth was also assessed with an adjuvant c-Met kinase inhibitor (PHA-665752) (n=8). Next, identification of upregulated proteins secreted by heated and unheated hepatocytes were assessed by protein microarray (SomaLogic, INC) and compared. Finally, mRNA expression profile of IL-6, STAT3, HGF, and VEGF (i.e. factors implicated in RF-induced tumorigenesis) were evaluated by qRT-PCR in the heated hepatocytes, with HSP70 and TNFa used as thermal and inflammation controls.

RESULTS

Medium of mouse primary hepatocytes heated to 45C°x5min induced accelerated cell growth of all four tumor cell lines studied compared to non-heated cell media ($p<0.05$). Addition of PHA to the heated medium reduced proliferation rates to control levels in R3230 and MC38 ($p<0.03$). Protein microarray of heated hepatocytes medium, indicated >50% increased expression in 137 proteins compared to unheated cells - many of which are implicated in pathways involved in tumor progression and immune system activation including multiple members of the fibroblast growth factors family, VEGFC, and CSF-1. Significant upregulation in mRNA expression of HSP70, IL-6, STAT3 and HGF (147.2±47.1, 12.8±0.8, 4.4±1.17 and 181.5±29.1 fold induction, respectively, $p<0.01$) were detected in the heated hepatocytes.

CONCLUSION

RFA of normal liver parenchymal cells may induce sufficient secretion of proliferative factors to induce tumor growth.

CLINICAL RELEVANCE/APPLICATION

Elucidation of mechanisms that induces post RFA tumorigenesis will allow us to determine the most efficient treatment to suppress these pro-tumorigenic effects.

VSIO31-03 Transcatheter Therapies

Tuesday, Nov. 27 2:00PM - 2:20PM Room: S405AB

Participants
Stephen J. Hunt, MD,PhD, Philadelphia, PA (*Presenter*) Consultant, Amgen Inc; Consultant, BTG International Ltd

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO31-04 IO and Combined Therapies

Tuesday, Nov. 27 2:20PM - 2:40PM Room: S405AB

Participants
Philippe L. Pereira, MD, Heilbronn, Germany (*Presenter*) 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; Research Grant, CIRSE; Speaker, Medtronic plc

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO31-05 A Novel Biodegradable Radiopaque in Situ Forming Embolic Material Customizable to Desired Depth of Vascular Occlusion

Tuesday, Nov. 27 2:40PM - 2:50PM Room: S405AB

Participants
Selva Jeganathan, Cleveland, OH (*Presenter*) Nothing to Disclose
Emily G. Budziszewski, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Hanping Wu, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Sidhartha Tavri, MBBS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Agata A. Exner, PhD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Current transarterial embolization strategies in the treatment of intermediate stage hepatocellular carcinoma (HCC) are limited by suboptimal microvascular penetration of delivery agents and drugs. Development of an embolic material that is radiopaque, biodegradable and customizable to occlude different size target vessels will have advantages over current bead embolization strategies. We have developed an easily-customizable biodegradable radiopaque in situ forming implant (BRISFI) that can be loaded into a syringe as a liquid solution. Upon intra-vascular injection, the BRISFI phase-inverts into a solid embolic depot occluding the vasculature. In this study, we altered the solvent polarity of our BRISFI to control at what vessel diameter the occlusion occurs.

METHOD AND MATERIALS

BRISFIs were formulated by co-dissolving poly(lactic-co-glycolic acid) with an iodinated contrast agent (Ioversol) in a solvent comprised of a mixture of N-methyl-2-pyrrolidinone (NMP) and benzyl benzoate (BB) The amount of BB used are as followed: 0, 26.8, and 33.5 wt.%. Direct portal vein injection of BRISFI was performed in Sprague Dawley rats (n=3/group). Doppler ultrasound on the liver was performed pre and post embolization to validate vascular occlusion from the BRISFIs. Livers were explanted 2 hours after embolization and imaged with microCT to determine minimum vessel diameter occluded.

RESULTS

MicroCT images of explanted livers show a negative linear regression of vessel diameter with respect to increasing BB wt.%. The 0 wt.% BB formulation shows complete occlusion of larger central portal vein branches with an average occlusion diameter of 863.06 $\pm$ 94.08 μm. The 33.5 wt.% BB formulation occluded significantly smaller peripheral portal vein branches ($p<0.0001$) compared to the 0 wt.% BB with an average occlusion diameter of 174.03 $\pm$ 23.16 μm. Doppler ultrasound images show complete portal vein occlusion for all formulations.

CONCLUSION

This study shows the successful capability of controlling the BRISFI phase-inversion to occlude desired vascular depths. Intra-arterial embolization in a HCC rat model will be performed in the future to determine treatment efficacy.

CLINICAL RELEVANCE/APPLICATION

Current transarterial embolization strategies for HCC are suboptimal due to poor heterogeneous drug penetration into tumor vessels. By controlling the solvent polarity, our BRISFI will have a more homogeneous and deeper penetration in tumor vasculature.

VSIO31-06 Procedural Image Guidance and Navigation

Tuesday, Nov. 27 2:50PM - 3:10PM Room: S405AB

Participants
Bradford J. Wood, MD, Bethesda, MD (*Presenter*) Researcher, Koninklijke Philips NV; Researcher, Celsion Corporation; Researcher, BTG International Ltd; Researcher, Siemens AG; Researcher, XAct Robotics; Researcher, NVIDIA Corporation; Intellectual property, Koninklijke Philips NV; Intellectual property, BTG International Ltd; Royalties, Invivo Corporation; Royalties, Koninklijke Philips NV; ; ;

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO31-07 Imaging Follow Up After Intervention

Tuesday, Nov. 27 3:10PM - 3:30PM Room: S405AB

Participants
Laura Crocetti, MD, Pisa, Italy (*Presenter*) Speaker, General Electric Company

LEARNING OBJECTIVES

1) To describe criteria for tumor response assessment and learn about their limitations after interverventional therapies. 2) To examine common findings after ablative and intra-arterial therapies. 3) To debate about new trends and applications for tumor response evaluation.

VSIO31-08 Sublethal Heat Stress Induces PI3K/MTOR/AKT-dependent Increased Cell Survival and Decreased Cell Death Protein Networks in Hepatocellular Carcinoma: A Quantitative Phosphoproteomic Study

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S405AB

Awards
Student Travel Stipend Award

Participants
Scott M. Thompson, MD, PhD, Rochester, MN (*Presenter*) Nothing to Disclose
Danielle Jondal, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Kim Butters, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Matthew R. Callstrom, MD,PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, EDDA Technology, Inc; Research Grant, Galil Medical Ltd; Consultant, Medtronic plc; Consultant, Endocare, Inc; Consultant, Johnson & Johnson; Consultant, Thermedical, Inc
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PURPOSE

To examine the effects of sublethal heat stress on PI3K/mTOR/AKT-dependent cell survival, growth, proliferation, invasion and cell death protein networks in hepatocellular carcinoma *in vitro*.

METHOD AND MATERIALS

N1S1 HCC cells pre-treated with a dual PI3K/mTOR inhibitor BEZ235 or vehicle control and subjected to sublethal heat stress (45°C x 10 minutes) or control (37°C x 10 minutes) were analyzed using immunoaffinity peptide enrichment followed by liquid chromatography-tandem mass spectrometry (LC-MS/MS). Protein interaction networks were derived from Ingenuity Pathway Analysis. Cellular function activation state (z-score) and fold-change in isoform-specific AKT phosphorylation (p-AKT) were compared between treatment groups. $p<0.05$ was considered statistically significant.

RESULTS

Sublethal heat stress induced AKT signaling (z-score 1.9, p= -log (24.7) and isoform specific AKT phosphorylation compared to vehicle control (p-AKT1 6.4 to 82.6-fold; p-AKT2 9.3 to 52.2-fold; p-AKT3 6.9 to 10.0-fold), findings that were prevented with PI3K/mTOR inhibition (z-score -0.23; p= -log (16.8)). Sublethal heat stress induced increased cell survival/viability (z-score 4.7 to 4.8; p=1e-19 to 1.7e-20), transcription/translation (z-score 2.2 to 2.3 p=3.7e-27 to 1.6e-28), proliferation/invasion (z-score= 3.0 to 5.2; p=1.9e-15 to 5.5e-49) and decreased cell death/apoptosis (z-score -2.1 to -4.0; p=7.1e-25 to 3.4e-29). However, adjuvant PI3K/mTOR inhibition decreased cell survival and viability (z-score -2.9 to -3.2; p=1.4e-10 to 1.5e-10), transcription and translation (z-score 0.3 to -2.0 p=5.5e-7 to 5.5e-10), proliferation and invasion (z-score -0.2 to -1.6; p=5.1e-8 to 1.5e-11) and increased cell death/apoptosis (z-score 0.4 to 1.1; p=1.0e-8 to 7.7e-12).

CONCLUSION

Sublethal heat stress activates PI3K/mTOR/AKT-dependent pro-survival, growth, and proliferation protein networks and inhibits cell death and apoptosis protein networks in hepatocellular carcinoma.

CLINICAL RELEVANCE/APPLICATION

Sublethal heat stress during thermal ablation may not only induce HCC cell survival but also activate cell growth, proliferation and invasion pathways. Adjuvant PI3K/mTOR/AKT inhibition in combination with thermal ablation represents a candidate therapeutic strategy to decrease HCC cell survival to thermal ablation induced heat stress.

VSIO31-09 Biomarkers for Stratification and Prognostication

Tuesday, Nov. 27 3:40PM - 4:00PM Room: S405AB

Participants
Etay Ziv, MD,PhD, New York, NY (*Presenter*) Research Grant, Johnson & Johnson; Research Grant, Cycle for Survival ; Research Grant, Functional Genomics Initiative

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO31-10 Future Directions for Interventional Oncology

Tuesday, Nov. 27 4:00PM - 4:20PM Room: S405AB

Participants
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LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO31-11 Interventional Oncology Series: Basic Science and Imaging

Participants
Muneeb Ahmed, MD, Boston, MA (*Moderator*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO31-12 Practical Primer of Immuno-Oncology for the Radiologist

Tuesday, Nov. 27 4:30PM - 4:50PM Room: S405AB

Participants
Lei Zheng, MD, Baltimore, MD (*Presenter*) Research Grant, Bristol-Myers Squibb Company; Research Grant, Merck & Co, Inc; Research Grant, iTeos Therapeutics SA; Research Grant, Gradalis, Inc; Research Grant, Amgen Inc; Research Grant, Halozyme Therapeutics, Inc; Royalties, Aduro BioTech, Inc; Advisory Board, Merck & Co, Inc; Consultant, Percan; Consultant, Biosynergics Inc; Consultant, AstraZeneca PLC; Consultant, Novarockbio

LEARNING OBJECTIVES

1) Understand the landscape of the immuno-oncologylandscape. 2) Understand the potential synergy between the fields of radiology and immno-oncology. 3) Discuss how interventional radiology approaches can be applied to the development of immuno-oncology treatments.

VSIO31-13 Effects of Idarubicin-Eluting Oncozene Microspheres on Pre-Clinical Tumor Microenvironment in Liver Cancer

Tuesday, Nov. 27 4:50PM - 5:00PM Room: S405AB

Participants
Tabea Borde, New Haven, CT (*Presenter*) Research Grant, Boston Scientific Corporation
Johanna M. van Breugel, MSc, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Tsa Shelton, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Lynn J. Savic, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Ming De Lin, PhD, New Haven, CT (*Abstract Co-Author*) Employee, Pro Medicus Limited
Fabian Laage-Gaupp, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Lucas C. Adam, MS, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
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Steffen Huber, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
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James S. Duncan, PhD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
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Todd Schlachter, MD, Farmington, CT (*Abstract Co-Author*) Nothing to Disclose
Julius Chapiro, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV; Research Grant, Guerbet SA; Consultant, Guerbet SA; Consultant, Eisai Co, Ltd

PURPOSE

The main purpose of this study was to evaluate the effect of Oncozene drug-eluting beads with 40 and 100 µm diameters loaded with idarubicin in a rabbit VX2 liver tumor model. Magnetic resonance imaging (MRI) was performed to investigate embolization effects on the tumor and tumor microenvironment by assessing physiological markers, e.g. extracellular pH (pHe), hypoxia, and vasculature.

METHOD AND MATERIALS

VX2 tumor chunks were implanted into the left liver lobe of 12 New Zealand White rabbits subjected to transarterial chemoembolization (TACE) with either 40 (n=5) or 100 µm (n=4) Oncozene microspheres (Boston Scientific, Maple Grove, MN, USA) or assigned as control (untreated, n=3). Multiparametric MRI was performed post-TACE including dynamic contrast enhanced (DCE), diffusion weighted imaging (DWI), and biosensor imaging of redundant deviation in shifts (BIRDS) for pHe assessment. Ex vivo analyses included fluorescence imaging to evaluate idarubicin penetration and immunohistochemistry stainings.

RESULTS

DCE showed devascularization of embolized tumors as compared to controls ($p=0.07$). Specifically, the outer tumor rim was less enhanced in treated animals. In controls, DWI revealed significantly lower levels of cellularity in the tumor core than in the tumor rim ($p=0.006$). Post-TACE, DWI results suggest loss of tumor cell integrity when compared to healthy liver parenchyma ($p<0.0001$). Regarding pHe, BIRDS showed that tumors were significantly more acidic than liver parenchyma both prior to ($p=0.02$) and post-TACE ($p<0.01$). On fluorescence imaging and histopathology, 40 µm and 100 µm microspheres caused matching tumor cell death and complete inhibition of tumor cell proliferation. 100 µm beads caused more peritumoral vascular occlusion and no non-target deposition.

CONCLUSION

The study revealed strengths and weaknesses for 40 and 100 µm Oncozene microspheres that need to be further investigated. mpMRI combining DCE, DWI, and BIRDS revealed could become an important tool in assessing changes within the tumor microenvironment. Thus, it could be used for advanced tumor detection, differentiation, and improved treatment response prediction.

CLINICAL RELEVANCE/APPLICATION

MpMRI combining DCE, DWI, and BIRDS revealed high significance and could become an important tool in assessing changes within the tumor microenvironment. Thus, it could be used for advanced tumor detection, differentiation, and improved treatment response prediction.

VSIO31-14 Combining Immuno-Oncology with Ablation

Tuesday, Nov. 27 5:00PM - 5:20PM Room: S405AB

Participants
Joseph P. Erinjeri, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO31-15 Immuno-Oncology and Arterially Directed Therapies

Tuesday, Nov. 27 5:20PM - 5:40PM Room: S405AB

Participants
Jens Ricke, MD,PhD, Munich, Germany (*Presenter*) Research Grant, Sirtex Medical Ltd Research Grant, Bayer AG

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO31-16 Is All This Activation Beneficial? IO and Tumorigenesis

Tuesday, Nov. 27 5:40PM - 6:00PM Room: S405AB

Participants
Muneeb Ahmed, MD, Boston, MA (*Presenter*) Research Grant, General Electric Company; Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

RCA34

Leveraging Machine Learning Techniques and Predictive Analytics for Knowledge Discovery in Radiology (Hands-on)

Tuesday, Nov. 27 2:30PM - 4:00PM Room: S401AB

AI IN RS

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

Participants
Kevin Mader, DPhil,MSc, Basel, Switzerland (*Moderator*) Employee, 4Quant Ltd; Shareholder, 4Quant Ltd
Kevin Mader, DPhil,MSc, Basel, Switzerland (*Presenter*) Employee, 4Quant Ltd; Shareholder, 4Quant Ltd
Barbaros S. Erdal, PhD, Columbus, OH (*Presenter*) Nothing to Disclose
Joshy Cyriac, Basel, Switzerland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the basic principles of predictive analytics. 2) Be exposed to some of the existing validation methodologies to test predictive models. 3) Understand how to incorporate radiology data sources (PACS, RIS, etc) into predictive modeling. 4) Learn how to interpret results and make visualizations.

ABSTRACT

During this course, an introduction to machine learning and predictive analytics will be provided through hands on examples on imaging metadata (scan settings, configuration, timestamps, etc). Participants will use open source as well as freely available commercial platforms in order to achieve tasks such as image metadata and feature extraction, statistical analysis, building models, and validating them. Imaging samples will include datasets from a variety of modalities (CT, PET, MR) and scanners. The course will begin with a brief overview of important concepts and links to more detailed references. The concepts will then be directly applied in visual, easily understood workflows where the participants will see how the data are processed, features are selected, and models are built.

RCC34

3D Medical Printing Technologies, Regulations and Education

Tuesday, Nov. 27 2:30PM - 4:00PM Room: S501ABC

IN

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

Participants
Peter C. Liacouras, PhD, Bethesda, MD (*Moderator*) Nothing to Disclose
Andy Christensen, BS, Littleton, CO (*Moderator*) Consultant, Integrum AB; Board Member, Integrum AB; Stockholder, Somaden LLC

LEARNING OBJECTIVES

1) Understand the basic concepts of 3D printing. 2) Know the basic procedures for producing 3D medical models from radiographic images. 3) Differentiate between 3D printing technologies. 4) Be able to identify the best 3D printing technology to use for different medical applications.

Sub-Events

RCC34A 3D Medical Printing Technologies

Participants
Peter C. Liacouras, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the Clincal Apllications of 3D printing in Craniomaxillofacial Reconstruction. 2) Discuss Simulation of Rare Events utilizing 3D printing. 3) Become familiar with the concept of biocompatibility and sterilization techniques as they relate to 3D printed parts. 4) Become aware of the varied types of 3D printing technology including benfetis and limitations.

ABSTRACT

3D printing in medicine has been growing at an exponential rate. One of the leading uses of this technology is in the care of craniomaxillofacial patients with oncologic and non oncologic needs. This talk will discuss the benefits and limitations of the varied 3D printing technologies as the relate to CMF patients. We will discuss the clinical benefits of patient specific models for oncologic planning and reconstruction as well as the simulation of rare possible complications using 3D printed models. In addition the audience will gain a brief understanding of the terms surrounding 3D printing/additive manufacturing of biocompatible materials and sterilization techniques.

RCC34B Technical and Quality Considerations for 3D Printed Medical Devices

Participants
James Coburn, MSc, Silver Spring, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Become familiar with a variety of indications for the production of 3D Models that may be of benefit to the Urologic surgeon prior to renal surgery to remove a renal mass or tumor. 2) Understand the many benefits the urologic surgeon can obtain from pre-operative production of renal 3D models in patients undergoing renal surgery to remove a renal mass. 3) Become familiar with the unique complexities of developing a renal 3D model prior to a planned renal surgery for renal tumor removal. 4) Become familiar with the appropriate CT and MR acquisition parameters that are required for optimal 3D Models of kidneys conatining a renal mass.

ABSTRACT

This presentation will discuss the various renal applications of 3D Models in patients with renal tumors undergoing nephron sparing surgery. Certain indications for 3D Modeling prior to nephron sparing surgery include: Masses in kidneys with congenital anomalies, kidneys with multiple renal masses, large renal masses, and renal masses in the hilum area of the kidneys

RCC34C Regulatory Compliance in Medical 3D Printing

Participants
Andy Christensen, BS, Littleton, CO (*Presenter*) Consultant, Integrum AB; Board Member, Integrum AB; Stockholder, Somaden LLC

LEARNING OBJECTIVES

1) Define methods that can be used to generate three-dimensional maps of aortic strain/growth to better characterize disease progression among patients with thoracic aortic aneurysm. 2) Describe techniques to generate color 3D printed maps of aortic strain/growth. 3) Apply color 3D printing techniques of three-dimensional aortic strain/growth maps to improve communication with and education of patients undergoing aortic surgical procedures.

RCC34D 3D Printing Education for Residents

Participants
Summer J. Decker, PhD, Tampa, FL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand why training in computer technologies such as 3D modeling and 3D printing is increasingly critical to resident training. 2) Learn how to develop methods for instruction in 3D technologies. 3) Identify potential opportunities and resources for resident training.

RCC34E Aortic Growth/Strain Mapping Pre-surgical and Patient Education

Participants
Nicholas S. Burris, MD, San Francisco, CA (*Presenter*) Entitled to royalties from liscensure of intellectual property to Imbio LLC

MSRO34

BOOST: Gastrointestinal-Case-based Multidisciplinary Review (Interactive Session)

Tuesday, Nov. 27 3:00PM - 4:15PM Room: S103AB

GI OI RO

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants
Smith Apisarnthanarax, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Jeff L. Weinstein, MD, Boston, MA (*Presenter*) Nothing to Disclose
James O. Park, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Tobias R. Chapman, MD, Boston, MA (*Presenter*) Consultant, Medtronic plc;

LEARNING OBJECTIVES

1) Differentiate between the various local treatment modalities (surgical, transarterial, thermal ablation, SBRT, proton beam therapy) used in the treatment of liver tumors (HCC, cholangiocarcinoma, metastasis) 2) Describe various advantages and disadvantages/limitations of each locoregional therapeutic modality 3) Appraise different clinical scenarios and select appropriate local therapy options based on specific technical and patient related factors

MSRO38

BOOST: Lung-Case-based Multidisciplinary Review (Interactive Session)

Tuesday, Nov. 27 3:00PM - 4:15PM Room: S103CD

CH OI RO

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Participants

Simon S. Lo, MD, Seattle, WA (*Presenter*) Editor, Springer Nature;
Subba R. Digumarthy, MD, Boston, MA (*Presenter*) Nothing to Disclose
Feng-Ming Kong, MD,PhD, Cleveland, OH (*Presenter*) Speakers Bureau, Varian Medical Systems, Inc
Jyoti D. Patel, MD, Chicago, IL (*Presenter*) Nothing to Disclose
David W. Johnstone, Milwaukee, WI (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Discuss the appropriate management of non-small cell lung cancer. 2) Discuss the appropriate management of small cell lung cancer.

ABSTRACT

Modern management of lung cancer typically involves interdisciplinary evaluation by radiologists, thoracic surgeons, medical oncologists, and radiation oncologists. This session reviews the most up-to-date multidisciplinary management of both non-small cell and small cell lung cancer through clinical cases.

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/ Subba R. Digumarthy, MD - 2013 Honored Educator

RC413

Pediatric Series: Gastrointestinal/Genitourinary

Tuesday, Nov. 27 3:00PM - 6:00PM Room: N228

GI GU PD US

AMA PRA Category 1 Credits ™: 2.75
ARRT Category A+ Credits: 3.25

FDA Discussions may include off-label uses.

Participants
Andrea S. Doria, MD, Toronto, ON (*Moderator*) Nothing to Disclose
Lynn A. Fordham, MD, Chapel Hill, NC (*Moderator*) Nothing to Disclose
Ting Y. Tao, MD, PhD, Saint Louis, MO (*Moderator*) Nothing to Disclose
Jonathan R. Dillman, MD, Cincinnati, OH (*Moderator*) Research Grant, Siemens AG; Research Grant, Guerbet SA; Travel support, Koninklijke Philips NV; Research Grant, Canon Medical Systems Corporation; Research Grant, Bracco Group
Sara M. O'Hara, MD, Cincinnati, OH (*Moderator*) Author, Reed Elsevier; Speakers Bureau, Canon Medical Systems Corporation; Medical Advisory Board, Canon Medical Systems Corporation

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LEARNING OBJECTIVES

-The participants should be able to obtain new knowledge in the field. -The participants should be able to clarify their questions during the alloted time for questions & answers. -The participants should be able to apply in their clinical practice knowledge gathered through the scientific papers presented. -The participants should be able to generate new ideas for research based on the topics presented.

Sub-Events

RC413-01 Pediatric Scrotal Sonography

Tuesday, Nov. 27 3:00PM - 3:15PM Room: N228

Participants
Lynn A. Fordham, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review technique of scrotal sonography. 2) Discuss key diagnostic findings. 3) Review common and uncommon pathologies and mimics of disease in the pediatric scrotum and other challenging pediatric cases.

RC413-02 A "Self-Driving Car" to Track Clinical Image Quality? Comparison between an Automated Image Analysis Program and Human Readers for Detectability of Subtle Liver Lesions in Pediatric Abdominopelvic CT

Tuesday, Nov. 27 3:15PM - 3:25PM Room: N228

Participants
Justin B. Solomon, PhD, Durham, NC (*Presenter*) License agreement, Sun Nuclear Corporation; License agreement, 12 Sigma Technologies
Taylor Smith, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Taylor Richards, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Jennifer S. Ngo, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Donald P. Frush, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Siemens AG; Advisory Board, medInt Holdings, LLC; License agreement, 12 Sigma Technologies; License agreement, Gammex, Inc

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PURPOSE

To develop a program to automatically analyze image quality directly from CT images and compare this program to radiologist-based detectability of subtle pediatric liver lesions.

METHOD AND MATERIALS

A detectability index (d') based on mathematical observer models and statistical decision theory was measured directly from patient's abdominopelvic (AP) CT images. This method consisted of automatically estimating the image noise magnitude (HU STD) and noise texture (noise power spectrum) based on a published technique. The estimated noise was combined with both an a priori phantom-based measurement of resolution (task-transfer function) and an assumed imaging detection task (low-contrast 5 mm liver lesion) to compute d' for a non-prewhitening matched filter observer model. This patient-specific d' was compared to results from an IRB approved human reader study in which nine radiologists were asked to detect virtually inserted subtle hypoattenuating liver lesions (~-25 HU contrast, <= 6 mm) in 90 pediatric AP CT cases (0-3 lesions per case) representing one baseline radiation dose level (100%) and two reduced dose levels (75% and 50% compared to baseline). The median CTDIvol [25th-75th percentiles] was 4.81 [4.35-6.26], 3.61 [3.27-4.70], and 2.41 [2.18-3.13] mGy for each dose level, respectively. The d' was measured on all the CT images and compared to the radiologist-based detection outcomes using a generalized linear mixed effects model (probit link function, random term for readers).

RESULTS

On average, the lesion detection sensitivities were 54±2%, 37±2%, and 28±2% for radiation dose levels of 100%, 75%, and 50%, respectively, for radiologists. The predicted detection sensitivities based on d' were 51±2%, 45±2%, and 38±2% for radiation dose levels of 100%, 75%, and 50%, respectively. Based on the multivariate statistical model, d' was strongly correlated to radiologists' detection rates (P<0.001).

CONCLUSION

The proposed detectability index measured directly from patient's CT images was representative of trained radiologists' detection sensitivities of subtle liver lesions in pediatric abdominal CT.

CLINICAL RELEVANCE/APPLICATION

An automated method for assessing CT image quality could allow for efficient and effective institution-wide monitoring of CT performance, improved reference levels based on both quality and dose, and improved AI-based investigations of image quality.

RC413-03 What Does the Echogenic Debris of the Bladder Mean in Pediatric Urinary Tract Infection?

Tuesday, Nov. 27 3:25PM - 3:35PM Room: N228

Participants
Hye Ji, MD, Daejeon, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sun Kyoung You, MD, Daejeon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the clinical significance of echogenic debris in the bladder of children with a first episode of febrile urinary tract infection (UTI).

METHOD AND MATERIALS

We retrospectively reviewed the data of children under 2 years of age with first febrile UTI admitted to our hospital, from March 2017 to February 2018. Blood test, urinalysis and urine culture were performed before initiation of antibiotics. All renal US procedures were performed within 3 days of admission. We recorded presence of echogenic debris in bladder, renal parenchymal change, renal pelvic wall thickening, and dilatation of renal collection system on renal ultrasonorphy. Patients were divided into D(debri)-group and non-D group. Student's t-test and Pearson Chi-Square (or Fisher's exact test) were used statistical analysis. We also used multiple logistic regression analysis to evaluate the association between echogenic debris in bladder on renal US and other data.

RESULTS

Of the 135 patients of our study (boys:girls=84:51, mean age=5.6±4.2 months, range; 1.1-23.9 months), 26 (19.3%) cases showed echogenic debris in bladder. Twenty one patients in D group (21/26, 80.8 %) were boys (Odds ratio = 3.06, 95% CI= 1.077 - 8.735, p=0.04). The level of CRP and BUN was significantly higher in D-group (6.1±4.2 vs. 4.3±3.7 mg/dL, p=0.03; 10.3±3.4 vs. 8.6±3.0 mg/dL, p=0.017). Twenty three patients in D group (23/26, 88.5%) showed hematuria (Odds ratio = 4.44, 95% CI= 1.255-15.741, p=0.01). The renal parenchymal changes and wall thickening of the renal collecting system were statistically significant different between two groups (p=0.02, <0.001, respectively). There was no significant difference in result of urine culture between two groups (p=0.59). According to the multiple logistic regression, there were significant association between presence of echogenic debris in bladder on renal US and male, presence of renal pelvic wall thickening, and elevated CRP (P= 0.025, 0.003, and 0.014; ORs = 0.26, 4.63, and 1.12, respectively).

CONCLUSION

The echogenic debris of bladder on renal US is not an uncommon finding in the first febrile UTI patients younger than 2 years of age. Presence of echogenic debris in bladder on renal US was related to the sex, CRP, and renal pelvic wall thickening.

CLINICAL RELEVANCE/APPLICATION

The echogenic debris of bladder on renal ultrasonography is more common in boys and is associated with CRP and renal pelvic wall thickening.

RC413-04 B-Flow Sonography for Assessment of Vascularity of Kidney Transplants in Children

Tuesday, Nov. 27 3:35PM - 3:45PM Room: N228

Participants
Elena Dammann, Hamburg, Germany (*Presenter*) Nothing to Disclose
Jochen Herrmann, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael Groth, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare B-flow Sonography (BFS) with Color Doppler Sonography (CDS) for assessment of vascularity in kidney transplants

To compare B-flow Sonography (BFS) with Color Doppler Sonography (CDS) for assessment of vascularity in kidney transplants (NTX) in children.

METHOD AND MATERIALS

All children after kidney transplantation who received a protocol based ultrasound examination (Loqiq 9, GE Medical Systems, Milwaukee, WI, USA) with corresponding images in BFS and CDS technique between January 2013 and January 2016 were retrospectively assessed. The obtained data sets of BFS and CDS were graded visually according to following criteria: (I) Delineation of the complete renal vascular tree, (II) delineation of cortical vessel density in ventral, lateral and dorsal part of NTX, (III) minimal distance of detectable vessels to renal capsule and (IV) best cortical vessel count on 1 cm. Statistics included t-test and Fisher´s exact test.

RESULTS

Forty children (mean age 11 ± 4 years, range 1-18 years; 24 male, 16 female) were analyzed using corresponding curved and linear transducer images (C1-6 and ML6-15). With a curved transducer, BFS compared with CDS showed superior delineation of the renal vascular tree ($p<0.001$), a lower vessel-capsule distance ($p<0.001$), and a higher vessel count ($p<0.001$). Regarding cortical vasculature, BFS demonstrated higher cortical density in the superficial cortex than CDS ($p=0.005$), but lower values in the dorsal and lateral aspects of the transplant (both $p<0.001$). With a linear high-resolution transducer, no significant differences were found.

CONCLUSION

BFS yields superior results than CDS for evaluating the vasculature of transplanted kidneys in children. Improved vessel delineation with a higher vascular density including the peripheral subcapsular renal cortex was noted on curved array images.

CLINICAL RELEVANCE/APPLICATION

The B-flow sonography technique may improve monitoring of transplant viability in children.

RC413-05 Risk Factors for Development of Perirenal Subcapsular Fluid Collections in Extremely Preterm Infants with Acute Kidney Injury

Tuesday, Nov. 27 3:45PM - 3:55PM Room: N228

Participants
Haewon Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Saelin Oh, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Tae Yeon Jeon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
So-Young Yoo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Se In Sung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yun Sil Chang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Won Soon Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Hye Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate the incidence, risk factors and clinical outcome of perirenal subcapsular fluid collections in extremely preterm infants with acute kidney injury (AKI).

METHOD AND MATERIALS

Extremely preterm infants (n=56) with AKI who underwent renal ultrasound during Neonatal Intensive Care Unit stay were classified into two groups according to the presence of perirenal subcapsular fluid collections at US. Relevant data including demographics and comorbidities of the infants as well as maternal demographics were analyzed and risk factors for the development of perirenal subcapsular fluid collection in infants with AKI were identified with multivariate logistic regression analysis.

RESULTS

The perirenal subcapsular fluid collection developed in 7 of 56 extremely preterm infants (13%) with AKI (male-female ratio, 5:2; mean gestational age, 23 ± 2 weeks). The mortality rate was 86% (6/7) and only one infant survived in infants with perirenal subcapsular fluid collection and AKI. Infants with perirenal subcapsular fluid collections and AKI were lower gestational age, and showed episodes of necrotizing enterocolitis, intestinal perforation, use of nephrotoxic medication, and a history of maternal chorioamnionitis more frequently ($P<.05$). In the multivariate analysis, the risk factor of perirenal subcapsular fluid collection was significantly higher in extremely preterm infants who treated by antifungal agents (OR, 13.2 [95% CI: 1.5, 119.4]; $P=0.02$).

CONCLUSION

A considerable proportion of extremely preterm infants with AKI developed perirenal subcapsular fluid collections. Careful follow-up is mandatory, especially for infants treated by antifungal agents.

CLINICAL RELEVANCE/APPLICATION

Perirenal subcapsular fluid collection may develop in critically ill extremely preterm infants as a sign of acute renal injury and it has a grave prognostic implication in these infants.

RC413-06 MR Depiction of Plicae Palmatae of the Uterine Cervix in Infants

Tuesday, Nov. 27 3:55PM - 4:05PM Room: N228

Participants
Yasuyuki Yamahana, MD, Kyoto, Japan (*Presenter*) Nothing to Disclose
Akiko Takahata, MD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose

Hiroshi Miura, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Sachimi Yamada, MD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Kei Yamada, MD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Plicae palmatae are normal endocerivcal folds of the uterus. They are often observed as a low signal protrusion of cervical stroma on axial T2 weighted images (T2WI) in fertile females. There are, however, only few reports describing plicae palmatae in infants. We aimed to evaluate the incidence of depicting this normal structure on pelvic MR of infants.

METHOD AND MATERIALS

We retrospectively evaluated 65 female infants under 24 months of age, who underwent pelvic MRI for various purposes in our institution between January 2008 and December 2017. Nine cases were excluded because of uterine aplasia, uterine neoplasm, or chemotherapy for neoplasms. After exclusion of these cases, 56 cases were enrolled in this study. The average age was 8.3 months (median; 7.0 months, range; 0-23 months).We defined the plicae palmatae as the protrusions into the cervical canal from cervical stroma on axial T2WI. The frequencies of observing these structures were calculated in each month age. We also evaluated the number, size and locations of plicae palmatae. Clinically relevant cut-off points of frequency (6,7,8, or 11 months old) were also tested statistically.

RESULTS

Plicae palmatae were identified in 67.9% (38/56) of the population. The frequency in the neonates was 100% (9/9) and this decreased in the higher aged group with a statistically significant difference ($p = 0.0073$). The clinically relevant cut-off point was 8 months old; the frequency was 83.9% (26/31) in 0-8 months old group and 48.0% (12/25) in 9-23 months old group ($p = 0.0043$). The total and average numbers per patients of these structures were 86 and 1.54 (range; 0-4), respectively. These structures were thicker than one's cervical stroma in 65.8% (25/38) of the cases. The locations were on the anterior wall, posterior wall and both walls in 21.1% (8/38), 5.3% (2/38) and 73.7% (28/38), respectively.

CONCLUSION

Plicae palmatae were frequently observed on axial T2WI in infants and its prevalence declined with age during infancy. Recognizing the MR findings of plicae palmatae in infants can be helpful to prevent misdiagnosis of these structures as a tumor or anomaly.

CLINICAL RELEVANCE/APPLICATION

Plicae palmatae are uterine cervical folds described in adults, and can be also observed in infants on MRI. Recognizing these normal structures may help us avoiding misdiagnosis as a tumor or anomaly.

RC413-07 Adnexal Pathology in Children: Beyond Ovarian Masses

Tuesday, Nov. 27 4:05PM - 4:20PM Room: N228

Participants
Ting Y. Tao, MD, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Develop an imaging approach to adnexal pathology in children. 2) Expand differential diagnoses of pediatric adnexal pathology beyond neoplastic ovarian masses. 3) Identify clinical features of non-neoplastic adnexal pathology.

RC413-08 Quantitative Imaging of the Pediatric Liver

Tuesday, Nov. 27 4:30PM - 4:45PM Room: N228

Participants
Jonathan R. Dillman, MD, Cincinnati, OH (*Presenter*) Research Grant, Siemens AG; Research Grant, Guerbet SA; Travel support, Koninklijke Philips NV; Research Grant, Canon Medical Systems Corporation; Research Grant, Bracco Group

For information about this presentation, contact:

jonathan.dillman@cchmc.org

LEARNING OBJECTIVES

1) To become familiar with the various causes of chronic liver disease in children. 2)To understand clinical and pre-clinical quantitative MRI methods available for evaluating pediatric chronic liver diseases. 3)To learn to apply quantaitive MRI techniques for evaluating chronic liver disease in clinical practice.

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 R. Dillman, MD - 2016 Honored Educator

RC413-09 Comparison between T2 and T2* For Cardiac and Hepatic Iron Content Estimation in Children and Adolescents

Tuesday, Nov. 27 4:45PM - 4:55PM Room: N228

Participants
Christian A. Barrera, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

Hansel J. Otero, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Helge Hartung, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Suraj D. Serai, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess the feasibility and performance of liver and cardiac T2* values measured on a single breath-hold acquisition for iron content estimation in children and adolescents.

METHOD AND MATERIALS

77 patients (mean age: 13.82 years) were included and 169 pairs of studies from these patients were analyzed. All liver and cardiac scans were performed using a 1.5T MRI scanner. T2 values in the liver were calculated by an external company for a fee per patient. Cardiac and liver T2* values were measured in a blinded manner by a single trained observer on the cardiac and liver MRIs. The relationship between liver T2* and T2 relationship was assessed. Cardiac bright-blood and dark-blood T2* sequences were also compared following the same analysis. Finally, liver T2* was measured on images from the dedicated cardiac and liver MRIs and were correlated and evaluated. Continuous variables were presented as mean ± standard deviation (SD). Paired t-test (2-tailed) was used to compare means. Correlation coefficient and Bland-Altman difference plot were used.

RESULTS

75.1% of the abdominal and chest MRI studies were performed on the same day and 4.1% one day later. 20.8% of our studies were performed between 4 - 74 days apart with a mean 26.71 ± 18.38 days apart .Mean liver T2 and T2* values measured in the dedicated liver MRI were 8.50 ± 5.25 ms (mean ± SD) and 4.43 ± 3.92 ms, respectively. Mean cardiac bright-blood and dark-blood T2* values were 26.44 ± 12.95 ms and 27.33 ± 11.90 ms, respectively. A strong correlation between liver T2 and T2* values was observed ($r = 0.95$, $p < 0.001$). Cardiac bright and dark-blood T2* values also showed a strong correlation ($r = 0.79$, $p < 0.001$). Mean liver T2* measured on cardiac MRI and dedicated liver MRI were 4.93 ± 4.06 ms and 4.66 ± 3.96 ms, respectively. A strong correlation between T2* values obtained from the cardiac and liver MRI was observed ($r = 0.97$, $p < 0.001$), Figure 1.

CONCLUSION

Cardiac and liver iron concentration measurements using the same single breath hold GRE sequences, on the same study and with the same field of view are feasible and accurate.

CLINICAL RELEVANCE/APPLICATION

MRI for cardiac iron concentration assessment includes a major portion of the liver in the field of view. Theoretically, it is possible to measure liver T2* values using a dedicated cardiac MRI only.

RC413-10 Shear Wave Ultrasound Elastography Positively Correlates with Severity of Sinusoidal Obstruction Syndrome (SOS)

Tuesday, Nov. 27 4:55PM - 5:05PM Room: N228

Participants
Amie L. Robinson, RT,BS, Kansas City, MO (*Presenter*) Nothing to Disclose
Sherwin S. Chan, MD, PhD, Kansas City, MO (*Abstract Co-Author*) Consultant, Jazz Pharmaceuticals plc;
Matthew Goette, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Robert Krance, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rakesh Goyal, MD, Kansas City, MO (*Abstract Co-Author*) Nothing to Disclose
Rajesh Krishnamurthy, MD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Nicholas Dodd, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Prakash M. Masand, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Severe and very severe SOS is associated with multi-organ failure and has ~60% mortality. SOS is classified into mild, moderate, severe and very severe based on new European Society for Blood and Marrow Transplantation (EBMT) criteria. Treatment with defibrotide is recommended only for severe and very severe patients. Our hypothesis is that SOS severity based on EBMT criteria will correlate with liver stiffness measured by SWE.

METHOD AND MATERIALS

This is a multi-site prospective cohort study evaluating the use of SWE in pediatric patients (0-21 years) receiving conditioning therapy from 10/2015 to 3/2018 at 2 pediatric institutions. Site 1 subjects underwent 1 SWE within 10-days prior to start of conditioning regimen and at days +5 and +14 after BMT. Site 2 enrolled subjects at the time of clinical suspicion for SOS and subjects received SWE examinations every other day up to 10 exams during inpatient stay. All SWE exams were performed on GE Logiq E9 with a curved 1-6 MHZ transducer. Each SWE exam was summarized using the median SWE velocity, and the maximum value during the clinical course were analyzed. Subjects were divided into 3 groups using the EBMTC criteria: (1) no SOS, (2) mild to moderate SOS and (3) severe to very severe SOS. Due to unequal variances and non-normal distribution, non-parametric tests were used for statistical analysis.

RESULTS

55 subjects were enrolled. Majority of patients were male (n=33, 60%) and the median age was 8 (range 0-20) years. 21 (38%) patients developed SOS, 15 (27%) had severe to very severe disease by EBMT criteria. The median days from max SWE velocity assessment and diagnosis of initial SOS severity grading was 2 (-12 to +16) days. SWE velocities were higher in SOS (2.23 + 0.38) versus non-SOS (1.5 + 0.04) patients ($p<0.001$). Mann-Whitney U demonstrated significant difference in median SWE values between groups 1 and 2 ($p<0.001$), but not groups 2 and 3 ($p=.104$). A linear trend test was performed that showed positive

correlation between EBMT grade and SWE velocity (r=.701, p<0.001).

CONCLUSION

Maximum liver stiffness during post-conditioning course as measured by SWE correlates with severity of SOS as graded using EMBT criteria.

CLINICAL RELEVANCE/APPLICATION

Imaging has no current role in sinusoidal obstruction syndrome grading. Shear wave elastography could play a future role because liver stiffness correlates to disease severity.

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/ Rajesh Krishnamurthy, MD - 2017 Honored Educator

RC413-11 Comparative Study of Contrast Enhanced Voiding Uro-Sonography versus Fluoroscopic Micturating Cystourethrography in Pediatric Vesico-Ureteric Reflux

Tuesday, Nov. 27 5:05PM - 5:15PM Room: N228

Participants
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PURPOSE

Vesicoureteric reflux is an important etiology of pediatric urological morbidity, which if uncorrected, leads to renal scarring, hypertension and culminates in renal failure. Currently evaluated under fluoroscopic guidance, the development of alternate radiation free methods for vesico-ureteric reflux (VUR) assessment is pivotal. The present study is aimed to evaluate the diagnostic performances of contrast enhanced voiding uro-sonography (CE-VUS) versus fluoroscopic micturating cystourethrography (MCU) in children.

METHOD AND MATERIALS

After obtaining Institutional Review Board approval, forty consecutive children (below five years) of consenting parents, were evaluated for VUR by both contrast enhanced VUS and fluoroscopic MCU in the same catheterization visit. Bladder capacity was estimated by using formula: Bladder capacity volume (ml) = [age (years) + 2] x 30ml. One percent sulphur hexafluoride solution was used for contrast enhanced voiding uro-sonography. Fluroscopic MCU was performed as per standard protocol. Positive VUR was defined as: presence of contrast microbbles or radiographic contrast in the ureter or pelvis, on CE-VUS and MCU respectively. Diagnostic accuracies of CE-VUS and MCU were compared using Mc Nemar test.

RESULTS

Forty patients consisting of eighty pelvi-ureter units (PUU) were evaluated. VUR was demonstrated in twenty two PUU. Of these, CE-VUS documented VUR in fourteen PUU whereas fluroscopic MCU identified VUR only in eight PUU. CE-VUS and fluoroscopic MCU had a concordance rate of 78.75% in detecting both presence and absence of VUR. CE-VUS has a significantly higher detection rate of VUR as compared to fluoroscopic MCU (p value <0.05).

CONCLUSION

CE-VUS has a better diagnostic performance than fluoroscopy MCU for the detection of VUR in pediatric population.

CLINICAL RELEVANCE/APPLICATION

Contrast enhanced Voiding urosonography is a radiation free modality for VUR assessment and has the potential to replace fluoroscopic MCU in the diagnostic workup of VUR in children.

RC413-12 Diagnostic Accuracy of Non-contrast MR Enterography in Detecting Active Bowel Inflammation in Pediatric Patients with Diagnosed or Suspected Inflammatory Bowel Disease to Determine Necessity of Gadolinium-based Contrast Agents

Tuesday, Nov. 27 5:15PM - 5:25PM Room: N228

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To determine whether administration of gadolinium-based contrast agents are necessary in the assessment of bowel inflammation on magnetic resonance enterography (MRE) in pediatric patients with diagnosed or suspected inflammatory bowel disease (IBD).

METHOD AND MATERIALS

A retrospective study of 79 patients (7-19 years; 67.1% M) with known (60) or suspected (19) IBD that underwent endoscopy within 30 days of an MRE without and with contrast was performed evaluating bowel and non-bowel findings. Two blinded radiologists reviewed pre-, post-, and pre/post-contrast MRE images in 3 joint visual analysis sessions spaced 4 weeks apart. A third blinded radiologist performed an independent visual analysis of 28 randomly selected studies to assess inter-reader reliability. Cohen's kappa (K) was used to compare pre- and pre/post-contrast session results and to assess inter-rater agreement of the pre/post-contrast MRE reading to the endoscopy/histopathology results. Pre- and pre/post-contrast assessments of inflammation were compared to endoscopy results using sensitivity and specificity. McNemar's test examined differences between pre- and pre/post contrast features of inflammation.

RESULTS

There was moderate agreement (87.3%) between the pre- and pre/post-contrast MRE and endoscopy results (K 0.746, $p<0.001$; McNemar's P-value 0.344). Pre-contrast to endoscopy vs. pre/post-contrast to endoscopy sensitivity (61%, CI 0.48-0.73 vs. 66%, CI 0.53-0.77) and specificity (88%, CI 0.62-0.98 vs. 82%, CI 0.56-0.95) varied little with K of 0.34 and 0.35, respectively ($p<0.001$ for both). Moderate agreement was seen among the joint readers and independent reader with 82.1% agreement (K 0.632, p 0.001; McNemar's P-value 1.00). Sensitivity and specificity of pre- vs. post-contrast readings were 75% (CI 0.57-0.87) and 70% (CI 0.54-0.82), respectively with $p=0.001$ (K 0.44; CI 0.25-0.64). Contrast identified more penetrating complications than pre-contrast (McNemar's P-value 0.05).

CONCLUSION

Use of contrast does not improve the detection of active bowel inflammation compared to noncontrast MRE, although contrast does appear to aid in the detection of penetrating disease.

CLINICAL RELEVANCE/APPLICATION

Concerns over gadolinium deposition in patients continue to grow, and pediatric patients with IBD are at increased risk given the need for multiple contrast-enhanced MREs over their life.

RC413-13 Sedated Ultrasound Guided Saline Reduction (SUR) of Ileocolic Intussusception: 17 Year Experience

Tuesday, Nov. 27 5:25PM - 5:35PM Room: N228

Participants
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PURPOSE

Ultrasound guided saline enema is an established technique for reducing ileocolic intussusception in children. However, there is debate as to how anesthesia affects reduction rates. The purpose of the study is to present our 17 years' experience of SUR in ileocolic intussusception. Its success/failure/complication rate relative to non-SUR and other methods of reduction will be reviewed.

METHOD AND MATERIALS

This is a retrospective study of patients presenting to a tertiary care hospital. A search through the EMR identified patients who underwent SUR during the years 2000-17. All patients received Propofol in the operating room followed by rectal tube placement and repeat ultrasound. If ileocolic intussusception was still present, saline solution was hung 1.2 meters above the bed and infused into the colon in a retrograde fashion under ultrasound supervision until filling of the cecum was visualized. If reduction did not occur initially, it was maintained for 0.5 minutes until reduction or passive decompression. After a 1 minute break, repeat hydrostatic reduction was attempted up to 2 additional times in the same session. Success was confirmed by direct ultrasound confirmation of resolution of ileocolic intussusception. Failure rates of SUR were calculated and compared to non-sedated methods.

RESULTS

Out of 274 total episodes of ileocolic intussusception, 246 (197 primary and 39 recurrences) began the SUR protocol. 21 spontaneously reduced prior to or after anesthesia. Of the 225 who proceeded to SUR, 201 were successfully reduced. Our protocol success rate was 90.2% ((201+21)/246) and there were no instances of perforation. Success rates were 83.8% (165/197) for primary intussusceptions and 92.3% (36/39) for recurrences. 42 non reduced intussusceptions proceeded to successful surgical management.

CONCLUSION

SUR is a safe and effective way to reduce ileocolic intussusception. Sedation improves the reduction rate overall without increasing

SUR is a safe and effective way to reduce ileocolic intussusception. Sedation improves the reduction rate overall without increasing complications.

CLINICAL RELEVANCE/APPLICATION

The method of SUR is an excellent technique to reduce ileocolic intussusception without unnecessary patient or parent distress.

RC413-14 Diagnostic Performance of CT for Pediatric Patients with Suspected Appendicitis in Various Clinical Settings: A Systematic Review and Meta-Analysis

Tuesday, Nov. 27 5:35PM - 5:45PM Room: N228

Participants
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PURPOSE

To assess the diagnostic performance of CT for pediatric patients with suspected appendicitis in various clinical settings and proportion of acute appendicitis on final diagnosis among equivocal CT findings.

METHOD AND MATERIALS

MEDLINE and EMBASE databases were searched till October 21st, 2017, for studies investigating diagnostic performance of CT for acute appendicitis in pediatric patients confirmed by histopathologic findings and/or clinical follow-up. Pooled estimates of sensitivity and specificity were calculated using a hierarchical logistic regression modeling. The proportion of true appendicitis among patients with inconclusive CT results was obtained using fixed and random effects meta-analyses.

RESULTS

Twenty-two articles with 3,396 patients were included. The pooled sensitivity and specificity were 95% (95% CI, 93%-97%) and 94% (95% CI, 90%-96%), respectively, and the area under the HSROC curve was 0.98 (95% CI, 0.96-0.99). Subgroup analyses revealed a comparable diagnostic performance in the low-dose CT group (sensitivity: 97%, specificity: 96%) and the unenhanced group (sensitivity: 95%, specificity: 95%). Other subgroups (publication year, study design, enrolled population, true appendicitis proportion, CT channel number and slice thickness) also showed good diagnostic performance. Six studies reporting the true appendicitis proportion among patients with equivocal CT findings had pooled proportion of 17% (95% CI, 9%-29%).

CONCLUSION

CT showed good performance for suspected appendicitis in pediatric patients under various clinical settings, including in cases with dose reduction or absence of IV contrast. The prevalence of true appendicitis among patients with equivocal appendicitis results on CTs was not low.

CLINICAL RELEVANCE/APPLICATION

Our result of the good sensitivity and specificity of CT supports the current ACR guidelines, which recommend CT when US results are equivocal. However, the diagnosis of acute appendicitis can still be missed even though CTs offer a superior diagnostic performance than USs; therefore, clinical attention should not be disregarded in this population.

RC413-15 Pediatric Liver Doppler

Tuesday, Nov. 27 5:45PM - 6:00PM Room: N228

Participants
Sara M. O'Hara, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Speakers Bureau, Canon Medical Systems Corporation; Medical Advisory Board, Canon Medical Systems Corporation

LEARNING OBJECTIVES

1) Develop a search pattern for performing/interpreting pediatric liver Doppler. 2) Become familiar with normal Doppler findings in healthy pediatric livers. 3) Identify abnormal Doppler findings in pediatric livers and recognize their associated causes/disease states.

SSJ01

Breast Imaging (Monitoring Response to Treatment)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E450A

BQ BR MR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Wendy B. Demartini, MD, Stanford, CA (*Moderator*) Nothing to Disclose
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Sub-Events

SSJ01-01 Complete Response on MR Imaging After Neoadjuvant Chemotherapy in Breast Cancer Patients: Factors of Radiologic-Pathologic Discordance

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E450A

Participants
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PURPOSE

Although MR imaging may show radiologic complete response (rCR) after neoadjuvant chemotherapy (NAC), there may be discordance between the MR imaging and pathology. The purpose of this study was to evaluate the radiologic and clinicopathologic factors of discordance between rCR and pathologic complete response (pCR) after NAC in breast cancer patients, and to determine whether there are differences among molecular subtypes.

METHOD AND MATERIALS

Our institutional review board approved this retrospective study. We evaluated 209 consecutive patients who showed rCR in MR imaging after NAC between January 2013 and December 2015. All patients had mammography, ultrasound and MR imaging before and after completion of NAC prior to definitive surgery. rCR was diagnosed when no enhancement or faint enhancement was shown in the previous lesion site equal to that of the background normal breast tissue. pCR was defined as the complete absence of both invasive cancer and ductal carcinoma in situ in the breast on the surgical histopathological examination. Clinicopathologic and initial radiologic findings were assessed and factors affecting the radiologic-pathologic discordance were analyzed.

RESULTS

One hundred eight patients (51.7%) showed pCR and 101 (48.3%) had residual lesion on surgical histopathology. The false negative findings were significantly more frequent in luminal A and B subtype (67.3%, 68/101), with radiologic findings such as larger tumor size ($p = 0.048$) in mammography, irregular shape ($p = 0.021$), high proportion of persistent component ($p = 0.008$), and low proportion of washout component ($p = 0.001$). On multivariate analysis of radiologic findings in all patients to predict residual lesion, calcification in mammography ($p = 0.037$), multifocal lesion ($p = 0.004$), and nonmass enhancement in MR ($p = 0.023$) were significantly associated with residual lesion.

CONCLUSION

Luminal subtype has a significant high false negative rate who achieved rCR after NAC. Patients with calcification in mammography, multifocal lesion, and nonmass enhancement in initial MR imaging are significantly associated with residual lesion.

CLINICAL RELEVANCE/APPLICATION

Although MR imaging showed rCR after NAC, multifocal breast cancer with calcification and nonmass enhancement, residual lesions should be considered and may impact surgical planning.

SSJ01-02 How Should a Radiologist Diagnose a Complete Imaging Response on Breast MRI after Neoadjuvant Chemotherapy?

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E450A

Participants
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PURPOSE

There is no standard definition regarding what constitutes a complete imaging response (CIR) on breast MRI post-neoadjuvant chemotherapy (NAC). The purpose is to evaluate the accuracy of a CIR defined as no residual enhancement in the tumor bed post-NAC in diagnosing a pathologic complete response (pCR).

METHOD AND MATERIALS

The IRB approved this HIPAA-compliant retrospective study and waived informed consent. Women were identified with biopsy proven invasive breast cancer who underwent: a) NAC, b) pre and post-NAC MRI and c) surgery between 2014-2016. CIR was defined as no residual enhancement on any of the three post-contrast phases on post-NAC MRI. Two breast radiologists (R1 and R2) independently reviewed all pre and post-NAC MRI blinded to pathology. pCR was defined as no residual invasive or in situ carcinoma. Measures of accuracy, including sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) were estimated using no enhancement on MRI to diagnose pCR. Kappa statistic was used to assess agreement between readers.

RESULTS

275 women were included with 280 breast cancers (n=5, 1.8% had bilateral cancers). Of the 280 breast cancers, 256 (91.4%) were invasive ductal carcinoma, 11 (3.9%) were invasive lobular carcinoma and 13 (4.7%) were other invasive carcinoma. 74 (26.4%) had a pCR and 186 (66.4%) had no pCR. The two readers had substantial agreement on enhancement (kappa=0.627, 87.5% concordant readings). Sensitivity was 40.5%(R1)/50.0%(R2), specificity was 87.9% (R1)/86.9%(R2), PPV was 54.5% (R1)/57.8% and NPV was 80.4%(R1)/82.9(R2). These measures of accuracy were not significantly different between different subtypes defined as: ERPR+HER2-(n=99), ERPR+HER2+(n=61), ERPR+HER2equiv (n=1), ERPR-HER2+(n=44) and ERPR-HER2- (n=75).

CONCLUSION

CIR defined as no residual enhancement in the tumor bed on post-NAC breast MRI is not sensitive in diagnosing a pCR. Residual enhancement can be seen with a pCR and a better definition of what constitutes a CIR is needed; our results suggest that it should include some degree of low-level tumor bed enhancement.

CLINICAL RELEVANCE/APPLICATION

Complete imaging response defined as no residual enhancement in the tumor bed is not an accurate assessment of pathologic complete response, which radiologists need to be aware of as management decisions based upon post-NAC MRI interpretation can impact the decision to perform breast conservation versus mastectomy.

SSJ01-03 Predicting Axillary Response to Neoadjuvant Chemotherapy Using Breast MRI and US Based Model in Patients with Clinically Node-Positive Breast Cancer

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E450A

Participants
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PURPOSE

The axillary LN pathologic complete response (pCR) is increasingly common after neoadjuvant chemotherapy (NAC) in breast cancer patients, for whom axillary LN dissection may be spared. The aim of our study was to develop a clinical model including MRI and US to better predict axillary pCR after NAC in clinically node-positive breast cancer patients.

METHOD AND MATERIALS

An IRB-approved retrospective review was performed for 172 consecutive clinically node-positive breast cancer patients who were treated with NAC and following surgery at our institution from 2016 to 2017. All the patients underwent breast MRI and US, before and after completion of NAC to evaluate the primary tumor extent and axillary LN status. The multivariate logistic regression analysis determined independent predictors of axillary pCR. With combination of those variables we developed a predictive model to increase axillary pCR rate.

RESULTS

Among 172 patients the overall axillary pCR rate was 59%, with 75% (46/61) and 42% (30/71) in cN1 and cN2 patients, respectively. Pretreatment characteristics of clinical N stage, axillary lymphadenopathy and tumor subtype were correlated with axillary pCR (all, $p<0.05$). Post-NAC imaging features including mean tumor size, the size change rate on MRI and the axillary LN cortical thickness on US were predictors of axillary pCR (all, $p<0.05$). From the multivariate logistic regression analysis, independent variables were clinical N stage, tumor subtype, tumor size change rate on MRI and axillary lymphadenopathy on post-NAC US, with an AUC of 0.884 (all, $p<0.05$). The axillary pCR rate of cN1 and non-luminal A model was 88% (38/43) and addition of absent axillary lymphadenopathy improved pCR rate to 94% (33/35). In cN2 patients, the axillary pCR rate of non-luminal A and no axillary lymphadenopathy model increased from 70% (24/34) to 91% (10/11) with additional condition of more than 80% size decrease on MRI.

CONCLUSION

Clinical N stage, tumor subtype and MRI/US findings were predictors of axillary LN pCR. Our predictive model including clinico-pathologic features and image findings could achieve high axillary pCR rate, which may guide LN dissection planning after NAC in clinically node-positive breast cancer patients.

CLINICAL RELEVANCE/APPLICATION

Our imaging based predictive model can improve risk stratification which may avoid unnecessary axillary LN dissection in clinically node-positive breast cancer patients after NAC.

SSJ01-04 Texture Analysis of Lymph Node MRI Characteristics Improves Prediction of Progression-Free Survival Following Chemotherapy in Breast Cancer

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E450A

Participants
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PURPOSE

Pathological complete response and reduction in lesion volume (LV) after chemotherapy do not guarantee progression-free survival (PFS). About 1/3 of patients with pathological complete response had relapse at 5 years in our cohort. Breast cancer metastasizes through the lymphatic system. Axillary lymph node (LN) is clinically evaluated by palpation and using ultrasound. This study investigated the efficacy the texture analysis of the LN MRI in predicting PFS.

METHOD AND MATERIALS

Data were obtained from I-SPY 1 trial of breast cancer patients undergoing chemotherapy. We extracted 48 textures for pre- (T1), early- (T2), during (T3) and post-chemo (T4) time points for a subset of patients (N=41) in whom LN MRI were usable. Area under the receiver-operating curve (AUC) was calculated, with PFS at 5-year as a reference variable. Multivariable generalized linear modeling was used to estimate model fit and assign a risk score at each time point based on top-ranking features.

RESULTS

For early (T1) in treatment, LV along with LN histogram skewness and grey-level run length matrix long-run emphasis were top predictors of PFS (AUC=0.68). LV became less predictive in later time points. LN features surpassed LV in post-chemo (T4) time point; the top features were neighborhood grey-level matrix coarseness and grey-level zone length matrix zone length non-uniformity. When changes in texture features over time were analyzed, LN features outperformed LV. Top early (T2-T1) predictors were change in compacity, gray-level non-uniformity, and volume of the LN. Top late (T4-T1) predictors were change in zone length non-uniformity and coarseness. The combination of risk scores across all time points resulted in a model with an AUC of 0.89 (sensitivity:91%, specificity:95%, p= 0.004).

CONCLUSION

Texture analysis of lymph node MRI improves prediction of PFS. The multivariable risk prediction model identified key characteristics and could provide strong predictors of relapse.

CLINICAL RELEVANCE/APPLICATION

Texture analysis of axillary lymph node MRI has the potential to accurately predict 5-year progression free survival.

SSJ01-05 Breast 3D Magnetic Resonance Fingerprinting Relaxometry: Utility in Measuring Early Response to Neo-Adjuvant Chemotherapy in Breast Cancer

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E450A

Participants
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Vikas Gulani, MD, PhD, Cleveland, OH (*Abstract Co-Author*) Research support, Siemens AG; Licensed Technology, Siemens Healthineers - both myself and my spouse. MR Fingerprinting, on which we are both inventors, has been licensed by Siemens.

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PURPOSE

To assess (1) Repeatability of breast 3D MRF-based relaxometry and (2) preliminarily assess utility in measuring early response to neo-adjuvant chemotherapy in breast cancer

METHOD AND MATERIALS

In this IRB approved pilot study,12 healthy pre-menopausal volunteers were scanned with 3D MRF twice within 7-15 days for repeatability analysis.In 5 volunteers,same-day test-retest scans were also performed with repositioning after a 10-minute scan interval.For breast cancer evaluation,13 women with biopsy-proven invasive ductal carcinoma underwent baseline 3D MRF scans before chemotherapy.So far,7 women have undergone repeat 3D MRF 7-10 days after first cycle of chemotherapy.All scans were performed at 3T(Siemens Verio) using 8-channel breast coil.A 3D FISP-based MRF sequence with fat suppression was used.Overall acquisition time was 5.5min.For repeatability analysis,ROIs were drawn on a 3D MRF partition containing the largest area of normal breast tissue by one radiologist(8 years radiology experience) in both breasts.In breast cancer patients,ROIs were drawn on partitions showing tumor and the opposite normal breast.Mean T1 & T2 were estimated for all scans.Treatment response was based on either final pathology staging after surgery or RECIST criteria and T1 & T2 changes were compared in responders & non-responders

RESULTS

Same-visit test-retest within-subject coefficient of variation(wCV) was <5% for T1 and <6.5% for T2.Two-visit wCV was <6% for T1 and <5% for T2,establishing a measurable effect size.In breast cancer,tumor T1 & T2 were longer than normal breast(mean±SD,Tumor T1:1175±203 ms,Normal T1:846±388 ms,Tumor T2:72±13 ms,Normal T2:48±12 ms,p=0.030 for T1,p<0.001 for T2).After one cycle of chemotherapy,responders(n=4) showed greater decrease in T1 & T2(p=0.026 for T1,p=0.033 for T2) while patients with stable/progressive disease(n=3) showed negligible changes in T1 & T2

CONCLUSION

Breast 3D MRF relaxometry was shown to be repeatable.Baseline tumor T1 & T2 were longer than normal breast.Treatment responders showed larger change in T1 & T2 compared to non-responders.These preliminary results suggest that breast 3D MRF may be useful in quantitatively predicting early response to chemotherapy

CLINICAL RELEVANCE/APPLICATION

Breast 3D MRF relaxometry is a repeatable technique for longitudinal studies in patients.Significant decrease in tumor T1 and T2 after one cycle of chemotherapy may predict treatment response

SSJ01-06 Are the Baseline Imaging Characteristics of Breast Cancer Associated With Reponses to Neoadjuvant Chemotherapy?

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E450A

Participants
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PURPOSE

Predictors of response to neoadjuvant chemotherapy (NACT) within subgroups are poor and not commonly used. We aimed to establish if baseline mammographic (MGM) and ultrasound (US) features of breast cancer and breast cancer subtypes are associated with rates of pathological complete response (pCR) after NACT.

METHOD AND MATERIALS

The baseline imaging of 210 consecutive women who underwent NACT were reviewed by an experienced breast radiologist blinded to outcomes. The MGM features assessed were the presence or absence of spiculation and calcification. The US features documented were echogenicity, distal effect, the presence of a circumscribed border and the US lesion size. The relationships between baseline imaging features and pCR after NACT were documented. The findings according to sub-group (HER2+ve, triple negative and ER+ve HER2-ve) were also assessed. The significance of differences were analysed using the chi-square test and ROC curves.

RESULTS

Of the 210 patients, 46(22%) had a pCR while 164 did not. The cohort consisted of women with 82 triple negative (21 pCR's), 75 HER2+ve (21 pCR's) and 53 ER+ve HER2-ve (4 pCR's) cancers. For the complete cohort the features significantly associated with pCR were the absence of MGM spiculation (4 of 58 (7%) vs. 42 of 151(28%), p=0.001), the absence of distal shadowing on US (8 of 73(11%) vs. 38 of 136(28%), p=0.015) and small US size (AUC 0.62, P=0.02). In HER2+ve patients all the above associations were confirmed and in addition the presence of a circumscribed border on US was associated with high pCR rates (7 of 14(50%) vs. 14 of 60(23%), p=0.04). None of the above associations held true for triple negative cancers. The number of pCR's in the ER+HER2-ve group was to small to allow analysis.

CONCLUSION

The baseline imaging features of HER2+ve breast cancer are strongly associated with the chance of achieving a pCR following NACT. This is not so for triple negative cancers.

CLINICAL RELEVANCE/APPLICATION

This data could be helpful when discussing NACT and associated surgery with patients who have HER+ve breast cancer.

SSJ02

Breast Imaging (US Advanced Applications)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E353C

BR MR MI US

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Jung Min Chang, MD, Seoul, Korea, Republic Of (*Moderator*) Research Grant, General Electric Company
Wei T. Yang, MD, Houston, TX (*Moderator*) Consultant, General Electric Company; Medical Advisory Board, Seno Medical Instruments, Inc

Sub-Events

SSJ02-01 Can Baseline Ultrasound and Mammographic Features Help Predict Metastasis Free Survival in Patients Receiving Neoadjuvant Chemotherapy?

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E353C

Participants
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PURPOSE

To determine if baseline mammographic and ultrasound features in patients receiving neoadjuvant chemotherapy (NACT) are associated with metastasis free survival (MFS).

METHOD AND MATERIALS

Informed consent for the study was obtained from consecutive women receiving NACT. All participants were metastasis free at diagnosis. Baseline images were retrospectively reviewed by a breast radiologist blinded to outcomes. Ultrasound (US) features documented included echo pattern, posterior effect, circumscribed margins, skin changes (invasion or thickening), lesion size and shear wave stiffness (mean). Mammogram (MMG) features documented were the presence or absence of spiculation and microcalcification. Tumour immunophenotype was assessed on core biopsy. Statistical significance was assessed using chi-square and ROC analysis.

RESULTS

134 breast patients were included; 52 had triple negative cancer, 48 were HER2+ve and 34 had ER+ve, HER2-ve disease. During the follow-up period (mean 4.3yrs) 41 women (31%) developed metastases. Across the whole cohort, skin involvement on baseline US was the only feature associated with metastasis development. MFS was 56% (23/41) vs 75% (70/93) for those with and without skin involvement respectively, p=0.03. US lesion size was not associated with MFS.In the HER2 positive subgroup mammographic calcification was associated with poorer MFS (12/24 (50%) vs 20/23 (87%), p=0.006). The presence of posterior shadowing on US was also associated with poorer MFS (11/22 (50%) vs 21/26 (81%), p=0.02) in this subgroup.No baseline imaging features were shown to be associated with MFS for triple negative and ER+ve HER-ve cancers.

CONCLUSION

We have demonstrated that baseline imaging characteristics are associated with MFS in patients treated with NACT particularly in the HER2 +ve subgroup. This prognostic information, which is available prior to treatment could aid patient treatment selection and counselling.

CLINICAL RELEVANCE/APPLICATION

Baseline imaging characteristics are associated with MFS in patients treated with NACT. This prognostic information, available prior to treatment, may aid patient treatment selection and counselling.

SSJ02-02 Combination of Different Types of Elastography in Downgrading Ultrasound Breast Imaging-Reporting and Data System Category 4a Breast Lesions

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E353C

Participants
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PURPOSE

When using single type of elastography to downgrade ultrasound (US) Breast Imaging-Reporting and Data System (BI-RADS) category 4a lesions, some cancers would be missed. This study purposed to determine whether combination of different types of elastography could improve the accuracy of elastography aided downgrading BI-RADS category 4a lesions and reduce unnecessary biopsies.

METHOD AND MATERIALS

For this prospective institutional review board-approved study, verbal informed consent was obtained from all patients. From January 2016 to February 2018, 329 consecutive women with 347 US BI-RADS category 4a breast lesions were enrolled in the study. These lesions, prior to biopsy, were subject to conventional US supplemented by elastography assessments, including strain elastography of elasticity imaging (EI), virtual touch tissue imaging (VTI) and Virtual Touch IQ (VTIQ). The diagnostic performances were calculated for BI-RADS category, EI, VTI and VTIQ, and the combination among EI, VTI and VTIQ (combined EI and VTI [EI+VTI], combined EI and VTIQ [EI+VTIQ] and combined VTI and VTIQ [VTI+VTIQ]).

RESULTS

Pathologically, 313 lesions (90.2%) were benign and 34 (9.8%) were malignant. The cut-off values were EI score>3, VTI score>3 and shear wave speed (SWS) on VTIQ>3.29 m/s, respectively. For EI, VTI and VTIQ alone, the specificity were significantly higher than that of BI-RADS (P <0.001), while the sensitivity were significantly lower than that of BI-RADS (76.5%, 70.6%, 67.6% vs. 100%, respectively, P <0.05). Among the combinations of different types of elastography, EI+VTI yielded the highest AUROC of 0.800 and negative predictive value of 99.5%. The sensitivity of EI+VTI was significantly increased as compared with single type elastography (P <0.05). There was no significant difference in the sensitivity between EI+VTI and BI-RADS (97.1% vs 100%, P =1.000) while the specificity was significantly higher than that of BI-RADS (P <0.001). When using EI+VTI to downgrade the lesions, 57.1% of the lesions would be downgraded and 99.5% of these lesions were benign.

CONCLUSION

Combinations of EI and VTI to downgrade BI-RADS category 4a lesions increased the sensitivity and reduced the misdiagnosis of breast cancers.

CLINICAL RELEVANCE/APPLICATION

Combination of different types of elastography provides a high sensitive way to downgrade BI-RADS category 4a lesions, potentially applied in clinical practice without increasing misdiagnosed cancers.

SSJ02-03 Correlation Between Apparent Diffusion Coefficient Values and Ultrasound Elasticity kPa Values in Breast Cancers

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E353C

Participants
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PURPOSE

DWI reflects tumor cellularity and integrity of cell membranes. Breast ultrasound elastography is a method of imaging tissue stiffness and the shear-wave elastography (SWE) allows measurement of the propagation speed of shear waves within the tissue to locally quantify its stiffness in kilopascals (kPa) or meters per second (m/sec). This study was performed to evaluate the correlation between breast apparent diffusion coefficient (ADC) values and ultrasound Shear wave elastography kPa values in biopsy proven breast cancers.

METHOD AND MATERIALS

From January 2016 to November 2017, 121 patients who have breast cancer confirmed by US-guided biopsy underwent both pre-operative breast diffusion MRI and breast SWE. Among these patients we included only who underwent examination by same operator to reduce inter-operator variability. Finally, this study included 94 breast cancer patients. The investigated factors included the ADC values, mean kPa values (Emean), maximum kPa values (Emax), pathology, size of tumor, associated calcifications, ER/PR/HER2 status, molecular subtypes, Ki-67 index, mammographic density and BI-RADS US assessment category. The results were analyzed using the statistical software SPSS for Windows (version 24). The correlation analysis was used to study correlation between ADC values, Emean/Emax, size and Ki-67. And independent samples of t-test and ANOVA including post hoc test were performed to evaluate for the above variables.

RESULTS

There was no correlation between ADC values and Emean (p=0.791)/Emax (p=0.634)[Fig1]. However, Emean (p=0.001), Emax (p<0.001), and Ki-67 index value (p=0.010) were significantly correlated with the size of tumor. High Ki-67 index group showed statistically significant lower ADC values (p=0.034) and higher Emean (p=0.064)/Emax value (p=0.065) without statistical insignificance. The Emean (p=0.002)/Emax (p=0.001) were correlation with T stage but ADC (p=0.813) was not. Howevre, the

Eman (p=0.000)/Emax (p=0.000) and ADC (p=0.017) were also correlated with US BIRADS categories.

CONCLUSION

The ADC values and Emean/Emax in breast cancers were nor correlated each other. However, the size of tumor, Ki67 index, BI-RADS assessment category affected the ADC and Emean/Emax values independently.

CLINICAL RELEVANCE/APPLICATION

The size of breast cancer, Ki67 index, BI-RADS assessment category affected the ADC and Emean/Emax values independently.

SSJ02-04 Breast Cancer Staging: Combined Digital Breast Tomosynthesis and Automated Breast Ultrasound versus Magnetic Resonance Imaging

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E353C

Participants
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PURPOSE

To investigate whether combined Digital breast tomosynthesis and Automated breast volume scanner (DBT-ABVS) are comparable to Magnetic resonance imaging (MRI) in staging breast cancer.

METHOD AND MATERIALS

We retrospectively included seventy-three patients with histologically proven breast cancer who underwent preoperative DBT, ABVS and 1.5T MRI in the period July 2015-July 2016. Two radiologists in consensus recorded the number, site and BI-RADS category of breast findings during two independent reading strategies, i.e. DBT-ABVS vs. MRI. Using histology or 1-year follow up as the standard of reference, we calculated the accuracy for cancer of both imaging strategies. Bland-Altman analysis was used to evaluate the agreement between MRI vs. DBT or ABVS in cancer size assessment.

RESULTS

Patients showed a total of 160 lesions (108 malignant and 52 benign). Malignant lesions were monofocal, multifocal, multicentric and biltateral in 53, 15, 4 and 1 cases, respectively. Diagnostic accuracy of DBT-ABVS vs. MRI was comparable for all cancers (90.0% vs. 93.8%, respectively), though DBT-ABVS showed lower sensitivity and positive predictive values for additional disease (76.5% vs. 91.7%, and 78.8% vs 93.4%, respectively). Compared to MRI, ABVS+DBT missed 6 lesions, including two invasive cancers and one extensive intravascular invasion associated to ductal carcinoma in situ. Bland-Altman analysis showed ABVS to agree with MRI at a higher extent than DBT in assessing cancer size.

CONCLUSION

DBT-ABVS is less accurate than MRI in staging additional disease.

CLINICAL RELEVANCE/APPLICATION

Though less performing than MRI, DBT-ABVS showed acceptable diagnostic accuracy in staging breast cancer. This strategy might be used if MRI is unavailable or unfeasible.

SSJ02-05 Quantitative Elastic Heterogeneity as a Potential Noninvasive Marker of Lymphovascular Invasion in Breast Cancer

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E353C

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PURPOSE

To evaluate the association between quantitative elastic heterogeneity (EH) and lymphovascular invasion (LVI) in breast cancers.

METHOD AND MATERIALS

This retrospective study consisted of 97 patients with breast cancers that had undergone shear wave elastography (SWE) with virtual touch tissue imaging quantification (VTIQ) between August 2015 and August 2017. Three region of interests (ROIs) were placed over the highest stiffness and the lowest stiffness areas of each lesion to measure shear wave velocity (SWV) and EH was determined as the difference between the averaged highest SWV and lowest SWV. Classical prognostic factors including lesion size, histopathological type and grade, subtype [luminal A, luminal B (HER2-), luminal B (HER2+), HER2 enriched and basal-like], and axillary lymph node (LN) status were reviewed and their correlation with EH values were stratified by the presence or absence of LVI. The diagnostic performance of EH in distinguishing LVI or not were analyzed in lesions smaller than 2 cm.

RESULTS

Tumors with LVI showed significantly higher EH values when compared to tumors without LVI (adjusted P < 0.001), regardless of the tumor size, histological grade and type, and LN status. Lymphovascular invasion (adjusted P < 0.001), large tumor size (adjusted P = 0.011) and lymph node involvement (adjusted P = 0.046) showed statistically positive association with high EH values. In breast cancers smaller than 2 cm, tumors with LVI (4.31±1.16 m/s) showed significantly higher EH values when compared to tumors without LVI (2.99±1.18 m/s) (adjusted P < 0.001). Using EH higher than 3.66 m/s to suggest LVI, the area under the receiver operating characteristic curve was 0.796, and the sensitivity, specificity, positive predictive value and negative predictive value were 78 % (14/18), 75 % (39/52), 52 % (14/27) and 91 % (39/43), respectively.

CONCLUSION

EH could be served as a potential marker to assess LVI status on preoperative imaging, especially for breast cancer less than 2 cm in size.

CLINICAL RELEVANCE/APPLICATION

Quantitative elastic heterogeneity of breast cancer can be used as a non-invasive marker for preoperative evaluation of LVI, thereby guiding clinical regulation and predicting prognosis.

SSJ02-06 Multiparametric Quantitative Ultrasound of the Breast Can Improve the Diagnostic Performance of the Radiologist

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E353C

Participants
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PURPOSE

To evaluate quantitative multiparametric ultrasound (mpUS) of the breast using B-mode US, elastography, Doppler and contrast enhanced US (CEUS) in different combinations of 2, 3 or 4 parameters for the differentiation of benign and malignant lesions and investigate a possible variation according to the degree of experience of the examiner.

METHOD AND MATERIALS

124 patients, each with one biopsy-proven, sonographically evident breast lesion were included in this prospective, IRB-approved study. Each lesion was examined with B-mode US, elastography (Virtual Touch IQ-VTIQ), Doppler US and CEUS. Different quantitative parameters were recorded for each modality: Shear Wave Velocity (SWV) for VTIQ, Pulsatility (PI) and Resistive Index (RI) for Doppler US. For CEUS, 11 different parameters were calculated using a dedicated software. 4 readers (2 experienced breast radiologists and 2 radiology residents) independently evaluated B-mode images of each lesion and assigned a BI-RADS score to it. Using ROC curve analysis, the quantitative parameter with the best diagnostic performance for each modality was chosen and cut-off values were calculated. Using these, all quantitative results were dichotomized. The BI-RADS scores of all readers were then combined with the quantitative parameters. Descriptive statistics were used to evaluate the diagnostic performance of mpUS. Histology served as the reference standard.

RESULTS

59 lesions were benign and 65 malignant. SWV, RI and mean transit time showed the highest diagnostic performance. MpUS with three parameters (B-mode, VTIQ and CEUS) showed the highest diagnostic performance irrespective of the experience level of the readers (averaged AUC 0.812 vs. 0.683 for B-mode US, p-value 0.0001), while the combination of B mode, VTIQ and Doppler US the second best (averaged AUC 0.789, p-value 0.0001). All other combinations (with 2, 3 or 4 parameters) showed a lower AUC. MpUS with B-mode, VTIQ and CEUS was able to significantly reduce the number of false positive biopsy recommendations (p<0.0001).

CONCLUSION

Quantitative breast mpUS with three parameters (B-mode US, VTIQ elastography and CEUS) significantly improves the diagnostic performance of B-mode US alone, irrespective of the experience level of the examiner.

CLINICAL RELEVANCE/APPLICATION

MpUS of the breast offers quantitative parameters that may be used as imaging biomarkers for the differentiation of benign from malignant breast lesions.

SSJ03

Cardiac (Myocardial Disease)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E353A

CA MR NM

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSJ03-01 Utility of Dual Energy CT for Assessment of Myocardial Fibrosis: Comparison of Single-Phase Iodine Map Extracellular Volume Fraction (ECV) With Standard Multiphase ECV Technique

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E353A

Awards
Student Travel Stipend Award

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PURPOSE

Diffuse myocardial fibrosis is associated with chronic heart diseases, including aortic stenosis, and may be quantified using cardiac CT or MRI calculation of extracellular volume fraction (ECV). This study compared a dual-energy CT approach using an iodine map from a single phase to calculate ECV to the standard multiphase technique to calculate ECV.

METHOD AND MATERIALS

61 patients with aortic stenosis (35 male, 26 female; average age = 81 years) undergoing preoperative CT for transcatheter aortic valve replacement (TAVR) were scanned on a Force (Siemens Inc.) using dual energy mode prior to (non-contrast phase) and 10 minutes following (delayed phase) administration of 120-150 cc of iodinated contrast. Matched 1cm² regions of interest were selected in the interventricular septum and ventricular blood pool in each phase. The ROI densities obtained from blended virtual 120 kV images in each phase were used to compute the ECV (standard technique), while the dual energy data from the delayed phase only was used to calculate ECV using iodine map technique. Bias between ECV computation methods was visualized using Bland-Altman plot. Linear regression with Pearson technique was also performed.

RESULTS

The mean ECV calculated using standard method was 28%, while mean ECV measured using the iodine map method was 30%; for a mean bias of +2% [95% CI, -5% to +9%]. The Pearson correlation coefficient between the two ECV measurements was $R^2 = 0.48$.

CONCLUSION

There was good correlation between ECV measured by standard multiphase technique and ECV measured by dual energy technique using iodine maps created from the delayed phase alone. The dual energy technique trended towards mild overestimation of fibrosis, possibly attributable to beam hardening, however this difference was not significant.

CLINICAL RELEVANCE/APPLICATION

Prior studies using histopathology and cardiac MRI have shown that the greater degree of myocardial fibrosis can predict worse outcomes after surgery. ECV is an accepted way to measure myocardial fibrosis. This study demonstrates a dual energy method that simplifies ECV measurement and reduces radiation dose without significant difference relative to standard measurement of ECV.

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/ Stefan L. Zimmerman, MD - 2012 Honored EducatorStefan L. Zimmerman, MD - 2015 Honored EducatorIhab R. Kamel, MD, PhD - 2015 Honored EducatorElliot K. Fishman, MD - 2012 Honored EducatorElliot K. Fishman, MD - 2014 Honored EducatorElliot K. Fishman, MD - 2016 Honored EducatorElliot K. Fishman, MD - 2018 Honored Educator

SSJ03-02 Occurrence of Myocardial Oedema After Sporting Event? Quantification by T1 and T2 Mapping

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E353A

Participants
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PURPOSE

Purpose of this study was to analyse the occurrence of myocardial oedema in triathletes after sporting events using T2 and T1 mapping.

METHOD AND MATERIALS

29 competitive asymptomatic triathletes (45 ±10 years) underwent a CMR study performed on a 1.5T Achieva (Philips) before (baseline) and after a sporting event (follow-up). CMR protocol included SSFP cine, T2w-GraSE and T1, T2 mapping using MOLLI 5(3)3 sequence. Additionally, LGE Imaging was performed in the CMR baseline study. T1 and T2 quantification was performed using the OsiriX Software.

RESULTS

CMR performed before the sporting event revealed a normal global T1 time (with 989 ±28ms) of the left ventricular (LV) myocardium. There was no significant change in the global T1 time after the sporting event (988 ±21ms; p=0.926). Furthermore, T2 time was in the normal range before the sporting event (54 ±3ms) without relevant change after the sporting event (53 ±3ms, p=0.797). In 10 of the 29 Triathletes (34%) a focal myocardial fibrosis with a non-ischemic pattern was detected (LGE+ triathletes). Likewise, in the subgroups (LGE+ und LGE-) no significant changes in T1, T2 times before and after the sporting event were detected.

CONCLUSION

In contrast to the previously published T2 STIR data our results using T1, T2 mapping have not revealed any myocardial oedema after sporting events. Exercise-induced myocardial oedema previously detected using T2 STIR sequences might be falsely interpreted due to signal inhomogeneities.

CLINICAL RELEVANCE/APPLICATION

No myocardial oedema indicating acute myocardial injury was detected using mapping methods after sporting events, suggesting that competitive endurance events are safe.

SSJ03-03 Focal and Interstitial Fibrosis in Highly Trained Endurance Athletes

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E353A

Participants
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PURPOSE

There is evolving evidence that cumulative effects of intensive endurance exercise may induce a broad spectrum of right ventricular (RV) adaptation/remodelling patterns. Thus, our aim was to assess the prevalence of myocardial fibrosis (MF), focal and interstitial, in the myocardium and its relationship with cardiac remodelling/adaptation, among a cohort of highly trained endurance athletes as compared to control subjects.

METHOD AND MATERIALS

93 highly trained endurance athletes (>12 hours training/week at least during the last 5 years; age: 36 ± 6 years; 52.7% male) and 72 age and gender-matched controls underwent a resting cardiac magnetic resonance to assess biatrial and biventricular dimensions and function. The presence of focal MF was assessed by late gadolinium enhancement (LGE). In a subgroup of 28 athletes, T1 mapping sequence was added and extracellular volume (ECV) measurements were performed in remote myocardium to asses interstitial MF.

RESULTS

High endurance training load was associated with larger bi-ventricular and bi-atrial sizes, mildly reduced systolic ventricular function, as compared to controls in both genders ($p < 0,05$). LGE was significantly more prevalent in athletes (n=35, 37.6% vs 2.8%; $p < 0,001$), with a constant pattern in the RV insertion points (Figure 1). Among men population, those athletes with LGE tended to have trained for more hours per week (14.55±3.6 vs 12.21±3.4, P = 0.07). In T1 mapping sequences, abnormal ECV values (>28%) were only found in 2 of 28 subjects. Those athletes who had focal fibrosis had higher ECV at remote myocardium than those without LGE (27,3±1,8 vs 25,1±2,2; P = 0,01).

CONCLUSION

Highly trained endurance athletes showed ten times higher prevalence of LGE than control subjects; always confined to the hinge point. Although this pattern of LGE may be another feature of the athlete's heart, our results suggest that those with focal fibrosis might have globally higher myocardial ECV values. Its clinical impact is currently uncertain, and it still warrants further investigation.

CLINICAL RELEVANCE/APPLICATION

Myocardial fibrosis, which is a predictive factor for adverse cardiac outcome, has been also described in some endurance athletes and its clinical meaning remains controversial.

SSJ03-04 Evaluation of a Shortened Cardiac MRI Protocol of Left Ventricular Examinations: Diagnostic Performance of T1-Mapping and Myocardial Function Analysis as a Screening Method

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E353A

Participants
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PURPOSE

In this study we sought to retrospective evaluate whether a very brief CMR protocol comprising only left ventricular(LV) function analysis and T1 mapping sufficiently distinguishes patients with relevant myocardial changes with need for further examination from healthy patients.

METHOD AND MATERIALS

From October 2015 until October 2017 all patients with clinical indication for CMR for any myocardial characterisation (n = 160) were included. The scanner was a Philips Ingina 3T. The full CMR protocol comprised sBTFE Cine-Imaging, T1 and T2 mapping, T2w Dark-Blood as well as Early- and Late-Gadolinium-Enhancement. Patients were categorized into two groups depending on presence of LV dysfunction. ROC-analysis was done for results of T1-, T2- mapping and extracellular volume(ECV) in patients without LV dysfunction. Reference was depicted pathology in the conventional CMR techniques and report.

RESULTS

In the patient's cohort without LV dysfunction (n = 78 [49%]) ROC for T1 mapping was 81% with $p < 0.001$, 65 % for T2 mapping with $p= 0.4$ and 82% for ECV with $p < 0.001$. T1 mapping was superior to T2 mapping by trend; $p = 0.057$. ECV was significantly superior to T1 mapping, $p = 0.026$. For maximum T1 relaxation times of 1300ms sensitivity was 83 % and specificity was 55%; the negative predictive value was 91%. In patients with no LV dysfunction 31 (40%) patients did not exceed a maximum T1 of 1300ms; out of those none had significant myocardial alterations but 3 patients were diagnosed with chronic myocarditis. In general, out of the daily routine study population 111 (70%) patients had a pathological finding and in 49 cases (30%) CMR did not provide additional information. In that group T1 mapping detected 57% of the patients who would not benefit from additional CMR.

CONCLUSION

A shortened CMR protocol comprising T1 mapping and LV-function analysis seems to rule out clinically relevant myocardial alterations. However, 3 cases of chronic myocarditis with normal LV-function were overlooked; yet therapeutic consequences remain uncertain in this entity. These results need to be prospectively confirmed in a lager study to increase confidence in this shortened protocol in clinical use.

CLINICAL RELEVANCE/APPLICATION

The proposed protocol might allow for an improvement of efficiency of CMR examinations in the future.

SSJ03-05 Ferumoxytol-Enhanced MRI for Intramyocardial Blood Volume Mapping: Early Pre-Clinical Results

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E353A

Participants
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PURPOSE

Myocardial perfusion is important for organ vitality. The intramyocardial blood volume (MBV) represents the fractional blood volume of the intravascular space within a unit volume of myocardial tissue. Because ferumoxytol has high r1 relaxivity and a long intravascular half-life, we hypothesize that ferumoxytol-enhanced (FE) MRI may enable mapping of the MBV. We aim to evaluate the vasodilator-induced variation in myocardial T1 signal in normal swine.

METHOD AND MATERIALS

In this ARC-approved study, four healthy Yorkshire swine (33-52 kg) underwent FE-MRI at 3.0T under general anesthesia. We acquired myocardial T1 maps using 5-(3)-3-(3)-3 MOLLI and FLASH-MOLLI pre- and post-ferumoxytol infusion (4mg/kg). We induced coronary vasodilation with 4-minute cycles of adenosine infusion (200-400 mcg/kg/min). Using in-house T1 fitting algorithms, we generated myocardial T1 maps and derived T1 values from regions of interest drawn in the mid interventricular septum of short axis FE T1 maps.

RESULTS

No adverse events occurred and vital signs were stable throughout the adenosine infusion and FE-MRI exam. Myocardial T1 signal differential between pre- and post-ferumoxytol was -48.5%±6.4%. The adenosine-induced native T1 response as reflected by the slope between baseline and peak adenosine was less robust when compared to FE T1 response (3.0±0.6ms/min vs -35.3±16.1ms/min, p=0.03). During the two adenosine-on cycles post-ferumoxytol, the FE T1 values steadily shortened due to adenosine-induced vasodilation and increasing MBV. During adenosine-off cycles, FE T1 values increased towards values at rest. For adenosine 200-300 mcg/kg/min, the FE T1 shortened (decreased) 10.2±5.4% from baseline. For 400 mcg/kg/min dose, the FE T1 shortened >15% (swine #4). Of note, the increase in native T1 from baseline to peak adenosine was 0.7±0.2%.

CONCLUSION

Ferumoxytol, as a potent intravascular contrast agent, sensitizes the T1 signal to changes in the MBV and substantially amplifies the intramyocardial vascular T1 estimate. Additional work in models of varying myocardial perfusion is needed to better characterize the T1 response in normal vs pathologic states.

CLINICAL RELEVANCE/APPLICATION

Vasodilator-induced changes in ferumoxytol-enhanced myocardial T1 reflect dynamic changes in the intravascular myocardial compartment and has implications for a panoply of myocardial disease states.

SSJ03-06 Simultaneous 18F-FDG PET/MR Study for Assessment of Different Stages of Cardiac Impairment in Patients with Anderson-Fabry Disease

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E353A

Awards
Student Travel Stipend Award

Participants
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PURPOSE

We evaluated the relationship between T1 mapping and 18F-FDG PET by cardiac PET/MR imaging in AFD female patients.

METHOD AND MATERIALS

Seventeen AFD female patients with normal left ventricular (LV) function underwent simultaneous cardiac PET/MR (Biograph mMR; Siemens Healthcare, Erlangen, Germany) imaging after administration of 18F-FDG and gadolinium-DPTA for assessment of late gadolinium enhancement (LGE). In all patients and in 7 female controls T1 mapping was performed using pre-contrast T1 Modified Look-Locker Inversion-recovery prototype sequence. Mean T1 values were measured by drawing 6-pixel regions of interest in the septal and lateral segments of LV apical, mid-ventricular and basal short-axis slices. Cardiac FDG uptake was quantified by measuring the standardized uptake value in 17 myocardial segments in each subject. The coefficient of variation (COV, i.e. the standard deviation divided by the average) of the uptake of the 17 segments was calculated as an index of heterogeneity in the heart and values >0.17 were considered abnormal.

RESULTS

Five patients showed focal LGE indicating intra-myocardial fibrosis and were excluded from the final analysis. Compared with controls, mean T1 values of AFD female patients were significantly lower (1238±51.1 vs. 1334.32±26.6, $p<0.001$). At PET, 7 out of the remaining 12 patients showed abnormal COV values suggesting inflammation pattern and the other 5 demonstrated normal COV values (0.32±0.1 vs. 0.12±0.03, $p<0.005$) with homogeneous FDG uptake. Patients with abnormal COV showed higher mean T1 values of lateral segments of the mid-LV wall (1219.16±23.4 vs. 1154±62.1, $p<0.05$), suggesting a potential relationship between progressive myocyte sphingolipid accumulation and inflammation.

CONCLUSION

This study highlights the role of 18F-FDG PET/MR imaging for early detection of cardiac involvement in AFD patients allowing to identify different stages of disease progression. In particular, pseudo-normalization of T1 mapping values, associated with abnormal COV values, may represent an intermediate "inflammatory" stage before the development of myocardial fibrosis.

CLINICAL RELEVANCE/APPLICATION

Simultaneous cardiac 18F-FDG PET/MR imaging may allow early detection of cardiac involvement in AFD patients identifying different stages of disease progression.

SSJ04

Science Session with Keynote: Cardiac (Oncology)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E260

CA MR NM OI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Gautham P. Reddy, MD, Seattle, WA (*Moderator*) Researcher, Koninklijke Philips NV;
Daniel Ocazionez, MD, Houston, TX (*Moderator*) Nothing to Disclose
Tina D. Tailor, MD, Durham, NC (*Moderator*) Nothing to Disclose

Sub-Events

SSJ04-01 Cardiac Keynote Speaker: Cardiac Complications of Oncology Therapy

Tuesday, Nov. 27 3:00PM - 3:20PM Room: E260

Participants
Gautham P. Reddy, MD, Seattle, WA (*Presenter*) Researcher, Koninklijke Philips NV;

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/ Gautham P. Reddy, MD - 2014 Honored Educator

SSJ04-03 Myocardial Tissue Characterization in Rat Models of Anthracycline-Induced Cardiotoxicity: Histologic Change and Correlation with T1 Mapping Parameters

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E260

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PURPOSE

To examine the pathologic changes in rat models of cardiotoxicity and to determine correlation with quantitative magnetic resonance imaging (MRI) parameters.

METHOD AND MATERIALS

All experiments were approved by our institutional animal care and use committee. Cardiotoxicity models were induced by injecting adult male Sprague-Dawley rats with doxorubicin (1mg/kg, twice a week). Cardiac MRI was performed with a 9.4-T scanner (Bruker Biospin Co., Billerica, MA, USA) using cine, pre- and post-T1 mapping sequences. T1 mapping sequences were performed by using a saturation recovery Look-Locker sequence. Left ventricular ejection fraction (LVEF) was evaluated using cine imaging. Native T1 and extracellular volume (ECV) were measured at the mid ventricle. All rats were sacrificed after MRI. Pathologic changes were graded according to their degree and then scored (0:absent, 1:minimal, 2:mild, 3:moderate, 4:severe) and correlated with MRI parameters (native T1 (ms), ECV (%)) and LVEF(%))

RESULTS

A total of 10 control and 14 cardiotoxicity models were included. Rats were classified into two groups, the early (n=9) and late (n=5) group, by 6 weeks after modeling. In cardiotoxicity models, LVEF decreased (control vs. cardiotoxicity subjects: 74%, 63.2%), native T1 and ECV increased (1,186 ms, 15.5% vs. 1,232.44 ms, 18.68%). The main histologic findings were vacuolar changes, inflammation, interstitial edema, expansion of interstitial space, and fibrosis. In subgroup analysis, myocardial fibrosis, expansion of interstitial space scores were significantly different between the two groups (p=0.007, p=0.002). Other histologic factors (e.g. vacuolar changes, inflammation, interstitial edema), native T1, ECV, and LVEF were not significantly different between the two groups. ECV was correlated with fibrosis (r=0.632, p=0.015), vacuolar change (r=0.705, p=0.005), and the sum of histologic scores (r=0.694, p=0.006). Native T1 was correlated with myocardial inflammation (r=0.638, p=0.012) and expansion of interstitial space (r=0.656, p=0.011)

CONCLUSION

Prominent changes in MRI parameters and pathologic findings were noted in both early and late cardiotoxicity models, even in subjects with preserved LVEF. ECV and native T1 values showed good correlations with histologic scores.

CLINICAL RELEVANCE/APPLICATION

T1 mapping MRI is a useful quantitative method to detect anthracycline-induced cardiotoxicity.

SSJ04-04 Myocardial Tissue Phase Mapping Detects Cardiac Dysfunction in a Mouse Model of Doxorubicin-Induced Cardiotoxicity

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E260

Participants
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PURPOSE

Cardiotoxicity following chemotherapy is common in cancer patients treated with anthracyclines such as doxorubicin (Dox). Conventional imaging approaches to identify anthracycline associated cardiac dysfunction have targeted reductions in ejection fraction (EF) with newer approaches focusing on detecting alterations in myocardial strain. The purpose of this study was to use myocardial tissue phase mapping (TPM) to study early functional changes in a mouse model of Dox-induced cardiotoxicity.

METHOD AND MATERIALS

16 week old female C57Bl/6 mice (n = 9) were imaged at 7T. 25 mg/kg Dox was administered over 3 weeks in the form of 5 mg/kg subcutaneous pellets (Innovative Research of America, Florida, USA). Mice were imaged at baseline, 6 weeks and 10 weeks post-treatment. MRI protocol included multi-slice cine MRI covering the entire LV, and TPM in a single mid-ventricular short-axis slice. The cine images were analyzed using Segment (Medviso, AB) to calculate EF. TPM was performed using 2D cine phase contrast MRI with prospective ECG and respiratory triggering. Imaging parameters included: image/time resolution = 0.117x0.117x1 mm3x20.8 ms, tri-directional VENC=4 cm/s. TPM images were analyzed in MATLAB to measure global peak radial and longitudinal velocities at systole and diastole. Following imaging at 6 weeks, 4 mice were sacrificed for histopathologic assessment utilizing terminal deoxynucleotidyl transferase (TdT) dUTP nick-end labeling (TUNEL) to detect apoptotic cells.

RESULTS

There were no significant differences in EF (72±11% at baseline, 75±12% at 6 weeks and 63±2% at 10 weeks). Global systolic longitudinal velocity was significantly reduced at 6 weeks (p=0.03) but our power was low to detect significant differences at 10 weeks. Histopathologic results demonstrated minimal apoptosis in all mice, suggesting early-stage cardiotoxicity.

CONCLUSION

Using myocardial TPM, we detected cardiac dysfunction prior to reduction in EF and the onset of cardiomyocyte apoptosis in a mouse model of Dox-induced cardiotoxicity. Future studies comparing this technique with other myocardial tissue and functional characterization may demonstrate a role for TPM as an early biomarker of cardiotoxicity.

CLINICAL RELEVANCE/APPLICATION

In the present study, we demonstrated that longitudinal systolic velocity quantified using myocardial tissue phase mapping may represent an early imaging biomarker for doxorubicin-induced cardiotoxicity.

SSJ04-05 68Ga-Galmydar: A PET Imaging Tracer for Noninvasive Detection of Doxorubicin-Induced Cardiotoxicity

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E260

Participants
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PURPOSE

Doxorubicin (DOX; Adriamycin), an anthracycline analogue is widely used chemotherapeutic drug in cancer. DOX treatments are susceptible to acute and chronic cardiac anomalies, including aberrant arrhythmias, ventricular dysfunction, and heart failure. PET tracers could also provide noninvasive assessment of early and reversible metabolic changes of the myocardium. Herein, we report a preliminary investigation of 68Ga-Galmydar potential to monitor DOX-induced cardiomyopathy in vivo, ex vivo, and in cellulo employing both nuclear- and optical imaging.

METHOD AND MATERIALS

Galmydar was obtained through a ligand exchange reaction. 68Ga-Galmydar was purified on C-18 column using radio-HPLC. MicroPET imaging was performed 5 d post treatment of rats either with a single dose of DOX (15 mg/kg) or vehicle as a control (saline). For correlation of PET imaging data, post-imaging quantitative biodistribution studies were also performed. In cellulo (H9c2) dose and time dependent doxorubicin treatments were also studied using live cell optical imaging.

RESULTS

68Ga-Galmydar, micro-PET static scan (10 min acquisition; 60 min post tail-vein administration) demonstrated 1.91-fold lower uptake in hearts of DOX-treated (Standard Uptake Value; SUV: 0.92, n=3) rats compared with their vehicle treated (SUV: 1.76, n = 3) counterparts. The post imaging pharmacokinetic data demonstrated heart uptake values of 2.02 fold lower for DOX treated rats compared to control counterparts (%ID/g; DOX: 0.44 ± 0.1, n=3; Control: 0.89 ± 0.03, n=3) thus correlating well with micro-PET imaging data. Employing moderate fluorescent traits of Galmydar, live cell optical imaging indicated a gradual decrease in uptake and retention of Galmydar within mitochondria of H9c2 cells following DOX-treatment, while indicating also dose-dependent pharmacological response and time-dependent uptake profiles. Furthermore, the decreased uptake in H9c2 cells also correlated with caspase-3 expression resulting from DOX-induced cardiotoxicity and cell death. Combined data indicate that 68Ga-Galmydar could provide a sensitive and specific readout of DOX-induced cytotoxicity attributed to depolarization of mitochondrial potential in heart cells.

CONCLUSION

68Ga-Galmydar could provide a noninvasive assessment of DOX-related early and likely reversible metabolic changes that remains to be evaluated clinically.

CLINICAL RELEVANCE/APPLICATION

none

SSJ05

Science Session with Keynote: Chest (Thoracic MRI)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S404AB

CH CT MR NM

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Jurgen Biederer, MD, Seeheim-Jugenheim, Germany (*Moderator*) Nothing to Disclose
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Sub-Events

SSJ05-01 Chest Invited Speaker: Beyond Morphology-Comprehensive Imaging of Pulmonary Disease with MRI

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S404AB

Participants
Juergen Biederer, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

SSJ05-02 Combination of MR Free-Breathing 3D T1-Weighted Star VIBE and DWI for the Differentiation of Benign from Malignant Peripheral Pulmonary Lesions: A Comparative Study Using Routine-Dose CT

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S404AB

Participants
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PURPOSE

The differentiation of benign pulmonary lesions from malignant pulmonary lesions is very difficult. High resolution CT is the most commonly used radiology methods for lung. While it is limited to children, child-bearing women and disorders requiring repeated examinations over prolonged periods because of its radiation dose.The result of our previous studies showed that: comparing with routine-dose CT, the MR T1-weighted 3D Star VIBE sequence was slightly lower in differentiating the peripheral pulmonary lesions(PPL) with morphological features. MR can provide not only the morphological information, but also functional information.The apparent diffusion coefficient (ADC) value was used widely in whole body, but this research of combining MR-DWI ADC value with morphological characteristics of PPL was rare. The purpose of this study was to evaluate the no radiation-dose MR (ADC value and T1-weighted 3D Star VIBE sequence) diagnostic efficiency in differentiating the malignant PPL from benign, with the routine-dose CT as a reference standard.

METHOD AND MATERIALS

Fourty-seven patients(30 males and 17 females,mean age 64.1 years old; age range 48-83 years) were enrolled in this study, all the patients had undergone routine-dose CT,MR T1 Star VIBE and DWI with 3.0T MR sanner. These lesions were all diagnosed by transthoracic needle biopsy or surgery. Two radiologists observed the morphological signs of MR and CT images independently. The order of observation was MRI first, and followed by CT. Then the ADC value of lesions were measured. The logistic regression analysis was used to calculate the probability. The ROC curve was used to analyze the capabilities of morphological characteristics and DWI in distinguishing malignant PPL from benign.

RESULTS

There was significant difference of the ADC value between benign and malignant groups(p=0.001). The cut-off ADC value was 1197×10-6 mm2/s. Combined MR T1 Star VIBE with ADC value can distinguish PPL better than only routine-dose CT, ADC value and T1 Star VIBE alone.

CONCLUSION

The ADC value could differentiate the peripheral pulmonary lesions initially, but the distinguishability was better if combing MR T1 Star VIBE morphological characteristics with ADC value.

CLINICAL RELEVANCE/APPLICATION

We can use MR T1-weighted 3D Star VIBE and DWI to replace routine-dose CT to distinguish PSPLs in order to avoid radiation exposure.

SSJ05-03 18F-Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography (PET/CT) and Diffusion-Weighted Magnetic Resonance Imaging (DWI-MRI) Diagnostic Performance in the

Evaluation of Pulmonary Lesions: A Systematic Review and Meta-Analysis

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S404AB

Awards

Student Travel Stipend Award

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PURPOSE

To perform a systematic review and meta-analysis of the diagnostic performance of DWI-MRI and 18F-FDG PET/CT in the evaluation of pulmonary lesions.

METHOD AND MATERIALS

Databases of MEDLINE and Embase were searched through December 2017. Studies published in English were included when the diagnostic performances of 18F-FDG PET/CT or DWI in detecting malignant pulmonary lesions were clearly identified in the articles. Two reviewers evaluated the study quality of all selected articles using QUADAS-2 and only those that met a minimum quality score were included. Parameters of lesion quantification were analyzed separately for each imaging modality (e.g., lesion-to-spine ratio (LSR), and apparent diffusion coefficient (ADC) for DWI-MRI). Meta-analysis using a random-effects model were conducted to calculate the pooled sensitivities, specificities, positive and negative likelihood ratios (PLR and NLR), diagnostic odds ratios (DOR) and area under the curve (AUC) for PET/CT and DWI with 95% confidence intervals (95% CI).

RESULTS

The literature search yielded 1280 results, and the inclusion criteria were met by 37 studies (23 FDG PET/CT studies, 8 MRI studies and 6 studies including both methods), with a total of 4224 participants and 4463 lesions (malignant, n = 3090, 69.2%; benign, n=1362, 30.8%). Pooled sensitivity and specificity of SUVmax (n = 25) were 0.86 (95%CI, 0.82-0.90) and 0.73 (95%CI, 0.62-0.82), respectively. For DWI-MRI, LSR studies (n = 4) showed a sensitivity of 0.81 (0.71-0.88) and a specificity of 0.90 (0.79-0.95), whereas studies utilizing ADC (n = 12) had a sensitivity and specificity of 0.83 (0.77-0.88) and 0.86 (0.76-0.92), respectively. DWI-LSR yielded the greatest diagnostic odds ratio (DOR = 38, 95%CI 12-115) compared to DWI-ADC (DOR = 30, 95%CI 14-66) and SUVmax (DOR = 17, 95%CI 10-28).

CONCLUSION

Diagnostic performance of DWI-MRI is comparable to 18F-FDG PET/CT for the evaluation of potentially malignant pulmonary lesions.

CLINICAL RELEVANCE/APPLICATION

This is the first meta-analysis to compare the diagnostic performance of DWI-MRI and 18F-FDG PET/CT in the evaluation of pulmonary lesions. Our study demonstrated that the diagnostic performance of DWI-MRI is comparable or even superior to that of PET/CT, which supports the inclusion of MRI as a low-cost and radiation-free option to the diagnostic work-up of pulmonary lesions.

SSJ05-04 Chemical Exchange Saturation Transfer (CEST) Imaging versus Diffusion-Weighted Imaging (DWI) versus FDG-PET/CT: Capability for Diagnosis of Solitary Pulmonary Nodule

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S404AB

Participants
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PURPOSE

To directly and prospectively compare the capability for diagnosis of solitary pulmonary nodules (SPNs) among chemical exchange saturation transfer (CEST) imaging, diffusion-weighted imaging (DWI), and FDG-PET/CT.

METHOD AND MATERIALS

113 consecutive patients (69 male and 44 female; mean age 71 year old) with 122 SPNs underwent CEST imaging and DWI at a 3T MR system, FDG-PET/CT, and pathological and/or follow-up examinations. According to final diagnoses, all SPNs were divided into malignant (n=76) and benign (n=46) SPNs. In each patient, magnetization transfer ratio asymmetry (MTRasym) was calculated from z-spectra at 3.5ppm in each pixel, and MTRasym map was computationally generated from CEST data. In each lesion, MTRasym, apparent diffusion coefficient (ADC) and SUVmax were assessed by ROI measurements. To compare all indexes between two groups, Student's t-test was performed. Then, multivariate logistic regression analyses were performed to investigate the discriminating factors of two groups. In addition, ROC analyses were performed to compare diagnostic performance among all indexes as well as combined methods. Finally, sensitivity, specificity and accuracy were compared among all methods by McNemar's test.

RESULTS

MTRasym, ADC and SUVmax had significant difference between malignant and benign SPNs ($p<0.05$). Multivariate regression analyses identified MTRasym (Odds ratio [OR]: 0.54), ADC (OR: 47.6) and SUVmax (OR: 0.47) as significant differentiators ($p<0.05$). ROC analyses showed area under the curve (Az) of MTRasym (Az=0.88) and combined all indexes (Az=0.92) were significantly larger than that of SUVmax (Az=0.77, $p<0.05$). Sensitivity (SE) and accuracy (AC) of MTRasym (SE: 81.6 [62/76] %, AC: 82.8 [101/122] %) and combined methods (SE: 85.5 [65/76] %, AC: 85.2 [104/122] %) were significantly higher than those of ADC (SE: 69.7 [53/76] %, $p<0.05$; AC: 77.9 [95/122] %, $p<0.05$) and SUVmax (SE: 64.5 [49/76] %, $p<0.05$; AC: 71.3 [87/122] %, $p<0.05$).

CONCLUSION

CEST imaging has a better potential and can improve diagnostic performance of SPNs, when compared with DWI and FDG-PET/CT.

CLINICAL RELEVANCE/APPLICATION

CEST imaging has a better potential and can improve diagnostic performance of SPNs, when compared with DWI and FDG-PET/CT.

SSJ05-05 2D-ROI and 3D-VOI Histogram Analysis of Apparent Diffusion Coefficient in Assessing Solitary Pulmonary Lesions

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S404AB

Participants
Shi Y. Deng, Guangzhou, China (*Presenter*) Nothing to Disclose
Xinhua Wei, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Xinchun Li, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine the diagnostic performance of apparent diffusion coefficient (ADC) histogram analysis derived from both largest cross-sectional (2D-ROI) and whole tumor region of interest(3D-VOI) in differentiating benign from malignant solitary pulmonary lesions(SPLs).

METHOD AND MATERIALS

Sixty-nine patients with pathologically confirmed lung lesions (benign: malignant = 23:46) were included in the study. All patients underwent 3.0T diffusion-weighted imaging (DWI) with 2 b values of 0 and 600s/mm2. The histogram metrics including minimum, mean, maximum, 10th, 25th, 50th, 75th and 90th percentiles, skewness, and kurtosis were calculated from the largest cross-section and whole tumor ROI, respectively. Inter-class correlation characteristic(ICC) was used to assess inter-observer reliability. Histogram metrics were analyzed using Mann-Whitney U-test. The diagnostic performance was evaluated using receiver-operating characteristic (ROC) analysis.

RESULTS

Minimum, mean, maximum and 10th,25th,50th,75th,90th percentile ADCs with two groups were significantly lower (all $P<0.05$), except for the maximum and 25th percentile ADCs in whole-volume group ($P=0.128$, $P=0.221$) in malignant lesions compared with benign ones. The 75th and 50th percentile ADCs in two ROI setting group respectively achieved the highest AUC (single-slice: whole-volume=0.891:0.894) with cutoff value of 1.57×10^{-3} mm²/s and 1.41×10^{-3} mm²/s in differentiating solitary pulmonary lesions. ICC for the whole-volume ROIs(0.76~0.97) was better the largest-slice ROIs(0.59~0.91) .

CONCLUSION

Both single-slice and whole-volume ADCs are helpful for distinguishing malignant from benign lung lesions. Whole-volume ADC histogram analysis could have greater diagnostic properties and repeatability.

CLINICAL RELEVANCE/APPLICATION

In conclusion, ADC histogram is helpful for distinguishing malignant from benign lung lesions, and the 75th percentile ADC derived from 2D-ROI and 3D-VOI could provide better imformation in characterizing in SPLs, with no statistical difference. Moreover, placing ROIs in the largest lesion would be more suitable for clinic practice considering about saving time.

SSJ05-06 Utilization of 19F MRI for Identification of Iraqi-Afghanistan War Lung Disease

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S404AB

Participants
Joseph G. Mammarappallil, MD,PhD, Durham, NC (*Presenter*) Nothing to Disclose

Scott Shofer, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Jesse L. Tucker, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Martha Carraway, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Samantha Womack, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Cecil Charles, PhD, Durham, NC (*Abstract Co-Author*) Research Grant, Merck & Co, Inc

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PURPOSE

Iraq-Afghanistan War Lung Injury (WLI) describes new onset respiratory symptoms occurring in deployed soldiers to the Middle East that can ultimately lead to constrictive bronchiolitis. This study sough to determine if 19F MRI could identify patients with WLI.

METHOD AND MATERIALS

Three soldiers who presented to local VA clinics were evaluated for reactive airways disease, post deployment dyspnea, and decreased respiratory fitness. All subjects had a full pulmonary function evaluation. Inspiratory and expiratory imaging with HRCT was also obtained for each subject. For 19F MRI studies, each subject inhaled a gaseous mixture of 79% PFP mixed with 21% O2 mixture over the course of several minutes in a protocol consisting of three tidal breaths followed by a 6 second breath-hold at total lung capacity during which a 3D imaging of the lung airspaces was obtained. The image data was analyzed to generate regional wash-in and wash-out time constants (seconds) throughout the lung airspaces. Finally, the fraction of slow filling compartments was calculated as the number of volume elements exhibiting a wash-in time constant of > 100 seconds divided by the total number of lung airspace elements in the imaged [FVR1>100].

RESULTS

Two subjects were non-smokers and the third is a current smoker (11 pack-years). All three subjects were exposed to aerosolized contaminants during deployment in Iraq/Afghanistan. Spirometry for all subjects were normal FEV1% predicted (81, 109, 86), FEV1/FVC (72, 75, 73). Expiratory CT imaging was normal for subject 1, while the 2nd and 3rd subjects had mild basilar or lobular areas of air trapping. Imaging with 19F for each subject was as follows: FVR1>100 = 17.5%, 37.8%, and 24.5% for the three subjects respectfully. While the first subject's FVR1>100 was close to values seen in subjects with normal lung function the second and third subjects more resembled patients diagnosed with COPD (25->60%).

CONCLUSION

19F MRI demonstrated delayed regional filling of PFP gas in two subjects with suspected WLI when compared to data from normal subjects.

CLINICAL RELEVANCE/APPLICATION

19F MRI has the potential to detect airway abnormalities at earlier time points than current techniques. This may ultimately lead to better diagnosis of challenging airway abnormalities such as WLI and perhaps a tool for evaluation of interventions.

SSJ06

Science Session with Keynote: Emergency Radiology (Practice Management)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S402AB

CT ER

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Zachary S. Delproposto, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose
Jennifer W. Uyeda, MD, Boston, MA (*Moderator*) Consultant, Allena Pharmaceuticals, Inc; Invited Speaker, Siemens AG

Sub-Events

SSJ06-01 Emergency Radiology Keynote Speaker: Dual Energy CT in the ED

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S402AB

Participants
Jennifer W. Uyeda, MD, Boston, MA (*Presenter*) Consultant, Allena Pharmaceuticals, Inc; Invited Speaker, Siemens AG

SSJ06-02 CT Utilization Patterns in an Expanded Level 1 Trauma Center

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S402AB

Awards
Student Travel Stipend Award

Participants
Katie P. Kinzer, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
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PURPOSE

To investigate CT utilization patterns in a major level 1 trauma center before and after the opening of a new facility with expanded ER and critical care capacity.

METHOD AND MATERIALS

A retrospective analysis of all CT scans ordered from the emergency department of a major level 1 trauma center was performed during a 36 month period spanning the opening and transition to a new facility in May of 2016. Eligible for inclusion were CT studies performed within call hours (5pm-8am weekdays, 24 hours on weekends). Data were conducted retrospectively, using ad hoc SQL query against PACS Oracle database, and classified into one of two subcategories based upon the findings 1) Type 1: critically acute findings usually necessitating hospital admission, and 2) Type 2: negative or non-critical. The incidence of Type 1 and Type 2 findings before (January 2015-May 2016) and after (May 2016-Dec 2017) transitioning to the new facility were analyzed.

RESULTS

Comparing 16 months prior and 20 months after opening of an expanded trauma center, there was a 12% increase in overall ED patient volume. There was an associated increase in overall CT utilization of 24.6%. When weighted by number of days, there was a total of 33 CT studies per day ordered before and 41 CT studies ordered per day after opening the new hospital. However, there was no significant increase in Type 1 studies (weighted average total increase of 9.2%). The increase in CT utilization was entirely accounted for by a significant increase type 2 studies which increased by 32.3% ($p<0.05$). The yield for type 1 studies (defined as the ratio of Type 1 to Type 2), decreased from 0.41 to 0.33.

CONCLUSION

Increased CT utilization following the opening of an expanded level 1 trauma center was accounted for entirely by an increase in volume of non-critical (type 2) studies. Potential contributors to this utilization pattern are explored and include overall increase in ED volume and increased proximity of CT scanners within the new emergency department.

CLINICAL RELEVANCE/APPLICATION

Hospital geography can play a role in increasing CT utilization without increasing clinical yield.

SSJ06-03 ED CT Utilization Has Increased but What Has Increased and Who Reads Them?

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S402AB

Participants
Santosh K. Selvarajan, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

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PURPOSE

The growth in CT utilization is considerable and has increased across the world. The continued growth in the ED may be partly related to increased applications with improved technology and partly from inappropriate use. Our purpose was to determine the different subcategories of CT that have increased since code bundling was used only for CT of abdomen and pelvis and secondly assess the change in Non-Radiologists interpretations of CT from 2004 to 2016.

METHOD AND MATERIALS

We used the Medicare Physician/Supplier Procedure Summary Master Files for 2004-2016. The codes for ER CT were selected and the procedure volumes in ED settings were calculated. We doubled the number of bundled codes, since these would have counted as 2 exams in 2010 and before. We performed a secondary analysis of the different CT examinations by categorizing them in to head, body, spine, musculoskeletal and CT vascular. The CTA of the head and neck were assigned to the head CT to help assess the utility of neuroimaging. Then used Medicare provider specialty codes to identify those exams interpreted by Radiologists and other specialties.

RESULTS

The utilization of CT in the EDs grew in all the categories with a more substantial increase in the utilization of CT spines (+423%), CT vascular (+306%), and CT MSK (+164%). The utilization of CT body has increased by 56%. The volume of neuroimaging has significantly increased from 1,875,263 in 2006 to 3,632,617 in 2016 (+94%). A small number of cardiac CTs are performed in the ED, which has increased from 194 in 2006 to 2430 in 2016 (+1153%). Radiologists interpret 99% of the studies in all categories. The percentage of non-Radiologists interpreting CTs in the ED have reduced in all subcategories except a mild increase in the interpretation of CT spines and CT vascular.

CONCLUSION

There is substantial increase in the utilization of all CTs in the ED. The growth is predominantly in CT spine, CT vascular and CT of extremities. The utilization of CT and CTA for neuroimaging has also increased markedly.

CLINICAL RELEVANCE/APPLICATION

These trends may be partially due to defensive medicine in ED and radiologists and ED physicians need to work together to better control utilization.

SSJ06-04 The Effect of Advanced Age on the Utilization of CT in Trauma

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S402AB

Participants
Brendan Kelly, BMBCh, Dublin, Ireland (*Presenter*) Nothing to Disclose
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Marie Therese Cooney, MBBCh,PhD, Dublin, Ireland (*Abstract Co-Author*) Nothing to Disclose
John Cronin, MBBCh, Dublin, Ireland (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

In the 1990s the most frequent mechanism of injury (MOI) in trauma was Road Traffic Accidents (RTA) with a mean age of 31; by 2013 falls from <2 meters were the predominant mechanism and the mean age had risen to 53.8. CT plays a major role in the management of trauma. The possibility exists for a delay in investigation and treatment in older trauma patients due to differences in MOI, mode of presentation and awareness.

METHOD AND MATERIALS

Trauma Audit Research Network (TARN) data from a tertiary referral urban university teaching hospital with an annual ED census of over 53,000 patients from 2012 to 2017 was analysed. Fisher's Exact test, multivariate logistic regression and Student's T Test were used for analysis in SPSS 24.

RESULTS

1422 trauma patients were included of whom 928 had CT. 721 were male and 701 were female. Mean age was 63 (range : SD) (3-99:22.2). Mean Injury Severity Score (ISS) was 13 (1-57 : 8.4). Fall <2m was the MOI in 61.5% and RTA in 15.3%. Trauma patients aged >65 were no more likely to require a CT than those <65 (p=0.575). Patients >65 were more likely to have a time to CT (TCT) >24 hours (p<0.001). This held true controlling for gender, ISS, date and time (p<0.01). Patients aged >65 with an ISS >15 were more likely to have a TCT >6 hours (p=0.016). Overall mean TCT was 262% longer (p<0.001) in those patients aged >65.

CONCLUSION

Trauma patients over 65 years of age wait longer for CT compared to those under 65.

CLINICAL RELEVANCE/APPLICATION

Outcomes for older trauma patients are worse in terms of morbidity, mortality and length of stay. While the cause and effect for the impact on outcomes of the delay to CT is difficult to elucidate; maximising controllable variables has the potential to benefit the patient.With the aging population and the changing face of trauma emergency departments need to plan for a different type of patient. Older patients who suffer traumatic injuries may not be identified as early and strategies should be implemented minimise delay in access to diagnostics and implementation of treatment. Emergency and radiology departments need to be accordingly resourced for this changing practise.

SSJ06-05 Defensive Medicine, Myth or Truth: The Evolution of Geriatric Trauma Imaging

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S402AB

Participants
Eldar Guliyev, Ankara, Turkey (*Abstract Co-Author*) Nothing to Disclose
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Emre Unal, MD, Ankara, Turkey (*Abstract Co-Author*) Nothing to Disclose
Mehmet Mahir Kunt, Ankara, Turkey (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The worldwide population is aging, and in proportion to this development the morbidity and mortality related to geriatric trauma, and its burden on healthcare is increasing. In this study, we aimed to analyze the imaging findings in a series of geriatric trauma patients admitted to our emergency department during the period of 2006-2011 and 2012-2017. We also investigated whether trauma induced pathologies or the need for imaging has changed over the years.

METHOD AND MATERIALS

We randomly selected two sets of 300 patients among 597 and 987 patients admitted to the emergency department during the time periods of 2006-2011(group I) and 2012-2017(group II), respectively. A comprehensive comparison was carried out between the groups regarding age, sex, reason for admission, associated comorbidities, Revised Trauma Score (RTS), Glasgow Coma Scale (GCS), radiological findings and number of radiological examinations, DLP values, duration of hospital stay, and trauma associated morbidity and mortality.

RESULTS

No statistically significant difference was observed between both groups regarding age and gender ($p>0.05$). Falls were the most common cause for admission in both groups, followed by traffic accidents. RTS and GCS values were similar in both groups ($p>0.05$). The number of patients who underwent X-ray and CT examinations in group II was higher compared to group I (89% vs. 82%, 73% vs. 44%, respectively, $p=0.021$). The total number of X-rays and CT scans was also higher in group II (613 vs. 310, 409 vs. 142, respectively, $p=0.01$). In 49% of patients in group I and 55% of patients in group II, CT scans were negative for a trauma related finding. In patients with radiological evidence of trauma, no significant difference was observed between the groups regarding major trauma related change ($p=0.151$). However, trauma related minor CT findings were more common in group II ($p=0.031$).

CONCLUSION

Increased need for radiological examinations over the years seem to occur as a consequence of the tendency to practice defensive medicine. In addition to increased radiation dose, unnecessary radiological examinations result in heavy burden on health care systems and radiologists' workload.

CLINICAL RELEVANCE/APPLICATION

Increased need for imaging in recent years appears to be related to 'defensive medicine' but not to Revised Trauma Score or Glasgow Coma Scale of the patients.

SSJ06-06 CT or MR for Pulmonary Embolism: 10 Years of Experience in Over 10,000 Cases in the Emergency Department

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S402AB

Participants
Lindsay Griffin, MD, Madison, WI (*Presenter*) Nothing to Disclose
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Daryn S. Belden, BS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Danielle Babb, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Mark L. Schiebler, MD, Madison, WI (*Abstract Co-Author*) Stockholder, Stemina Biomarker Discovery, Inc; Stockholder, HealthMyne, Inc;
Scott K. Nagle, MD, PhD, Madison, WI (*Abstract Co-Author*) Stockholder, General Electric Company Research Consultant, Vertex Pharmaceuticals Incorporated

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PURPOSE

We sought to determine if patient characteristics of those referred for pulmonary magnetic resonance imaging (MR) differed from those referred to computed tomographic angiography (CT) for the primary diagnosis of pulmonary embolism (PE) from our

Emergency Medicine Department (ED).

METHOD AND MATERIALS

This is a retrospective HIPPA-compliant, IRB-approved study of CT and MR performed for PE evaluation in the ED from January 1, 2009 - December 31, 2017. All ED patients with an imaging order placed and not canceled during an ED encounter were identified. Patient encounters were included if (1) study type was CT or MR and (2) study description included 'PE protocol' or study information entered by the ED clinician included a PE variant (i.e. pulm* embol*, vte). Patient factors were populated via the electronic medical record (EMR); comorbidity indices were calculated from ICD 9/10 codes. Logistic regression was used to calculate odd ratios (OR) of factors associated with use of MR versus CT.

RESULTS

There were 10,986 CT and 1,448 MR patient EMRs reviewed. MR patients were younger ($p<.001$) and female ($p<.001$). CT patients had higher morbidity indices ($p<.001$). In the patient factor model, female sex, lower age, slightly lower comorbidity index, and history of renal disease increased odds of MR use (female OR 2.7, $p<.001$; age OR 0.93, $p<.001$; Elixhauser OR 0.97, $p<.001$; renal disease OR 3.5, $p<.001$). In a separate vital signs model, slightly lower maximum respiratory rate (RR_max) and slightly higher minimum oxygen saturation (O2_min) increased odds of MR (RR_max OR 0.97, $p<.01$; O2_min OR 1.04, $p<.001$).

CONCLUSION

ED ordering of MR occurred more often in female, younger patients with lower comorbidity and more favorable vital signs. History of renal disease also significantly increased the OR of MR.

CLINICAL RELEVANCE/APPLICATION

ED clinicians have consistently utilized MR for PE evaluation since its introduction, with selection of MR in stable patients to mitigate perceived risks of CT.

SSJ07

Gastrointestinal (Hepatocellular Carcinoma Response Imaging)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S104A

BQ GI MR OI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

An Tang, MD, Montreal, QC (*Moderator*) Research Consultant, Imagia Cybernetics Inc; Speaker, Siemens AG; Speaker, Eli Lilly and Company
Erik Soloff, MD, Seattle, WA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ07-01 Prediction of TACE Refractoriness in Patients with HCC Using Imaging Features of Gadoxetic Acid-Enhanced MRI

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S104A

Participants

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PURPOSE

To investigate magnetic resonance imaging (MRI) features associated with transarterial chemoembolization (TACE) refractoriness in patients with HCC and to develop a prediction model.

METHOD AND MATERIALS

Among 407 patients with intermediate-stage HCC (BCLC-B) who underwent TACE as a first-line treatment from January 2012 to December 2015, 181 patients having pre-procedural gadoxetic acid-enhanced MRI were included in this study. TACE refractoriness was determined according to the Japan Society of Hepatology guidelines. Univariate and multivariable analyses were performed to investigate the association between clinical factors including MRI features and the refractoriness. A prediction scoring model was constructed by a bootstrap resampling method. The performance of the prediction model was evaluated with respect to discrimination for TACE refractoriness using the area under the receiver operating characteristic curve (AUC).

RESULTS

55 patients (30.4%) showed TACE refractoriness, while the remaining 126 (69.6%) showed good responses after TACE. Independent features associated with TACE refractoriness were alpha fetoprotein level, tumor number, maximum tumor size, atypical arterial enhancement pattern, arterial peritumoral enhancement, and presence of nonhypervascular hypointense nodule (NHHN) on hepatobiliary phase images. The prediction model derived from these variables showed good discrimination (AUC, 0.82, 95% CI, 0.75-0.89) for TACE refractoriness.

CONCLUSION

The prediction model based on the MRI features can be used to estimate the risk of TACE refractoriness in patients with HCC.

CLINICAL RELEVANCE/APPLICATION

The identification of high risk patients of TACE refractoriness can be helpful to the initiation and maintenance of TACE in patients with HCC.

SSJ07-02 Radiofrequency Ablation versus Cryoablation for Perivascular Hepatocellular Carcinoma: Local Tumor Control and Vascular Complications

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S104A

Participants

Soyeon Cha, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

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Kyoung Doo Song, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Min Woo Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Hyo Keun Lim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare cryoablation with radiofrequency ablation (RFA) in patients wtih perivascular HCC and to evaluate the local tumor control and vascular complications of both therapies.

METHOD AND MATERIALS

The retrospective study was approved by the institutional review board. The requirement for informed consent was waived. Between January 2015 and December 2017, 111 patients (93 men, 18 women; mean age, 62.3 years; age range, 44-48 years) who underwent percutaneous cryoablation (n=61) or FRA (n=50) were enrolled. All patients had a single perivascular HCC (mean size, 1.3 cm) that were in contact with hepatic vessels (periportal or perivenous), $\geq$ 3mm or larger in axial diameter. Cumulative local tumor progrssion (LTP) was evaluated. In addition, several procedure-related vascular complications were evaluated immediately after treatment and during follow-up images: peritumoral vessel thrombosis; transient hepatic ischemia or hepatic infarction; aggressive intrasegmental recurrence (AIR) (the simultaneous deveolpment of $\geq$ 3 nodular or infiltrative tumors).

RESULTS

The median follow-up was 18 months. Both groups did not show significant differences in terms of baseline characteristics except the proportion of periportal tumor location (40.0% in the RFA group vs. 86.9% in the cryoalblation group, p=0.031). The cumulative LTP rates at 1 and 2 years were 5.7% and 22.1%, respectively, in the RFA groups, and 6.5% and 22.7%, respectively, in the cryoablation group, without siginificant difference (p=0.918). However, peritumoral thrombosis (25% vs. 11.5%, p=0.031) and transient hepatic ischemia or hepatic infarction (24% vs. 4.95%, p=0.005) were more common in the RFA group than in the cryoablation group. Although there were not significant differences between two groups, AIR was only occurred in the RFA group (2% vs. 0%, p=0.450).

CONCLUSION

In patients with perivascular HCC, cryoablation is an effective treatment for local tumor control, comparable to RFA, with a low risk of vascular complications.

CLINICAL RELEVANCE/APPLICATION

Although cryoablation has not been included as a standard care for HCC according to the recent Barcelona Clinic Liver Cancer guidelines, based on the our results, cryoablation may be a reasonable alternative for patients with limited liver function to avoid vascular complications.

SSJ07-03 Trends in Ablative and Surgical Treatment of Hepatic Tumors in the Medicare Population, 2003-2016

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S104A

Participants
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Laurence Parker, PhD, 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

Percutaneous ablation of liver tumors has become increasingly accepted as a less invasive alternative to open ablation and surgical resection in patients with liver tumors. Our purpose was to assess utilization trends in these procedures in recent years.

METHOD AND MATERIALS

Using the nationwide Medicare Part B databases for 2003-2016, we selected the CPT codes for percutaneous ablation (PA), open ablation (OA), and partial lobectomy (PL) of the liver. Codes for both radiofrequency- and cryoablation were included. The databases provide volumes for each code. Medicare's specialty codes were used to identify the specialty of the provider. Trend lines were plotted for total volumes and volumes by radiologists, surgeons, and all other physicians as a group. Because these databases represent a full population, sample statistics are not required.

RESULTS

Medicare total PA volume increased from 1221 in 2003 to 2788 in 2016 (+128%), with the most rapid growth occurring from 2012-2016. Radiologists performed 99% of all PAs in 2016. Of the 2788 performed that year, 2599 were radiofrequency ablations, while 189 were cryoablations. OA volume decreased steadily from 835 in 2003 to 435 in 2016 (-48%). The vast majority of OAs were done by surgeons. PL volume increased from 2090 in 2003 to 2945 in 2016 (+41%). Again, the vast majority were done by surgeons.

CONCLUSION

OA use is declining steadily, while use of both PA and PL has increased. PA growth has been especially strong in recent years. The large majority of PAs use the radiofrequency approach, rather than cryo. Radiologists perform virtually all PAs. The data demonstrate that radiologists have assumed a major role in the treatment of hepatic tumors.

CLINICAL RELEVANCE/APPLICATION

Radiologists are virtually the only physicians performing percutaneous treatment of liver tumors, and have driven the rapid growth of these procedures in recent years.

SSJ07-04 The Impact of Gadoxetic Acid Enhanced Hepato-Biliary MRI on Treatment Decisions in Hepatocellular Carcinoma: The SORAMIC Trial Diagnostic Cohort

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S104A

Participants
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PURPOSE

SORAMIC is a RCT comprising diagnostic, local ablation and palliative studies in patients with hepatocellular carcinoma (HCC) in BCLC stages A-C. Based on the diagnostic study pts. were assigned to the local ablation or palliative cohort. The diagnostic study (reported here) was designed to determine the accuracy of treatment decisions based on hepato-biliary MRI employing Gadoxetate (hbpMRI) as compared to contrast enhanced CT (CECT).

METHOD AND MATERIALS

This multicenter trial recruited 692 pts. to receive standardized hbpMRI and CECT. Primary study objective was to confirm in a 2-step procedure hbpMRI is non-inferior (first step) or superior (second step) compared with CECT for assignment to a palliative or local ablation treatment strategy. In addition, we included a seperate set of dynamic MRI (dynMRI) sequences (obtained from the Gadoxetate data set) for comparison. Central read of all image sets was performed by 2 readergroups (R1, R2). Image criteria for CECT and dynMRI were wash-in and wash-out according to EASL. Modified HCC criteria for the hbpMRI are outlined in fig. 1. Readers determined a treatment recommendation according to standard criteria (local ablation, palliative treatment, neither recommendation; e.g. <=4 lesions <=5cm: ablation). Standard of reference was a joint truthpanel decision by a hepatologist and a radiologist with access to all available data incl. follow-ups.

RESULTS

The intention-to-treat (ITT) and the per-protocol (PP) population consisted of 530 and 442 pts., respectively. In the ITT population, the accuracy of CECT/ dynMRI was 73.8%/ 75.5% for R1 and 70.9%/ 70.4% for R2, respectively. In the PP population, the accuracy of CECT/dynMRI was 72.9%/ 76.5% (R1) and 72.2%/ 71.5% (R2). Non-inferiority (difference, -5%points; 1-sided; alpha, 2.5%) between modalities was shown for ITT as well as PP (power > 95%). For hbpMRI, the accuracy for R1/R2 was 83.4%/ 80.6% in the ITT and 82.6%/ 81.2% in the PP population. HbpMRI superiority was significant compared to CECT or dynMRI (all, $p<0.001$).

CONCLUSION

hbpMRI was superior to CECT or dynMRI for treatment decision making in HCC. Image artifacts did not affect treatment decisions in Gadoxetate based hbp MRI, dynMRI or CECT.

CLINICAL RELEVANCE/APPLICATION

Hepatobiliary MRI employing gadoxetic acid was superior to CECT or dynamic MRI for treatment decision making in pts. with BCLC stages A-C.

SSJ07-05 Diffusion-Weighted MR Imaging to Assess Immediate Response to Irreversible Electroporation in a Rabbit Liver Tumor Model: Pathologic Correlation

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S104A

Participants
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PURPOSE

Irreversible electroporation (IRE) is a relatively new strategy for the interventional treatment of liver tumors. Accurate follow-up imaging is critical for properly monitoring and evaluating treatment responses. The purpose of our study was to test the hypothesis that DW-MR imaging can be used to assess the immediate treatment response to IRE in animal models with liver VX2 tumors.

METHOD AND MATERIALS

New Zealand white rabbits were implanted with VX2 tumor tissue blocks in the left median and left lateral lobes of liver. Tumors were allowed to grow for 7-10 days to reach a size typically at least 10 mm in longest diameter, as verified with MR imaging. IRE electrodes were inserted, and eight 100-μsec, 2000-V square wave pulses were applied to ablate the tumor tissue in the left median lobe. Tumor in the left lateral lobe served as a control. DWI scans were performed at baseline and immediately after IRE for each animal (b= 0, 400, 800, 1200 s/mm2). Then, rabbits were euthanized and tumors harvested for hematoxylin-eosin (H-E), and caspase-3 staining. The ratio of ADC values (ADClesion/ADCnormal liver) and changes in the ADC measurements were calculated and compared. The percentage of viable tumor was calculated for treated tumors by using both radiologic methods and pathologic techniques. Pearson correlation coefficients were calculated to assess the relationship between ADC and H-E-stained measurements of viable area immediately post-IRE. The differences of apoptosis index (AI) between irreversible electroporation (IRE) zone and reversible electroporation (RE) zone were compared.

RESULTS

The ratio of ADC values, ΔADC, the mean percentage of viable tumor, and AI significantly differed between treated and untreated tumors (P<.05 for all). In treated tumors, the ratio of ADC values and AI significantly differed between IRE zone and RE zone, and there was a strong correlation between results of viable tumor measured on ADC value and pathologic techniques after IRE.

CONCLUSION

DW-MR imaging biomarkers can be used for the early evaluation of therapeutic response to IRE treatment of liver tumors in a rabbit model.

CLINICAL RELEVANCE/APPLICATION

Early changes in ADC values highlighted by DW-MRI correlate with histopathologic changes in liver tumors after IRE procedure. DWI-MRI may be helpful for timely adjustments to patient therapeutic strategies as needed to improve clinical outcomes.

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/ Vahid Yaghmai, MD - 2012 Honored EducatorVahid Yaghmai, MD - 2015 Honored EducatorVahid Yaghmai, MD - 2017 Honored Educator

SSJ07-06 Therapeutic Response Monitoring After Targeted Therapy in an Orthotopic Rat Model of Hepatocellular Carcinoma Using Contrast-Enhanced Ultrasound: Focusing on Inter-Scanner and Inter-Operator Reproducibility

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S104A

Participants
Hwaseong Ryu, Yangsan, Korea, Republic Of (*Presenter*) Nothing to Disclose
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PURPOSE

To assess therapeutic responses monitoring after targeted therapy in an orthotopic rat model of hepatocellular carcinoma (HCC) using contrast-enhanced ultrasound (CEUS) with focusing on inter-scanner, and inter-operator reproducibility.

METHOD AND MATERIALS

For reproducibility evaluation, CEUS was performed using two different US scanners by two different operators in sixteen N1-S1 rat models of HCC. Using perfusion analysis software (VueBox ®), 11 parameters were collected, and intra-class correlation (ICC) was used to analyze reproducibility. Then, seventeen N1-S1 rat models of HCC were divided into a treatment group (n = 8, 30 mg/kg/day sorafenib for 5 days) and a control group (n = 9). CEUS was performed at baseline, 1 day and 7 day after the first treatment and changes of perfusion parameters were analyzed.

RESULTS

In treatment group, CEUS perfusion parameters showed significant change, and among them, peak enhancement (PE, 2.50 x103±1.68 x103vs 5.55x102±4.65x102, p = 0.010), and wash-in and wash out AUC (WiWo AUC, 1.07x105±6.48 x104vs 2.65x104±2.25x104, p = 0.009), had significantly decreased 7 day following treatment. On the contrary, in control group, CEUS parameters did not show significant change including PE (1.15 x103±7.53x102vs 9.43x102± 7.81 x102, p = 0.632) and WiWoAUC(5.09 x104±3.25x104vs 5.92 x104±3.20x104, p = 0.646). For reproducibility, the various degrees of inter-scanner reproducibility from poor to good (ICC: <0.01-0.63) and inter-operator reproducibility from poor to excellent (ICC: <0.01-0.93) were observed. However, inter-operator reproducibility was good and excellent in WiWo AUC (ICC: 0.65 and 0.88) and fair and good in PE (ICC: 0.30 and 0.65) in different scanner.

CONCLUSION

CEUS was useful for assessment of treatment response after targeted therapy using PE and WiWo AUC with fair and excellent inter-operator reproducibility.

CLINICAL RELEVANCE/APPLICATION

CEUS perfusion parameters, including PE and WiWo AUC, had significantly decreased after targeted therapy with fair and excellent inter-operator reproducibility. However, CEUS parameters obtained by different scanner should not be used interchangeably.

SSJ08

Gastrointestinal (Pancreas Imaging)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S102CD

GI MR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSJ08-01 Accurate Therapeutic Response Assessment of Pancreatic Ductal Adenocarcinoma Using Quantitative DCE-MRI with Novel Perfusion Phantom: A Pilot Study

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S102CD

Participants
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PURPOSE

To validate quantitative dynamic contrast enhanced magnetic resonance imaging (qDCE-MRI) with a novel perfusion phantom for predicting therapeutic response in patients with pancreatic ductal adenocarcinoma (PDAC).

METHOD AND MATERIALS

A pilot study was conducted with eight patients (7 males and 1 female; median age = 66 yrs) having either locally advanced (n=7) or metastatic (n=1) PDAC. All had two DCE-MRI exams before and 8±1 weeks after starting first-line chemotherapy. The perfusion phantom was small enough to be imaged with each patient, serving as an internal reference for accurate quantitative image analysis. Tumor boundary was demarcated by board-certified radiologist blinded to therapy and clinical response. Tumor response was assessed by RECIST criteria. Tumor perfusion was measured with Ktrans using extended Tofts model before and after phantom-based data correction. Results are presented as mean±SD and 95% confidence intervals (CI). Statistical difference was evaluated with one-way ANOVA.

RESULTS

Mean tumor long axis before therapy was 38±17 mm. Tumor-size change of the responding group (n=4) was -12±4% for 8 weeks of therapy, while that of the non-responding group (n=4) was 18±15% (p=0.010). Baseline mean tumor Ktrans before therapy was 0.090±0.032 min-1 without statistical difference between the two groups (p=0.206). Before phantom-based data correction, the Ktrans change of responding tumors was 69±23% (95% CI: 32% to 106%) at 8 weeks, whereas that of non-responding tumors was -1±41% (95% CI: -65% to 64%) (p=0.025). After correction, the data variation in each group was significantly reduced; the Ktrans change of responding tumors was 73±6% (95% CI: 64% to 82%) compared to non-responding tumors of -0±5% (95% CI: -7% to 8%) (p<0.001).

CONCLUSION

To our knowledge, this is the first clinical data to demonstrate significant perfusion increase of PDAC responding favorably to first-line chemotherapy. Use of the small perfusion phantom imaged together with the patient reduced the data variation in quantitative DCE-MRI up to 50%, enhancing precision.

CLINICAL RELEVANCE/APPLICATION

The perfusion phantom is portable, inexpensive, easily utilized, and thus has potential to enhance precision for standard-of-care early PDAC therapy monitoring.

SSJ08-02 Dynamic Contrast Enhanced MRI for Pancreatic Perfusion in Acute Pancreatitis

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S102CD

Participants
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PURPOSE

To assess the characteristics of perfusion for normal pancreas and acute pancreatitis (AP) by using dynamic contrast enhanced MRI (DCE MRI).

METHOD AND MATERIALS

85 patients with AP and 26 normal controls underwent routine and DCE MRI sequences on a 3.0T MRI scanner. The Omitk DCE MRI Tool was used to analyze perfusion parameters, such as Ktrans, Vp and AUC values. The perfusion parameters of pancreas between AP group and control group were compared. In AP patients, the perfusion parameters were also compared between edematous and necrotizing pancreatitis, among different grades of AP by MR severity index (MRSI) and the revised Atlanta classification.

RESULTS

The Ktrans, Vp and AUC values of AP were lower than those of control group (all $P<0.05$). According to MRSI, the Ktrans and AUC values were significant difference between mild and moderate AP, mild and severe AP ($P<0.05$), except for between the moderate and severe AP ($P>0.05$); there was no significant difference for pancreatic Vp value in the different severity grades of AP ($P>0.05$). According to the revised Atlanta classification of AP, the Ktrans value was significant difference between mild and moderately severe AP, mild and severe AP ($P<0.05$), except for between the moderately severe and severe AP ($P>0.05$); there were no significant difference for pancreatic Vp and AUC values in the different severity grades of AP($P>0.05$). And the Ktrans was significant difference between edematous and necrotizing pancreatitis ($P<0.05$), except for the Vp and AUC values ($P>0.05$).

CONCLUSION

The application of DCE MRI to evaluate pancreatic perfusion contributes to AP diagnosis and AP severity grade. Pancreatic perfusion is significantly lower in patients with AP than that in normal pancreas, and with the increase of the severity of acute pancreatitis, pancreatic perfusion tends to decrease.

CLINICAL RELEVANCE/APPLICATION

The application of DCE MRI to evaluate pancreatic perfusion contributes to AP diagnosis and AP severity grade.

SSJ08-03 Multi-Parametric MRI to Assess Focused-Ultrasound Therapy of Pancreatic Ductal Adenocarcinoma

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S102CD

Participants
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PURPOSE

Pulsed focused ultrasound (pFUS) therapy has shown promising results in disrupting dense fibrotic stroma and decreasing high interstitial fluid pressure characteristic of pancreatic ductal adenocarcinoma (PDA). Our goal is to use multi-parametric MRI to non-invasively assess and quantitate tumor response to pFUS in PDA mouse models.

METHOD AND MATERIALS

Three murine models of PDA, including subcutaneous, orthotopic, and a genetic model (KPC) were evaluated with multi-parametric MRI at 14T (Paravision 5.1 software, Bruker Corp, Billerica, MA) to assess tumor response to ultrasound-guided pFUS (VIFU 2000 Alpinion Medical Systems; 475 W peak electric power, 1 millisecond pulse duration, 1 Hz, duty cycle 0.1%) or sham treatments. Maps for T1 and T2 relaxation, apparent diffusion coefficient (ADC), magnetization transfer ratio (MTR), and chemical exchange saturation transfer (CEST) for the amide proton and glycosaminoglycan (gag) spectrum were generated. Images were collected 48hrs pre-pFUS and immediately post-pFUS therapy. Tumors were excised and prepared for sectioning and staining with hematoxylin and eosin, Masson's trichrome, picrosirius red, and immunohistochemistry for CD31 and hyaluronan.

RESULTS

Following pFUS treatment, mean ADC increased significantly for all animal models, with the greatest increase observed in the KPC group. Mean gag CEST and T2 map quantitations decreased significantly post-treatment only for the KPC group. Mean MTR and mean amide CEST values increased 21.6% ($p<0.001$) and 14.5% ($p=0.01$), respectively for the KPC group. No significant differences were observed in sham groups. Significant increase in ADC likely reflects increased diffusivity within the treated tumors. Significant decreases in gag CEST and T2 relaxation may represent disruption of glycosaminoglycans and associated liberation of complexed water molecules. Variable changes in T1 relaxation and significantly increased MTR and amide CEST signals post-treatment most likely represent hyperacute hemorrhage from microcapillary vessels. Histological quantifications are currently being processed.

CONCLUSION

T2 relaxation, gag CEST, and ADC may provide reliable quantitation for monitoring therapeutic effect of pFUS for PDA.

CLINICAL RELEVANCE/APPLICATION

Multi-parametric MRI may be utilized to non-invasively assess the therapeutic effects and changes in tumor composition to improve medical monitoring of pFUS treatment for patients with PDA.

SSJ08-04 Prediction of Overall Survival after Surgery of Pancreatic Cancer Using Preoperative MR Imaging, Clinical, and Histopathological Findings

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S102CD

Participants
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PURPOSE

To predict overall survival in patients who underwent surgery for pancreatic cancer using preoperative MR imaging, clinical, and histopathological findings.

METHOD AND MATERIALS

In this retrospective study, 150 patients with pancreatic cancer who underwent MR and surgery were included. Preoperative MR findings were assessed by two radiologists. Clinical characteristics and histopathological results such as T, N stage and resection status were investigated as well. Cox proportional hazard model was used to find prognostic factors for overall survival and intraclass correlation coefficient was used to estimate interobserver agreement.

RESULTS

Median and mean survival period was 21.0 months (interquartile range, 10.0-41.3) and 31.1 ± 29.2 months in the patients. Tumor size on MR (hazard ratio (HR) 1.041, 95% CI: 1.011-1.072) and over-abutment of superior mesenteric vein on MR (HR 1.919, 95% CI: 1.177-3.130), N1 stage (HR 2.672, 95% confidence interval (CI): 1.503-4.750), macroscopic residual tumor (HR 10.340, 95% CI: 4.349-24.580), were predictors of poor survival ($P<0.05$). Interobserver agreement on MR was substantial for tumor size (0.682, 95% CI: 0.582-0.762) and was moderate for superior mesenteric vein involvement (0.469, 95% CI: 0.292-0.607).

CONCLUSION

Both preoperative MR findings and histopathological results are useful for prediction of overall survival after surgery for pancreatic cancer.

CLINICAL RELEVANCE/APPLICATION

Combination of preoperative MR findings and histopathological results can be useful for prediction of overall survival after surgery for pancreatic cancer.

SSJ08-05 Exploratory Study of ADC Histogram Metrics in Assessing Ampullary/Pancreatic Malignancy

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S102CD

Participants
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PURPOSE

To evaluate the utility of whole-lesion 3D-histogram apparent diffusion coefficient (ADC) metrics in the assessment of ampullary/pancreatic malignancy.

METHOD AND MATERIALS

Forty-two ampullary/pancreatic malignancies (36 adenocarcinoma, 6 neuroendocrine) underwent abdominal MRI with DWI followed by endoscopic ultrasound biopsy or surgical resection. A single radiologist used dedicated post-processing software to place 3D-volumes-of-interest encompassing the entire masses to derive whole-lesion histogram ADC metrics. Mann-Whitey tests and ROC analyses were used to assess the diagnostic performance of the histogram metrics for determining lesion histology, and among adenocarcinomas, T-stage, N-stage, and grade.

RESULTS

Whole-lesion ADC histogram metrics demonstrating significant differences between adenocarcinoma and neuroendocrine tumors were mean ADC (1.40 vs. 1.04 x10-3mm2/sec, respectively; p=0.020, AUC = 81%), mean of the bottom 10th percentile (mean0-10) (0.97 vs. 0.50; p<0.001, AUC=88%), and mean of the 10th-25th percentile (mean10-25) (1.16 vs. 0.77, p<0.001, AUC=92%). For the metric with highest AUC for histology (mean10-25), a threshold >0.94 achieved sensitivity of 94% and specificity of 83%. Metrics with significant differences between nodal status No vs. >=N1 were mean ADC (1.69 vs.1.24; p=.004; AUC = 81%), mean0-10 (1.19 vs. 0.71, p=0.012, AUC=82%), and mean10-25 (1.45 vs. 0.96; p=0.002, AUC=82%). For the metric with highest AUC for nodal status (mean10-25), a threshold >0.94 achieved sensitivity of 94% and specificity of 83%. No metric was significantly associated with T stage (all p>0.195) or tumor grade (all p>0.215). Skewness and kurtosis were not significantly different between any groups (all p>0.087).

CONCLUSION

Volumetric ADC histogram metrics may serve as non-invasive biomarkers in assessing ampullary/pancreatic malignancy. The metric reflecting the bottom quarter of the histogram distribution outperformed the standard mean in determining lesion histology and nodal status, supporting the role of histogram analysis. More advanced methods may be needed for T stage and tumor grade differentiation.

CLINICAL RELEVANCE/APPLICATION

Although these findings require validation in larger studies, histogram diffusion metrics may be helpful in guiding prognosis and treatment selection for ampullary/pancreatic malignancy.

SSJ08-06 Noncontrast Computed Tomography Factors that Predict Outcome after Extracorporeal Shock Wave Lithotripsy in Patients with Pancreatic Duct Stones

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S102CD

Participants
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PURPOSE

To assess the usefulness of noncontrast computed tomography (NCCT) factors for predicting the outcome of extracorporeal shock wave lithotripsy (ESWL) in patients with pancreatic duct stone (PDS).

METHOD AND MATERIALS

We retrospectively evaluated 148 patients with multiple PDS in the pancreatic head region who had undergone ESWL therapy. All patients received NCCT examination both before and after ESWL. The following parameters are measured and recorded: patients characteristics including sex and age; NCCT parameters including mean stone length (MSL), mean stone volume before (V0) and after (V1) ESWL, mean value of CT attenuation (MSD), standard deviation of CT attenuation (SDSD), the variation coefficient of CT attenuation (VCSD), skin-to-stone distance (SSD) and pancreatic duct diameter (PDD); ESWL outcome indexes including stone clearance rate (SCR) calculated by , and the number of ESWL sessions (ESWL No.). All patients were respectively divided into A group (patients with SCR>=90%), B group (patients with SCR between 50% and 90%) and the C group (patients with SCR<50%). Analysis of variance (ANOVA) was applied among three groups to evaluate the potential predictors for SCR, and the receiver operating curve (ROC) was made for finding the cutoff value with optimal sensitivity and specificity. The Pearson correlation analysis and histogram were further used for finding factors related to ESWL No. .

RESULTS

ANOVA analysis revealed that MSD was the only significant predictor for SCR ($p < 0.05$), and ROC showed the cutoff value of +1000.45 HU, with sensitivity up to 78.0% and specificity of 48.6%. Stones with MSD lower than +1000.45 HU had higher SCR (69.3%) than that (59.6%) in higher-density ones. The Pearson correlation analysis and histogram indicated significantly positive correlation between ESWL No. and MSL (r= 0.536), MSD (r= 0.250), SDSD (r= 0.247) and PDD (r= 0.227), all with p<0.01.

CONCLUSION

MSD is the optimal predictor of ESWL efficacy, and PDS with lower MSD had the better clearance rate with fewer fragment sessions.

CLINICAL RELEVANCE/APPLICATION

MSD(mean stone density) is the optimal predictor of ESWL efficacy, and PDS with lower MSD had the better clearance rate with fewer fragment sessions.

SSJ09

Gastrointestinal (Quantitative Imaging Analysis)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S104B

BQ CT GI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
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Elizabeth M. Hecht, MD, New York, NY (*Moderator*) Nothing to Disclose
Stephan W. Anderson, MD, Cambridge, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ09-01 Automated Measurement of Liver Attenuation to Identify Hepatic Steatosis from Low-Dose CT Lung Screening Scans

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S104B

Participants
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PURPOSE

To measure liver attenuation automatically from low-dose lung screening CT scans to identify patients with moderate-to-severe hepatic steatosis (HS) and compare the automated method to manual region of interest (ROI) based measurement.

METHOD AND MATERIALS

This IRB-approved, HIPAA compliant study included 251 participants with a baseline low-dose CT scan with a slice thickness of <=1 mm (111 from a lung cancer screening program and 140 from the World Trade Center (WTC) cohort). Radiologists measured the liver attenuation (Hounsfield units; HU) at the level of the portal vein in four sectors defined by the Couinaud system. In each sector, the average liver HU was measured in a 1.0 cm2 circular (ROI), avoiding lesions and large vessels. The automated method samples cubic ROIs in the liver region, which is determined using a computer-based automated segmentation of the right diaphragm as the upper bound of the region, extending to 7.0 cm below the diaphragm. This region is divided into non-overlapping 1.0 cm3 cubes, and the mean intensity is computed for each cube. To account for regions that may be outside the liver or include blood vessels, cubes with mean values outside of the inner quartile range (50%) are excluded. An overall mean attenuation is computed from the remaining cubes for each CT scan. A threshold for HS was defined as the mean - 2*standard deviation from the lung screening cohort for both methods. The manual ROI measurement and automated methods were compared by using limits of agreement of average liver attenuation values and comparing the detection of HS in the WTC cohort using the established thresholds.

RESULTS

The overall mean and SD for the automated liver attenuation measurement was 51.52 HU ± 12.72 and for the manual measurement, 55.31 HU ± 11.21. The limits of agreement were (-14.09, 6.51). The threshold for HS was 40 HU for the manual method and 37 HU for the automated method; using these thresholds, 97.1% (136/140) of WTC participants had the same classification by both methods.

CONCLUSION

Automated measurement of liver attenuation from low-dose chest CT scans is feasible and shows good agreement (97%) with manual ROI based measurements for detecting HS.

CLINICAL RELEVANCE/APPLICATION

Automated identification of hepatic steatosis (HS) from low-dose lung screening CT scans has good agreement with radiologists, enabling physicians to identify patients at risk of liver disease.

SSJ09-02 Increased Adipose Tissue Attenuation on Computed Tomography (CT) Predicts One-Year Mortality in Older Adults

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S104B

Participants
Leon Lenchik, MD, Winston-Salem, NC (*Presenter*) Nothing to Disclose
Kristin M. Lenoir, MPH, Winston-Salem, NC (*Abstract Co-Author*) Nothing to Disclose
Josh C. Tan, MS, Winston-Salem, NC (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To determine relationships between visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT) index and attenuation on abdominopelvic CT examinations with one-year survival in older adults.

METHOD AND MATERIALS

Relationships between adipose tissue metrics and all-cause mortality were determined retrospectively in a cohort 436 consecutive Medicare patients (52% women, mean age 75 years) who had non-contrast abdominopelvic CT exams for routine clinical indications. On CT images, VAT and SAT were segmented at the level of L3 pedicle using segmentation software (Mimics) and a threshold of -190 to -30 Hounsfield units. VAT and SAT cross-sectional area (CSA) and attenuation were measured. VAT and SAT index was determined by dividing adipose CSA by patient height in meters squared. Cox regression models were fit to determine associations between VAT and SAT metrics and one-year mortality, adjusted for age, sex, race, body mass index, smoking status, and Charlson comorbidity index.

RESULTS

Within one year of follow-up, 90 patients (20.6%) died. In the fully-adjusted models, higher values of VAT and SAT attenuation were associated with higher hazard ratios (HR) for mortality at 1 year. A 1 SD increase in the VAT attenuation was associated with a 103% increase in mortality (HR/SD=2.03; 95%CI=1.45-2.83; p<0.0001). A 1 SD increase in the SAT attenuation was associated with a 75% increase in mortality (HR/SD=1.75; 95%CI=1.40-2.19; p<0.0001). VAT index and SAT index were not associated with increased mortality.

CONCLUSION

In older adults, increased adipose tissue attenuation on abdominopelvic CT examinations was associated with increased one-year mortality, independent of other causes of death.

CLINICAL RELEVANCE/APPLICATION

Quantitative data mining for adipose tissue attenuation on abdominal CTs of older adults may help determine prognosis.

SSJ09-03 Accuracy of CT Texture versus Mean Attenuation for Quantification of Liver Fat Content

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S104B

Participants
Andrew D. Smith, MD,PhD, Birmingham, AL (*Presenter*) President and Owner, Radiostics LLC; President and Owner, eRadioMetrics LLC ; President and Owner, Liver Nodularity LLC ; President and Owner, Color Enhanced Detection LLC ; Patent holder
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Harald Kramer, MD, Munich, Germany (*Abstract Co-Author*) Research Consultant, Bayer AG; Speakers Bureau, b.e. imaging AG
Perry J. Pickhardt, MD, Madison, WI (*Abstract Co-Author*) Stockholder, SHINE Medical Technologies, Inc; Stockholder, Elucent Medical; Advisor, Bracco Group;
Scott B. Reeder, MD, PhD, Madison, WI (*Abstract Co-Author*) Institutional research support, General Electric Company; Institutional research support, Bracco Group; Founder, Calimetrix, LLC; Shareholder, Elucent Medical; Consultant, ArTara

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PURPOSE

To develop a CT texture prediction model to accurately and reproducibly measure liver fat content.

METHOD AND MATERIALS

Retrospective secondary analysis of a prospective study that included 50 adult participants (23 men, 27 women; mean age 57 years; BMI 27) who underwent unenhanced single energy CT and MRI proton density fat fraction (MRI-PDFF). In separate independent reading sessions, three readers measured 110 first order CT texture parameters (before and after application of median and Gaussian filters) and liver fat content on MRI-PDFF-maps. Linear regression was used to examine the association between predictors and liver fat content per MRI-PDFF (reference standard). CT texture parameters with higher reproducibility (ICC >0.60) were moved forward into development of a multivariable model. The CT texture multivariable model was built using least absolute shrinkage and selection operator (LASSO) on those significant predictors (p-0.05). The root-mean square error (RMSE) and the coefficient of determination (R) were used to assess the goodness of fit of the models. Using a subset of significant predictors, accuracy (AUROC), sensitivity and specificity for correctly classified patients with >5.56% liver fat content were calculated.

RESULTS

The CT texture model most strongly associated with liver fat content consisted of percent of pixels less than 40 HU on unfiltered images (ICC=0.97-0.98, p=0.001), mean after median filtration (ICC=0.98-0.99, p=0.0001), and percent of pixels less than 40 HU after Gaussian filtration (ICC=0.95-0.97, p=0.0001). The CT texture prediction model had less deviation from and higher correlation with the reference standard than mean attenuation (RMSE = 0.474 vs. 0.513; R = 0.77 vs. 0.72, respectively). The AUROC, sensitivity and specificity for detecting >5.56% liver fat content were 0.96, 86.5%, and 92.3% for the CT texture prediction model vs. 0.93, 83.8% and 92.3% for mean attenuation.

CONCLUSION

A CT texture prediction model is highly reproducible and more accurate than CT mean attenuation for estimating liver fat content.

CLINICAL RELEVANCE/APPLICATION

CT texture can be used to accurately and reproducibly quantify liver fat content in patients at risk for NAFLD.

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/ Perry J. Pickhardt, MD - 2014 Honored EducatorPerry J. Pickhardt, MD - 2018 Honored Educator

SSJ09-04 Quantitative Evaluation of Heterogeneous Hepatic Injury with Gd-EOB-DTPA Enhanced MRI: An Initial Experimental Study

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S104B

Participants
Yanyan Zhang, Shenyang, China (*Presenter*) Nothing to Disclose
Yi Liu, MD, PhD, Shengyang, China (*Abstract Co-Author*) Nothing to Disclose
Yang Sun, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose
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Liying Xia, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose
Chaoxu Zhang, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess heterogeneous hepatic injury with Gd-EOB-DTPA enhanced MRI on a novel rat model.

METHOD AND MATERIALS

This study is approved by institutional review board. Seventy male Sprague-Dawley rats were randomly divided into control group (n=10) and colchicine group (n=60). The solution with 0.25% colchicine (0.4ml/kg) was injected via the splenic vein to develop a rat model of heterogeneous hepatic injury. An equal volume of normal saline was injected via the splenic vein in the control group. After the operation, at Day 3, week 1, week 2, week 4, week 8 and week 12 ten rats of the colchicine group were selected randomly for MRI examinations respectively, then they were euthanized. The ten rats of control group underwent MRI examinations at the same time points, and were euthanized at week 12 after MRI examinations. Gd-EOB-DTPA enhanced T1WI, T2WI and diffusion weighted imaging (DWI)were used to evaluate the heterogeneous hepatic injury. The quantitative data of left and right hepatic lobes, which were calculated on MRI, were compared and correlated with the pathological result of hepatic injury, which was assessed on liver sections according to the histological scoring criteria. P value of <0.05 was considered statistically significant.

RESULTS

There was obvious pathological change of rat hepatic parenchyma after colchicine injection through splenic vein, and the hepatic injury of left and right lobes was significantly difference (P <0.05). Meanwhile there were significant difference in ADC of DWI, LMR(liver-to-muscle ratio) of T2WI and ΔLMR(the difference value of LMR between pre- and post-enhanced T1WI)between left and right lobes of colchicine groupat each time point respectively(P <0.05), and it is similarly between colchicine and control group(P <0.05). Besides, there were significant correlation between ADC, LMR, ΔLMR value and hepatic injury score, respectively (r=-0.682, P=0.000; r=-0.245, P=0.018; r =-0.807,P =0.000).

CONCLUSION

Gd-EOB-DTPA enhanced MRI is useful for evaluation of heterogeneous hepatic injuty, which induced by injection of colchicine through splenic vein. It is necessary for the further research on clinic.

CLINICAL RELEVANCE/APPLICATION

Gd-EOB-DTPA enhanced MRI is useful for evaluation of heterogeneous hepatic injuty,which is necessary for the further research on clinic.

SSJ09-05 Expanded Quantitative Ultrasound of the Liver in Healthy Adults

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S104B

Participants
Andrew T. Trout, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Research Grant, Siemens AG; Research Grant, Canon America Medical Systems Corporation; Board Member, Joint Review Committee on Educational Programs in Nuclear Medicine Technology; Travel support, Koninklijke Philips NV; Consultant, Guerbet SA
Jonathan R. Dillman, MD, Cincinnati, OH (*Abstract Co-Author*) Research Grant, Siemens AG; Research Grant, Guerbet SA; Travel support, Koninklijke Philips NV; Research Grant, Canon Medical Systems Corporation; Research Grant, Bracco Group
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PURPOSE

Imaging techniques including ultrasound are becoming increasingly quantitative. With shear wave elastography (SWE) becoming increasingly utilized clinically, ultrasound system manufacturers are developing additional methods of tissue quantification. Two such techniques are shear wave dispersion (SWD) and attenuation imaging (ATI). SWD quantifies the variation in shear wave speed (SWS) with frequency (i.e. dispersion slope in units of (m/s)/kHz) and should provide information about viscoelasticity. ATI quantifies the ultrasound attenuation coefficient in tissue and may serve as a means to quantify hepatic steatosis. The purpose of this study was to acquire SWE, SWD, and ATI data in healthy adults to demonstrate applicability of the technique and define normal values.

METHOD AND MATERIALS

Under IRB approval, 28 healthy adults without a known personal or family history of liver disease were recruited to undergo a quantitative ultrasound of the liver including SWE, SWD and ATI. Imaging was performed by a group of experienced technologists utilizing an Aplio i800 (Canon Medical Systems, USA). 10 SWE and SWD measurements and 5 ATI measurements were obtained from the right lobe in each patient. Study population data were summarized utilizing descriptive statistics (means, medians, standard deviations and ranges).

RESULTS

Median age for the population was 45.2 years (range: 17.6-64 years) and 18 of 28 participants (64.2%) were female. Median body mass index was 24 kg/m2 (range: 20-29 kg/m2). Mean average (for the 10 measurements) SWS for the population was 1.37±0.11 m/sec (median: 1.34 m/sec, range: 1.17-1.6 m/sec). Mean interquartile range (IQR) was 0.17 for the population and mean IQR/median was 0.15. Mean SWD was 10.68±1.53 (m/s)/kHz (median: 10.15 (m/s)/kHz, range: 8.4-14.8 (m/s)/kHz) and mean attenuation was 0.59±0.09 dB/cm/MHz (median 0.59 dB/cm/MHz, range: 0.42-0.8 dB/cm/MHz).

CONCLUSION

Mean shear wave speed for adults without known liver disease on an Aplio i800 was 1.37±0.11 m/sec. SWD and ATI provide quantitative information that is additive to SWE. Data acquired in healthy adults presented here may serve as a reference against which to compare data from patients with suspected liver disease.

CLINICAL RELEVANCE/APPLICATION

Attenuation imaging and shear wave dispersion provide quantitative measures of tissue characteristics in addition to shear wave elastography. Normative values for adult liver on the Aplio i800 are provided.

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 R. Dillman, MD - 2016 Honored Educator

SSJ09-06 Validation of Tumor-Host Interface on Pancreatic Protocol CT Scan as a Prognostic Biomarker in Patients with Pancreatic Ductal Adenocarcinoma

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S104B

Awards
Student Travel Stipend Award

Participants
Ahmed M. Amer, MD, Birmingham, AL (*Presenter*) Nothing to Disclose
Yufeng Li, PhD, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose
Eugene J. Koay, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
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Michelle M. McNamara, MD, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To validate a previously published pre-therapy conventional single energy multiphasic CT imaging biomarker that stratifies pancreatic ductal adenocarcinoma (PDAC) patients into different clinical groups and outcomes, using dual energy CT.

METHOD AND MATERIALS

IRB approved HIPAA compliant retrospective analysis of consecutive adult PDAC patients. Single operator recorded regions of interest (ROI) in tumor core, tumor border, pancreas border, normal pancreas using dedicated DECT server. ROIs were simultaneously populated to identical image locations on DECT 70 keV pancreatic parenchymal phase (PPP), single energy portal venous phase (PVP), and conventional unenhanced images. Imaging based classification of High Delta (HD-defined as increased enhancement difference across tumor-host tissue interface >= 40 HU on either 70 keV PPP or PVP) and Low Delta (LD- lower enhancement difference) was evaluated for resectable, borderline resectable (BRPC), locally advanced (LAPC), and metastatic PDAC groups and compared to outcomes using Cox proportional-hazards model.

RESULTS

158 subjects (79M, 79F, mean age 67.8) included: 93 advanced stage -50 locally advanced, 43 metastatic; 65 lower stage -48

resectable, 17 borderline resectable. 44 underwent Whipple. 28 received neoadjuvant therapy. Median overall survival (OS) was significantly shorter for HD tumors in both advanced stage patients (10.8 vs 18 months; HR, 2.03; 95%CI, 1.22 to 3.48; P= .0062) and in lower stage patients (13.5 vs 23.3 months; HR, 1.87; 95%CI, 1.01 to 3.53; P= .042). In lower stage patients, delta was associated with OS after accounting for age, tumor size, surgery, and neoadjuvant therapy (P= .04) In non-metastatic patients, HD was associated with shorter time to distant metastasis development (HR, 2.28; 95%CI, 1.04 to 5.25; P= .03).

CONCLUSION

Our results validate the prognostic value of CT-based classification of PDAC patients using DECT; those with tumors characterized by high delta have significantly shorter survival.

CLINICAL RELEVANCE/APPLICATION

As with conventional MDCT, Delta score is a visually apparent and quantifiable DECT imaging biomarker that can stratify distinct subtypes of tumors in PDAC patients.

SSJ10

Science Session with Keynote: Genitourinary (Benign Gynecologic Disease)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S404CD

GU MR OB US

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Victoria Chernyak, MD,MS, Bronx, NY (*Moderator*) Nothing to Disclose
Douglas S. Katz, MD, Mineola, NY (*Moderator*) Nothing to Disclose

Sub-Events

SSJ10-01 Genitourinary Keynote Speaker: MRI of Ovarian Lesions: 2018 Update

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S404CD

Participants
Elizabeth A. Sadowski, MD, Madison, WI (*Presenter*) Nothing to Disclose

SSJ10-02 Comparison of Routine Pelvic US and MR Imaging in Patients with Pathologically Confirmed Endometriosis

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S404CD

Participants
David J. Bartlett, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Shannon P. Sheedy, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Tatnai Burnett, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Brian J. Burkett, MD , Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Joel G. Fletcher, MD, Rochester, MN (*Abstract Co-Author*) Grant, Siemens AG; Consultant, Medtronic plc; ;
Wendaline M. VanBuren, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To estimate the benefit of pelvic MR imaging after a negative routine pelvic ultrasound (US) in patients with pathologically or surgically proven endometriosis.

METHOD AND MATERIALS

In this retrospective observational study, patients with surgically or pathologically proven endometriosis had routine pelvic US followed by pelvic MR imaging within six months. Patients were excluded if they had a previous history of confirmed endometriosis, were pregnant, > 18 years of age, or surgery > 1 year after MR. Clinical pelvic US and MR reports were independently reviewed to assess the ability of each modality to detect endometriosis, and to compare the detection rate based on disease location and sequela using the surgical and pathology reports as a reference standard. Examinations were considered negative if findings were normal or if a detected lesion was reported indeterminate or nonspecific.

RESULTS

83 female patients (ages 25-53) with pathologically proven endometriosis were included. The mean duration between the pelvic US and MR was 33 ± 43 days, with 64 ± 69 days between MR examination and surgery. Suspicion of endometriosis occurred in 18/83 (22%) of patients for pelvic US and 51/83 (59%) for MR examinations ($p<0.0001$). Of 65 patients with a negative pelvic US exam, 33/65 (51%) had a positive MR. Of 18 patients with a positive US exam, MR identified additional sites or sequela in the majority (14/18; 78%). Additional information on the MR examinations included extraovarian locations [e.g., fallopian tubes 7/18 (39%), uterus 7/18 (39%), uterosacral ligaments 3/18 (17%), other uterine ligaments 6/18 (33%), posterior cul de sac 5/18 (28%), pelvic side walls 5/18 (28%), abdominal wall 1/18 (6%)] and sequela [tethering of the ovaries 5/18 (28%), 6/18 bowel adhesive disease (33%), obliteration of the posterior cul de sac 2/18 (11%), hydrosalpinx 2/18 (11%), and hydronephrosis 1/18 (6%)].

CONCLUSION

Pelvic MR imaging had a higher detection rate of endometriosis and provides more information about disease location and sequela compared to routine pelvic US. In patients with suspected endometriosis, pelvic MR or endometriosis protocol US is required to identify important sequela identified at surgery.

CLINICAL RELEVANCE/APPLICATION

A substantial proportion of patients undergoing evaluation for endometriosis with a negative routine pelvic ultrasound will benefit from pelvic MR imaging.

SSJ10-04 Efficacy of MRgFUS in Treating Focal Uterine Adenomyosis After 24 Months of Follow-Up

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S404CD

Participants
Sonia Iafrate, LAquila, Italy (*Presenter*) Nothing to Disclose
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Federica de Matteis, LAquila, Italy (*Abstract Co-Author*) Nothing to Disclose
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Giulio Mascaretti, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo Masciocchi, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the treatment of focal uterine adenomyosis by using MRgFUS as a mini-invasive therapy after 24 months of follow-up

METHOD AND MATERIALS

From June 2014 to June 2016, 17 patients affected by focal uterine adenomyosis (focal form), diagnosed by MRI, were subjected to a single treatment using MRgFUS. The therapeutic plan consisted of a high-energy-grid sonication. MRI was performed without and after administration of contrast medium before treatment and at 3,6,12 and 24 months from the procedure to evaluate the focal thickness of the junctional area, the uterine wall morphology and the possibility of recurrence of this pathology. Clinical symptom outcome was assessed with a symptom severity score questionnaire (UFS-QOL) obtained at baseline and after 24 months from the procedure.

RESULTS

After MRgFUS, 10/17 patients with focal adenomyosis did not show disease recurrence showing a focal thickness of the junctional area of less than 12-13 mm and a good uterine wall morphology. Furthermore, in 7/17 treated-women, we found a disease recovery with focal thickness of the junctional area greater than 12 mm. In all patients, a reduction of about 75% of the symptomatology, assessed by UFS-QOL, was observed after 24 months from MRgFUS.

CONCLUSION

MRgFUS is an important mini-invasive treatment to treat focal adenomyosis allowing to maintain the integrity of the uterus wall in a pathology with limited therapeutic possibility.

CLINICAL RELEVANCE/APPLICATION

Adenomyosis is a gynecologic medical condition characterized by the abnormal presence of endometrial tissue within the myometrium In contrast, when endometrial tissue is present entirely outside the uterus, it represents a similar but distinct medical condition called endometriosis.MRgFUS is an important mini-invasive treatment to treat focal adenomyosis.

SSJ10-05 Urge Urinary Incontinence: Spectrum of Abnormalities on Static and Dynamic MR Imaging

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S404CD

Participants
Rania F. el Sayed, MD,PhD, Cairo, Egypt (*Presenter*) Nothing to Disclose
Noha M. Mokble, MD,PhD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To prospectively analyze static and dynamic magnetic resonance (MR) images to determine whether urge urinary incontinence (UUI) is associated lax uterosacral ligaments (USL)

METHOD AND MATERIALS

Study included 71 women: 41 healthy continent volunteers as a control group and 30 patients with UUI. Static MRI of the 71 women was performed using PD &T2 weighted turbo spin echo sequences; MR defecography was acquired using balanced fast-field echo. A standardized grid system that allowed us to record structural observations of the USL on sequentially numbered axial MR images was used by a radiologist who then applied a 4-point grading scale to assess ligament visibility. Cumulative data from the 41 continent control subjects were compiled so that a "normal" standard appearance for the USL could be defined and then compared with that of the UUI patient. MR images were interpreted by a trained radiologist , trained urologist and revised by an expert radiologist with 20 years experience in MR imaging of the pelvic floor. The expert radiologist was not aware of the clinical data of the patients.Inter observer reliability was evaluated for the collected data by the three observers

RESULTS

In the control group the mean length of right USL= 23.88 ± 9 mms while the left USL is 21.97 ± 9 mms. In the patient group, the mean length of right USL is 35.11 ± 11 mms while the left USL is 34.03 ±11 mms. There is significant statistical difference between the lengths in both groups with longer length in the cases group ($P<0.01$).The highest inter observer agreement was on the image number on which origin could be visualized .The lowest agreement was on the site of insertion of USL in both control and patient group.

CONCLUSION

We found that the average length of both USLs in the cases group is significantly longer than that of the control group. Moreover, we found a correlation between the increased length of the USLs and UUI.

CLINICAL RELEVANCE/APPLICATION

Pharmacological treatments of UUI are disappointing, since they are only slightly more effective than placebo. Urologist reported that operative repair of the USL know as cervical-rectal-sacral fixation (CERESA) could cure patients withUUI

SSJ10-06 MR of the Female Pelvis on 1.5 Tesla Scanner: Image Quality and Acquisition Time Comparison Between Synthetic MR Imaging and Turbo Spin Eco Sequences

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S404CD

Participants
Marta Montesano, MD, Latina, Italy (*Presenter*) Nothing to Disclose
Marco Rengo, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Davide Bellini, MD, Latina, Italy (*Abstract Co-Author*) Nothing to Disclose
Simona Picchia, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Stefano Badia, Latina, Italy (*Abstract Co-Author*) Nothing to Disclose
Iacopo Carbone, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Andrea Laghi, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

to compare the image quality and acquisition time of synthetic MR imaging, based on multiple-dynamic multiple-echo (MDME) sequence, and turbo spin eco (TSE) sequences on 1.5 Tesla MR study of the female pelvis.

METHOD AND MATERIALS

Fifteen women were prospectively subjected to MRI examination of the pelvis according to the clinical indication. All exams were performed on a 1.5T MR scanner. The acquisition protocol was composed of conventional TSE T2w, TSE T1w, STIR T2w acquired on the axial plane. Then, a multiple-dynamic multiple-echo (MDME) sequence was performed for synthetic reconstruction of T2w, T1w and STIR T2w images on the axial plane. Two radiologists separately evaluated image quality by using Likert scale with 5 values. A quantitative evaluation was performed by measuring the signal intensity (SI) by placing a circular ROI of 5 mm in diameter in endometrium, junctional zone and myometrium. Signal to noise ratio (SNR) for the three layers were estimated. Image acquisition time of synthetic and conventional sequences was recorded. Results of conventional and synthetic imaging were compared using noninferiority statistics.

RESULTS

Overall qualitative and quantitative scores of synthetic MR images were non inferior to conventional imaging ($p>0,05$). The cumulative scan time of conventional sequences was significantly longer than synthetic sequences($p<0,05$).

CONCLUSION

Overall imaging quality and SNR obtained with synthetic imaging were similar to those obtained with conventional sequences. Thanks to the single acquisition, this could lead to a considerable time-saving for the hospital and the patient.

CLINICAL RELEVANCE/APPLICATION

Thanks to a single acquisition there is a great time savings for the patient in terms of comfort and for department in terms of productivity

SSJ11

Genitourinary (Scrotum and Bladder)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S403A

BQ GU MR OI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Raghunandan Vikram, MBBS, FRCR, Bellaire, TX (*Moderator*) Nothing to Disclose
Geoffrey E. Wile, MD, Nashville, TN (*Moderator*) Nothing to Disclose

Sub-Events

SSJ11-01 Usefulness of Testicular Volume, Apparent Diffusion Coefficient, and Normalized Apparent Diffusion Coefficient in the Magnetic Resonance Imaging in Evaluation of Infertile Men with Azoospermia

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S403A

Participants
Sung Bin Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Byoung Hee Han, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess retrospectively the usefulness of testicular volume, apparent diffusion coefficient (ADC), and normalized ADC (nADC) as measured using MRI in predicting the histopathological grade of azoospermia and in differentiating obstructive from non-obstructive azoospermia.

METHOD AND MATERIALS

A computerized search generated a list of 30 infertile men with azoospermia who had undergone both scrotal MRI and testis biopsy. MRI-determined testicular volumes, ADCs and nADCs were compared between infertile men with obstructive and those with non-obstructive azoospermia. The nADC was calculated as ADC (testis)/ADC (bladder lumen).

RESULTS

16 were obstructive azoospermia and 14 were non-obstructive azoospermia. The testicular volume in obstructive azoospermia (8.7-27.6 mL) was significantly greater than that in non-obstructive azoospermia (1.8-15.4 mL; $p < 0.001$). The area under the ROC curve for distinguishing non-obstructive from obstructive azoospermia using testicular volume was 0.92 (<= 13.06 mL, sensitivity of 85.71% and specificity of 87.5%). Testicular ADC and nADC in obstructive azoospermia (0.329×10-3 to 1.578×10-3 mm2/s for ADC, 0.113-0.449 for nADC) were significantly lower than in non-obstructive azoospermia (0.801×10-3 to 2.211×10-3 mm2/s; $p = 0.0094$ for ADC, 0.235-0.61; $p = 0.0001$ for nADC). The area under the ROC curves for distinguishing non-obstructive from obstructive azoospermia using testicular ADC and nADC were 0.741 (> 1.031×10-3 mm2/s, sensitivity of 92.86% and specificity of 56.25%) and 0.875 (> 0.425, sensitivity of 78.57% and a specificity of 93.75%).

CONCLUSION

Testicular volume, ADC, and nADC, as measured using MRI, are useful in predicting the histopathological grade of azoospermia and in differentiating obstructive from non-obstructive azoospermia.

CLINICAL RELEVANCE/APPLICATION

MRI can evaluate azoospermia with good performance, the testicular volume, ADC and normalized ADC values measured on MRI are useful in predicting the histopathologic grading of azoospermia and differentiating obstructive from non-obstructive azoospermia. Therefore, DWI seems to be a promising imaging method with great potential for the differential diagnosis of azoospermia.

SSJ11-02 Validation of Vesical Imaging Reporting and Data System (VI-RADS) in Untreated Patients with Bladder Cancer at a Single Reference Center

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S403A

Participants
Stefano Cipollari, Rome, Italy (*Presenter*) Nothing to Disclose
Isabella Ceravolo, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Giovanni Barchetti, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To date, several studies have evaluated the ability of Multiparametric MRI of the bladder (mpMRI) to detect and stage bladder cancer (BCa). Nevertheless, there is still no standardized reporting system. Our aim was to validate the recently developed Vesical Imaging Reporting and Data System (VI-RADS) for BCa.

METHOD AND MATERIALS

This is a retrospective study of 54 consecutive patients who underwent 3T MRI with a body-array coil for diagnostic confirmation and local staging of BCa between September 2017 and April 2018. The mpMRI protocol included T2-Weighted sequences, Diffusion-weighted images with Apparent Diffusion Coefficient Maps reconstruction and Dynamic Contrast-enhancement Imaging. The goal of the mpMRI was to exclude the presence of muscle invasive BCa (MIBCa). MpMRI exams were interpreted by two readers, blinded to cystoscopy and/or other imaging exams. Sensitivity, specificity, and agreement were calculated based on a criterion of VI-RADS score = 4. Inter-examiner agreement was determined by the weighted kappa statistic.

RESULTS

Patients' median age was 67 years. There were 42 males and 12 females. Histological findings were positive for MIBCa in 15 patients. The remaining 39 had superficial BCa. Considering a VI-RADS score of 4 as positive for MIBCa, the accuracy of each reader was 92% and 89%, respectively, and interobserver agreement was excellent (weighted κ = 0.81; 95% confidence interval: 0.73-0.88; P?=?0.023). Considering PI-RADS 2 as absence of MIBCa, the accuracy of each reader was 95% and 92%, respectively, with excellent agreement (weighted κ = 0.85; 95% confidence interval: 0.71-0.92; P?=?0.031). Sensitivity and Specificity were 91% and 94% respectively. Positive Predictive Value and Negative Predictive Value were 92% and 95% respectively.

CONCLUSION

The recently developed VI-RADS score at 3T has a high accuracy for exclusion of MIBCa, with excellent inter-reader agreement. These results are promising for improving the management of patients with BCa.

CLINICAL RELEVANCE/APPLICATION

The introduction of a standardized reporting system for multiparametric MRI of the bladder could greatly simplify its introducion in clinical practice.

SSJ11-03 Testicular Microlithiasis and Extragonadal Germ Cell Tumors: Clinical-Radiologic-Pathologic Correlation in 22 Patients

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S403A

Awards
Student Travel Stipend Award

Participants
Marianne de la Mora Malvaez, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose
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PURPOSE

The majority of germ cell tumors have testicular origin, while only 2-5% of those tumors have extragonadal location. It has been said before that the presence of testicular microlithiasis has a very strong association with extra gonadal germ cell tumors.Our purpose is to demonstrate the correlation between these two in a series of 22 cases.

METHOD AND MATERIALS

This is a retrospective observational study of prospectively collected data of 22 consecutive patients with extra gonadal germ cell tumors from a tertiary care center between 2008 and 2017. Baseline characteristics (the presence of comorbidities, hypogonadism, primary tumor site, tumor histology, and clinical stage) and testicular ultrasonographic characteristics (testicular volume and the presence of microlithiasis) were recorded for every patient. Imaging characteristics were analyzed between groups according to primary tumor site and tumor histology.

RESULTS

The median age at diagnosis was 24.6 6.5 years and 9.5 % of the patients had a history of cryptorchidia. The most common extragonadal location was mediastinum (63.6%), followed by supraselar region (18.2%) and retroperitoneum (13.6%). Non-seminomatous tumors were more frequent (75%) than seminomas. Sixteen patients had testicular ultrasound and bilateral TML was observed in 43.8% while testicular atrophy (volume <12 cc) was detected in 53.3% of the patients. Furthermore, the presence of bilateral TML was associated with testicular atrophy (85.7% v.s. 14.3%, p<0.04). On univariate logistic regression analysis, testicular microlithiasis was associated with testicular atrophy (OR 18, CI 1.3-255.7, p <0.03).

CONCLUSION

The most common primary site for EGCT was the mediastinum and the most frequent histologic type were non-semminomatous tumors. The prevalence of TML in patients with EGCT is far more common than the one reported in healthy individuals. Bilateral TML was observed in 43.8% of the patients and it was associated with testicular atrophy.

CLINICAL RELEVANCE/APPLICATION

Testicular microlithiasis has been associated with intratubular germ cell neoplasia in patients with testicular cancer. The clinical relevance of this finding in patients with EGCT remains unknown. To our knowledge, this is the largest case series in literature.

SSJ11-04 Improving Treatment Response Assessment of Bladder Cancer by Integrating Deep Learning, Radiomics and Clinical Information

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S403A

Participants
Lubomir M. Hadjiiski, PhD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
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Heang-Ping Chan, PhD, Ann Arbor, MI (*Abstract Co-Author*) Institutional research collaboration, General Electric Company
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PURPOSE

To evaluate the accuracy of treatment response assessment of bladder cancer using deep learning, automatically extracted radiomic features from CT scans, and clinically estimated feature.

METHOD AND MATERIALS

A deep-learning neural network (DL) was trained to recognize the patterns of bladder lesions indicative of treatment response. 47 radiomic features (RF) including pre- and post- treatment change in volume, 5 gray level and 9 shape descriptors and 32 texture features were also extracted from automatically segmented lesions. A clinically estimated feature, the bimanual exam under anesthesia (EUA), was also collected from the clinical reports. Linear discriminant analysis and max function were used to generate combined response indices (CRIs): RFs alone (CRI-RF), RFs and DL (CRI-RF-DL), RFs, DL and EUA (CRI-RF-DL-EUA). Pre- and post-chemotherapy CT scans of 98 patients with bladder cancers were collected with IRB approval. For all cases, cystectomy was performed after treatment and the disease outcome was available as reference standard of treatment response. 25% of patients had pT0 disease (complete response) at cystectomy. A radiologist marked 122 temporal pairs of primary site cancers. Stepwise feature selection and leave-one-case-out cross-validation were performed. The area under the test ROC curve (AUC) was calculated to estimate the accuracy for predicting pT0 stage (complete response) at cystectomy by the methods. Two radiologists also estimated the likelihood of pT0 stage of the tumor by reading the pre- and post-treatment paired CT scans.

RESULTS

For the 122 cancers, the AUC for DL in predicting pT0 disease at cystectomy was 0.69±0.05. The AUC for CRI-RF based on 2 Contrast and 2 RLS features was 0.75±0.05, which increased to 0.79±0.04 by adding DL (CRI-RF-DL), and further increased to 0.80±0.04 with EUA (CRI-RF-DL-EUA). The two radiologists' AUCs in predicting pT0 disease were 0.77±0.05 and 0.75±0.05. The differences in any pairs of AUCs did not reach significance ($p>0.05$).

CONCLUSION

CRI-RF, CRI-RF-DL and CRI-RF-DL-EUA performed similarly to the radiologists for estimation of treatment response. The addition of DL and EUA improved the accuracy of treatment response assessment.

CLINICAL RELEVANCE/APPLICATION

The combined response index using deep learning knowledge, the radiomic features and clinically estimated EUA has the potential to provide accurate treatment response assessment.

SSJ11-05 Evaluation of Quantitative T2-Weighted and Apparent Diffusion Coefficient Textural MRI Features to Predict Muscle Invasive Bladder Cancer (Stage >=T2) and Extravesical Extension (Stage >=T3) Prior to Surgery

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S403A

Participants
Christopher Lim, MD, Boston, MA (*Presenter*) Nothing to Disclose
Sreeharsha Tirumani, MBBS, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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Atul B. Shinagare, MD, Boston, MA (*Abstract Co-Author*) Advisory Board, Arog Pharmaceuticals, Inc; Research Grant, GTx, Inc

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PURPOSE

To evaluate quantitative MRI textural features associated with muscle invasive bladder cancer (MIBC) (stage >=T2) and extravesical extension (stage >=T3) on T2-weighted (T2W) and apparent diffusion coefficient (ADC) images in patients post transurethral resection of bladder tumor (TURBT).

METHOD AND MATERIALS

This IRB-approved, HIPAA-compliant retrospective study identified 36 patients (27 men, 9 women; mean age 70.8, SD 11.1) with bladder cancer diagnosed by TURBT who subsequently underwent mp-MRI, followed by cystectomy, and without intervening treatment, between 08/2011-08/2016. A radiologist blinded to T stage manually contoured the primary bladder cancer (BC), and extravesicular fat (EF) immediately adjacent to the tumor on T2W and ADC images using a commercially available texture analysis software (TexRAD Ltd, Cambridge, UK). Six textural features (mean, sd, entropy, mpp, skewness and kurtosis) derived from the contoured BC and AF were compared between stage T1 versus >=T2 and between stage =T3 tumors using independent sample Kruskal-Wallis or Mann-Whitney U test and multivariate logistic regression analysis (p-value <0.05).

RESULTS

Total of 72.2% (26/36) bladder cancers were stage >=T2 stage and 52.8% (19/36) were stage >=T3. BC entropy on T2W, and EF entropy on both T2W and ADC, were significantly increased in stage >=T3, compared to stage =T2, compared to stage T1, tumors on T2W and ADC (p<0.05) with univariate analysis; however, the difference did not persist on multivariate analysis.

CONCLUSION

Higher entropy of BC and EF may help identify >=T3 tumor on T2W and ADC. Entropy may also be different between T1 and >=T2 tumors but that difference was not significant on multivariate analysis in this pilot study.

CLINICAL RELEVANCE/APPLICATION

Staging bladder cancer with TURBT alone can be inaccurate. Entropy, a quantitative textural feature, of the bladder cancer and extravesicular fat immediately adjacent to the tumor may be predictive of higher stage cancers on multiparametric MRI, allowing for more informed management decisions.

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/ Sreeharsha Tirumani, MBBS, MD - 2016 Honored EducatorAtul B. Shinagare, MD - 2017 Honored Educator

SSJ12

Health Service, Policy and Research (Economics and Cost-Effectiveness)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S403B

HP

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Hanna M. Zafar, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose
Christoph I. Lee, MD, Mercer Island, WA (*Moderator*) Research Grant, General Electric Company; Investigator, General Electric Company

Sub-Events

SSJ12-01 Can a Pseudo-Reader Study Design Estimate Observer Results Obtained Using Fully-Crossed, Multi-Reader, Multi-Case Studies?

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S403B

Participants
Rickey E. Carter, PhD, Jacksonville, FL (*Presenter*) Nothing to Disclose
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Tammy A. Drees, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To examine the ability of a pseudo-reader study design to estimate the observer performance obtained using a traditional prospective, fully-crossed, multi-reader, multi-case (MRMC) study.

METHOD AND MATERIALS

The pseudo-reader study design assumes readers in an MRMC study are exchangeable (same confidence scale usage and detection ability), but uses only a fraction of the total possible reading impressions by randomly allocating what normally would be one reader's reading list to multiple readers (Fig A). To better understand the operating characteristics of the design, we compared results using a pseudo-reader study design with ten radiology trainees and four CT noise reduction methods (NRMs) (2 projection space, 2 image space) to interpretations by 10 different radiology trainees in a traditional MRMC study. Following reader training, JAFROC Figures of Merit (FOM) were calculated for each NRM and reader, and differences of FOMs were estimated using the Hillis improvement to the Dorfman, Berbaum and Metz (DBM) method under the modeling assumption of random readers - random cases using the RJafroc (v1.0.1) and mrmctools (v1.0.2) packages on R version 3.4.2.

RESULTS

The best performing NRM by the pseudo-reader approach retained the first place ranking in this traditional MRMC validation study with the highest FOM (0.71; 95% CI: 0.60 to 0.81), providing qualitative validation to the pseudo-reader approach; however, all FOMs in this traditional MRMC validation study overlapped widely with the pseudo-reader estimate but were numerically lower than that observed using the pseudo-reader with decreases ranging from 2% to 10%. Reading times in the fully crossed study dropped from 3.1 minutes to 1.9 minutes ($p<0.001$). The agreement of the readers' confidence scores, measured by the intraclass correlation, ranged from 0.60 to 0.66 across the NRM, representing moderate agreement.

CONCLUSION

The results of our fully-crossed MRMC validation study design provided qualitative agreement with the pseudo-reader estimate; however, agreement of confidence scores and changes in reading times may suggest that the operating characteristics of the pseudo-reader and fully-crossed MRMC study designs may not be the same.

CLINICAL RELEVANCE/APPLICATION

Multireader multicase studies are needed to determine observer performance; shortening trial design using a pseudoreader may be one optiojn, but requires careful attention to reader training and study design.

SSJ12-02 Which Patients with Small Renal Tumors Would Benefit Most from Preference Elicitation to Guide Management Decisions? A Quality of Life Analysis

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S403B

Participants
Rahul D. Mali, MBBS,MPH, New York, NY (*Presenter*) Nothing to Disclose
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PURPOSE

To identify patient subgroups for whom the most effective treatment for small renal masses depends upon preferences for watchful waiting, by comparing quality-adjusted life expectancy (QALE) across various treatment strategies.

METHOD AND MATERIALS

We used a state transition microsimulation model to estimate QALE for patients with mild chronic kidney disease (CKD) and small renal masses. The model compared 5 strategies: partial nephrectomy, ablation, biopsy based treatment, watchful waiting using CT, and MRI selection for watchful waiting. We incorporated renal function loss according to treatment and tumor anatomy, CKD and other comorbidities, and oncologic risk. Nephrometry Score (NS), a system for quantifying tumor anatomic complexity, was used to correlate with renal function loss after partial nephrectomy using published regression formulas. Utilities specific to health state were used to weight the quality of life. The utility for watchful waiting can vary widely due to anxiety and preferences for intervention, and we assessed the impact of varying this utility on the optimal treatment. We used sensitivity analysis to test effects of varying parameters on model results.

RESULTS

In 65-year-old men and women with anatomically simple small renal masses (NS 4-6), partial nephrectomy yielded far greater QALE (up to +3.4 months) compared with watchful waiting. For moderate anatomic complexity (NS 7-8), watchful waiting using CT surveillance yielded the highest QALE compared with the next highest QALE from biopsy based management (+1.1 months for NS of 7). In this group, the optimal treatment was dependent upon the utility related to watchful waiting. Specifically, watchful waiting using CT was the preferred treatment for patients with a utility for watchful waiting above 0.88. For high anatomic complexity (NS 9-10), watchful waiting offered greatest benefit compared with all other treatments (+1.2 months vs. ablation); ablation became favored when the utility of watchful waiting was under 0.59.

CONCLUSION

To optimize quality of life in treatment selection for patients with mild CKD, anatomically complex renal tumors warrant formal preference elicitation for watchful waiting vs. other treatment options.

CLINICAL RELEVANCE/APPLICATION

In decision making for small renal tumors, preference elicitation for watchful waiting vs. intervention likely improves longterm quality of life for patients at risk for worsening CKD after surgery.

SSJ12-03 Preference and Cost-Comparison for Iodinated and Barium-Based Oral Contrast Media: Prospective Clinical Trial in Cancer Patients with Multiple Prior CT Exams

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S403B

Participants
Anushri Parakh, MBBS, MD, Boston, MA (*Presenter*) Nothing to Disclose
Manuel Patino, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Travis L. Redel, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Fredrick McNulty, Boston, MA (*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

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PURPOSE

Oncological patients undergo multiple abdominopelvic CT with positive oral contrast media (CM). Aim of this study was to evaluate patient preference and cost-comparison for iodine- and barium-based CM used in abdominopelvic CT studies.

METHOD AND MATERIALS

In this prospective clinical trial, 157adults (74M, 83F; 63±12 yrs) with prior 120kVp abdominopelvic CT performed using barium-based CM (bCM; Readi-cat 2% w/v, Bracco) were enrolled. Subjects were randomly assigned to receive iodinated CM (iCM; Omnipaque 300mgI/ml, GE Healthcare) in standard concentration (iCMs 7.7mgI/ml) or 25%-reduced concentration (iCMr 5.8mgI/ml). iCM was diluted in water to obtain 900ml solution. Subjects were instructed to consume iCM in a similar protocol to bCM (900ml over 45 minutes). CT scans were performed with 100kVp single-energy-CT or dual-energy CT. A paper survey about patient's experience was conducted to rate and describe the taste of iCM on a 5-point Likert scale (1 dislike very much to 5 like very much), report adverse effects and indicate CM preference for future scans. Cost comparison of the two CM was also performed.

RESULTS

79/157 patients received iCMs and 78/157 received iCMr which was consumed over 37±10 min). Mean volume of iCM consumed was 877ml(450-900ml) and bCM was 870ml(400-900ml). 3 patients found it difficult to consume 900ml of bCM but were able to consume 900ml of iCM. Mean taste score for iCM was 3.7±1, with no significant difference between iCMs and iCMr ($p>0.05$). 77% (121/157) patients preferred iCM over bCM. Nine patients had no preference. Immediately after iCM consumption, 92% (145/157) had no adverse effects with iCM, whereas 5% (n=8/157) complained of minor gastrointestinal symptoms not requiring management (nausea-6, mild abdominal discomfort-2). Within 24 hours of iCM, 2% (4/157) patients developed diarrhea. 12 patients complained of diarrhea with bCM but not with iCM. The cost per patient for bCM was $6.86 compared with $5.30 to $6.6 for iCM, depending on the amount consumed.

CONCLUSION

Cancer patients who undergo multiple CTs as part of standard of care demonstrate a stronger preference for iCM due to its neutral taste and decreased viscosity.

CLINICAL RELEVANCE/APPLICATION

Palatable CM solutions are likely to improve patient acceptance and experience. With increased use of low kVp/keV imaging, iCM has the potential for being used as an oral CM with the advantage of being customizable and as a cost-saving alternate

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

SSJ12-04 Diagnostic Imaging in the Management of Patients with Possible Cerebral Venous Thrombosis: A Cost-Effectiveness Analysis

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S403B

Participants
Wolfgang G. Kunz, MD, Munich, Germany (*Abstract Co-Author*) Grant, Medtronic plc
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Jose M. Ferro, MD, Lisbon, Portugal (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the cost-effectiveness of different noninvasive imaging strategies in patients with possible cerebral venous thrombosis (CVT).

METHOD AND MATERIALS

A decision model based on Markov simulations estimated lifetime costs and quality-adjusted life years (QALY) associated with the imaging strategies non-contrast CT (NCCT), CT venography (CTV), routine MRI without vascular imaging, and MR venography (MRV, Figure 1). The analysis was performed from a United States healthcare perspective. Model input parameters were based on best available and most recent evidence (Table 1), including outcome data from the International Study on Cerebral Vein and Dural Sinus Thrombosis (ISCVT). Starting age was 37 years as in ISCVT. The prior probability of CVT was set low at 1.6%, the reported frequency of CVT in consecutive brain imaging exams for isolated headaches at emergency departments. ISCVT outcome data were taken from CVT patients who also presented with isolated headache to reflect this low prior probability. Probabilistic sensitivity analyses (PSA) were performed using 10,000 Monte Carlo simulations to estimate model uncertainty. The percentage of cost-effective iterations was determined for different willingness-to-pay (WTP) thresholds.

RESULTS

The base-case analysis showed that NCCT and CTV were dominant over routine MRI and MRV. CTV led to incremental lifetime QALYs compared to NCCT (23.385 QALYs vs. 23.374 QALYs) at slightly higher lifetime costs ($5,210 vs. $5,057). CTV was the optimal strategy in the base-case analysis. In PSA, CTV was the strategy with the highest percentage of cost-effective iterations if the WTP threshold was set higher than $10,000/QALY (Figure 2). Complying with contemporary WTP thresholds and adjusting for model uncertainty, CTV was thus identified as the most cost-effective strategy. When the prior probability for CVT was set to 50%, diagnostic imaging with CTV was also preferred over MRV, routine MRI, or NCCT.

CONCLUSION

In patients at the peak age of CVT incidence yet low clinical pre-test probability of CVT, diagnostic imaging with contrast-enhanced venous CT angiography is the most cost-effective strategy.

CLINICAL RELEVANCE/APPLICATION

CTV should be the preferred imaging strategy, not only in patients with high prior probability, but also in patients with lower clinical suspicion of CVT.

SSJ12-05 Cost-Effectiveness of Thrombectomy for Ischemic Stroke in Extended Time Windows

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S403B

Awards
Trainee Research Prize - Resident

Participants
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PURPOSE

Two endovascular thrombectomy (EVT) trials have recently shown significant benefits over standard care (SC) medical management in large vessel occlusion stroke beyond 6 hours of symptom onset or last known to be well (i.e. for the first time also including the patient population with wake-up stroke). We aimed to determine the cost-effectiveness of EVT in this context.

METHOD AND MATERIALS

A decision model based on Markov simulations estimated lifetime costs and quality-adjusted life years (QALY) associated with EVT or SC (Figure 1). The analysis was performed in a United States setting from a societal perspective. Input parameters for the model were based on most recent and best available evidence (Table 1), including two recent late time window randomized clinical trials (DAWN, DEFUSE 3, Figure 2). Probabilistic sensitivity analyses (PSA) were performed using 10,000 Monte Carlo simulations to estimate overall uncertainty of the results. Incremental costs (IC), incremental effectiveness (IE), and incremental cost-effectiveness ratios (ICER) were derived. The willingness-to-pay (WTP) thresholds were set to $50,000, $100,000, or $150,000 per QALY respectively.

RESULTS

The base-case analysis identified EVT as the optimal strategy based on outcome data from DAWN (IC: -$51,561; IE: +1.90 QALYs; ICER: EVT dominant) or DEFUSE 3 (IC: -$6,905; IE: +1.63 QALYs; ICER: EVT dominant). Adjusting for all input parameter uncertainty in PSA, EVT was the preferred strategy with acceptability rates of 100% at WTP thresholds of $50,000, $100,000, and $150,000 per QALY based on DAWN or DEFUSE 3 data (Figure 3). DAWN-based simulations led to 99.9% dominant/cost-saving iterations, DEFUSE 3-based simulations to 66.1% dominant/cost-saving iterations (Figure 4).

CONCLUSION

EVT is not only a cost-effective but also long-term cost-saving therapy of large vessel occlusion stroke in patients presenting beyond 6 hours of symptom onset or last known to be well.

CLINICAL RELEVANCE/APPLICATION

Proven EVT effectiveness in late time windows will markedly increase the need for EVT procedures. Based on its cost-effectiveness, investments are justified to cover this increasing demand.

SSJ12-06 Changing Utilization of Imaging in Multiple Sclerosis Patients during Emergency Department Visits

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S403B

Participants
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Valeria Makeeva, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

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PURPOSE

To study the changing nature of imaging utilization in multiple sclerosis patients in US emergency departments (EDs).

METHOD AND MATERIALS

Using 2006-2014 data from the Healthcare Cost and Utilization Project (HCUP) Nationwide Emergency Department Sample (NEDS), the largest all-payer ED database in the US, we identified multiple sclerosis (MS) patients vising EDs, and studied their utilization and independent predictors of imaging tests using logistic regression.

RESULTS

Overall, an estimated total of 275,808 weighted cohort patients with a primary diagnosis of MS visited a US ED between 2006 and 2014 (mean age 44±13; 74% female), increasing from 25,815 in 2006 to 35,680 in 2014. Only 8.8% of patients underwent any imaging tests during their ED visits, and these were most commonly of the brain: CT (3.8%) and brain MRI (1.8%). ED imaging counts in MS patients increased from 1,422 in 2006 to 4,236 in 2014. Patients' primary insurance was Medicare in 34%, Medicaid in 21%, private insurance in 34%, other types in 4% and self-pay in 7%. Independent factors associated with higher utilization of ED imaging tests were age older than 45 year (OR 1.2), an ED visit year after 2009 (OR, 1.3), a primary payer other than Medicare/Medicaid (OR, 1.2), and an ED visit location in Northeast or South (OR 2.3) (All p values < 0.05).

CONCLUSION

Although uncommon overall, the use of imaging tests during ED visits for MS patients has increased over time, and most of these involve brain imaging. A variety of sociodemographic characteristics are associated with a higher likelihood of imaging utilization.

CLINICAL RELEVANCE/APPLICATION

Primary payer, location of ED and patient age are independent factors impacting increased use of imaging tests in MS patients during ED encounters.

SSJ13

Informatics (Patient Safety, Data Sharing and Security)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: N230B

IN SQ

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Nabile M. Safdar, MD, Milton, GA (*Moderator*) Nothing to Disclose
Srini Tridandapani, MD,PhD, Decatur, GA (*Moderator*) Co-founder, CameRad Technologies, LLC; Spouse, Co-founder, CameRad Technologies, LLC;
Tejas S. Mehta, MD, MPH, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ13-01 Visible Light Imaging: Adding Patient Point-of-Care Photography to Portable Radiolography-A First Clinical Implementation Experience

Tuesday, Nov. 27 3:00PM - 3:10PM Room: N230B

Participants
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CONCLUSION

Point-of-care photographs obtained simultaneously with portable radiographs can reduce wrong-patient errors. In addition, they provide clinical context improving confidence in radiograph interpretation.

Background

Wrong-patient errors in Radiology, where one patient's medical images are placed in another patient's Picture Archiving and Communications Systems folder, can cause serious problems for both patients. For example, in the State of Pennsylvania alone, 196 serious adverse events were attributed to wrong-patient errors in Radiology in 2009. To increase the detection rate of wrong-patient errors, we developed an automated system to obtain point-of-care photographs along with portable radiographs. The system is fully automated and does not require any technologist intervention.

Evaluation

Within the first 400 images that were obtained with our automated photography system, we found one potential instance of a wrong-patient error, which the photos helped to identify. The photos also helped in providing clinical context for several abdominal radiographs obtained for evaluation of feeding tube placement. In some instances, no feeding tube was seen in the radiograph, which prompted the radiologist to look at the photo: if, on the photo, no tube was seen in the nose or mouth it provided confidence that no call to the referring service needed to be made. If no feeding tube was seen in the abdomen but was was seen in the nose or mouth on the photo, this would prompt a confident call to the patient's nurse. Soft tissue injuries were also better evaluated by radiography when the concurrently obtained photos were available. The patient's face was captured in the photo along with more than 98% of chest and abdominal radiographs.

Discussion

The addition of point-of-care photographs provides an intrinsic, externally-obtained biometric identifier that can increase the detection of wrong-patient errors. This identifier is superior to identifiers such as arm-bands with bar-codes since the latter is an extrinsic identifier. In addition to providing positive patient identification, the photographs have provided clinical context and have been useful in adding confidence to the diagnosis.

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/ Elizabeth A. Krupinski, PhD - 2017 Honored Educator

SSJ13-02 Sharing De-Identified Medical Images Electronically for Research: Patients Have a Say

Tuesday, Nov. 27 3:10PM - 3:20PM Room: N230B

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PURPOSE

As part of the Medical imaging network enterprise (MiNE) initiative, an electronic repository of medical imaging data and metadata, we have examined health care consumers' opinions regarding sharing their de-identified medical images and related medical information for research purposes. We have considered the criteria that could influence patients' decision, whether or not to share their medical information, like data storage/access, and safeguards to maintain privacy and security.

METHOD AND MATERIALS

Patients from the Greater Toronto Area (GTA) attending Sunnybrook Health Sciences Centre for imaging in MRI, CT or US examination areas were invited to undertake a cross-sectional electronic survey. Patients were recruited while waiting for their examination. The survey was in an electronic format using tablet computers on site. Descriptive and parametric statistical analyses were performed.

RESULTS

Imaging clerks approached 1083 patients within the imaging areas (CT 609, US 314 & MRI 160) during patient check-in, 798 (74%) agreed to undertake the survey. Overall median age was 60 (IQR=18,Q1=52,Q3=70), 52% were females. Participants' level of education was: university degree (42%) and diplomas/certificates (34%), while 7% did not have any high school diploma. When assessing willingness to share their de-identified medical images for research, 453 (76%) were willing (agreed & strongly agreed), while 7% refused. Most patients (85%) felt comfortable with automatic storage of their images and gave unconditional data access to their family physicians (73%) and other physicians (57%). Also, 70% chose hospitals/research institutions to regulate electronic images databases. 89% of the respondents wanted safeguards against unauthorized access to their data and over 70% wanted full control over access.

CONCLUSION

Our study found that people are willing to share their clinically acquired medical images for research after full consent that clearly outlines privacy, confidentiality, security and control over permissions and duration of access. Respondents are more comfortable when medical image data warehouses/repositories are affiliated with universities/research institutions.

CLINICAL RELEVANCE/APPLICATION

Participants support sharing clinically acquired medical imaging data for research. These images could provide a great source of information when shared securely and confidentially among researchers with associated robust policies.

SSJ13-03 Using TLS (Transport Layer Security) and the ACME Protocol (Automatic Certificate Management Environment) for Securing DICOM Communications

Tuesday, Nov. 27 3:20PM - 3:30PM Room: N230B

Participants
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CONCLUSION

We wish to encourage sites to use the DICOM Secure Transport Connection Profiles, vendors to include the DICOM Secure Transport Connection Profiles in their product offerings, and both sites and vendors to support the ACME protocol to reduce the burden of managing and distributing security certificates.

Background

The Basic TLS (Transport Layer Security) Secure Transport Connection Profile has been part of the DICOM Standard since 1999, and has been updated over the years as technology improves. The lastest enhancements were approved this year. The Profile has also been incorporated into the IHE ATNA (Audit Trail Node Authentication) profile, and has been tested by multiple vendors at multiple IHE Connectathons. One of the barriers to deploying the Basic TLS Secure Transport Connection Profile at institutions is the need to manage security certificates. The ACME protocol (Automatic Certificate Management Environment) has the promise of simplifying the certificate management and distribution needed to properly deploy TLS-secured communications.

Evaluation

To demonstrate how to secure DICOM communications using automated certficate management, we set up an open source DICOM archive, an ACME server for managing certificates, simulated modalities, and viewing stations. Using wire snooping software, we show how information is clearly visible on the network without encryption, and is hidden when encryption is enabled. We compare the performance of common DICOM operations both with encryption turned on and turned off. Both DIMSE based operations (DICOM binary protocol) and the new DICOM web-based, RESTful operations are demonstrated and measured.

Discussion

The use of the ACME protocol greatly simplifies the task of certificate management and distribution, which in turn makes it easier to deploy the Secure DICOM Connection Profiles. While the addition of TLS to secure DICOM communications does have a small performance hit, with modern compute speeds we feel that the additional security offered by TLS is well worth the performance hit.

SSJ13-04 The Achilles Heel of Draconian Hi-Tech Act Penalties: The Inadequacy of Current Data Encryption and Protection Technology

Tuesday, Nov. 27 3:30PM - 3:40PM Room: N230B

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PURPOSE

High-profile data breeches are now common. Penalties levied by HHS accompanying these data breeches are often in the millions of dollars. Hi-Tech Act assumes high penalties force players to use only 'breech-proof' systems and workflows. Users require workflows that are intuitive and easy to use. In data security, any skipped step may drastically increase the vulnerability of the entire system being protected. We have examined the healthcare environment to assess viability of the current technologies used in preventing data breeches.

METHOD AND MATERIALS

We examined the available data protection and encryption tools currently available to both civilian consumers and enterprises to assess the capability of storing 100% breech-proof data yet maintain high 'usability' for day-to-day use. We did not assess classified technologies not available for civilian use. We also examined some of the security workflows being enforced by large organizations to gain a realistic view of compliance versus users bypassing these protections in order to 'get their work done.' This was done by data collection of methods used by large and small healthcare organizations.

RESULTS

No single technology is yet available that allows automated, background encryption/decryption on all platforms used, Windows, MacOS, IOs and Android and include portable data transfers using USB Flash technology and other means, is yet available As organizations harden their policies and data access, both onside and remote, users become more creative and use BYOD, or even entire data sets off the enterprise or organizational servers, for access and ease of use.

CONCLUSION

Draconian Hi-Tech Act penalty assumptions appears false. Data currently cannot be 100% protected and adding stiff penalties just pushes organizations to enact harsher data access rules, forcing their own workers to bypass security systems to 'get their work done.'

CLINICAL RELEVANCE/APPLICATION

Organizational and enterprise data security today is being driven by the fear of extreme financial penalties, leading to policies and access rules that actually entice users to bypass the organizational security, weakening the overall security of the protected data.

SSJ13-05 CTrl-Alt-Radiate?

Tuesday, Nov. 27 3:40PM - 3:50PM Room: N230B

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PURPOSE

Computed Tomography (CT) is an essential and commonly used X-ray generator modality that uses ionizing X-ray radiation to produce images. The CT modality consists of an ecosystem of components, which communicate with each other within the CT's ecosystem. As technology advances, the CT's ecosystem is becoming more connected to the hospital's network and the Internet, exposing it to a variety of security vulnerabilities and threats to potential cyber-attacks. The combination of ionizing radiation, potentially harmful to patients, and security vulnerabilities to cyber-attacks results in possible dangerous scenarios that compromise patients' safety. To illustrate the importance of the topic, we demonstrate how we hacked a CT.

METHOD AND MATERIALS

We present a step-by-step implementation of how we bypass current security protection mechanisms of a CT in order to manipulate its behavior, making it potentially dangerous to patients. This attack demonstrates how additional cyber-attacks on *medical imagining devices* (MIDs) can be similarly implemented. To accurately measure the potential damage to patients' health, we use a phantom device (i.e., a CT radiation measuring device), and analyze the risks that such attack can cause. Furthermore, we demonstrate how to exploit our cyber-attack covertly, so that it is difficult to detect it using current security solutions; thus, such attack may have long-term effects on a large-scale of the population.

RESULTS

A live demonstration of how we hacked a CT device and how we manipulated its behavior to create various dangerous scenarios for patients' health. Moreover, we analyze this attack in depth, to better understand the potential impacts of such attacks.

CONCLUSION

CT and MIDs are vulnerable to cyber-attacks; we demonstrate forcefully that hacking CT and MIDs is no longer theoretical. By analyzing the potential impacts to patients, we can conclude that such impacts are critical and must be dealt with urgently.

CLINICAL RELEVANCE/APPLICATION

This calls for an immediate improvement of CTs and MIDs security and further mitigation of risks to patients.

SSJ13-06 Kaleidoscope: A Series Projection Visualization Tool for Review of DICOM Images for Protected Health Information

Tuesday, Nov. 27 3:50PM - 4:00PM Room: N230B

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PURPOSE

Collections submitted to The Cancer Imaging Archive (TCIA) can approach one-million DICOM files. It is time consuming to review each image for burned-in-PHI, pixel data that contains names, dates, or other personal identifying information. Kaleidoscope was developed to increase throughput of visual review.

METHOD AND MATERIALS

Kaleidoscope, part of the open source Posda curation suite, displays minimum, maximum, and average projection images of a series. If the geometric information is not consistent across a series (different coordinate system) the series is divided into distinct subsets called equivalency classes to minimize image artifacts. An example of this is a longitudinal scout used to show the spatial positions of axial slices. Each equivalency class is viewed as individual sets of projection images. Kaleidoscope organizes images for review by collection. Upon review, a curator labels the series, or series equivalence class, as Good (definitely no PHI), Bad (has definite PHI), or Indeterminate (curator is unsure whether the image is ok to be included in the archive or not). A curation manager reviews Bad and Indeterminate cases and determines their final acceptance or rejection. Queries may be run to get lists of series based on the label assigned during visual review. If needed, these images may be retrieved by a query and inspected with other visualization tools. Kaleidoscope currently handles modalities CT, MR, PT, and SC.

RESULTS

To review a single image takes on average 0.7 seconds per image using the National Biomedical Imaging Archive (NBIA) quality control (QC) tool where an entire equivalency class can be reviewed using Kaleidoscope in that same amount of time. There are 203,099 series 21,082,265 CT images in the NLST collection. Reviewing NLST with the NBIA QC tool estimated 4100 hours and in practice took multiple curators weeks to complete. Using Kaleidoscope would take 1 curator about 40 hours.

CONCLUSION

Kaleidoscope is two orders of magnitude faster than using the NBIA QC tool.

CLINICAL RELEVANCE/APPLICATION

Kaleidoscope allows rapid inspection of DICOM images to ensure data are free of PHI or other personal identifying information prior to public dissemination to promote Open Science.

SSJ14

Molecular Imaging (Novel Multi-Modal Applications)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S505AB

CT MR MI NM

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

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Sub-Events

SSJ14-01 Multispectral Optoacoustic Tomography of Systemic Sclerosis: A Feasibility Study Using a Hybrid Approach at the Patient's Bedside

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S505AB

Participants
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PURPOSE

Systemic sclerosis is an autoimmune disease with dysfunctional connective tissue repair inducing skin and internal organ fibrosis as well as vasculopathy, leading to serious complications such as digital ulcers. Microvascular dysfunction is a prognostic marker for morbidity and mortality in systemic sclerosis. However, due to a lack of functional tissue information using established imaging technologies, risk stratification remains challenging.We aimed to evaluate the clinical feasibility of a hybrid multispectral optoacoustic tomography (MSOT)/ultrasound (US) approach in systemic sclerosis.

METHOD AND MATERIALS

We used a combined handheld MSOT/US imaging system (iThera Medical, Munich) for imaging fingers D2 to D5 of systemic sclerosis patients (n=7, n=56 fingers) and healthy volunteers (n=8, n=64 fingers). In subcutaneous tissue, tissue levels of hemoglobin (deoxygenated (HbR), oxygenated (HbO2) and total (HbT)) were calculated after spectral unmixing. Furthermore, MSOT values were analysed to stratify patients with either progressive or stable disease activity. Statistical analysis was performed using unpaired t test.

RESULTS

In systemic sclerosis, MSOT values for HbR, HbO2 and HbT were significantly lower compared with healthy volunteers. On an individual basis, all patients had - as compared to healthy volunteers - a reduced ratio (<1.0) for HbO2 (ratio 0.53, p<0.0001) and HbT (ratio 0.49, p<0.0001). Additionally, in systemic sclerosis patients with a progressive disease significantly lower MSOT values were detected than in patients with a stable disease activity (HbR: 27.31 vs. 33.03 AU, HbO2: 23.87 vs. 29.22 AU, HbT: 51.18 vs. 62.24 AU; p<0.001).

CONCLUSION

This preliminary study demonstrates the feasibility of MSOT imaging to detect and quantify microvascular dysfunction in systemic sclerosis and to distinguish between progressive and stable disease activity. Therefore, MSOT may serve as a valuable non-invasive tool for disease stratification and therapy monitoring.

CLINICAL RELEVANCE/APPLICATION

As an easy-to-use, non-invasive and contrast-free imaging technique hybrid MSOT/US may facilitate both diagnosis and monitoring of treatment response in systemic sclerosis at the patient's bedside.

SSJ14-02 Optimization of Chest Acquisition on Whole Body PET/MRI for HCC Tumor Staging Using Non-Cartesian K Space Reconstructions

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S505AB

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PURPOSE

To compare diagnostic performance and image quality for chest imaging of stack-of-stars T1 EG acquisition (STARVIBE) with non cartesian reconstructions of k-space, and Caipirinha 3D T1 EG acquisition, during whole-body PET-MR of HCC patients.

METHOD AND MATERIALS

33 consecutive patients referred for HCC staging in PET MRI (Biograph mMR, Siemens erlangen) were retrospectively included. All benefited from Caipirinha Dixon 3D T1 (T1EG Dixon post gadolinium) and Starvibe (post-gadolinium T1EG Dixon with radial filling of the Fourrier plan). A subjective evaluation of the image quality was performed. Detection of pulmonary nodular lesions with both sequences was compared by taking the chest CT scan as the standard of reference (Exact Fisher test). The signal-to-noise ratio of lung parenchyma (SNR) and contrast-to-noise ratio (CNR) of nodules, muscles and pulmonary vessels were compared between the two sequences (Student T-test).

RESULTS

The Starvibe sequence was judged subjectively better in 42% of cases and at least equivalent to Vibe in 88% of cases. It improved SNR (375% vs 89%, $p < 0.001$) and CNR for muscles (53% vs 41%, $p < 0.001$), vessels (84% vs 73%, $p < 0.001$) and pulmonary nodules (34% vs 24%, $p = 0.03$). The detection of nodules was improved (sensitivity = 55% vs 41%) with a decrease in false positives (VPP = 92% vs 35%), without significant difference.

CONCLUSION

K space non cartesian reconstruction improves MRI's diagnostic performance at the chest stage by elevation of SNR and CNR.

CLINICAL RELEVANCE/APPLICATION

This new type of sequence without apnea could allow an improvement of the MRI diganostic performances especially at the thoracic stage in patients followed in oncology.

SSJ14-03 Whole-Body Functional PET-MR for Multiple Myeloma Staging: Impact of Sequence Design on Bone Marrow Infiltration and Focal Lesion Assessment

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S505AB

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PURPOSE

To study the impact of functional simultaneous 18FDG-PET-MR on bone marrow infiltration evaluation and focal lesion detection in initial staging of Multiple Myeloma (MM).

METHOD AND MATERIALS

25 consecutive patients referred to our centre for initial staging of a monoclonal gammopathy were included. PET-MR sequence design included whole-body T1-weighted spin-echo and T2-fat supressed DIXON weighted images (CWB-MRI) combined to whole-body Simultaneous Multi-Slice diffusion-weighted imaging (WB-DWI), 3D whole-body isotropic dynamic contrast-enhanced images (WB-DCE) and 3D-T1 weighted images combined with PET (T1-PET) acquisition using 4-5 MBq/kg of 18FDG-glucose. In the first part of the evaluation, the mean apparent diffusion coefficient (mADC), the mean enhancement (mE) and mean maximal standard uptake value (mSUV) of the bone marrow measured at the posterior part of the ischium, the lowest lumbar vertebral, and lowest thoracic vertebral possible outside of focal lesions were measured. The second part of the evaluation comprised the counting of focal lesions on CWB-MRI, CWB-MRI combined with WB-DWI, CWB-MRI combined with WB-DCE, CWB-MRI combined with PET, and PET-MR. Based on these findings, each patient was allocated a specific staging for bone marrow infiltration (BMI) and the number of focal lesions.

RESULTS

Functional imaging significantly impacted assessment of BMI; Compared to CWB-MRI, WB-DWI upstaged 7 and down staged 8 patients, WB-DCE upstaged 17 and down-staged 5 patients, PET upstaged 6 and down-staged 4 patients. Correlation between functional imaging and percentage of plasma cell infiltration were [$r=0.7655$, $p<10^{-6}$], [$r=0.549$ $p<0.005$], [$r=0.678$, $p=0.0001$] for mADC, mE, and mSUV. Compared to CWB-MRI, PET-MRI detected 30 additional focal lesions among 8 patients and upstaged 6 of them. 4 patients were upstaged from MGUS to stage 1 Multiple Myeloma (MM), 1 patient from stage 1 to stage 2 MM, and 1 patient from stage 1 to stage 3 MM. The detection of additional focal lesions did not modify staging for 2 patients.

CONCLUSION

PET-MRI modifies initial staging of patients with a monoclonal gammopathy. Further studies are necessary to improve medullary infiltration evaluation as well as prospective longitudinal studies to evaluate the prognostic value of these modifications.

CLINICAL RELEVANCE/APPLICATION

Functional PET-MRI significantly impacts initial staging of patients with suspected MM.

SSJ14-04 Multispectral Optoacoustic Tomography of Vascular Malformations

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S505AB

Participants
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PURPOSE

Differential diagnosis and treatment of congenital vascular anomalies is challenging and misdiagnosis is frequent. A novel non-invasive imaging approach combining not only visualization of anatomical features but also quantitative assessment of molecular tissue biomarkers would aid both diagnosis and monitoring of treatment response of vascular anomalies. We aimed to evaluate the feasibility of hybrid ultrasound (US) and multispectral optoacoustic tomography (MSOT) for non-invasive, real-time imaging of vascular malformations.

METHOD AND MATERIALS

In this pilot study 6 patients with arteriovenous (AVM) and 6 patients with venous (VM) malformations were investigated with a clinical hybrid MSOT/US system before and after either endovascular embolization (AVM) or percutaneous sclerotherapy (VM). All patients were diagnosed with AVM or VM according to the classification system of the International Society for the Study of Vascular Anomalies (ISSVA). Region of interest analysis of the lesion and contralateral healthy tissue revealed quantitative values for oxygenated (HbO2) and deoxygenated hemoglobin (HbR). Ratios of HbO2 over HbR were calculated for all vascular malformations and healthy tissue before and after treatment.

RESULTS

HbO2/HbR ratio was significantly higher for AVM versus VM and compared with healthy tissue (1.82 ± 0.08 vs. 1.12 ± 0.04 vs. 0.89 ± 0.03, all p-values<=0.001). Therefore MSOT provided intrinsic biomarker patterns to distinguish arteriovenous from venous malformations. After therapy the HbO2/HbR ratio decreased in correlation to treatment success validated by MRI and angiography.

CONCLUSION

Different types of vascular malformations are clearly distinguished by MSOT-based, non-invasive assessment of hemoglobin levels in vascular malformations. Therapy effects could be instantly visualized and quantified.

CLINICAL RELEVANCE/APPLICATION

As an easy-to-use, non-invasive and contrast-free imaging technique hybrid MSOT/US may facilitate both diagnosis and monitoring of treatment response of vascular malformations at the patient's bedside.

SSJ14-05 Ultra-Fast Whole-body PET/CT Enabled by Digital Photon Counting PET Detector Technology: Findings from a Phase II Clinical Trial

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S505AB

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PURPOSE

To assess in a Phase II study the clinical feasibility of ultrafast whole body PET imaging using the new generation digital photon counting PET and to compare by intraindividual comparison the diagnostic and quantitative findings to current clinical whole body PET acquisition.

METHOD AND MATERIALS

52 patients scheduled for FDG whole body PET/CT were imaged using three separate acquisitions as part of an intra-individual comparison study to compare a new genertaion digital system, dPET/CT (Vereos) with a current generation conventional sytem, cPET/CT (Gemini). Standard cPET imaging was performed at ~75 min p.i. of 13mCi FDG with investigational dPET imaged at ~55 min p.i. The first dPET acquisition was performed using 90s/bed position, immediately followed by a 9s/bed position acquisition lead to average table times of ~15 and ~2 min and compared with 90s/bed position cPET ~20 min . The 9s/bed dPET were reconstructed using a previously optimized methodology. All other aspects of image acquisition were kept identical. Three blinded reviewers

evaluated the data sets regarding visual characteristics, diagnostic confidence and semi-quantitative readouts.

RESULTS

All ultrafast scans were classified to be assessible. As expected, visual assessment scores were significant higher for 90s/bed dPET whole body (p<.01), while no significant between the ultra-fast wholebidy and the cPET scans were reported. The ultra-fast scan presented with slightly increased background noise levels. The ultra-fast scans also presented with substantially less motion artefacts including bowl movements. A county density regularized reconstruction approach is essential to achieve the acceptable image quality on a consistent basis.

CONCLUSION

Next generation digital photon counting detector technology enabled consisten accepatable image quality even for ultra-fast wholebody imaging with a whole body acquistion time of 2 min. The concept of ultra-fast whole-body acquisition is feasible, however requires count density adaptive, regularized reconstruction, New PET workflow concepts, improved patient comfort, minimized patient motion and whole-body pseudo dynamic imaging of tracer were demonstated as feasible.

CLINICAL RELEVANCE/APPLICATION

Ultra-Fast Wholebody PET/CT with 2 min acquisition time was shown to be feasible using a new generation digital photon counting PET/CT system

SSJ14-06 SiPM-Based versus LYSO-based 68Ga-DOTA-TATE PET/CT: Comparison of Semi-Quantitative Measurements in Normal Tissues and Lesions

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S505AB

Participants
Lucia Baratto, Stanford, CA (*Presenter*) Nothing to Disclose
Akira Toriihara, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Negin Hatami, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Guido A. Davidzon, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Shyam Srinivas, MD, PhD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Sanjiv S. Gambhir, MD, PhD, Stanford, CA (*Abstract Co-Author*) Board Member, Enlight Biosciences Board Member, ImaginAb, Inc Board Member, FUJIFILM Holdings Corporation Board Member, ClickDiagnostics, Inc Consultant, FUJIFILM Holdings Corporation Consultant, Gamma Medica, Inc Speaker, ImaginAb, Inc Stock, Enlight Biosciences Stock options, Enlight Biosciences Travel support, Gamma Medica, Inc
Andrei Iagaru, MD, Emerald Hills, CA (*Abstract Co-Author*) Research Grant, General Electric Company

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PURPOSE

To compare the performance of a silicone photomultiplier (SiPM)-based PET/CT scanner (DMI) and a LYSO-based PET/CT scanner (D690) used in our clinic and to determine any differences in semi-quantitative measurements.

METHOD AND MATERIALS

We prospectively enrolled patients referred for 68Ga-DOTA-TATE PET/CT. All patients underwent a single 68Ga-DOTA-TATE injection dual imaging protocol: they were randomly scanned first on the D690 or the DMI scanner. SUVmax of detectable lesions and SUVmean of different normal tissues were measured independently by two Nuclear Medicine Physicians, from data acquired using both scanners.

RESULTS

Data from 61 patients (35-80 year-old; 36 women, 25 men) was analyzed. Thirty-one patients out of 61 (51%) underwent DMI as first scan and a total of 95 lesions were detected on both scanners; the average SUVmax measurements for all 95 lesions were higher on DMI than D690 (28.1 and 25.2, respectively, r = 0.944, p<0.001, 95% CI, 1.382 to 4.375). Thirty patients out of 61 (49%) performed D690 PET/CT as first scan and a total of 84 lesions were seen on both scanners; the average SUVmax measurements for all 84 lesions were higher on DMI than D690 (38.3 and 33.8, respectively, r = 0.991, p<0.001, 95% CI, -6.139 to -2.879). Mean lesion:aortic arch ratios were higher on DMI than D690 (47.1 vs 42.7, and 26.6 vs 26.4 when D690 was performed first and when DMI was done first, respectively), but differences were not statistically significant (p<0.006 and p<0.877, respectively). The agreement analysis for different background organs indicated that scanners are similar in normal tissues uptake regardless of scan order.

CONCLUSION

We observed higher SUVmax values for lesions measured from DMI compared to D690 regardless of the order of the scan, while the measurements were similar for normal tissues. While delayed imaging can lead to higher SUVmax values in cancer lesions, in the series of lesions identified when DMI was performed as first scan this was not seen; therefore, the data suggests superior performance of the DMI scanner.

CLINICAL RELEVANCE/APPLICATION

DMI PET/CT new generation scanner have better performance on standard of care PET/CT scanners. This would allow to reduce the injected dose or the scan time without missing images quality.

SSJ15

Musculoskeletal (Advances in Computed Tomography)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E350

CT MK

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Frank J. Simeone, MD, Boston, MA (*Moderator*) Nothing to Disclose
Stacy E. Smith, MD, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ15-01 Color-Coded Virtual Non-Calcium Dual-Energy CT for the Detection of Bone Marrow Edema in Patients with Acute Knee Trauma: A Multireader Diagnostic Performance Study

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E350

Awards
Trainee Research Prize - Resident

Participants
Christian Booz, MD, Frankfurt am Main, Germany (*Presenter*) Nothing to Disclose
Lukas Lenga, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Simon S. Martin, MD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Ibrahim Yel, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Katrin Eichler, MD, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose
Julian L. Wichmann, MD, Frankfurt, Germany (*Abstract Co-Author*) Speaker, General Electric Company; Speaker, Siemens AG
Tatjana Gruber-Rouh, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Moritz H. Albrecht, MD, Frankfurt am Main, Germany (*Abstract Co-Author*) Speaker, Siemens AG

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PURPOSE

To evaluate the diagnostic performance of a dual-energy computed tomography (CT) virtual non-calcium (VNCa) technique for the detection of bone marrow edema in patients with acute knee trauma.

METHOD AND MATERIALS

Data from 41 patients with acute knee trauma who had presented to a level 1 trauma center emergency department were retrospectively included. Subjects had undergone clinically indicated third-generation dual-source dual-energy CT and 3-T magnetic resonance imaging (MRI) of the knee within 7 days between January 2017 and March 2018. Six blinded radiologists independently evaluated conventional grayscale dual-energy CT series for the presence of fractures; after 8 weeks, readers reevaluated all cases using color-coded dual-energy CT VNCa reconstructions for the presence of bone marrow edema for six femoral and six tibial regions. Quantitative analysis of CT numbers on VNCa reconstructions was performed by a seventh blinded radiologist. Results from MRI evaluated by two separate blinded experienced radiologists (20 and 32 years of experience in musculoskeletal imaging) served as standard of reference. Diagnostic performance was calculated taking into account clustering.

RESULTS

MRI revealed a total of 136 areas with focal posttraumatic bone marrow edema in 492 regions (61/246 femoral, 75/246 tibial). Fractures were present in 12 patients. In the subjective analysis, VNCa showed high overall sensitivity (95.6%), specificity (96.6%), positive predictive value (PPV, 91.5%) and negative predictive value (NPV, 98.3%) for the detection of bone marrow edema. Area under the curve was 0.959 (femur) and 0.962 (tibia). Inter-reader agreement was excellent (κ=0.91). CT numbers obtained from VNCa were significantly different in areas with or without edema (p<0.001). A cut-off value of -35 HU provided a sensitivity of 92.3%, specificity of 93.1%, PPV of 87.3% and NPV of 95.2% for the differentiation of bone marrow edema.

CONCLUSION

Dual-energy CT VNCa reconstructions yield excellent diagnostic performance for the detection of posttraumatic bone marrow edema compared to MRI in patients with acute knee trauma by enabling direct color-coded visualization.

CLINICAL RELEVANCE/APPLICATION

Presence and extent of bone marrow edema may be visualized during dual-energy CT performed for detection of fracture in patients with acute knee trauma by using color-coded VNCa reconstructions, potentially replacing MRI in patients with contraindications.

SSJ15-02 Identification of Bone Marrow Edema of the Ankle and Foot: Diagnostic Accuracy of Dual-Energy CT and Virtual Non-Calcium Techniques

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E350

Participants
Giovanni Foti, MD, Negrar, Italy (*Presenter*) Nothing to Disclose
Matteo Catania, MD, Trieste, Italy (*Abstract Co-Author*) Nothing to Disclose
Emanuele Demozzi, MD, Negrar, Italy (*Abstract Co-Author*) Nothing to Disclose
Simone Caia, Negrar, Italy (*Abstract Co-Author*) Nothing to Disclose
Alberto Beltramello, MD, Negrar, Italy (*Abstract Co-Author*) Nothing to Disclose
Giovanni M. Carbognin, MD, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose

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gfoti81@yahoo.it

PURPOSE

To evaluate the diagnostic accuracy of dual-energy Computed Tomography (DECT) and virtual non calcium (VNC) techniques to identify bone marrow edema of the ankle and foot

METHOD AND MATERIALS

This prospective institutional review board-approved study included 38 consecutive patients (21 males and 17 females; mean age of 62.3, range 26-79 years) studied between January 2017 and January 2018. All patients underwent DECT (80 kV and tin filter 150 kV) and MRI with Short Tau Inversion Recovery images (STIR) within 7 days. DECT data were postprocessed on a dedicated offline workstation (SyngoVia® VB20; Siemens, Erlangen, Germany) by using a three-material decomposition algorithm for generating noncalcium images of the ankle and foot. Two radiologists, blinded to clinical and MRI data (25 and 11 years of experience, respectively) evaluated the presence of abnormal attenuation of each ankle on dedicated color-coded maps and on grey scale images. STIR images served as standard of reference. Diagnostic accuracy values of the DECT maps and of the CT numbers (quantitative assessment) by using receiver operator curves (ROC) and relative area under the curve (AUC) were calculated. Inter-observer and intra-observer agreement were calculated with k-statistics. Continuous and categorical variables were evaluated by using t test and x2 or Fisher exact test, as appropriate. A value of $p<0.05$ was considered statistically significant

RESULTS

MRI revealed the presence of bone marrow edema in 25/38 cases (65.8%). DECT numbers were significantly different between positive (mean -12.6 ± 29.6 HU) and negative cases (mean -64.2 ± 34.5 HU) with a p value <0.001. The ROC curve analysis revealed an AUC of 0.896 (95% confidence interval: 0.764-0.942). By using -20HU cutoff to identify bone marrow edema, the sensitivity, specificity, PPV and NPV and accuracy of DECT were 88.0, 92.3, 95.6, 80.0 and 89.5%, respectively. The interobserver and intraobsever agreement were near perfect (k=0.88 and k=0.91, respectively)

CONCLUSION

DECT represents a reliable imaging tool for demonstration of bone marrow edema of the ankle and foot

CLINICAL RELEVANCE/APPLICATION

DECT represents a fast and reliable imaging tool for demonstration of bone marrow edema of the ankle and foot and could be proposed as an alternative imaging modality in patients with contraindications for MRI

SSJ15-03 Sub-Milisievert Ultralow-Dose CT of the Cervical Spine: A Feasibility Study in Human Cadavers

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E350

Participants
Julius M. Weinrich, Hamburg, Germany (*Presenter*) Nothing to Disclose
Peter Bannas, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Lennart Well, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Susanne Sehner, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Oleh Nykolyn, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Axel Heinemann, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Marc Regier, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Cyrus Behzadi, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Klaus Puschel, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Azien Laqmani, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare radiation dose and image quality of a standard-dose (SD) and four different reduced-dose (RD) computed tomography (CT) protocols of the cervical spine using filtered back-projection (FBP) and iterative reconstruction (IR) in human cadaver specimen.

METHOD AND MATERIALS

The cervical spine of 29 human cadavers (15 male) was examined using different RDCT protocols (P) with decreasing reference tube currents (P1:70; P2:50; P3:30; P4:10 mAs) at a tube voltage of 140 kV while a clinical SDCT protocol (120 kV, 160 mAs) served as reference. Raw data was reconstructed using FBP and two increasing levels of IR (4&6). Two radiologists assessed image quality for the upper (C1-4) and lower (C5-7) cervical spine. Images were evaluated for overall image quality and visibility of three separate anatomical structures according to a 5-point Likert scale. Additionally, diagnostic acceptability was evaluated. Results were compared using a linear mixed-effects regression model. This study was HIPAA compliant and was approved by our institutional review board, the need for informed consent was waived.

RESULTS

Image quality did not significantly differ between SDCT and RDCT P1-4 using IR 4&6 ($p>0.05$). Subjective image quality of the upper cervical spine was diagnostic for SDCT and all four RDCT protocols using FBP and IR except for only two cadavers in RDCT P4 using

FBP. Image quality of the lower cervical spine was rated as non-diagnostic in RDCT P3 (n=8/29) and RDCT P4 (n=22/29) reconstructed with FBP and in RDCT P4 (n=10/29) reconstructed with IR 4&6. Compared with the SDCT all RDCT protocols resulted in a significant effective dose reduction (SDCT:1.5±0.7 mSv; RDCT P1:1±0.6 mSv; P2:0.7±0.4 mSv; P3:0.4±0.2 mSv; P4:0.2±0.1 mSv; p<0.001).

CONCLUSION

Diagnostic acceptable sub-milisievert CT of the cervical spine is feasible with a reference mAs of 30 at 140 kV with iterative reconstruction.

CLINICAL RELEVANCE/APPLICATION

RDCT of the cervical spine with an effective dose of 0.4 mSv is feasible and should be implemented in clinical routine. Further dose reduction is possible, but IR seems not to compensate for image quality loss at the lower cervical spine.

SSJ15-04 Bone Marrow Imaging Using Dual Energy CT for the Evaluation of Diffuse Infiltrative Lesions of Multiple Myeloma: Correlation with the Severity of Marrow Infiltration Assessed by MRI

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E350

Participants
Qin Wang, MD, Beijing, China (*Presenter*) Nothing to Disclose
Huadan Xue, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Zhao Yong Sun, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Shuo Li, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Zhengyu Jin, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the feasibility of using dual-energy CT(DECT) with virtual noncalcium(VNCa) technique for the evaluation of the severity of diffuse marrow infiltration of multiple myeloma, using MRI as reference standard.

METHOD AND MATERIALS

22 consecutive patients with plasma disorders were recruited prospectively, including active MM(n=12), MM in complete remission(n=2), MGUS(n=4) and systemic amyloidosis(n=4). All patients underwent whole-body DECT scan (80kV/Sn150kV) and MRI evaluation, including T1-weighted sequence, short TI inversion recovery sequence and fat fraction(FF) map quantified by six-echo volume interpolated breath-hold gradient echo Dixon sequence. VNCa CT numbers, regular CT numbers and FF of vertebral bone marrow were measured. The severity of marrow infiltration was graded as "normal", "moderate" and "severe", according to marrow signal intensities on T1-weighted images. The relationship between VNCa and severity of marrow infiltration was evaluated by Spearman correlation. ROC analysis was performed for the diagnosis of diffuse infiltration.

RESULTS

A total number of 173 vertebrae were measured. VNCa CT numbers were significantly positive correlated with the severity of marrow infiltration(r=0.580, P=0.000) and significantly negative correlated with FF of bone marrow (r=-0.546, P=0.000). The AUCs of VNCa(0.958) were significantly higher than that of regular CT numbers(0.472) for the diagnose of marrow infiltration. With the cut-off value of -34HU, the sensitivity and specificity of VNCa was 97.2% and 85.4%, respectively.

CONCLUSION

VNCa based on DECT is feasible for the evaluation of diffuse marrow infiltration of MM. A significant correlation was observed between VNCa and the severity of marrow infiltration assessed by MRI.

CLINICAL RELEVANCE/APPLICATION

VNCa technique based on DECT may severe as an alternative method for the evaluation of the severity of marrow infiltration in MM patients.

SSJ15-05 Diagnostic Accuracy Values of Dual-Energy CT and Virtual Non-Calcium Techniques to Evaluate Bone Marrow Edema in Vertebral Compression Fractures

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E350

Participants
Giovanni Foti, MD, Negrar, Italy (*Presenter*) Nothing to Disclose
Matteo Catania, MD, Trieste, Italy (*Abstract Co-Author*) Nothing to Disclose
Emanuele Demozzi, MD, Negrar, Italy (*Abstract Co-Author*) Nothing to Disclose
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Giovanni M. Carbognin, MD, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the ability of dual-energy Computed Tomography (DECT) to identify bone marrow edema in vertebral compression fractures of thoracic and lumbar spine

METHOD AND MATERIALS

This prospective institutional review board-approved study included 76 consecutive patients (29 males and 47 females; mean age of 62.3, range 51-82 years) studied between February 2017 and February 2018. All patients underwent DECT (80 kV and tin filter 150 kV) and MRI with Short Tau Inversion Recovery images (STIR) within 7 days. DECT data were postprocessed on a dedicated workstation (SyngoVia® VB20; Siemens) by using a three-material decomposition algorithm for generating noncalcium images of vertebral bodies. Two radiologists blinded to clinical data (25 and 11 years of experience, respectively) evaluated the presence of abnormal attenuation of each vertebral body on dedicated color-coded maps. STIR images served as standard of reference. Diagnostic accuracy values of the DECT maps (qualitative assessment) and of the CT numbers (quantitative assessment) by using receiver operator curves (ROC) and relative area under the curve (AUC) were calculated. Inter-observer and intra-observer agreement were calculated with k-statistics. Continuous and categorical variables were evaluated by using t test and x2 or Fisher exact test, as appropriate. A value of $p<0.05$ was considered statistically significant

RESULTS

MRI revealed 61/774 (7.9%) edematous vertebrae and 52/774 (6.7%) collapsed non edematous vertebrae. The sensitivity, specificity, PPV and NPV and accuracy of the DECT maps were 88.6, 92.3, 93.1, 87.3 and 90.3%, respectively. DECT numbers were significantly different between positive (mean -23 HU, range -189, 29 HU) and negative cases (mean -126 HU, range -321, -66 HU) with $p<0.001$. The ROC curve analysis revealed an AUC of 0.886 (95% confidence interval: 0.722-0.913). By using -50HU cutoff to identify vertebral edema, the sensitivity, specificity, PPV and NPV and accuracy of DECT were and 91.8, 90.4, 91.6, 90.4 and 91.1%, respectively. The interobserver and intraobsever agreement were near perfect (k=0.87 and k=0.83)

CONCLUSION

DECT represents a reliable imaging tool for demonstration of bone marrow edema in vertebral compression fracture

CLINICAL RELEVANCE/APPLICATION

DECT could be proposed as an alternative imaging modality in the suspect of vertebral compression fracture in patients with contraindications for MRI

SSJ15-06 Is CT-Based Cinematic Rendering Superior to Volume Rendering Technique in the Preoperative Evaluation of Complex Lower Extremity Fractures?

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E350

Participants
Lena Marie Wollschlaeger, Duesseldorf, Germany (*Presenter*) Nothing to Disclose
Johannes Boos, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Christoph Schleich, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Pascal Jungbluth, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Gerald Antoch, MD, Duesseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Benedikt M. Schaarschmidt, MD, Essen, Germany (*Abstract Co-Author*) Stockholder, Bayer AG; Stockholder, General Electric Company; Stockholder, Siemens AG; Stockholder, Teva Pharmaceutical Industries Ltd

PURPOSE

Cinematic rendering (CR) is a recently launched, FDA-approved 3D reconstruction technique which converts conventional CT images into almost photorealistic 3D reconstructions using a unique lightning model. The purpose of this study is to compare CR and volume rendering technique (VRT) in complex lower extremity fractures and to evaluate the value of CR for traumatologists to improve preoperative planning.

METHOD AND MATERIALS

In this retrospective, IRB approved study, 41 consecutive patients (female: n=13; male: n=28; mean age: 52.3±17.9y) with complex lower extremity fractures (calcaneus: n=16, tibial pilon: n=19, acetabulum: n=6) were included. All datasets were acquired using a 128-row dual-source CT. CR and VRT images were reconstructed on a dedicated workstation. Two experienced board-certified traumatologists trained in special lower extremity trauma surgery reviewed VRT and CR images in independent sessions. Image quality, anatomical accuracy and fracture visualization were rated using a 6-point Likert scale (1=non-diagnostic to 6=perfect visualization). Furthermore, the additional value of CR in comparison to conventional VRT images on preoperative planning was assessed. For each score, median values between both readers were calculated. A Wilcoxon-Ranksum test was performed to compare both reconstruction methods. $p<0.05$ indicated statistical significance.

RESULTS

In comparison to VRT, CR had a higher image quality (VRT: 2.5; CR: 6.0; $p<0.001$), a higher anatomical accuracy (VRT: 3.5; CR: 5.5; $p<0.001$) and provided a more detailed visualization of the fracture (VRT: 2.5; CR: 6.0; $p<0.001$). Furthermore, both readers reported an additional value of CR images for preoperative planning in 65.9% (27/41) of all patients in comparison to VRT.

CONCLUSION

CR provides a more detailed visualization of complex lower extremity fractures compared with VRT. Additionally, CR is a useful tool for traumatologists to improve preoperative planning.

CLINICAL RELEVANCE/APPLICATION

Cinematic rendering is superior to volume rendering technique in the preoperative evaluation of complex lower extremity fractures.

SSJ16

Musculoskeletal (Muscle, Tendon and Nerve)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E353B

MR MK US

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Darryl B. Sneag, MD, Plainview, NY (*Moderator*) Nothing to Disclose
Michael J. Tuite, MD, Madison, WI (*Moderator*) Nothing to Disclose

Sub-Events

SSJ16-01 Ultrasound versus MRI in Post-Traumatic Brachial Plexopathy

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E353B

Participants
Anne Jonkergouw, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Scott Wolfe, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Steve K. Lee, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Joseph Feinberg, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Darryl B. Sneag, MD, Plainview, NY (*Abstract Co-Author*) Nothing to Disclose
Ogonna K. Nwawka, MD, New York, NY (*Presenter*) Research Grant, General Electric Company

PURPOSE

This study aims to evaluate the use of ultrasound in detecting traumatic lesions of the brachial plexus, comparing them to magnetic resonance (MR) imaging findings.

METHOD AND MATERIALS

Patients with symptoms suggestive of post-traumatic brachial plexopathy were recruited to undergo high resolution magnetic resonance (MR) imaging and ultrasound (US) of the brachial plexus. 30 patients fit criteria for study inclusion. Standard high resolution MR and US imaging was performed. The brachial plexus was imaged from the paravertebral region through the infraclavicular region on both MRI and US. Evaluation of radiographic findings were performed by two fellowship-trained musculoskeletal radiologists expert in brachial plexus imaging, of which one focused on MR imaging and one on US evaluation. MR and US findings were compared for characterization of injury at the root, trunk, division, cord and terminal branch level using kappa coefficient measurements.

RESULTS

On MR imaging, brachial plexus injury was detected in 25 of 30 patients, including 9 with high-grade lesions (neuroma, root avulsion or nerve transection). On US imaging, brachial plexus injury was detected in 28 patients, including 6 patients with high-grade lesions. False-negative US findings, were related to a limited field of view, obscuring of the field by bony structures, and limited mobility of patients. False-positive US findings were related to scarring. MR imaging suffered from hardware susceptibility effects in 3 patients and motion artifacts in 1 patient. Kappa values were >0.75 for the C5-C8 nerve roots, trunks, divisions, cords, and the suprascapular, median and ulnar nerves, indicating excellent agreement. The kappa values were < 0.75 for the T1 nerve root (0.30), axillary (0.74), radial (0.70) and musculocutaneous nerve (0.29). All kappa values were statistically significant ($p < 0.001$).

CONCLUSION

US and MRI demonstrate excellent agreement in the evaluation of brachial plexus trauma. Ultrasound detection is limited in regions obscured by bony structure and in patients with limited mobility. MRI evaluation is limited by hardware susceptibility artifacts and patient motion.

CLINICAL RELEVANCE/APPLICATION

As ultrasound demonstrates excellent agreement with MRI in the detection of traumatic brachial plexus lesions, it can serve as an alternative to MRI for evaluation of traumatic brachial plexopathy, particulary useful in patients who cannot tolerate MR imaging.

SSJ16-02 Shear Wave Elastography Demonstrates Reduced Patellar Tendon Elasticity in Jumping Athletes with Patellar Tendinopathy Compared to Activity-Matched Healthy Jumping Athletes

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E353B

Awards
Student Travel Stipend Award

Participants
Stephan J. Breda, MD, Rotterdam, Netherlands (*Presenter*) Institutional research collaboration, General Electric Company
Robert-Jan de Vos, MD,PhD, Rotterdam, Netherlands (*Abstract Co-Author*) Institutional research collaboration, General Electric Company
Gabriel P. Krestin, MD, PhD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Edwin H. Oei, MD, PhD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Patellar tendinopathy (PT) is characterized by localized patellar tendon pain and decreased performance in athletes. Morphologic changes and neovascularization are sequelae of PT, however sometimes subtle or absent. Evaluating elastic properties of the patellar tendon could improve the sonographic diagnosis of PT. Shear wave elastography (SWE) is a quantitative ultrasound-based imaging method measuring tissue elasticity. To explore the diagnostic performance of SWE to visualize PT, we evaluated patellar tendon elasticity in athletes with PT compared to activity-matched healthy jumping athletes.

METHOD AND MATERIALS

Athletes aged 18-30 years, playing tendon-loading sports at least 3 times per week were included for clinical and radiological evaluation of the patellar tendon. Symptomatic athletes underwent both clinical examination and sonographic evaluation (conventional ultrasound and power Doppler) to confirm the diagnosis of PT. SWE was performed in supine position with extended knees using a GE Logiq E9 ultrasound system. Activity-matched healthy controls without history of knee pain were recruited for ultrasound of both knees. Primary outcome was mean elastic modulus of the proximal patellar tendon measured in kilopascal (kPa). Tendon thickness was a secondary outcome measure. To compare tendon elasticity in healthy versus affected tendons, a Mann-Whitney U test was used. Linear regression analysis was performed to determine the association between tendon thickness and elasticity.

RESULTS

We included 37 athletes (30 affected with PT). Median elastic modulus of the proximal patellar tendon was 76.5 kPa [IQR 59.2-106.9] in PT, compared to 35.4 kPa [IQR 31.9-42.3] in healthy controls ($p<0.001$). Increased tendon thickness was associated with reduced tendon elasticity in jumping athletes with PT after adjustments for age and sex, ß=9.7 (95%CI 5.5-13.8), $p<0.001$.

CONCLUSION

Patellar tendon elasticity is reduced in jumping athletes with patellar tendinopathy compared to activity-matched controls. Furthermore, tendon elasticity is associated with tendon thickness. Further research is ongoing to explore the potential of SWE as an imaging biomarker to monitor treatment response in a randomized clinical trial.

CLINICAL RELEVANCE/APPLICATION

SWE is a promising quantitative imaging tool to visualize patellar tendinopathy and is currently evaluated to monitor treatment effects.

SSJ16-03 Simultaneous Multi-Band Fast Spin Echo MRI: Scan Time and Image Quality Improvement for Peripheral Nerve Imaging

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E353B

Participants
Erin C. Argentieri, BS, New York, NY (*Abstract Co-Author*) Institutional research agreement, General Electric Company
Darryl B. Sneag, MD, Plainview, NY (*Presenter*) Nothing to Disclose

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PURPOSE

To determine whethere a novel, fast spin echo (FSE) MR acquistiion using a multiband (MB) excitation, which has a minimal noise penalty, provides equivalent image quality at reduced scan time compared to a standard of care FSE acquistiion for evaluating peripheral neuropathies.

METHOD AND MATERIALS

This was an IRB-approved study of 8 patients (5F/8M), mean age 41.7± 14.5 years, who presented in clinic for routine MRI evaluation of peripheral neuropathy and who provided written consent. Data was acquired in: 4 knees, 1 elbow, 1 pelvis and 2 lower legs. For the knees and lower legs, evaluation was focused on the saphenous, tibial and commo peroneal nerves, while the ulnar nerve was evaluated for the elbow, and the lumbosacral plexus and sciatic nerves were the focus for the pelvis. All MRIs were performed at 3T (MR750 GE Healthcare, Waukesha WI), using a 16-channel flex-coil for all exams except the pelvis where a 32-channel torso coil was used. Axial proton density (PD) and T2-weighted fat saturation (T2-FS) standard-of-care (SOC)-FSE and MB-FSE scans were acquired with matching scan parameters: FOV:11-30 cm;512x352 (freq x phase); 26-62 slices; PD TR/TE: 4500/24 ms, T2-FS TR/TE 4800/86 ms; NEX:2.

RESULTS

No appreciable differences betweeen MB-FSE and SOC-FSE acquisitions were observed between qualitative evaluations of image quality based on the 5-point scale. All grades of MB-FSE image quality were ± 1 point of the corresponding SOC-FSE images: 38% of grades were + 1, and 50% of grades indicated that MB-FSE and SOC-FSE image sets were of equal image quality. Comparsions of MB-FSE and SOC-FSE image sets with identical imaging parameters revealed that the utilization of a MB-FSE acquisition saved, on average, 1.5 min. of scan stime (min: 30 sec; max: 2.5 min 27 sec).

CONCLUSION

Preliminary results of this pilot study indicate that the MB-FSE acquistion provides similar imaging quality compared to SOC-FSE acquisitions. MB-FSE accelerates FSE imaging without the noise penalty associated with in-plane acceleration techniques. For peripheral nerve imaging, where SNR and resolution are paramount, decreased scan time can be traded off to significantly improve image quality.

CLINICAL RELEVANCE/APPLICATION

Multi-band fast spin echo (FSE) MRI may provide similar image quality to conventional FSE within a shorter scan time, faciliating the acquistion of higher spatial resolution sequences for detecting peripheral neuropathies.

SSJ16-04 MR Neurography for the Evaluation of Peripheral Nerves and Associated Neurogenic Muscle Atrophy in Non-Systemic Vasculitic Neuropathy

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E353B

Participants
Thorsten Lichtenstein, MD, Cologne, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

Non-systemic vasculitic neuropathy (NSVN) is a frequent cause of chronic progressive axonal peripheral neuropathy. Nerve biopsies can demonstrate axonal damage with asymmetric loss of nerve fibers. In contrary, diagnosis and evaluation of the clinical course remain difficult by non-invasive techniques (e.g. electroneurography (ENG) or electromyography (EMG)). Thus, the objective of this prospective clinical study was to evaluate MR neurography at 3T as a potential diagnostic tool for diagnosis and follow-up. NSVN causes damage of nerve fiber integrity, therefore diffusion tensor imaging (DTI) was evaluated to detect changes in NSVN patients. Since NSVN causes neurogenic muscle atrophy, the second aim of this study was to quantify the intramuscular fat fraction using proton density fat fraction (PDFF) mapping.

METHOD AND MATERIALS

In this prospective study, patients with NSVN and healthy controls (HC) were investigated by MR neurography at 3T (n = 9 respectively). In all patients tibial nerves were examined by DTI and fractional anisotropy (FA) was calculated. Secondly, fat fractions of the soleus muscle (SM) and gastrocnemius muscle (GM) were analysed by PDFF mapping. MR neurography data was correlated with clinical follow-up by ENG and EMG.

RESULTS

In tibial nerves of NSVN patients FA values were significantly lower compared to healthy controls (0.33 vs 0.42 respectively, $p=0.002$). Muscle PDFF showed significantly higher values in NSVN compared to healthy controls, thus detecting fatty muscle atrophy reliably. Mean values measured 5.74% vs 10.78% respectively for SM ($p=0.003$) and 4.17% vs 23.71% for GM ($p<0.001$).

CONCLUSION

In this study, MR neurography at 3T proved as a reliable biomarker for the affection of peripheral nerves in NSVN. Fractional anisotropy allows for a reliable distinction between healthy and functionally impaired nerves while PDFF reliably detects fatty neurogenic muscle atrophy as an indirect surrogate marker in those patients. This is possible without the administration of iv contrast agent.

CLINICAL RELEVANCE/APPLICATION

In patients with NSVN, the combination of DTI and PDFF detects nerve damage and neurogenic muscle atrophy and might be helpful to guide treatment.

SSJ16-05 Lumbar Plexus in Patients with Chronic Inflammatory Demyelinating Polyradiculoneuropathy: Evaluation with Simultaneous T2 Mapping and a Neurography Method with SHINKEI

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E353B

Participants
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Hiroshi Honda, MD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

MR neurography (MRN) is a useful technique with which to evaluate abnormal conditions of the peripheral nerves such as chronic inflammatory demyelinating polyradiculoneuropathy (CIDP). We have developed a simultaneous T2 mapping and MRN method with 'nerve-sheath signal increased with inked rest-tissue rapid acquisition of relaxation enhancement imaging' (SHINKEI). The purpose of this study was to evaluate the usefulness of this technique in lumbar plexus to distinguish patients with CIDP from healthy controls.

METHOD AND MATERIALS

Ten patients with CIDP (7 males and 3 females; age range 11 - 68-year-old; median 47.5 year) from 2015 to 2017 were studied along with five healthy controls (4 males and 1 female; age range 27 - 45-year-old; median 41 year). MRI was conducted on a 3T clinical scanner. Typical imaging parameters were as follows; TR = 2500 ms, TE = 51 ms, FOV = 290 x 290 mm, ETL = 90, matrix =

256 x 245, Acquisition voxel size = 1.13 x 1,18 x 4.0 mm3, Reconstructed voxel size = 0.60 x 0.60 x 2.0 mm3, b = 10 s/mm2, iMSDE duration = 36 and 72 ms, acquisition time = 5 min 45 s. The T2 relaxation time and the size of the dorsal root ganglia and nerves of the lumbar plexus at L3-S1 were measured on coronal plane. Statistical analyses were performed with the Mann-Whitney U-test and a receiver operating characteristics (ROC) analysis.

RESULTS

The T2 relaxation times of the dorsal root ganglia and the nerves of the lumbar plexus were longer in the CIDP patients (133.34 ± 41.36 msec and 130.40 ± 47.78 msec) compared to the healthy controls (114.69 ± 24.90 msec and 83.72 ± 17.51 msec, p=0.0265 and p<0.0001, respectively). The sizes of the nerves were larger in the CIDP patients (6.19 ± 2.28 mm) compared to the controls (4.54 ± 0.86 mm, p<0.0001). However, there was no significant difference between the sizes of the ganglia in the CIDP patients and the controls. The ROC analysis revealed that the T2 relaxation time of the nerves was best at distinguishing the CIDP patients from the controls (Az = 0.848).

CONCLUSION

Patients with CIDP could be distinguished from healthy controls using simultaneous T2 mapping and MRN method with SHINKEI in lumbar plexus.

CLINICAL RELEVANCE/APPLICATION

With our new method we could obtain high resolution neurography with simultaneous T2 mapping. CIDP could be distinguished from controls using our technique.

SSJ16-06 Quantitative Ultrasound Measures in the Patellar Tendon are Associated with VISA-P Scores of Collegiate Basketball Players Over One Season of Play

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E353B

Participants
Ogonna K. Nwawka, MD, New York, NY (*Presenter*) Research Grant, General Electric Company
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PURPOSE

This study of collegiate basketball players evaluated change over time (COT) in ultrasound shear wave (SW) elastography metrics across the basketball season, and correlated to morphologic changes on conventional ultrasound imaging, and VISA-P scores.

METHOD AND MATERIALS

In eleven male collegiate basketball players (mean age 19, age range 18-21), patella tendon (PT) ultrasound and SW elastography of both knees were performed at pre-season and post-season time points, and players reported their VISA-P scores throughout the season. Patella tendinopathy grade and SW metrics were correlated to VISA-P scores using Spearman correlation coefficients. Paired t-test was used to assess differences in mean SW metrics at pre-and post-season timepoints, accounting for leg dominance.

RESULTS

6 of 11 players (54.5%) had baseline patella tendinopathy on ultrasound progressing in 4 players. The mean change in VISA-P score was 15.18 (+/-8.55). No significant correlation was seen between ultrasound grades of tendinopathy and VISA-P. Pre-season SW velocities did not significantly correlate with baseline VISA-P scores. Post-season SW values and SW COT demonstrated strong correlation with change in VISA-P score in dominant and non-dominant knees. Although not statistically significant, there was a trend towards higher SW velocity for tendinopathy in both dominant and non-dominant knees at both study visits.

CONCLUSION

SW metrics of the PT correlated to change in VISA-P scores in the dominant and non-dominant knees, whereas conventional ultrasound grades of patella tendinopathy did not. There was a trend towards higher SW velocities in patella tendinopathy which may indicate detection of change in intrinsic tissue stiffness.

CLINICAL RELEVANCE/APPLICATION

These results showed significant correlation between SW values and patella tendinopathy symptom scores, demonstrating the benefit of this quantitative imaging technique over conventional ultrasound imaging in the characterization of clinically symptomatic patella tendinopathy.

SSJ17

Science Session with Keynote: Nuclear Medicine (Chest/Breast Oncology Nuclear Imaging)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S504CD

BR CH CT MR NM OI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Peter S. Conti, MD, PhD, Los Angeles, CA (*Moderator*) Nothing to Disclose
Andrew C. Homb, MD, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

SSJ17-01 Nuclear Medicine Keynote Speaker: Radiomics in Lung Cancer

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S504CD

Participants
Lawrence H. Schwartz, MD, New York, NY (*Presenter*) Committee member, Celgene Corporation Committee member, Novartis AG Committee member, ICON plc Committee member, BioClinica, Inc

SSJ17-02 An Updated and Validated PET/CT Volumetric Prognostic Index for Non-Small Cell Lung Cancer

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S504CD

Participants
Joshua H. Finkle, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Bill C. Penney, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Yonglin Pu, MD, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Whole-body metabolic tumor volume (MTVWB) and TNM staging are independent prognostic factors for overall survival (OS) in non-small cell lung cancer (NSCLC). We aimed to update and validate the PET/CT volumetric prognostic index (PVP index) using the new 8th edition TNM staging system to evaluate its prognostic power versus TNM staging and MTVWB alone.

METHOD AND MATERIALS

This study was a retrospective analysis of 949 non-small cell lung cancer (NSCLC) patients diagnosed between 2004 and 2014. Clinical TNM stage, MTVWB, age and gender, tumor histology type at the initial staging PET/CT exam, as well as treatment history and long-term survival data were obtained. Patients were randomly assigned to modeling or validation group. Univariate and multivariate Cox regression analyses were performed to compare PVP index, TNM stage, and MTVWB in the validation group.

RESULTS

The updated PVP index included the 3 variables TNM stage, and MTVWB and age. Univariate Cox models showed significant association of PVP index with overall survival (OS) in patients with NSCLC (with Hazard ratio HR= 2.88 in the validation group, $p<0.001$). The C-statistic of the PVP index (C-statistic = 0.71 in the validation group) was significantly greater than that of 8th edition TNM staging (C-statistic = 0.68, $p=0.029$), MTVWB (C-statistic = 0.68, $p=0.001$), and patient age (C-statistic = 0.53, $p<0.001$). Multivariate Cox regression analyses demonstrated significant association of PVP index with OS (with HR= 2.80, $p<0.001$) after adjusting patient's gender and tumor histology.

CONCLUSION

The updated PVP index provides a quantitative risk assessment for NSCLC patients using 8th edition TNM staging, MTVWB, and age. The index provides a simple and practical way for the care team to incorporate the independent prognostic value of both the TNM stage and MTVWB. This approach can further improve the accuracy of overall survival prognosis.

CLINICAL RELEVANCE/APPLICATION

The PVP index combines the prognostic power of the TNM stage, whole-body metabolic tumor volume and age, offering prognostic accuracy superior to whole-body metabolic tumor volume or TNM stage alone.

SSJ17-03 Prospective Comparison of 18F-FDG PET/MRI and 18F-FDG PET/CT for Thoracic Staging of Non-Small Cell Lung Cancer

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S504CD

Participants
Lino Sawicki, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To compare the diagnostic performance of 18F-FDG PET/MRI and 18F-FDG PET/CT for primary and locoregional lymph node staging in non-small cell lung cancer (NSCLC).

METHOD AND MATERIALS

In this prospective study a total of 84 patients (51 men, 33 women, mean age 62.5 ± 9.1 years) with histopathologically confirmed NSCLC underwent 18F-FDG PET/CT followed by 18F-FDG PET/MRI in a single injection protocol. Two readers independently assessed T and N staging in separate sessions according to the seventh edition of the American Joint Committee on Cancer staging manual for 18FFDG PET/CT and 18F-FDG PET/MRI, respectively. Histopathology as reference standard was available for N staging in all 84 patients and for T staging in 39 patients. Differences in staging accuracy were assessed by McNemars chi2 test. The maximum standardized uptake value (SUVmax) and longitudinal diameters of primary tumors were correlated using Pearson's coefficients.

RESULTS

T stage was categorized concordantly in 18F-FDG PET/MRI and 18F-FDG PET/CT in 38 of 39 (97.4%) patients. Herein, 18F-FDG PET/CT and 18F-FDG PET/MRI correctly determined the T-stage in 92.3% and 89.7% of patients, respectively. N-stage was categorized concordantly in 83 of 84 patients (98.8%). 18F-FDG PET/CT correctly determined the N stage in 78 of 84 patients (92.9%), while 18F-FDG PET/MRI correctly determined the N stage in 77 of 84 patients (91.7%). Differences between 18F-FDG PET/CT and 18F-FDG PET/MRI in T and N staging accuracy were not statistically significant ($p > 0.5$, each). Tumor size and SUVmax measurements derived from both imaging modalities exhibited excellent correlation (r=0.963 and r=0.901, respectively).

CONCLUSION

18F-FDG PET/MRI and 18F-FDG PET/CT showed an equivalently high diagnostic performance for T and N staging in patients suffering from NSCLC.

CLINICAL RELEVANCE/APPLICATION

PET/MRI as a dose-saving alternative to PET/CT proved coequal to the current gold standard for thoracic staging of NSCLC. Thus, clinicians might use PET/MRI instead of PET/CT for this purpose. However, considering the longer examination times and higher expenses of PET/MRI, a general recommendation in favor of PET/MRI cannot be drawn from this study.

SSJ17-04 The Relationship Between PET/CT Imaging Features and Pathological Types and Gene Mutations of Primary Lung Cancer: A Study of 213 Untreated Lung Cancer Patients with Bone Metastases

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S504CD

Participants
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Ning Wu, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the relationship between 18F-FDG PET/CT image characteristics and pathological types and gene mutations of primary lung cancer in untreated lung cancer patients with bone metastases.

METHOD AND MATERIALS

A total of 213 untreated lung cancer patients with bone metastases were enrolled in this study. All patients underwent 18F-FDG PET/CT examination, pathological and gene mutation examination of primary lung cancer. Spearman's correlation test was performed to evaluate the association between primary tumors and bone metastases. Single factor analysis of variance was used to compare groups.

RESULTS

(1)A total of 213 cases were evaluated. The mean SUVmax of primary lung cancer was 7.9±4.7; that of bone metastases was 8.2±4.3. The SUVmax of primary lesions had a significantly positive correlation with the SUVmax of bone metastases (r = 0.622; p = 0.000). Osteolytic metastasis was the most common type. (2)The SUVmax of primary lung lesions with different pathological types were statistically different (all P = 0.000): squamous cell carcinoma > small cell carcinoma > adenocarcinoma. Their SUVmax were 11.7±3.7, 9.3±3.1, and 6.7±4.6, respectively. (3)In non-small cell lung cancer (NSCLC), the gene mutation rates of epidermal growth factor receptor (EGFR), K-ras and anaplastic lymphoma kinase (ALK) were 35.7%, 10.1% and 3.8%, respectively. There was no statistical difference in SUV*max* of primary lung cancer between gene mutation type and wild type (P>0.05).

CONCLUSION

The SUVmax of primary lung lesions with different pathological types were statistically different. Squamous cell carcinoma was the highest, and adenocarcinoma was the lowest. The SUVmax of primary lung cancer had a significantly positive correlation with the SUVmax of bone metastases. In NSCLC, the mutation rate of EGFR is the highest. There was no statistical difference in SUVmax of primary lung cancer between gene mutation type and wild type.

CLINICAL RELEVANCE/APPLICATION

The SUVmax of primary lung cancer is suggestive of its pathological type. But the SUVmax of primary lung cancer is not helpful to predict the gene mutations in NSCLC.

SSJ17-05 Local and Whole-Body Staging in Patients with Primary Breast Cancer: A Comparison of One-Step to Two-Step-Staging-Algorithms Utilizing PET/MRI

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S504CD

Participants
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PURPOSE

To compare the diagnostic value of a one-step to a two-step staging algorithm for local and whole-body staging utilizing 18F-FDG PET/MRI in breast cancer patients.

METHOD AND MATERIALS

A total of 38 patients (37 females and one male, mean age 57 ± 10 years; range 31-78 years) with newly diagnosed, histopathologically proven breast cancer were prospectively enrolled in this trial. All PET/MRI examinations were assessed for local tumor burden and metastatic spread in two separate reading sessions: (1) One-step algorithm comprising supine whole-body 18F-FDG PET/MRI, (2) Two-step algorithm comprising a dedicated prone 18F-FDG breast PET/MRI and supine whole-body 18F-FDG PET/MRI.

RESULTS

On a patient based analysis the two-step algorithm correctly identified 37 out of 38 patients with breast carcinoma (97%), while 5 patients were missed by the one-step 18F-FDG PET/MRI algorithm (33/38; 87% correct identification; p=0.37). On a lesion-based analysis 56 breast cancer lesions were detected in the two-step algorithm and 44 breast cancer lesions could be correctly identified in the one-step 18F-FDG PET/MRI (79%), resulting in statistically significant differences between the two algorithms (p=0.0015). For axillary lymph node evaluation sensitivity, specificity and accuracy was 93%, 95 % and 94%, respectively. Furthermore, distant metastases could be detected in 7 patients with both modalities.

CONCLUSION

The results demonstrate the necessity and superiority of a two-step 18F-FDG PET/MRI algorithm, comprising dedicated prone breast imaging and supine whole-body imaging, when compared to the one-step algorithm for local and whole-body staging in breast cancer patients.

CLINICAL RELEVANCE/APPLICATION

Two-step 18F-FDG PET/MRI comprising dedicated breast and whole-body imaging enables high-quality local and whole-body staging in patients with breast cancer.

SSJ17-06 Multimodal Radiomic Imaging: Comparison of PET and MRI-pCM Heterogeneity in Breast Cancer

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S504CD

Participants
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Christian Leissing, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Stephanie Tanadini-Lang, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Patrick Veit-Haibach, MD, Zurich, Switzerland (*Abstract Co-Author*) Research Grant, Bayer AG Resaarch Grant, F. Hoffmann-La Roche Ltd Research Grant, General Electric Company

PURPOSE

This study investigated the value of pre-treatment F-18-Fluorodeoxyglucose (FDG)-positron-emission-tomography (PET) radiomics in comparison to T1-weighted-post-contrast-magnetic-resonance-imaging (MRI-pCM) radiomics in patients with breast cancer.

METHOD AND MATERIALS

Following IRB approval and informed consent, a total of 30 patients with histologically proven breast cancer were prospectively recruited. Patients were injected 225+/-55 MBq FDG intravenously. PET and MRI-pCM were acquired on the same machine. 154 radiomic features of first, second, and higher order were extracted from the primary tumor. Dimensionality of features was reduced with a Principal Component Analysis. The relationship of selected features to staging and histological parameters was determined. Association of features between the different modalities was compared (Spearman "ρ").

RESULTS

Selected radiomic features of PET showed moderate correlation to T-stage ($-0.52 < \rho < 0.54$) and weak correlation to N-Stage ($-0.35 < \rho < 0.38$). Selected radiomic features of MRI-pCM showed moderate correlation to T-stage ($-0.64 < \rho < 0.57$) and to N-stage ($-0.52 < \rho < 0.54$). Correlation of radiomic features of both modalities to hormone receptor status is shown in Table 1. Comparison between PET and MRI-pCM showed moderate to strong correlation for the comparison of all radiomic features (-0.66 <

$\rho < 0.68$) (Figure 1), whereas the correlation for the comparison of a respective radiomic parameter was only weak to moderate ($0.22 < \rho < 0.56$) (1st diagonal in Figure 1).

CONCLUSION

Radiomics in a multimodality approach might be a complementary tool for non-invasive pre-therapeutic characterization of breast cancer.

CLINICAL RELEVANCE/APPLICATION

Combining radiomic features from different imaging modalities may help in non-invasive specification of breast cancer.

SSJ18

Neuroradiology (Artificial Intelligence in Neuroimaging)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E451B

AI MR NR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Max Wintermark, MD, Lausanne, Switzerland (*Moderator*) Advisory Board, General Electric Company; Consultant, More Health; Consultant, Magnetic Insight; Consultant, Icometrix; Consultant, Nines;
Mark D. Herbst, MD, PhD, Saint Petersburg, FL (*Moderator*) Nothing to Disclose

Sub-Events

SSJ18-01 Automated Detection of Abnormality in Multi-Parametric Brain MRI Using an Artificial Intelligence 3D Pipeline

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E451B

Participants
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Zahi A. Fayad, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

With rapid growth and increasing use of brain MRI, there has been a significant interest in automated image processing and classification of brain MRI scans to supplant human interpretation and improve workflow. In this study we aim to assess the diagnostic accuracy of an AI 3D pipeline in classifying multi-parametric brain MRI to normal vs. abnormal.

METHOD AND MATERIALS

A total of 1,516 consecutive clinical brain MRI studies including sagittal T1W and axial FLAIR, ADC and B1000 sequences were selected from our institution HIPAA compliant imaging registry. Brain MR studies were obtained using standardized protocol across 1.5T MR scanners from two manufacturers (GE and Siemens). Each sequence was reformatted to common resolution to accommodate for differences between vendors. A board certified neuroradiologist assigned each case to normal vs. abnormal based on the review of clinical report of each case. Consequently, 88% of the MRI scans were marked as abnormal. A 3D AI pipeline was developed: first, a deep reinforcement learning based landmark detection was used to estimate positioning and brain coverage. Brain was extracted using an adversarial dense image-to-image based technique then sequence-independent dense convolutional networks were trained in a supervised way, with data augmentation (random rotation, translation and added noise at each iteration), and merged to flag abnormal cases. Training was performed on 1,566 cases (200,448 images - 85% abnormal) with class weights to address class imbalance, testing included 175 cases (22,400 images - 84% abnormal).

RESULTS

Receiver operating characteristic (ROC) analysis showed that an area-under-the-curve (AUC) of 0.90 with accuracy of 86%, sensitivity of 85%, and specificity of 89% for our detection pipeline.

CONCLUSION

Our proposed intelligent pipeline accurately identifies abnormal brain MRIs from the individual patients. If its potential is realized, it can be used as a clinical tool to flag abnormal MRIs, allowing for improved triage and timely interpretation of abnormal scans in a busy and large clinical practice.

CLINICAL RELEVANCE/APPLICATION

Our proposed automated and intelligent 3D pipeline can flag abnormal brain MRI scans, catering available human expertise in interpreting abnormal cases in a timely manner.

SSJ18-02 Multi-Metric Characterization of Resting-State Functional Connectivity for Machine Learning Classification in Major Brain Networks

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E451B

Participants
Rosaleena Mohanty, MS, Madison, WI (*Presenter*) Nothing to Disclose
Veena A. Nair, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Vivek Prabhakaran, MD, PhD, Fitchburg, WI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Population differences have been identified based on resting-state functional connectivity (FC) derived from blood-oxygen-level-dependent (BOLD) response using machine learning classification. While Pearson's correlation is the conventional metric used to quantify FC, it may not capture the true dynamic and non-linear relationship between BOLD responses from distinct brain regions. This motivates the need for a more complete notion of FC for better classification performance.

METHOD AND MATERIALS

Ten-minute eyes closed functional MRI were acquired on 3T GE MR750 scanner from 50 right-handed healthy participants consisting of 25 older (age=57.5±7.1 years; 13 females; education=16.68 years) and 25 younger (age=23.9±5.9 years; 13 females; education=16.76 years) participants. Data were preprocessed using standard steps on SPM12 to extract the BOLD time courses in 6 major brain networks. Network-wise FC was computed based on 8 distinct metrics: cross-correlation, coherence, mutual information, dynamic time warping (DTW) distance, Euclidean distance, cityblock distance, wavelet coherence and the conventional Pearson's correlation. Individual and combined discriminatory power of the metrics was assessed using a linear support vector machine classifier to differentiate between the older and younger groups for each network. Neighborhood component analysis and leave-one-out cross-validation were used for feature selection and evaluation of classification performance respectively.

RESULTS

Groups were significantly different in age (p-value<0.001) but not in gender distribution or education. Comparative results showed that Pearson's correlation may not always be the optimal choice for FC. The combined metric performed comparable/better than individual metrics for each network. This could imply that a more meaningful definition of FC encompassing linear, non-linear, dynamic, time-, frequency- and wavelet-domain information could be created for classification by drawing contributions from multiple metrics.

CONCLUSION

Combining the inter-dependencies in BOLD signals in time, frequency and wavelet domains could provide a more comprehensive notion of FC for population-based classification using machine learning.

CLINICAL RELEVANCE/APPLICATION

Multi-metric characterization offers a more complete definition of FC and could be useful in delineating group differences between patient and healthy population using machine learning classification.

SSJ18-03 Use of a Deep Convolutional Neural Network for Automated Detection of Intracranial Hemorrhage

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E451B

Awards
Student Travel Stipend Award

Participants
Chad W. Farris, MD,PhD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

The purpose of this study is to investigate the possibility of automated detection of all varieties of intracranial hemorrhage (ICH), including epidural (EDH), subdural (SDH), subarachnoid (SAH), intraparenchymal (IPH), and intraventricular (IVH) on unenhanced head CT examinations (HCT) using a deep residual convolutional neural network (DRCNN) in all possible clinical scenarios, including initial HCT for diagnosis of ICH, follow-up HCT for known ICH, and post-operative HCT after surgical intervention.

METHOD AND MATERIALS

IRB approved retrospective HIPAA compliant study with requirement for informed consent waived. Included cases were identified through a keyword search of our RIS for HCT with ICH and normal HCT (NHCT) between 7/1/2014-7/1/2016. A total of 95 ICH cases and 46 NHCT cases were included in this study. The hemorrhages in the ICH cases were segmented by hand using an inhouse MATLAB annotation tool. The DRCNN was trained using 60 annotated ICH cases and validated with 5 ICH cases. The trained DRCNN was then tested on 30 ICH cases (with many of the cases including different types of hemorrhage for a total of 56 hemorrhages) and 46 NHCT cases using two different DRCNN thresholds for hemorrhage detection and minimal post-processing of the DRCNN output. The percentage of hemorrhages detected, and the false positive rate (FPR) were evaluated at each of the DRCNN thresholds. For the lower DRCNN threshold, a minimum number of DRCNN identified pixels containing hemorrhage was employed to consider the case positive for hemorrhage to limit the FPR.

RESULTS

The DRCNN with a high threshold (HT) for ICH detection correctly detected 70% (39/56) ICH including, 0% (0/1) EDH, 60% (6/10) SDH, 50% (6/12) SAH, 81% (17/21) IPH, and 83% (10/12) IVH. The DRCNN with a low threshold (LT) for ICH detection correctly detected 89% (50/56) ICH including, 100% (1/1) EDH, 80% (8/10) SDH, 83% (10/12) SAH, 90% (19/21) IPH, and 100% (12/12) IVH. The DRCNN with a HT for ICH detection had a FPR of 2% (1/46 NHCTs evaluated). The DRCNN with a LT for ICH detection had a FPR of 28% (13/46 NHCTs evaluated).

CONCLUSION

DRCNNs can be trained to successfully detect all types of ICH on HCT examinations in all possible clinical scenarios.

CLINICAL RELEVANCE/APPLICATION

Automated detection of intracranial hemorrhages could potentially be used clinically to help triage completed unread examinations and assist with detection of subtle hemorrhages.

SSJ18-04 Substantially Shortened Brain and Lumbar Spine MR Scan Times with a Machine Learning-Based Iterative Image Reconstruction Algorithm

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E451B

Participants
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PURPOSE

To evaluate the scan time shortening potential of a novel 3D image enhancement algorithm for brain and lumbar spine MRI exams.

METHOD AND MATERIALS

Fifty-six subjects (mean age 48+/-16 years) were scanned on four 1.5T scanners (Philips-Ingenia: 18 brain, 6 spine; Siemens-Aera: 9 brain, 2 spine; General Electric Signa-HDxt: 10 brain, Optima MR450w 11 spine), at three different sites using the site's routine clinical protocols as well as an average of ~30% shorter scan time-reduced variants. The time-reduced variant protocols were set by altering routine acquisition parameters, trading scan time reductions, mainly, for decreased signal to noise ratio. The faster, SNR challenged scans were processed with a novel 3D image enhancement algorithm (iQMR by Medic Vision Ltd.) and compared with the corresponding sites' routine scans (153 brain scans and 43 lumbar spine scans). Independent, blinded, side-by-side comparisons of diagnostic quality, visual image quality, presence of artifacts and brain gray-white matter differentiation were performed by six neuroradiologists for brain data and three neuroradiologists for spine data, using a 5-point Likert-scale (3= equal, >3 processed image is superior).

RESULTS

The processed-reduced scan time images (614 brain reads, 129 lumbar spine reads) were rated higher or equal to the conventional routine scans with respect to diagnostic quality (brain: median=3, mode=3, mean=2.94+/-0.39; spine: median=3, mode=3, mean=3.05+/-0.39), visual image quality (brain: median=3, mode=3, mean=2.83+/-0.69; spine: median=3, mode=3, mean=3.14+/-0.77), the presence of artifacts (brain: median=3, mode=3, mean=2.91+/-0.54; spine: median=3, mode=3, mean=3.11+/-0.66) and for brains, gray-white matter differentiation (median=3, mode=3, mean=2.91+/-0.46).

CONCLUSION

iQMR processed, reduced scan time images were similar in overall image quality to standard protocols with a reduction of MRI exam scan time of about 30%.

CLINICAL RELEVANCE/APPLICATION

iQMR can produce clinically acceptable MR images at significantly shorter scan times, facilitating patient comfort and clinical practice workflow. Faster scans could potentially decrease motion artifacts and reduce the need for repeat scans.

SSJ18-05 Radiomics-Based Prediction of Malignant Potential in Patients with Parotid Gland Cancer

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E451B

Participants
Hidemi Kamezawa, Omuta, Japan (*Presenter*) Nothing to Disclose
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PURPOSE

Prediction of malignant potential (low+intermediate and high grades) in patients with parotid gland cancer (PGC) is crucial in determination of treatment approaches. Although the fine needle aspiration cytology (FNAC) is performed for prediction of malignant potential for PGC, various researchers have reported the prediction accuracy of malignant potential in PGC by the FNAC, which depends on the operator experience, was from 69 to 92%. Therefore, we developed the radiomics-based prediction of malignant potential in patients with parotid gland cancer.

METHOD AND MATERIALS

A total of 972 radiomic features (statistic, texture, wavelet-based features) were extracted from tumor regions in preoperative T1- and T2-weighted images of 42 PGC patients. Radiomic signatures for prediction of malignant potential in PGC patients were generated by using least absolute shrinkage and selection operator (LASSO), which is one of sparse coding approaches that performs both feature selection and regularization to avoid the curse of dimensionality. Malignant potential for PGC was predicted by using Gaussian support vector machine (G-SVM), which is a machine learning classifier. The accuracy and the mean area under the receiver operating characteristic curve (AUC) of G-SVM model by a leave-one-out cross validation test were evaluated.

RESULTS

The 5 features, which included T1_LLH_Skewness, T1_HLH_Min, T2_gray-level non-uniformity (GLN), T2_LLH_Long Run Emphasis (LRE), and T2_LLH_Small Zone High Gray-Level Emphasis (SZHGE), were selected by LASSO as the radiomic signatures for the malignant potential for PGC. The prediction accuracy of the malignant potential for PGC by using the G-SVM based on the selected 5 features was 90.5%, and the AUC was 0.96 with a sensitivity of 0.90 and a specificity of 0.90.

CONCLUSION

The proposed approach demonstrated high accuracy in classification of the malignant potential for PGC. Our results suggested that the proposed approach based on radiomics using preoperative MR images could be feasible to predict the malignant potential for PGC.

CLINICAL RELEVANCE/APPLICATION

The proposed approach contributes to the higher accuracy and lower intra- and inter-observer variabilities for prediction of malignant potential in parotid gland cancer.

SSJ18-06 Brain Tumor Segmentation on Fluid-Attenuated Inversion Recovery MRI Using Transfer Learning on U-Net

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E451B

Participants
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PURPOSE

Lesion assessment of glioma hyperintense volumes on fluid-attenuated inversion recovery (FLAIR) MRI is important for surgery, treatment planning, and genomic analysis. Manual delineation of the hyperintense region is time-consuming and subject to inter- and intra-operator variability. The purpose of this study is to assess the feasibility of FLAIR hyperintense region segmentation using a fully automated convolutional neural network (CNN) technique.

METHOD AND MATERIALS

We retrospectively collected 151 patients (363 time points) with low and high-grade gliomas. Each of the patients had a 3D T2-weighted FLAIR sequence with TE/TR = 126/6000 ms, TI = 863, and FOV = 24 cm. Prior to analysis, raw data were corrected for bias field and distortion, image registration, and skull stripping. FLAIR hyperintense volumes were segmented semi-automatically (Amira software package, Visage Imaging) on the co-registered images by two trained image analysts and approved by a board-certified neuro-radiologist with expertise in neuro-oncology. We developed a 2D U-net algorithm for segmentation and serially trained the model with images containing large lesions, small lesions, and no lesions. Three hundred of the cases were used for training and sixty-three were used for validation. We evaluated our model using Dice coefficients between the manually segmented and CNN-derived FLAIR volumes on the validation set.

RESULTS

Our proposed model segmented the hyperintense regions with the average Dice coefficient of 0.85. In 79% of patients, the dice coefficient was more than 0.8. Prediction of FLAIR volume from our cascaded U-net model closely matched with expert annotation (ρ=0.91).

CONCLUSION

In this study, we demonstrate the utility of a fully-automated CNN technique for segmenting the hyperintense region on FLAIR. We increased the performance of our model with transfer learning from images with large hyperintense regions to the images with no lesion. Implementation of this CNN into the clinical workflow may help improve the ROI drawing performance and reduce the discrepancies among image analysts.

CLINICAL RELEVANCE/APPLICATION

We present a fully automated technique for tumor segmentation of the FLAIR MRI of the patients with gliomas. Our model will increase accuracy of clinical interpretations by standardizing and quantifying the determination of the FLAIR hyperintense volume as a crucial part of Response Assessment in Neuro-Oncology (RANO).

SSJ19

Neuroradiology (Movement Disorders: Moving Fast and Moving Slow)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E351

BQ MR NR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Kei Yamada, MD, Kyoto, Japan (*Moderator*) Nothing to Disclose
Joshua S. Shimony, MD, PhD, Saint Louis, MO (*Moderator*) Nothing to Disclose

Sub-Events

SSJ19-01 Prediction of Presynaptic Dopaminergic Function in Subjects with Parkinsonism: Quantitative Comparison Between Nigrosome-1 Susceptibility Map-Weighted Imaging and High-Spatial-Resolution Neuromelanin-Sensitive Imaging

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E351

Participants

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PURPOSE

Dopamine transporter imaging such as 18F-FP-CIT PET (CIT PET) is needed to assess presynaptic dopaminergic function, but its accessibility and cost are limited. We sought to compare nigrosome-1 susceptibility map-weighted imaging (SMWI) with 0.8-mm isovoxel NMI for predicting presynaptic dopaminergic function.

METHOD AND MATERIALS

We enrolled 79 subjects who underwent both MRI and CIT PET for parkinsonism. Oblique axial 0.5×0.5×1.0-mm3 SMWI and 0.8-mm isovoxel 3D T1-weighted NMI were obtained at 3T. SMWI was resliced in 0.5-mm increments. Below the red nucleus, 4 consecutive SMWI images (2-mm slab) and were only assessed. Three NMI images (2.4-mm slab) that encompassed the slab of the 4 SMWI images were also included for analysis. For SMWI, the pixels less than the mean background (decussation of the superior cerebellar peduncle) signal intensity (SImean) - 3SD (SMWI3SD) and those less than SImean - 7SD (SMWI7SD) were separately selected in a semi-automated manner. For NMI, the pixels greater than SImean + 3SD (NMI3SD) and those greater than SImean (NMImean) were selected in a similar way. The volume ratios of SMWI7SD to SMWI3SD and NMI3SD to NMImean were calculated. Each side of the basal ganglia was separately assessed on CIT PET and was served as the reference standard for per substantia nigra (SN) analysis. For per participant analysis, more affected side was chosen on each MRI.

RESULTS

Patients were diagnosed as Parkinson's disease (n=54; advanced stage [n=16]) and drug-induced parkinsonism (n=25) based on clinical and imaging findings (106 abnormal basal ganglia on CIT PET). For per SN analysis, NMI showed sensitivity of 86.8% and specificity of 88.5% (AUC=0.896[95% CI, 0.838-0.939]; criterion<=0.424); SMWI demonstrated sensitivity of 89.6% and specificity of 75.0% (AUC=0.846[95% CI, 0.780-0.898]; criterion>0.368), showing no significant difference (*P*=0.2593). For per participant analysis, NMI showed sensitivity of 96.3% and specificity of 92.0% (AUC=0.939[95% CI, 0.861-0.980]; criterion<=0.385); SMWI demonstrated sensitivity of 92.6% and specificity of 72.0% (AUC=0.881[95% CI, 0.789-0.43]; criterion>0.4), showing no significant difference (*P*=0.3404).

CONCLUSION

For predicting presynaptic dopaminergic function, SMWI and high-spatial-resolution NMI were comparable.

CLINICAL RELEVANCE/APPLICATION

Both SMWI and NMI can serve as a screening imaging tool for patients who need further evaluation by dopamine transporter imaging.

SSJ19-02 MR Fingerprinting: A Possible Source for Imaging Biomarkers in Parkinson's Disease

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E351

Participants
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PURPOSE

Parkinson's Disease (PD) is a neurodegenerative disease with increasing incidence but currently limited availability of an MRI-based diagnosis or monitoring by imaging biomarkers. MR fingerprinting (MRF) is a recently developed quantitative MR acquisition and post-processing technique, which may have the potential to both significantly shorten MR protocols and detect PD-specific alterations of T1 and T2 signal relaxation times.

METHOD AND MATERIALS

25 PD patients (18m/7f, mean age±SD 69.6±6.9 yrs) and 25 healthy controls (HC; 13m/12f, mean age±SD 67.5±4.3 yrs) participated after informed consent. A new FISP-based MRF sequence (TR 15ms, TE 3.5ms, two spiral interleaves / layer; starting with an adiabatic inversion pulse; scan time: 3.2 min.) was added to the 3T standard MRI protocol (scan time: 28 min). The MRF dictionary used the extended phase graphs algorithm to generate B1-corrected MRF-qT1 and qT2 maps. The registration and segmentation of substructures was performed with FSL. Independent T-tests were applied to compare regional T1 and T2 values between PD and HC. Each participant was evaluated by a neurologist including the minimal mental state test (MMST).

RESULTS

PD patients and HC did not differ significantly with regard to age, sex and MMST score (p=0.2, 0.08, 0.28 respectively).MRF-qT1 mapping, but not MRF-qT2, identified significant differences between PD patients and HC: Gray matter: (PD: 1408.6±42.7ms vs. HC: 1435.9±39.3ms, p=0.02); white matter: (PD: 1053.9±45.1ms vs. HC: 1010.8 ± 65.8ms, p = 0.01); left amygdala: (MP: 1517.9 ± 81.3 ms vs. HC: 1579.7±95.7ms, p=0.02); right amygdala: (PD: 1523.1±111.6ms vs. HC: 1601.7±87.8ms, p=0.01).

CONCLUSION

MR fingerprinting-based T1 mapping seems to be a promising tool to identify PD patients. The regions identified as abnormal, including white matter and the amygdalae, indicate that PD affects the brain globally rather than being limited to the basal ganglia.

CLINICAL RELEVANCE/APPLICATION

We are in need for reliable MR tools to diagnose and monitor PD by MRI. This study indicates that MR fingerprinting is a method worth following as a solution to achieve this goal. Future studies need to go deeper into machine learning applications of MRF for PD.

SSJ19-03 Clinical Application of Quantifying Consecutive Dopamine Neuronal Changes in the Substantia Nigra Pars Compacta During the Development of Early Parkinson's Disease Using Neuromelanin and Diffusion Tensor Imaging

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E351

Participants
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PURPOSE

Early Parkinson's disease (PD) develops from rapid eye movement sleep behavior disorder (RBD) which has been previously reported as a precursor of PD. Our aim was to assess the utility of consecutive dopamine neuronal changes in the substantia nigra pars compacta (SNpc) with MRI in evaluating the early stages of PD development.

METHOD AND MATERIALS

Eighteen patients (PD group) with early PD (Hoehn and Yahr scale: 1-2), 13 patients with RBD (RBD group) and 20 age-matched healthy controls (HC group) underwent neuromelanin imaging and diffusion tensor imaging (DTI) on a 3T magnetic resonance imager. The neuromelanin SNR (signal-to-noise rario) and the DTI value [mean diffusivity (MD) and fractional anisotropy (FA) values] of the SNpc were calculated using an automatic volumetric region of interest selection method. The significance of the intergroup differences using analysis of variance with Tukey's post hoc test was tested for each neuromelanin area with an SNR higher than that of the background and DTI value. The correlation between the neuromelanin area and the DTI value of all the groups was assessed. Logit (p) was used to estimate the probability of each RBD and early PD in relation to the neuromelanin area and the DTI value, and the diagnostic performance of each value for RBD and early PD was assessed using receiver operating characteristic (ROC) analysis.

RESULTS

The neuromelanin area was significantly less and the MD value was significantly higher in both RBD and PD group than in HC group ($P < 0.05$), whereas, no significant intergroup difference was shown in the FA value. A moderate correlation between the neuromelanin area and the MD value was found ($|r|$: 0.47). The respective areas under the ROC curve for neuromelanin area/MD value were 0.76/0.79 for RBD and 0.80/0.80 for the early PD. The respective areas under the ROC curve for logit (p) in relation to neuromelanin area and MD value were 0.81 for RBD and 0.85 for the early PD. (See optional figure)

CONCLUSION

Quantifying consecutive dopamine neuronal changes in the SNpc using both neuromelanin and MD values may be a useful technique in the evaluation of the early stages of PD.

CLINICAL RELEVANCE/APPLICATION

Comprehensive MRI assessment for PD-related consecutive dopamine neuronal changes in the SNpc can provide a high diagnostic accuracy of the early stages of PD.

SSJ19-04 Differentiation of Atrophy Patterns and Diagnosis of Parkinsonian Syndromes Based on Combination of Manual and Automated Brain Measurements

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E351

Participants
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PURPOSE

To retrospectively assess the value of magnetic resonance (MR) imaging automated volumetric measurements of midbrain, pons, cerebellum, third ventricle, putamen and manual magnetic resonance (MR) imaging indexes to study the different atrophy patterns of Parkinsonian syndromes and differentiate progressive supranuclear palsy (PSP) from Parkinson's disease (PD) and multiple system atrophy (MSA).

METHOD AND MATERIALS

Brain volumetric ratios adjusted for intracranial volume (ICV) of pons, midbrain, cerebellum, third ventricle and putamen were automatically measured by segmentation tool Accubrain on 3D T1-weighted MR images in 56 consecutive patients with PSP (39 male, 17 female; mean age, 70.9 years), 69 with PD (36 male, 33 female; mean age, 63.9 years), 15 with MSA (9 male, 6 female; mean age, 58.2 years), and 50 healthy controls (30 male, 20 female; mean age, 66.1 years). MR parkinsonism index and midbrain-pons short axis ratio (M/P) were also manually calculated. Differences in MR imaging volumetric measurements among groups were evaluated with Kruskal-Wallis H test and differences between two groups were evaluated with Mann-Whitney U test. Receiver operating characteristic curve analysis was used to define cutoff values in PSP.

RESULTS

Pons volumetric ratio in MSA was smaller than that in PD (P=0.0007) and control (P=0.0006). Midbrain volumetric ratio in PSP was smaller than that in PD (P 0.52 and 34 patients (60.71%) whose MRPI 13.55. In our study, midbrain-pons short axis ratio (M/P) of 0.57 (specificity 86.57%, sensitivity 76.54%) and MRPI of 10.81 (specificity 82.84%, sensitivity 78.57%) were the more proper cutoff values for PSP.

CONCLUSION

Combination of manual and automated cerebral measurements can present different brain atrophy features in Parkinsonian syndromes and help distinguish PSP from other Parkinsonian degenerative disorders.

CLINICAL RELEVANCE/APPLICATION

Different brain atrophy features of Parkinsonian Syndromes may help clinically differentiate these degenerative disorders and the more accurate cutoff values for diagnosis of PSP was newly set in our study

SSJ19-05 Quantifying Consecutive Changes in Dopaminergic Nigrostriatal System During the Early Stages of Parkinson's Disease Development Using Diffusion Tensor Imaging

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E351

Participants
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PURPOSE

The development of Parkinson's disease (PD) is characterized pathologically by dopaminergic neurodegeneration in the substantia nigra pars compacta (SNpc) and resulting in dopamine neuronal dysfunction in the striatum. Recently, rapid eye movement sleep behavior disorder (RBD) has been reported as a precursor of PD. Our aim was to access the clinical application of measuring water diffusivity in consecutive changes in dopaminergic nigrostriatal system during the early stages of PD development.

METHOD AND MATERIALS

Eighteen patients (PD group) with early PD (Hoehn and Yahr scale: 1-2), 13 patients with RBD (RBD group) and 20 age-matched healthy controls (HC group) underwent diffusion tensor imaging (DTI) and three-dimensional T1W imaging on a 3T magnetic resonance imager. All MR imaging data were transferred to a computer. For highly reproducible image analysis, an automatic volumetric region of interest selection method was developed with the voxel-based morphometric technique. By using this method, the DTI value [mean diffusivity (MD) and fractional anisotropy (FA) values] of each SNpc and putamen was calculated. The significance of the intergroup differences using analysis of variance with Tukey's post hoc test was tested for the DTI value of each SNpc and putamen.

RESULTS

In the SNpc, the MD value in both RBD and PD group was significantly higher than in HC group ($P < 0.05$), while no significant intergroup difference was shown in the FA value. In the putamen, the MD value in PD group was significantly higher than in both HC and RBD group and the FA value was significantly higher in RBD group than in HC group and significantly less in PD group than in RBD group ($P < 0.05$). (See optional figure)

CONCLUSION

The measurement of water diffusivity in dopamine neuron in the SNpc can significantly differentiate patients with both RBD and early PD from healthy subjects. Meanwhile, the measurement of water diffusivity in the putaminal dopamine neuron may be useful in not only differentiating patients with both RBD and early PD from healthy subjects but also, in evaluating the evolution of RBD to early PD.

CLINICAL RELEVANCE/APPLICATION

Quantifying consecutive changes in dopaminergic nigrostriatal system with DTI technique can be useful in monitoring the early stages of Parkinson's disease development.

SSJ19-06 Individual Classification of Parkinson Disease with Diffusion Magnetic Resonance Imaging

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E351

Participants
Wenliang Fan, BMedSc,PhD, Wuhan, China (*Presenter*) Nothing to Disclose

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PURPOSE

To investigate the feasibility and performance of the PD classification using diffusion MRI of different machine learning methods.

METHOD AND MATERIALS

A total of 285 PD patients and 135 healthy controls were included and underwent diffusion tensor imaging scans. DTI images were processed with the FSL toolbox to get the parameters such as fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD), radial diffusivity (RD). Values of each brain areas in stereotaxic white matter atlas were extracted by the ICBM template as the raw features for subsequent machine learning based classifiers. All of the PD patients and healthy controls were separated to training data sets and testing data sets. Feature optimization was performed by the LASSO and principal component analysis. And both the filter- and wrapper-based feature selection models were used to get the final features used in the last classifier. The k-nearest neighbor algorithm (KNN), naïve Bayes algorithm and support vector machine (SVM) models were trained on the training data sets and the performance of these models were evaluated by the testing data sets.

RESULTS

Compared to healthy control subjects, PD patients showed significantly alteration of white matters in wide spread brain regions. The machine learning analyses showed that the SVM model performs best than KNN and naïve Bayes algorithm with an overall accuracy of 86.7%, sensitivity of 83.3% and specificity of 89.0% when discriminated PD patients from healthy controls.

CONCLUSION

The combination of DTI and machine learning methods is a promising method to discriminate PD patients from healthy controls. These findings may be useful for future incorporation of DTI and machine learning methods for disease classification, or as a useful tool for clinical diagnosis by diffusion MRI.

CLINICAL RELEVANCE/APPLICATION

DTI-based machine learning methods can help to better PD diagnosis.

SSJ20

Neuroradiology (Spine Imaging: Backbone of Neuroradiology)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E352

NR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Andrew P. Klein, MD, Pewaukee, WI (*Moderator*) Nothing to Disclose
Wende N. Gibbs, MD,MA, Pasadena, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSJ20-01 Comparative Trends in Utilization of Cervical Spine Imaging: A Reflection of Shifting Trends in Outpatient Imaging to the ED?

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E352

Participants
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PURPOSE

To study utilization trends in CT, MRI, and plain radiography (XR) of the cervical spine (CSP) among outpatients in the Medicare population.

METHOD AND MATERIALS

The nationwide Medicare Part B Physician/Supplier Procedure Summary databases for 2004 to 2016 were queried. Medicare's location codes were used to identify CSP imaging examinations done in EDs, outpatient offices, and hospital outpatient departments (HOPDs). These are the 3 locations where virtually all outpatients will undergo imaging. CPT-4 codes were selected for CT, MRI, and plain XR of the CSP. For each code, the database provides procedure volume; utilization rates per 100,000 beneficiaries were then calculated. Utilization trends were studied between 2006 and 2016. As this database represents a complete population, sample statistics are not required.

RESULTS

In EDs, the CSP CT rate per 100,000 enrollees increased from 217 in 2004 to 2031 in 2016 (+836%). The ED CSP XR rate decreased from 783 in 2004 to 261 in 2016 (-67%). ED CSP MRI utilization rate also increased, rising from 13 in 2004 to 47 in 2016 (+262%). In HOPDs the rate changes from 2004 to 2016 were as follows: CT 154 to 335 (+117%); MRI 555 to 791 (+43%); XR 1109 to 1142 (+3%). In private offices the rate changes were as follows: CT 64 to 96 (+50%); MRI 616 to 700 (+14%); XR 1497 to 1495 (no change). In all 3 outpatient locations together, the CSP rate changes were: CT 435 in 2004 to 2462 in 2016 (+466%); MRI 1184 in 2004 to 1538 in 2016(+30%); XR 3389 in 2004 to 2898 in 2016 (-14%). In 2004, CT and MRI comprised 21% and 1.3% of CSP imaging in the ED, which increased to 71% and 1.6% respectively in 2016.

CONCLUSION

The utilization rate of outpatient CSP CT imaging is increasing rapidly, especially in EDs. The utilization rate of CSP MRI has more than doubled but is well below that of CT. CSP XR utilization is declining. By 2016, the CT rate was almost as high as the XR rate.

CLINICAL RELEVANCE/APPLICATION

Among Medicare population outpatients who undergo imaging of the CSP, the utilization rate of cross sectional imaging is increasing rapidly, especially in EDs, while the utilization rate of XR is declining. The proportion of the increase in ED utilization may represent a shift of outpatient imaging to the ED.

SSJ20-02 Evaluation of Dual-Energy Metal Artifact Reduction Methods for Patients with Instrumented Spines

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E352

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PURPOSE

Spine hardware causes artifacts in CT imaging due to beam hardening, photon starvation, scatter, noise, and non-linear partial volume effect. This study aims to evaluate three dual-energy CT (DECT) metal artifact reduction methods in patients with instrumented spines.

METHOD AND MATERIALS

20 patients with instrumented spines who underwent DECT were retrospectively identified. All scans were performed on a dual-source 128-slice scanner (SOMATOM Flash, Siemens Healthcare) using 100/140Sn kV pair with CARE Dose4D. In addition to the original DE linearly mixed images, images were reconstructed using iterative metal artifact reconstruction algorithm (DE iMAR), virtual monochromatic imaging (DE Mono+) at 130 keV, and a combination of the two methods (DE iMAR Mono+). Slice thickness and reconstruction kernel were kept the same. The four image series were anonymized and randomized for a reader study. Four experienced neuroradiologists rated them in terms of artifact scores for four relevant anatomical regions and an overall image quality score for both bone and soft tissue display window settings. In addition, a quantitative analysis was performed to assess the performance of the three metal artifact reduction methods by counting artifact-contaminated pixels that were recovered by the metal artifact reduction methods.

RESULTS

There were statistically significant differences in the artifact scores and overall image quality scores among the four image sets (both $p < 0.001$). DE iMAR Mono+ showed the best artifact scores and quality scores (all $p < 0.001$). Intraclass correlation coefficient among the readers was 0.779 and 0.892 for the overall quality score using the bone display window and soft tissue window, respectively (both $p < 0.001$). In addition, DE iMAR Mono+ reduced the artifacts by the greatest amount in the quantitative analysis.

CONCLUSION

DE iMAR Mono+ method demonstrated the best performance for spine metal artifact reduction using DECT data. These results may be specific to this CT vendor and spine implant types.

CLINICAL RELEVANCE/APPLICATION

A dual-energy CT metal artifact method was identified to best reduce metal artifacts for patients with spinal hardware, which would benefit spine and other CT exams affected by spine metal artifacts.

SSJ20-03 Osteoporosis Identification and Treatment Among Previously Undiagnosed Patients with Vertebral Fractures

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E352

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PURPOSE

Unexplained fractures are an accepted indication for osteoporosis screening. Our aim was to determine how often patients without prior histories of osteoporosis undergo bone densitometry (DEXA scans), receive their initial diagnoses, or start osteoporosis medication after imaging studies demonstrated vertebral fracture.

METHOD AND MATERIALS

We used data from a pragmatic cluster randomized trial, consisting of adult patients from four integrated health care systems who received lumbar spine plain films, CT or MRI ordered by primary care providers from 10/2013 through 9/2016. We identified men $\geq$ 50 and women $\geq$ 52 years old with at least one vertebral fracture on their index imaging exams. We excluded patients with histories within the previous 12 months of severe trauma, diagnosis codes for osteoporosis/osteoporotic fractures or cancer, and/or bone densitometry procedure codes. Prior prescriptions for osteoporosis medications will be added as an exclusion factor, as well as an outcome, before presentation. We report the proportion of patients with subsequent osteoporosis diagnoses, defined as having at least one of the following within 12 months: CPT code for DEXA; ICD diagnosis code for osteoporosis; or prescription for an osteoporosis medication. (Patients with any of these on day 0 were considered to be newly diagnosed, and therefore were classified as outcomes, rather than excluded.)

RESULTS

Of the 23,199 patients who had fractures on index imaging (10% of the entire cohort), 56% (n=12,935) met inclusion criteria. After 12 months, 16% (n=2130) had bone densitometry scans and 23% (n=2999) received osteoporosis diagnoses; 29% (n=3772) had at least 1 of these outcomes, and 10% (n=1357) had both.

CONCLUSION

Only 29% of primary care patients who underwent lumbar spine imaging and had vertebral fractures received *de novo* osteoporosis diagnoses and/or bone densitometry scans within the next year. A large proportion of patients who have potentially identifiable osteoporosis remain undiagnosed.

CLINICAL RELEVANCE/APPLICATION

A large proportion of patients who present with vertebral fractures and are at risk for osteoporosis remain undiagnosed.

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/ Jeffrey G. Jarvik, MD - 2017 Honored EducatorJeffrey G. Jarvik, MD - 2018 Honored Educator

SSJ20-04 MR-Based Radiomic Analysis of Radiofrequency Lesion Predicts Outcomes After Percutaneous Cordotomy: A Feasibility Study

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E352

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PURPOSE

The aim of the present study is to evaluate the utility of MR-based radiomic analysis to quantify microstructural changes created by the cordotomy lesion and predict outcome in patients undergoing percutaneous cordotomy for medically refractory cancer pain.

METHOD AND MATERIALS

This is a retrospective interpretation of prospectively acquired data in 10 patients (5 males, age range 43-76 years) who underwent percutaneous CT-guided high cervical cordotomy for medically refractory cancer pain between 2015-2016. All patients underwent MR imaging of the cordotomy lesion on postoperative day 1. Aftersegmentation of T2-weighted images, 310 radiomic features were extracted. Pain outcomes were recorded on postoperative day 1 and day 7 using the visual analog scale. R software was used to build statistical models based on MRI radiomic features for prediction of pain outcomes.

RESULTS

Six of 10 patients (60%) showed decreased pain on postoperative day 1, and all patients had decreased pain on postoperative day 7. Twenty relevant radiomic features were identified using the mRMR method. Radiomics predicted postoperative day 1 pain scores with an accuracy of 90% (p-value= 0.046), 100% sensitivity, 75% specificity, 85.7% positive predictive value and 100% negative predictive value. The radiomics model also predicted if the postoperative day 1 pain score was sustained on postoperative day 7 with an accuracy of 100% (p-value= 0.02825), 100% sensitivity, 100% specificity, and 100% positive and negative predictive value.

CONCLUSION

MR-based radiomic analysis of the cordotomy lesion was predictive of pain outcomes at 1 week after percutaneous cordotomy for intractable cancer pain.

CLINICAL RELEVANCE/APPLICATION

MR-based radiomic analysis can non-invasively characterize microstructural changes created by the cordotomy lesion.

SSJ20-05 How Can Inter-Observer Reliability of Cervical Central Spinal Stenosis Evaluation and Cord Compression Be Improved?

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E352

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PURPOSE

To evaluate the potential value of quantitative analysis of the bony canal size and CSF space to improve the quality and consistency of the standard qualitative visual assessments of cervical spinal stenosis (CSS).

METHOD AND MATERIALS

IRB-approved retrospective review of 39 levels of CSS from 20 patients were qualitatively assessed independently by 3 radiologists to rate the degree (mild, moderate, or severe) of CSS. The degree of CSS was then separately assessed quantitatively using calipers and categorized by the reduction of the bony canal level relative to the assumed normal diameter (10 mm): 7-10 mm (<30%), 4-6 mm (31-60%) and <4 mm (>61%), respectively. Similarly, quantitative analysis of the CSF space was assessed at the levels of CSS with different parameters of the thecal sac, including AP diameter, Left-right (LR) diameter and CSF area. Inter-reader agreement among the 3 readers was evaluated using Light's kappa and the intraclass correlation coefficient (ICC). The non-parametric bootstrap was used to calculate confidence intervals (CIs) and compare kappa/ICC values.

RESULTS

Inter-reader agreement of the qualitative assessment of the degree of CSS was fair with unweighted kappa 0.39 (95% CI: 0.23-0.57). Inter-reader agreement for the quantitative analysis of bony canal narrowing was significantly higher than that for qualitative degree of CSS (p=0.005), with unweighted kappa 0.69 (95% CI: 0.46, 0.86). For the quantitative analysis of the CSF space, there was also good inter-reader agreement on CSF AP diameter (ICC 0.80, 95% CI: 0.65-0.86) and CSF axial areas (ICC 0.75, 95% CI: 0.50-0.90), though agreement was lower for CSF LR diameter (ICC 0.50, 95% CI: 0.25-0.64).

CONCLUSION

Consistency of qualitative visual analysis of CSS can be improved with quantitative measurements of the bony canal diameter, although this 'one size fits all' approach to CSS evaluation does not account for individual size variation of the spinal canal and cord. Quantification of the CSF space has great potential since it can be performed consistently by different readers, accounts for thecal sac deformity and size variations of the bony canal and cord, and provides direct visualization of cord compression.

CLINICAL RELEVANCE/APPLICATION

Qualitative evaluation of cervical spine stenosis suffers from inconsistent interpretation and individual anatomic variation which can be improved by quantitative analysis of bony canal and CSF space.

SSJ20-06 Over-Reliance on Fluoroscopy Guided Lumbar Punctures Can Negatively Impact Neuroradiology Training in Radiology Residency: An Analysis and Potential Solution through Establishing Departmental Guidelines for Referring Clinicians

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E352

Awards
Student Travel Stipend Award

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PURPOSE

Requests for fluoroscopy guided lumbar punctures have increased over the past decades. They are primarily performed by radiology trainees in many academic institutions. We evaluated the impact of the number of fluoroscopy guided lumbar punctures performed on the number of cross-sectional neuroimaging studies residents dictated during their neuroradiology rotation. We also evaluated the effect that introducing department guidelines for lumbar punctures had on the number of lumbar puncture referrals we received in our neuroradiology division.

METHOD AND MATERIALS

We retrospectively reviewed the fluoroscopy guided lumbar punctures and myelograms performed and neuroimaging studies dictated by radiology residents on our neuroradiology service from July 2008 - December 2017. We used Poisson regression analysis to directly examine the relationship between the number of fluoroscopy guided lumbar punctures performed and neuroimaging studies (CT and MRI) dictated per day by residents. We developed and instituted guidelines for ordering fluoroscopy guided lumbar punctures and evaluated its effect on the number of these procedures performed before and after institution of the guidelines.

RESULTS

Radiology residents (n=84) performed a total of 3436 fluoroscopy guided lumbar punctures and myelograms and interpreted 33,402 cross-sectional studies. For each fluoroscopy guided lumbar puncture or myelogram performed, there was an estimated factor reduction in the total number of neuroimaging studies dictated of 0.77 for both first year residents and all residents (p<0.001). After institution of the guidelines, there was a statistically significant decrease in the number of fluoroscopy guided lumbar punctures performed (p<0.001).

CONCLUSION

We demonstrated that performing fluoroscopy guided lumbar punctures has an inverse relationship with the number of neuroimaging studies radiology residents dictate on the neuroradiology rotation. We instituted department guidelines which significantly decreased the number of fluoroscopy guided lumbar punctures performed.

CLINICAL RELEVANCE/APPLICATION

Performing fluorscopy guided lumbar punctures significantly decreases the number of cross-sectional neuroimaging studies read by radiology residents, which could potentially delay the development of their diagnostic neuroradiology skills.

SSJ21

Physics (Diagnostic X-Ray)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: N229

CH PH

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

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Sub-Events

SSJ21-01 METIS: Next-Generation Performance Informatics Platform for Value-Based Clinical Imaging Practice

Tuesday, Nov. 27 3:00PM - 3:10PM Room: N229

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PURPOSE

To develop a new performance informatics platform, called 'METrology for Imaging Systems (METIS)', that enables both radiation safety and image quality monitoring for prospective and retrospective assessments of dose and quality

METHOD AND MATERIALS

METIS has been developed with multi-year input and pilot trials at a large academic medical center. This data-centric platform integrates a multi-infrastructure workflow for collecting patient data and clinical images from the PACS, imaging workstations (CT, Mammography, Radiography, and Fluoroscopy), and electric health record system (Epic). Dose and image quality metrics are implemented from previously validate algorithms in a modality context-specific fashion. Device-, protocol-, and size-specific reference levels are established with supervised machine learning technologies. High-dimensional data analysis is performed to provide multi-dimensional visualizations to aid users in evaluating clinical performance and highlighting inconsistencies. All metrics and image data are managed in a MySQL-MongoDB hybrid database.

RESULTS

METIS was deployed in clinical operation since 2016. Dose data from 460,000 CT, 350,000 Mammography, 300,000 Radiography, and 10,000 Fluoroscopy exams are recorded. Over 500 dose reference lines are created for CT outlier identification. Over 60,000 chest radiographs are automatically evaluated to simulate radiologists' perceptual evaluation process. 1000 adult and 1000 pediatric CT scans are sampled from contrast and non-contrast enhanced CT chest/abdomen/pelvis exams to build the dose-quality metrics by using measured image noise, spatial resolution, contrast, and dose. A web-based dashboard with high-dimensional data visualization is developed to provide a holistic performance view, consolidating large-scale diverse clinical and operational data into a single graphics.

CONCLUSION

METIS offers the first strategy for combined dose and image quality monitoring. Adding quality-dose metrics and advanced prospective and retrospective data analysis, it provides opportunities for assessing and addressing the aggregate aspects of clinical imaging practice to ensure rigorous patient safety and consistent imaging quality.

CLINICAL RELEVANCE/APPLICATION

METIS fulfills an unmet need for a prospective and retrospective dose monitoring, along with image quality and device performance assessment, to ensure rigorous patient safety and consistent image quality.

SSJ21-02 Signal and Noise Performance of the Apodized-Aperture Pixel (AAP) X-Ray Detector Design to Increase Detective Quantum Efficiency (DQE)

Tuesday, Nov. 27 3:10PM - 3:20PM Room: N229

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PURPOSE

Recent studies from screening programs have shown significantly higher detection rates attributed to higher detector performance. X-ray detector performance, in terms of signal-to-noise ratio (SNR) for a given amount of radiation, is quantified by the detective quantum efficiency (DQE). Current clinical detectors have low DQE (<30%) at high-frequencies which are important for visualization of small image features. We have developed a novel x-ray detector design, called Apodized-Aperture Pixel (AAP), that could achieve high DQE at high-frequencies. The purpose of this research is to determine AAP performance in the presence of correlated or uncorrelated noise due to x-ray interactions or converter blur.

METHOD AND MATERIALS

Conventional x-ray detectors have the same element and pixel size. AAP design separates physical elements from image pixels by using micro-elements (0.01-0.025mm) to produce current clinical pixel sizes (0.07-0.2mm). Conventional and AAP designs were modeled with cascaded system analysis including x-ray interactions, converter blur, collection efficiency and readout noise. DQE was measured to evaluate proof-of-concept experiments with radiography and mammography detectors. Simulations of sinusoidal patterns and demonstration x-ray images were acquired for visual comparison.

RESULTS

Excellent agreement was found between theoretical and experimental results. AAP design provides 1.5x greater MTF at high frequencies than conventional design. For cases when detector DQE is dominated by converter blur (ie. pixel size is smaller than converter blur), x-ray reabsorption or element size, high-frequency DQE of the AAP design was 1.5x greater, 1.8x greater and 2.5x greater respectively compared to conventional design.

CONCLUSION

Compared to conventional design at high-frequencies, the AAP design has greater MTF from use of a micro-elements and greater DQE due to reduced noise aliasing. MTF and DQE improvement is greatest when x-ray reabsorption and converter blur effects are minimal. Simulations and x-ray images with the AAP design (Fig. 1) show increased contrast and reduced aliasing artifacts. The AAP design can achieve a flat-DQE that approaches an 'ideal detector' which was not previously possible.

CLINICAL RELEVANCE/APPLICATION

The Apodized-Aperture Pixel (AAP) x-ray detector design can increase high frequency MTF by 1.5x and DQE by 2.5x with the implication that this may help increase cancer detection rates.

SSJ21-03 Validation and Performance Evaluation of a Remote and Automated QC Program for Digital Radiography

Tuesday, Nov. 27 3:20PM - 3:30PM Room: N229

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PURPOSE

This study evaluates the performance viability of the Remote QC program as well as comparing the performance of ATIA with other established image quality assessment tools.

CONCLUSION

The easy-to-use ATIA provides results that are in agreement with those obtained by established methods. The results show the great applicability of the Remote QC program in monitoring trends. The results also show that however, caution needs to be used as not to damage the QC phantom and avoid using different image filtering, the consistent results will be still reproducible upon using the same phantom and acquisition protocol.

CLINICAL RELEVANCE/APPLICATION

Insufficient qualified medical physics support in some parts of the world may lead to an ineffective quality control program for digital radiography systems. To mitigate this situation a remote QC program package (ATIA) including a simple, yet data-rich phantom and software tool was developed in order to quantitative image assessment which remotely informs the medical physicists of issues in trend analysis.

SSJ21-04 Assessment of Scatter Emitting From the Exit Window of Interventional X-Ray Tubes

Tuesday, Nov. 27 3:30PM - 3:40PM Room: N229

Awards

Student Travel Stipend Award

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PURPOSE

Radiation safety practices have been based on the tenet that the primary source of occupational radiation dose to interventional radiologists is from the patient. The purpose of this work was to quantify the contribution of scatter emitting from the exit window of the x-ray tube to occupational radiation dose.

METHOD AND MATERIALS

Air kerma (KA) to the average location of the upper body of an interventional physician (height = 150cm) was measured with and without a 25 cm thick anthropomorphic phantom positioned in the x-ray beam. The experimental technique allowed isolation of radiation dose emitting from the phantom versus directly from the X-ray tube. KA measurements were normalized by dose area product. Experimental geometry was consistent with that of PA imaging during thoracic and abdominal interventional procedures. No accessory radio-protective shields were used. Scatter from x-ray tubes by three manufacturers was assessed and systems were configured to produce similar quality beams (81 kVp, filtration: 0.2 mm Cu or 0.1 mm Cu + 1 mm Al). Further, scatter from a selected X-ray tube was reassessed following the addition of 0.5 mm Pb to the inside surface of the collimator assembly housing.

RESULTS

The magnitude of scatter originating from within the phantom was equivalent for all systems. Considering all x-ray tubes and variable distance from the central ray, scatter emitting from the beam exit window of the tubes accounted for 20% to 55% of the total scatter. There was a minimum of 20% tube scatter at all distances with respect to the central axis of the X-ray beam, with some tubes exhibiting increased tube contribution as the measurement point was moved toward the central axis. The X-ray tube scatter originated from interaction of the x-ray beam with x-ray collimator assembly components, including the DAP meter. The addition of 0.5 mm Pb to the collimator assembly housing provided an approximately 50% reduction of tube scatter to the location of an interventional physician.

CONCLUSION

X-ray scatter originating from within the x-ray collimator assembly was found to contribute substantially to the radiation dose measured at a typical location of the upper body of an interventional physician.

CLINICAL RELEVANCE/APPLICATION

The primary source of occupational radiation dose was thought to be from the patient. However, our study shows that X-ray tube scatter is in fact a significant contributor to occupational dose.

SSJ21-05 Comparison of Stationary Digital Chest Tomosynthesis to Portable Chest Radiographs: A Patient Study

Tuesday, Nov. 27 3:40PM - 3:50PM Room: N229

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PURPOSE

ICU patients are often too unstable to move for CT imaging. In these cases, portable chest radiographs (CXR) are used to assess pathology. Tomosynthesis can provide additional diagnostic information, but is not readily available at the bedside. The primary goal of our study was to compare the stationary digital chest tomosynthesis (s-DCT) system to portable CXR in the evaluation of patients with various lung pathologies.

METHOD AND MATERIALS

Patients undergoing clinically indicated chest CT were recruited to have a portable CXR and s-DCT scan, with our carbon nanotube (CNT) x-ray source array. Three thoracic radiologists evaluated the images. Readers scored the imaging on a scale of 1-5 based on 10 criteria; visualization of lung fields, vasculature, trachea, proximal bronchi, retrocardiac lung, diaphragm, costophrenic angles, ribs, spine, and hardware. Readers were asked to rate their confidence in interpreting the scans on a scale of 1-7. Furthermore, readers evaluated whether s-DCT gave them more information than CXR. A t-test for independent means was used to analyze the data.

RESULTS

A total of twenty-two patients were successfully imaged. The average age was 64.7 +/- 8.5 years. All readers gave s-DCT statistically higher scores when evaluating vasculature, proximal bronchi, and the spine (p: <0.00026). Readers 1 and 2 rated the ribs higher on s-DCT (p: <0.00001). Reader 2 gave statistically higher scores to s-DCT for the trachea, retrocardiac lung, and costophrenic angles (p: <0.0033). Reader 3 gave CXR higher scores for visualization of the diaphragm (p: 0.018). Confidence scores were not statistically different between techniques for readers 1 and 3. Reader 2 gave higher confidence scores to s-DCT (p: <0.00001). Readers 1 and 3 stated that s-DCT gave them information that CXR did not 36% and 41% of the time. While reader 2 indicated that s-DCT gave additional information 95% of the time.

CONCLUSION

Portable stationary-DCT in the ICU setting should be possible with our CNT s-DCT system. Tomosynthesis imaging improves visualization of thoracic structures compared to portable CXR. Reader confidence in s-DCT can be comparable or higher to CXR, and in a significant number of cases s-DCT gives information that is not provided by CXR.

CLINICAL RELEVANCE/APPLICATION

Stationary digital chest tomosynthesis is a potentially superior alternative to portable chest x-ray for patients in the ICU setting that cannot undergo CT examination.

SSJ21-06 Virtual Dual-Energy (VDE) Imaging: Separation of Bones from Soft Tissue in Chest Radiographs (CXRs) by Means of Deep Residual Learning (DRL)

Tuesday, Nov. 27 3:50PM - 4:00PM Room: N229

Participants
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PURPOSE

Lung nodules that overlap ribs and/or clavicles in CXRs can be difficult to be detected by radiologists, as well as by computer-aided detection (CAD) systems. Our purpose was to develop a new VDE imaging technique to separate ribs and clavicles from lung nodules and soft-tissue in CXRs by means of our newly developed DRL.

METHOD AND MATERIALS

We developed a novel DRL model employing our neural network convolution (NNC) framework in a residual convolutional manner to convert a standard CXR to an image that looks like a dual-energy (DE) bone image; thus, term VDE imaging. Our model consisted of 2 convolutional layers and 9 residual blocks, resulting in a deep 20-layer network. Each residual block contained two convolutional layers with batch normalization, and a shortcut connection, passing information from finer to coarser image features. Our DRL model was trained in an image-based fashion to learn the relationship between input CXRs and the corresponding "teaching" DE bone images. We used a large database of 118 CXRs with nodules with corresponding "gold-standard" DE images acquired with a DE imaging system (FCR 9501 ES, Fuji Medical Systems, CT). We trained and evaluated our model with a nested 2-fold cross validation protocol. Once trained, our technology no longer required DE images, and it provided VDE bone images where soft tissue was substantially attenuated, while bony structures were preserved. This image was then subtracted from the corresponding CXR to provide a VDE soft-tissue image from which bones were removed. We performed quantitative evaluation of our results by using the structural similarity (SSIM) image-quality index.

RESULTS

Our VDE technology was able to separate ribs and clavicles from lung nodules and soft-tissue structures very accurately in 118 CXRs and provided bone and soft-tissue images. Comparing to a state-of-the-art bone-suppression technique, our new VDE soft-tissue images had higher (t-test; $P<.01$) similarity (SSIM from 0.90 to 0.93) to the "gold-standard" DE soft-tissue images.

CONCLUSION

Our new DRL model converted CXRs to VDE soft-tissue images, where bones were separated from soft-tissue accurately, which offered the improved conspicuity of lung nodules and vessels.

CLINICAL RELEVANCE/APPLICATION

VDE technology requiring only a "single" CXR without requiring specialized equipment or additional radiation dose would be beneficial to radiologists as well as CAD in detection of lung nodules in CXRs.

SSJ22

Physics (Image Reconstruction)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: N227B

AI CT MR NM PH

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

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Sub-Events

SSJ22-01 Modified Model Based Iterative Reconstruction Method to Improve CT Number Accuracy in Low-Dose CT

Tuesday, Nov. 27 3:00PM - 3:10PM Room: N227B

Participants
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PURPOSE

Recent theoretical and experimental studies about CT number accuracy in low dose CT have shown that filtered backprojection (FBP) and conventional model based iterative reconstruction (MBIR) methods are biased by an amount that is dose and contrast dependent. This work validates that the data weighting scheme in the MBIR framework is the culprit for both these biases and that a more optimal weighting scheme has been found to eliminate bias across all dose and contrast levels.

METHOD AND MATERIALS

Raw CT data was acquired for two phantoms on a benchtop CT system using a photon counting detector (XC-HYDRA FX50, XCounter AB, Sweden). The Catphan phantom (Catphan 600, Phantom Laboratory, Salem, New York) was scanned at several dose levels in the range 69-367 mAs, with 50 repeated scans for each dose level. A customized head phantom was also scanned in the range 40-400 mAs, with 30 repeated scans for each dose level. Reference images for each phantom were obtained by averaging the pre-log projections for the highest dose level across all repetitions, and then performing FBP reconstruction. These references served as the experimental ground truth. For each dose level and reconstruction method (FBP, MBIR, proposed MBIR), bias images were calculated by subtracting the reference image from the mean of the reconstructions of each repeated scan. Bias was measured in 4 small inserts of varying contrast in the Catphan phantom. Bias images of the Catphan and head phantoms were also assessed across the image field of view (FOV).

RESULTS

There are three main results: 1) The theoretical relationship bias=$\pm a/mAs*(1+\beta\Delta HU)$ was validated experimentally for both FBP (positive polarity) and conventional MBIR (negative polarity). 2) The proposed MBIR method, which uses a modified weighting scheme, eliminates bias for each contrast and dose level in the Catphan phantom. 3) The proposed MBIR method demonstrates promising preliminary results for reducing bias across the FOV in a more complex anthropomorphic head phantom.

CONCLUSION

The proposed MBIR method maintains CT number accuracy of varying contrast across dose levels by using a theoretically based modified data weighting scheme.

CLINICAL RELEVANCE/APPLICATION

Certain tasks, e.g. detection of acute cerebral venous sinus thrombosis (CVST), rely on CT number estimation. It is critical the CT reconstruction method maintains accurate HU values.

SSJ22-02 Joint Reconstruction of Low-Count PET and Undersampled MR in PET/MR Using Deep Learning

Tuesday, Nov. 27 3:10PM - 3:20PM Room: N227B

Participants

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PURPOSE

Acquiring low-count PET and undersampled MR can shorten PET/MR scan time, which, however, may also lead to noisy PET images and MR images with artifacts. The goal of this report is to evaluate whether deep learning method can reconstruct high-quality PET/MR images from its low-quality counterpart, potentially enabling shorter scan time in PET/MR. We also compared the proposed model with single modality models to investigate whether the resulting image quality can benefit from sharing features of the two modalities in the network.

METHOD AND MATERIALS

We developed a fully convolutional encoder-decoder network to predict high quality PET and MR images from low-count PET and undersampled MR. Concatenate skip connections and strategy of residual learning is adopted to restore high resolution details. Brain PET/MR data are acquired with a simultaneous PET/MR system (uPMR790, United Imaging Healthcare) from 50 patients who received 0.12 mCi/kg FDG. To generate low-count PET, the PET list-mode data was randomly undersampled for 10% events. Both standard-count and low-count PET images were reconstructed with OSEM (4 iterations, 20 subsets). Undersampled T1 weight MR is generated using radial sampling in k-space with sampling rate equal to 10%. Standard-count PET and fully sampled MR were taken as ground-truth in network training.

RESULTS

Models were trained on 40 patients and evaluated on the other 10 patients. The proposed joint model gains 4.5/7.9dB in peak signal-to-noise ratio (PSNR) and 0.036/0.42 in structural similarity index (SSIM) compared with low-count PET/undersampled MR. When compared with the single modality model of PET/MR, results shows that our joint model has an improvement of 0.97/0.15dB in PSNR and 0.006/0.0012 in SSIM.

CONCLUSION

Using a deep learning algorithm, we can estimate high-quality PET and MR images from low-count PET and undersampled MR images. Results also showed that joint reconstruction of PET and MR by sharing features in network can improve image quality of two modalities compared with single modality model.

CLINICAL RELEVANCE/APPLICATION

This method was demonstrated promising in greatly reducing the scan time in PET/MR imaging by up to 90%.

SSJ22-03 Implementation of a CT Reference Library Containing Manufacturer-Neutral Projection Data, Images, and Clinical Metadata

Tuesday, Nov. 27 3:20PM - 3:30PM Room: N227B

Participants
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PURPOSE

A manufacturer-neutral CT projection data (PD) format (DICOM-CT-PD) has been previously developed and used to allow access to CT PD and the scanner information required for image reconstruction. Access to such data was not previously possible, limiting the ability of reconstruction scientists to work with patient data. In this work, we aim to construct a reference DICOM-CT-PD library containing patient PD with corresponding images and clinically relevant metadata, and to publish this library for public access.

METHOD AND MATERIALS

CT images and PD were acquired from three different manufacturers for three clinical scanners at routine dose levels for head, chest and abdomen exams. The PD were converted to the DICOM-CT-PD format and a lower dose exam was simulated for each PD set using a validated noise-insertion method. Radiologists reviewed each case and marked lesion locations and diagnosis. Reference truth was obtained from the patient medical record, either from histology or subsequent imaging. Metadata such as lesion location, diagnosis, and source of truth were acquired for each case and formatted into a reference report. Each case was anonymized to remove protected health information for transfer to an NCI-hosted public data archive, The Cancer Imaging Archive (TCIA).

RESULTS

450 total cases from Siemens (n=150), GE (n=150), and Philips (n=150) scanners were obtained, including both negative and positive patient cases. PD are available for two dose levels, routine full dose and simulated low dose (25% of routine dose for head and abdomen cases and 10% of routine dose for chest cases). Routine dose image series are available for all of the cases, and reduced dose images are additionally available for exams acquired on a Siemens scanner. Clinical metadata are organized in an easy to use spreadsheet. The assembled projection, image and clinical data provide a rich data library with which CT image reconstruction scientists can validate their algorithms.

CONCLUSION

A large patient library containing manufacturer-neutral PD, the corresponding full dose images, and clinical reference information has been developed and is being made available through the TCIA.

CLINICAL RELEVANCE/APPLICATION

The successful implementation of this library will provide open source CT PD with correlated images and clinical information to investigators for reconstruction research and development.

SSJ22-04 Motion Compensation in Liver SPECT using Simultaneous X-Ray and Nuclear Imaging

Tuesday, Nov. 27 3:30PM - 3:40PM Room: N227B

Participants
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PURPOSE

Quantitative accuracy of liver SPECT/CT is crucial for e.g. dosimetry in radioembolization, but due to respiratory motion limited in precision. Motion can be compensated for in the reconstruction, but in clinical practice this requires an external device for the tracking of the motion signal and a prior motion vector field estimate to link the motion signal to organ movements, complicating the acquisition. A device under development, which simultaneously measures x-ray and nuclear projections, could be used to retrieve both measures intrinsically. Such a data-driven approach eliminates the need for external devices and provides a real-time vector field. The purpose of this work is to evaluate the performance of the proposed motion compensation technique using simulations.

METHOD AND MATERIALS

Nuclear and x-ray projections of a realistic digital phantom with respiratory motion were generated using Monte Carlo simulations for several breathing patterns. X-ray projections were sampled at 1 to 5 Hz; nuclear projections were acquired continuously. Total x-ray imaging dose was varied from 1 to 1000 μGy. The motion signal was extracted from x-ray projections by calculation of the center of mass and then used to bin the projections into gates. The x-ray gates were individually reconstructed and registered onto each other, resulting in the vector field to be included in the nuclear reconstruction.

RESULTS

The respiratory motion signal was accurately extracted from the x-ray projections, provided the x-ray sampling rate was greater than 2 Hz and the motion was stable in amplitude. The total minimally required dose for x-ray sampling was 10 μGy for a 5 minute scan. The inclusion of motion correction into the SPECT reconstruction improved contrast-to-noise ratio, in comparison with no motion correction, from 11.9 ± 0.5 to 19.1 ± 0.7.

CONCLUSION

The proposed motion compensation technique has the potential to improve quantitative SPECT reconstructions. Additionally, the need for external devices and a prior vector field estimate are eliminated. Only a limited amount of dose is required to obtain significantly improved results, paving the way for clinical use.

CLINICAL RELEVANCE/APPLICATION

Liver radioembolization requires quantitative SPECT to study the activity distribution. In order to improve accuracy and personalize dosimetry, motion should be accounted for in reconstructions.

SSJ22-05 Motion Compensated Reconstruction of the Aortic Valve for Non-Gated Helical CT Scans

Tuesday, Nov. 27 3:40PM - 3:50PM Room: N227B

Participants
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PURPOSE

Precise CT imaging is prerequisite for reliable planning of transcatheter aortic valve implantation (TAVI). Especially in non-gated CT scans, cardiac motion leads to severe artifacts in the reconstructed CT images. Blurring of the valve and the neighboring vascular anatomy potentially result in incorrect device sizing. A second pass motion correction method for non-gated helical CT scans with a pitch <1 is introduced here.

METHOD AND MATERIALS

The new post-processing method was applied to five non-gated clinical datasets acquired with a 256-slice CT scanner (Brilliance iCT, Philips Healthcare). Redundancy in the helical projection data was used to generate three image volumes at identical spatial positions, but different time points. During each reconstruction a subset of detector rows was selected which may be either overlapping or fully separated depending on the pitch size. The 3D edge-filtering scheme included Gaussian smoothing for noise reduction, gradient calculation for edge enhancement, non-maximum-suppression and hysteresis thresholding for reduction of incoherent edges. The sparse filter results were taken as input for an elastic registration to estimate the displacement of each voxel between the given time points. Reconstructed datasets were evaluated with a TAVI planning software (IntelliSpace Portal, Philips Healthcare) by two blinded readers.

RESULTS

The method achieved significant motion artifact reduction in CT aortic valve reconstructions. A removal of doubled structures at the aortic boundaries could be observed, as well as reduced blurring compared to the uncompensated reconstructions.

CONCLUSION

Motion compensated reconstruction is feasible for non-gated helical CT scans using edge filtering and image based registration for motion estimation. Reconstructed CT image datasets may improve planning and device selection for TAVI procedures.

CLINICAL RELEVANCE/APPLICATION

Motion compensated reconstruction yields reduced artifact levels at the aortic valve in non-gated helical CT scans with a pitch <1.

SSJ22-06 Multi-Channel GAN: A Machine Learning Approach to Parallel MRI Reconstruction

Tuesday, Nov. 27 3:50PM - 4:00PM Room: N227B

Participants
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PURPOSE

Magnetic resonance imaging (MRI) has a low imaging speed. MRI acceleration relies on undersampling that may introduce aliasing artifacts in image reconstruction. Here we propose a machine learning approach that can automatically learn parallel MRI mechanisms underlying multi-channel k-space data and reconstruct high-quality MR images from undersampled data.

METHOD AND MATERIALS

Parallel MRI is a standard approach to imaging acceleration on clinical MRI scanners. This approach can effectively suppress aliasing artifacts associated with undersampling, but requires an additional calibration procedure that limits the overall imaging speed. Here a deep learning based neural network model, multi-channel generative adversarial network (multi-channel GAN), is developed to process multi-channel raw MRI data. This model can learn parallel MRI reconstruction mechanisms underlying a large amount of multi-channel k-space data. The trained model can be used to reconstruct images from undersampled data without calibration, thereby providing a higher imaging speed than conventional parallel MRI. In our approach, the basic unit of multi-channel GAN has two sub-networks: a generator network which learns the relationship between undersampled and fully-sampled data and a discriminator network which justifies if the generated data are real. The whole model consists of the same number of basic unit networks as that of radiofrequency channels on the MRI scanner for parallel MRI reconstruction. The training process uses a stochastic gradient descent and back-propagation algorithm. The trained multi-channel generator network is used to perform image reconstruction.

RESULTS

We evaluate the proposed method with a total of 170 sets of 2D multi-channel brain MRI images. Figure 1 shows an example of reconstruction results with an undersampling factor of 5. It is found that the machine learning method outperforms other state-of-the-art parallel MRI reconstruction methods.

CONCLUSION

We demonstrate a machine learning approach to parallel MRI reconstruction.This approach can generate high-quality images from undersampled data without calibration, providing a higher imaging speed than conventional parallel MRI.

CLINICAL RELEVANCE/APPLICATION

The machine learning approach to parallel MRI reconstruction can enhance diagnostic MRI quality, shorten clinical MRI procedures and improve clinical MRI throughput.

SSJ23

Physics (CT: Cone-Beam CT in Imaging and Radiation Therapy)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: N226

CT PH RO

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
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Cem Altunbas, PhD, Aurora, CO (*Moderator*) Nothing to Disclose

Sub-Events

SSJ23-01 Quantitative Extremity Cone-Beam CT Using Model-Based Polyenergetic Reconstruction

Tuesday, Nov. 27 3:00PM - 3:10PM Room: N226

Participants
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PURPOSE

Quantitative evaluation of bone mineral density (BMD) using cone-beam CT (CBCT) is challenged by a high level of artifacts typically associated with CBCT. We apply a polyenergetic model-based iterative reconstruction (MBIR) with a material mixing model to obtain accurate and reproducible density estimates in extremity CBCT.

METHOD AND MATERIALS

An ideal solution model was used in polyenergetic MBIR (MBIR-poly, Elbakri PMB 2003) to account for mixing of Ca and marrow in bone. The model was calibrated using BMD inserts of known concentration (Gammex 467, 472). Scans were acquired at 90 kVp on a test-bench emulating the geometry of extremity CBCT. Monte Carlo scatter estimates obtained from water-corrected FBP were subtracted from projection data. Artifact reduction and quantitative accuracy were evaluated in water phantoms with muscle, adipose and BMD inserts (from 20 mg/cc to 500 mg/cc Ca). MBIR-poly reconstructs the density map of the object and thus the reconstructed voxel values were compared with measured physical densities of the inserts. To assess robustness to imaging conditions (essential in longitudinal studies), we compared density estimates in cortical and trabecular regions-of-interest (ROI) of a cadaveric ankle imaged in the following configurations: ankle alone (C1), ankle+water+2 BMD inserts (C2), ankle+water+2 BMD inserts+2 cm shift (C3).

RESULTS

With MBIR, the error in density was <0.009 g/cc across all BMD inserts. The magnitude of streak artifacts (departure from uniformity in a water region) was reduced by 96% compared to FBP with water-correction only. The spread (standard deviation) of mean cortical and trabecular density across configurations C1-C3 was reduced by 78% and 51%, respectively. The estimates of physical BMD insert density remained accurate when imaged in the presence of the ankle (configurations C2 and C3), with errors<0.015 g/cc.

CONCLUSION

MBIR-poly with an ideal solution mixture model yielded correction of beam hardening artifacts and provided quantitatively accurate estimates of object density in extremity CBCT. The density estimates were reproducible across a variety of imaging conditions.

CLINICAL RELEVANCE/APPLICATION

A polyenergetic model-based reconstruction algorithm yields accurate and reproducible estimates of tissue density in extremity CBCT, enabling quantitative studies of bone mineralization.

SSJ23-02 Two-Dimensional Anti-scatter Grids for CBCT: Transmission Properties of High Grid Ratio 2D Grid

Prototypes

Tuesday, Nov. 27 3:10PM - 3:20PM Room: N226

Participants
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PURPOSE

CT number accuracy and low contrast resolution can be poor in CBCT images due to high levels of scattered radiation. To reduce scatter, we have been investigating the utility of 2D antiscatter grids for flat panel detector based CBCT. In this study, we developed two prototypes, and characterized their scatter and primary transmission performance in a CBCT system for image guided radiation therapy.

METHOD AND MATERIALS

Two prototypes with grid ratio of 12 (R12) and 16 (R16) were developed and fabricated by using direct metal laser sintering process. Both grids have 2 mm grid pitch, and 0.1 mm septal thickness, and their grid cells were focused towards the x-ray source, in offset detector CBCT geometry. Prototypes were integrated with the flat panel detector in a clinical CBCT system. Primary and scatter transmission properties were measured using PMMA phantoms and beam-stops, at tube voltages of 80, 125, and 140 kVp. To benchmark the performance of prototypes, a fluoroscopic 1D antiscatter grid with a grid ratio of 21 (R21) was also evaluated under identical imaging conditions.

RESULTS

At 140 kVp, scatter-to-primary ratio (SPR) at 40 cm phantom thickness was 10.1 without a grid. SPR was reduced to 0.36 and 0.29 with our R12 and R16 prototypes, whereas SPR was 1.47 with the 1D grid. Scatter transmission fraction (Ts) with R12 and R16 prototypes were 3.1% and 2.4%, and Ts for 1D grid was 10.8%. When tube voltage increased for 80 to 140 kVp, Ts values increased by 13% for both 2D grids, whereas Ts increased by 31% for the 1D grid. Similar trends were observed for all grids when phantom thickness was varied between 10 and 40 cm. Average primary transmission fraction of R12, R16 prototypes, and 1D grid were 83%, 71%, and 70%, respectively.

CONCLUSION

Scatter transmission of our 2D grids were up to factor of 4.5 lower than a conventional antiscatter grid, while providing higher primary transmission. Thus, lower scatter transmission provided by 2D grids may lead to higher CT number accuracy and improved contrast resolution in CBCT. Lower scatter transmission may also play an important in the context of dual-energy CBCT, where highly accurate projection images are required.

CLINICAL RELEVANCE/APPLICATION

Scattered radiation is one of the leading causes of image quality degradation in CBCT imaging, limiting the utility of CBCT in a range of clinical applications. Our research on 2D antiscatter grid development aims to address this problem.

SSJ23-03 Deep Scatter Estimation (DSE) for Truncated Cone-Beam CT (CBCT)

Tuesday, Nov. 27 3:20PM - 3:30PM Room: N226

Participants
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PURPOSE

To correct for x-ray scatter in truncated CBCT in real time.

METHOD AND MATERIALS

Cone-beam CT (CBCT) acquisitions suffer from scatter artifacts. To correct for these artifacts, we recently developed the deep scatter estimation (DSE) that trains a deep convolutional neural network to reproduce Monte Carlo (MC) scatter estimates. Once trained, DSE combines both real-time capability and high accuracy. Applied to non-truncated data, DSE turned out to be equivalent to MC while outperforming known scatter estimation approaches. In the present work, however, we deal with truncated data as they occur in interventional C-arm CBCT or dental CBCT. In this case MC simulations are not possible because the object, which is needed as input to the MC simulation, cannot be fully reconstructed. To overcome this drawback, we developed the truncated DSE which uses a U-net architecture to reproduce the outcome of MC simulations from non-truncated objects given only the truncated projection data as input. Here, DSE is trained on 10800 simulated truncated projection images (pelvis, abdomen, and thorax). The training is performed on a GeForce GTX 1080 for 100 epochs using an Adam optimizer and the mean absolute error between the output and the MC scatter distribution as loss function. The performance of DSE was evaluated for simulated and measured testing data of a truncated CBCT system and compared against a kernel based scatter estimation (KSE).

RESULTS

Considering simulated data, the accuracy of KSE and DSE scatter estimates was quantified by calculating the mean absolute error (MAE) with respect to the simulated ground truth scatter distribution. Here, we observe a MAE of 19.2 % (KSE) and 1.8 % (DSE).

To quantify the performance for measured data, a slit scan measurement was performed as reference. Compared to the slit scan, CT reconstructions that were corrected using DSE show an almost similar CT value distribution while there are discrepancies of up to 150 HU using KSE.

CONCLUSION

DSE is able to derive highly accurate scatter estimates very close to MC simulations. Compared to conventional scatter estimation approaches DSE shows a superior performance while requiring similar processing time (20 ms / projection).

CLINICAL RELEVANCE/APPLICATION

Scatter correction is crucial to maintain the diagnostic value of CBCT examinations. DSE can overcome the drawback of existing approaches that are optimized for performance at the cost of accuracy.

SSJ23-04 Daily Edge Deformation Prediction Using a Conventional Neural-Network Regression for Low Dose Prior Contour Based Total Variation CBCT Reconstruction (PCTV-CNN)

Tuesday, Nov. 27 3:30PM - 3:40PM Room: N226

Participants
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PURPOSE

Previously we developed a PCTV reconstruction method to enhance the edge sharpness of low-dose CBCT. PCTV deforms the edge map from planning CT to on-board volumes to obtain the on-board edge information for enhancement in TV reconstruction. However, the deformable registration used for deforming the edge is time consuming and prone to errors due to the low quality of CBCT. This study aims to develop a novel method for predicting daily on-board edge deformation using deep conventional neural networks (CNN) to bypass deformable registration to improve the PCTV reconstruction efficiency.

METHOD AND MATERIALS

The new method uses patch-based CNN deformation prediction and PCTV reconstruction. Deformation vector field (DVF) registered from CT to full-sampling CBCTs and retrospectively under-sampled low-dose CBCT are obtained on the first day to train the model, which is then updated with following days' data. The model predicts DVF for low-dose CBCT acquired on the following day to generate on-board contours for PCTV reconstruction. Specifically, 3D patches are extracted from the same location in the planning-CT and low-dose CBCT as the inputs. Only DVF and voxels at the edge regions of planning-CT are selected for the prediction model. The CNN model is developed in MATLAB using 4 convolutional layers interleaved with pooling layers to directly learn the mapping from the input image patch pair. The method is evaluated using lung SBRT patient data. The first n-1 day's CBCTs are used for CNN training to predict nth day edge information (n=2, 3, 4, 5). 45 half-fan projections covering 360° from nth day CBCT is used for reconstruction. Results from Edge-preserving (EPTV), PCTV and PCTV-CNN are compared.

RESULTS

The cross-correlations between predicted and reference edge maps are 0.9734, 0.9706, 0.9624 and 0.9477, for day 2-5 respectively. PCTV-CNN enhanced bone edges in CBCT compared to EPTV and achieved comparable image quality as PCTV while avoiding time-consuming deformable registration process.

CONCLUSION

Preliminary results demonstrated the feasibility to use CNN to predict daily deformation of on-board edge information for PCTV based low-dose CBCT reconstruction.

CLINICAL RELEVANCE/APPLICATION

PCTV-CNN has a great potential for enhancing the edge sharpness with high efficiency for low dose 3D CBCT or 4D CBCT to improve the precision of on-board target localization and adaptive radiotherapy.

SSJ23-05 A Robust Fully Automatic Method for Intrinsic Respiratory and Cardiac Gating for Cone-Beam CT Scans of the Thorax Region

Tuesday, Nov. 27 3:40PM - 3:50PM Room: N226

Participants
Andreas Hahn, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael Knaup, PhD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Marc Kachelriess, PhD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

PURPOSE

To automatically extract a respiratory and a cardiac signal from cone-beam CT (CBCT) rawdata.

METHOD AND MATERIALS

Due to the relatively slow acquisition speed of CBCT systems, patient respiration and cardiac motion lead to motion blurring. This can be compensated using motion-compensated image reconstruction in 4D and in 5D [Brehm et al., MedPhys 42(4)] which requires accurate motion information. Without an external signal, motion surrogates have to be retrieved intrinsically from the rawdata. While there are several methods for respiratory gating, only few are dedicated to cardiac gating but are not very robust. We propose a robust method that is able to retrieve a respiratory and a cardiac signal fully automatically. The respiratory signal is retrieved by analyzing the mean signal over the whole detector as a function of the projection angle. The cardiac signal starts from

50×50×50 uniformely distributed grid points in the field of measurement to which x-y-circles of radius r are attached. We iterate over radii between 3 cm and 5 cm in steps of 2 mm and compute the intersection of the x-ray that runs through the tangent of each circle with the detector. The intersection points are centers of rectangular ROIs of about 8 cm by 4 cm whose mean value serves as a surrogate for the cardiac motion phase. The most regular signal after band pass filtering is selected as the cardiac surrogate. The method was tested on 10 patient thorax scans acquired with a Varian True Beam system and compared to the AS method [Van Herk et al., ICCR 07] (M1) and the method of reference [Hahn et al., SPIE Medical Imaging 2016] (M2).

RESULTS

The proposed method, M1 and M2 determined the correct number of respiratory peaks. While the proposed method showed good results for the cardiac gating with a maximum error of 1 heart beat, M2 showed good results for 6 patients (max. error 1), it did not perform well for 4 patients (max. error 23). M1 cannot detect cardiac motion.

CONCLUSION

The proposed method is able to acquire a respiratory and cardiac surrogate in a fully automatic way for CBCT scans of the thorax region and outperformed M2 in terms of robustness.

CLINICAL RELEVANCE/APPLICATION

Clinically, intrinsic gating will be useful in cases where no gating signals are available, such as it is the case in many interventional imaging scenarios. With intrinsic gating those cases can benefit from motion-compensated reconstruction and thus from better image quality.

SSJ23-06 Multi-Structure Segmentation of Hard Tissues, Maxillary Sinus, Mandible, Mandibular Canals in Cone Beam CT of Head and Neck with 3D U-Net

Tuesday, Nov. 27 3:50PM - 4:00PM Room: N226

Participants
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Jongha Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Namkug Kim, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Stockholder, Coreline Soft, Co Ltd

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PURPOSE

we proposed automatic segmentation method on four facial structures including hard tissues, maxillary sinus, mandible, and mandibular canals using 3D U-Net with convolutional neural net (CNN) in CBCT.

METHOD AND MATERIALS

We obtained 100 data sets of i-Cat CBCT scans (Imaging Science International, Hatfield, PA, USA).The training and validation dataset of hard tissues, maxillary sinus and mandible consists of 7 and 4 cases, 20 and 4 cases, and 20 and 4 cases, respectively. The training, and validation dataset of mandibular canals consist of 40 and 15 cases, respectively. Each test dataset was used in the same 7 patients. Depending on the structures, the segmentation result as gold standard was made differently. The hard tissues and mandibular canals were manually drawn by an expert and confirmed by an expert dentist. The initial mandible and maxillary sinus mask was created by in-house software with conventional image processing techniques including 3D sculpting and thresholding. These masks were filled per slice, and manually corrected by experts. Before training,we pre-processed images to change brightness (window level = 450) and contrast (window width = 5000). Also, the number of each dataset was augmented by flip and rotation. We used the 3D U-Net, one of the most widely used CNN architectures for image segmentation.

RESULTS

For the evaluation metrics, the Dice similarity coefficient (DSC), Jaccard similarity coefficient (JSC), mean surface distance (MSD) and Hausdorff surface distance (HSD) were 82.60±0.04%, 70.47±0.06%, in hard tissues, 86.60±0.01%, and 92.80±0.01%, and 82.00±0.07%, 0.35±0.29mm, 0.49±0.09mm in maxillary sinus, 90.00±0.04 %, 0.89±0.66 %, 11.29±10.21mm, 3.21±2.56mm and 18.42±19.72mm, in mandible, respectively. In the mandibular canals, mean error distances were 0.89±0.40mm.

CONCLUSION

In this study, we proposed an automatic 3D segmentation method, demonstrated very fast segmentation results with reasonable accuracies of multi-facial structures in CBCT including hard tissues, maxillary sinus, mandibular, and mandibular canals.

CLINICAL RELEVANCE/APPLICATION

This study could be used to the planning of dental implant and orthognathic surgeries.

SSJ24

Science Session with Keynote: Radiation Oncology (Gastrointestinal Malignancies)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E261

GI RO

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants

Anna Shapiro, MD, Syracuse, NY (*Moderator*) Nothing to Disclose
Tarita O. Thomas, MD, PhD, Chicago, IL (*Moderator*) Nothing to Disclose

Sub-Events

SSJ24-01 Invited Speaker:

Tuesday, Nov. 27 3:00PM - 3:20PM Room: E261

Participants
Tarita O. Thomas, MD, PhD, Chicago, IL (*Presenter*) Nothing to Disclose

SSJ24-03 Dose Escalation with Simultaneous Integrated Boost (SIB) Using 3DCRT and VMAT in Neoadjuvant Radiotherapy of Rectal Cancer: Evaluation of Normal Organ Doses

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E261

Participants
Mustafa Adli, MD, Istanbul, Turkey (*Presenter*) Nothing to Disclose
Ayse Dagli, Istanbul, Turkey (*Abstract Co-Author*) Nothing to Disclose
Funda Ozturk, Istanbul, Turkey (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate normal organ doses in rectal cancer patients treated with neoadjuvant radiotherapy using dose escalated SIB with three-dimensional conformal radiotherapy (3DCRT) and volumetric modulated arc therapy (VMAT).

METHOD AND MATERIALS

Treatment planning CT images of 88 rectal cancer patients (F: 31, M: 57) were included. Median patient age was 60 (30-85). Patients with inguinal lymph nodes in the treatment field were excluded. Two treatment plans were done for each patient using SIB with VMAT and 3DCRT techniques. Normal organ and target volume doses in two plans were dosimetrically compared. CTV-tumor volume was covering GTV plus 2 cm proximally and distally, and mesorectum radially. Pelvic lymph node dose was 50.4 Gy with 1.8 Gy/fx and PTV-tumor dose was 56 Gy with 2 Gy/fx in 28 fractions, for both plans. Maximum target volume doses (Dmax), homogeneity index (HI) and conformity number (CN) for target volumes (PTV-Tumor and PTV-Total), maximum bladder dose (Dmax), bladder volumes receiving 40 Gy (V40), 50 Gy (V50), 56 Gy (V56), maximum bowel dose (Dmax), doses to 90 ml (D90), 130 ml (D130) and 230 ml (D230) bowel, mean femoral head (FH) doses (Dmean) and FH volumes receiving 40 Gy (V40), and 50 Gy (V50) were compared between two plans.

RESULTS

Median bladder and bowel volumes were 393 (43-1128) and 1629 (280-4792) cm3, respectively. For both PTV volumes, HI ($p<0.02$) and CN ($p<0.01$) were significantly better in VMAT plans and Dmax was ($p<0.65$) not significantly different between two plans. Bladder and bowel Dmax were not significantly different between VMAT and 3DCRT plans. Bladder V40, V50, V56 volumes and bowel D90, D130 and D230 doses were significantly lower in VMAT plans compared with 3DCRT plans ($p<0.01$). FH Dmean and V40, V50 were significantly lower in VMAT plans compared with 3DCRT plans ($p<0.05$).

CONCLUSION

Except bladder and bowel Dmax, VMAT decreases all normal organ doses compared with 3DCRT in rectal cancer patients treated with neoadjuvant radiation therapy using dose escalated SIB. Clinical studies are needed to evaluate these results' clinical impact on treatment side effects.

CLINICAL RELEVANCE/APPLICATION

VMAT decreases normal organ doses compared with 3DCRT in rectal cancer patients treated with neoadjuvant radiotherapy using dose escalated simultaneous integrated boost, but maximum bladder and bowel doses do not change. Clinical studies needed to evaluate impact of these results on treatment side effects.

SSJ24-04 Fat-Free Muscle Mass Predicts Overall Survival of Patients Undergoing Radioembolization of Colorectal Cancer Liver Metastases

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E261

Participants
Anton Faron, MD, Bonn, Germany (*Presenter*) Nothing to Disclose
Claus C. Pieper, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Martin A. Sprinkart, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Daniel Kuetting, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Daniel K. Thomas, MD, PhD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Carsten Meyer, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Markus Essler, MD, Muenchen, Germany (*Abstract Co-Author*) Nothing to Disclose
Hans H. Schild, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Julian A. Luetkens, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Sarcopenia is associated with poor prognosis in various types of cancer. We therefore aimed to investigate the clinical potential of fat-free muscle mass as a marker for outcome prediction in patients with liver-predominant metastatic colorectal cancer undergoing radioembolization (RE) with 90Yttrium-microspheres.

METHOD AND MATERIALS

Patients with liver-predominant metastatic colorectal cancer who underwent RE between June 2008 and August 2014 at our department were included in this retrospective study. Medical records were reviewed and several clinical parameters were determined. Using standard liver magnetic resonance imaging (MRI) scans, the total erector spinae muscle area and the intramuscular fat tissue area were measured and subtracted to calculate the fat-free muscle area (FFMA). Sarcopenia was defined as FFMA less than 3653 mmSquared and 2866 mmSquared for men and women, respectively. The main outcome was overall survival (OS). Univariate and multivariate Cox-regression analyses were performed comparing various variables with potential impact on OS (e.g. age at RE, bodyweight, ascites prior to RE, cholestasis, clinical scores, tumor burden).

RESULTS

Seventy-seven patients (49 male, mean age 59.9±10.8 years) were investigated. Mean time between MRI and RE was 19±38 days. Mean FFMA was 2878±613 mmSquared in female patients and 3706±779 mmSquared in male patients. Median OS after RE was 200 (range: 25-1650) days. In patients without sarcopenia OS was significantly longer compared to patients with sarcopenia (mean 348±48 vs. 226±36 days, p=0.006). On multivariate Cox-regression analysis, OS was best predicted by FFMA (p<0.001, HR 2.692, 95% CI 1.559-4.648), Model for End-Stage Liver Disease (MELD) (p<0.001, HR 1.165, 95% CI 1.089-1.245), and pattern of tumor manifestation (solitary, oligofocal, multifocal, diffuse) (p<0.001, HR 2.006, 95% CI 1.418-2.840).

CONCLUSION

Fat-free muscle mass might be a new prognostic biomarker for survival prognosis in patients receiving RE for treatment of colorectal liver metastases.

CLINICAL RELEVANCE/APPLICATION

This study offers an easy-to-apply MRI-based measurement of fat-free muscle mass as a marker of sarcopenia which can predict OS in patients receiving RE for treatment of colorectal liver metastases.

SSJ24-05 Stereotactic Body Radiotherapy (SBRT) in Pancreatic Cancer Patients Aged 70 and Older

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E261

Awards
Student Travel Stipend Award

Participants
Rachel Tobillo, Boca Raton, FL (*Presenter*) Nothing to Disclose
Jasmine Martin, MD, Boca Raton, FL (*Abstract Co-Author*) Nothing to Disclose
Michael DeDonno, PhD, Boca Raton, FL (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Over 50% of pancreatic cancer is diagnosed in people over the age of 70, many of whom have limited treatment options due to preexisting comorbidities. This study reports on the outcomes and tolerability of stereotactic body radiation therapy (SBRT) in patients aged 70 and older with pancreatic cancer.

METHOD AND MATERIALS

Twenty-six and 2 patients aged >=70 with pancreatic and ampullary cancer respectively, treated with SBRT +/- chemotherapy and surgery at one institution from 2009 to 2017 were retrospectively reviewed. Patients without up-to-date records or at least 6-months of follow-up were excluded. Patients were analyzed for treatment toxicity, local recurrence, and distant metastases. Kaplan-Meier was used to estimate overall survival, defined as date of diagnosis to date of death or last follow-up.

RESULTS

Median age was 84 years (range 70-94), and median follow-up was 6.9 months. Twenty-five (89%) patients had locally advanced disease and 3 (11%) had metastatic disease. Most common doses delivered were 30, 32.5, 35 and 37.5 Gy (20-45 Gy), most commonly in 5 fractions. Twenty-four (86%) patients were treated at time of initial diagnosis and 4 (14%) were treated for recurrence. Six patients had pre-radiation surgery, either with a Whipple procedure (14%) or an endoscopic resection (7%). Two patients had previously been treated with external beam radiation therapy (EBRT) before SBRT. Nineteen patients (68%) were treated with some form of chemotherapy. Twenty-one (75%) patients had an acute toxicity grade of 1-2, and 3 patients had an acute toxicity grade of 3, 2 with GI symptoms and 1 with sepsis and fatigue (CTCAE V5.0). Most common acute toxicities were GI symptoms (57%) and fatigue (36%), while most common late morbidities were GI symptoms (68%), fatigue (68%), and nutritional disorders (50%). There were no acute or late grade 4+ toxicities. Fourteen (50%) patients recurred locally, 14 (50%) patients developed distant metastases, and 10 (36%) had both. Median overall survival was 15.0 months.

CONCLUSION

SBRT for pancreatic cancer seems to be a safe and effective method for treatment of elderly patients who decline surgery, have unresectable disease, or comorbidities precluding surgery.

CLINICAL RELEVANCE/APPLICATION

The literature on treatment of elderly patients with pancreatic cancer is sparse. SBRT appears to be safe and effective for those who cannot undergo surgery.

SSJ24-06 Evaluation in Predicting Tumor Sensitivity on Radiotherapy for Esophageal Cancer Using Magnetic Resonance Diffusion Kurtosis Imaging

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E261

Participants
Yanfei Wang, Shijiazhuang, China (*Abstract Co-Author*) Nothing to Disclose
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Andu Zhang, Shijiazhuang, China (*Abstract Co-Author*) Nothing to Disclose
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Hui Feng, Shijiazhuang, China (*Abstract Co-Author*) Nothing to Disclose
Tongxin Xu, Shijiazhuang, China (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate magnetic resonance diffusion kurtosis imaging (MR-DKI) values for predicting the tumor sensitivity on radiotherapy for esophageal cancer.

METHOD AND MATERIALS

There were 40 Eca-109 nude mice models with esophageal cancer xenogrfts before and during radiotherapy (test group=24; control group=16) used in this study. The test group was given 6MV-X line 15Gy single dose during radiation therapy. The control group did not undergo any radiation or other treatments. Sixteen time points included at 1 day before and 1 day after radiotherapy and then very two days during radiotherapy until 29th day. In the time points, mice models in both test and control groups were performed on MRI scan with T1WI, T2WI, and multiple b-value DWI values. Tumor volume, MR-DWI ADC value, MD value and MK value in test group were compared with the control group.

RESULTS

The tumor volume was double at the 5th day in the control group and at the 17th day in the test group after the radiotherapy. At the 7th day after radiotherapy and then, the volume of the transplanted tumor was significantly smaller in the test group (1.729±0.906 mm3) than that in the control group (2.671±0.915 mm3) ($P<0.05$). ADC values in test group rapidly increased at the 3rd day (reached highest point at the 7th day) and then gradually decreased and returned to pre-therapy levels from the 17th day. In the control group, the ADC values gradually decreased from the first day and kept at a low level from the 9th day. The MK values in the test group decreased after radiotherapy (reached lowest point on the 9th day), and then gradually increased to the pre-therapy level from the 17th day. In the control group, the MK values gradually increased (high level since the 17th day). The changes of the MD values were similar to those in ADC values in both groups.

CONCLUSION

MR-DKI values could change prior to tumor morphological features in esophageal cancer during radiotherapy in an animal experimental study, and may have the potential in predicting tumor sensitivity for clinical tumor patients during their radiation or chemotherapy.

CLINICAL RELEVANCE/APPLICATION

(dealing with MR-DKI) 'MR-DKI values could change prior to tumor morphological features in esophageal cancer during radiotherapy in an animal experimental study, and is recommended in predicting tumor sensitivity for clinical tumor patients during their radiation or chemotherapy.'

SSJ25

Vascular Interventional (Dialysis and Venous Intervention (Including IO))

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S503AB

VA **IR**

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Gordon McLennan, MD, Chagrin Falls, OH (*Moderator*) Grant, Siemens AG; Grant, Surefire Medical, Inc; Speakers Bureau, Medtronic plc; Speakers Bureau, General Electric Company; Speakers Bureau, Stryker Corporation; Advisory Board, Siemens AG; Advisory Board, Surefire Medical, Inc; Advisory Board, Stealth Medical; Advisory Board, Rene Medical, Inc; Advisory Board, F. Hoffmann-La Roche Ltd; Advisory Board, Bristol-Myers Squibb Company; Advisory Board, B. Braun Melsungen AG; Advisory Board, General Electric Company;

Sub-Events

SSJ25-01 Rapid Geometric Estimation of Dialysis Fistula Blood Flow Using 2D Angiography

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S503AB

Awards
Student Travel Stipend Award

Participants
Sanjit Datta, MS, Cleveland, OH (*Presenter*) Nothing to Disclose
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Nischal Koirala, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The ability to quantify the blood flow rate in a particular vessel using two-dimensional digital subtraction angiography (DSA) remains an elusive goal. Proceduralists could use such a technique to plan and define quantitative endpoints for interventions involving embolization and recanalization among others. Dialysis fistula interventions are an ideal testbed since alternative validated techniques, such as thermodilution, are commonly used. This study aims to assess the precision of simple, rapid geometric flow estimation techniques applied to in vitro acquisitions mimicking dialysis fistulagrams.

METHOD AND MATERIALS

The true flow rate through a phantom with 9.5mm internal diameter was measured by collecting the outflow. Triplicate DSA acquisitions were performed using a fixed contrast injection protocol. Flow rates were calculated by dividing the cylindrical volume of the tube (based on linear measurements from each acquisition) by transit time determined using three methods: (1) visual estimation of contrast arrival time on DSA ("DSA"), (2) automated measurement of time of arrival using parametric color-coded angiography ("TOA"), (3) automated measurement of time-to-half-peak using parametric color-coded angiography ("TTHP"). Results were analyzed using Bland-Altman plots and ANOVA.

RESULTS

True flow rates through the phantom ranged from 620-1210 ml/min. The normalized variance was 0.023 for DSA, 0.031 for TOA, and 0.013 for TTHP ($p<0.05$), with a significant pairwise difference only between TOA and TTHP. Bland-Altman analysis showed the normalized 95% confidence interval for a given measurement was 0.75 to 1.34 for DSA, 0.67 to 1.36 for TOA, and 0.70 to 1.16 for TTHP. The normalized bias of each measurement technique was +0.047 for DSA, +0.016 for TOA, and -0.070 for TTHP.

CONCLUSION

Any proceduralist using any angiographic system without advanced post-processing software can quickly perform a geometric calculation to obtain an estimate of blood flow rate using the DSA method. In this preliminary in vitro study, the margin of error for such a calculation was ±15%. Using a parametric color-coded angiography tool that calculates time-to-half-peak can reduce this margin of error to ±11%.

CLINICAL RELEVANCE/APPLICATION

This preclinical study demonstrates a rapid, accessible estimation technique. In vivo characterization is necessary in both healthy and diseased vessels at a wider range of flow rates and frame rates.

SSJ25-02 Transjugular Access for Interventions in Upper Extremity AV Fistulas

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S503AB

Participants
Maria A. Kotarska, PhD, Chicago, IL (*Presenter*) Nothing to Disclose

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PURPOSE

Describe our experience using a transjugular venous approach for endovascular interventions in patients with dysfunctional hemodialysis AV fistulas.

METHOD AND MATERIALS

This is an IRB approved, retrospective study. The imaging files of all patients who underwent a hemodialysis access intervention between January 2015 and May 30, 2017 were reviewed. Patients who underwent the procedure using a transjugular approach were selected for analysis. A total of 600 upper extremity hemodialysis intervention procedures were performed and 30 were performed using a transjugular approach (5 %). Technical procedural details were recorded.

RESULTS

The technical success rate was 97 % (29/30). An additional puncture into the AV fistula was necessary in 13% (4/30) cases to enable retrograde access to the circuit. Indications for the use of the transjugular approach included: Declotting: (13/30) juxta-anastomotic stenosis (13/30), non-maturing AV fistula (2/30) and bleeding pseudoaneurysm (2/30). Most procedures were initially performed using an ipsilateral jugular venous approach, however, most of our recent procedures have been performed using a contralateral approach as it appears to be technically easier. A temporary dialysis catheter can be inserted after the procedure in case of a technical failure or in case the fistula is not ready for use immediately after intervention. No major complications were encountered. There was no post-procedural jugular vein thrombosis.

CONCLUSION

The transjugular approach is safe and effective for interventions in dysfunctional or clotted upper extremity AV fistulas. In selected case, this approach may be better than using the direct access technique.

CLINICAL RELEVANCE/APPLICATION

AVFs have lowest morbidity and mortality among choices for hemodialysis and well-functioning vascular access is the crucial to performing efficient AV fistula intervention.

SSJ25-03 Prospective, Randomized Single-Center Trial to Compare the Efficacy of Ultrasound-Guided Supraclavicular Brachial Plexus Block to Reduce Pain During Angioplasty of Dysfunctional Arteriovenous Fistulas

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S503AB

Participants
Subin Heo, Suwon, Korea, Republic Of (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the efficacy and safety of ultrasound-guided supraclavicular brachial plexus block (BPB) for reducing pain during angioplasty of dysfunctional arteriovenous fistulas (AVFs).

METHOD AND MATERIALS

Eighty patients (mean age, 64.6 years) were enrolled in this study. Forty were randomized to receive regional BPB (0.75% ropivacaine and 2% lidocaine) prior to undergoing angioplasty and forty to receive local anesthesia (2% lidocaine). Pain was assessed on a 10-point visual analog scale after the procedure. Both patient and operator satisfactions were examined.

RESULTS

There were no significant differences in the baseline demographics between the two groups. The mean block execution time was 5.1 minutes and the mean time to achieve complete block was 10.7 minutes. The mean time to fully recover from the BPB was 476 minutes. BPB group showed profoundly lower average pain scale compared to the control group (0.93 vs 6.40, $p<0.001$). Patient satisfaction ($p<0.001$), and operator satisfaction ($p<0.001$) were significantly higher in the BPB group. There were no significant differences in procedure time ($p=0.084$), fluoroscopy time ($p=0.059$), and cumulative dose area product ($p=0.869$). There were no major complications and two patients experienced minor complications of self-limited nausea. In 6 months follow up periods there were no delayed complications.

CONCLUSION

Compared with conventional local anesthesia, ultrasound-guided BPB provides excellent benefit of reducing pain with acceptable safety profile during angioplasty of dysfunctional AVFs.

CLINICAL RELEVANCE/APPLICATION

US-guided BPB is a superior method of pain control compared to local anesthesia during angioplasty of dysfunctional AVFs.

SSJ25-04 Single-Center Experience of IVC Filter Placement and Retrieval Practice Patterns

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S503AB

Participants
Peter Lo, St Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Marah Van Diest, BS, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Adam Fang, St Louis, MO (*Abstract Co-Author*) Nothing to Disclose
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Jerome L. Kao, MD, Knoxville, TN (*Abstract Co-Author*) Nothing to Disclose
Sameer D. Gadani, MD, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Kirubahara Vaheesan, MD, Chennai, India (*Presenter*) Research Grant, Siemens AG; Proctor, Terumo Corporation; Consultant, Terumo Corporation; Proctor, Sirtex Medical Ltd; Speaker Bureau, Sirtex Medical Ltd

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PURPOSE

To compare practice patterns in the placement and retrieval of inferior vena cava filters (IVCF) at a single academic center over four years (2013-2017).

METHOD AND MATERIALS

Retrospective analysis of 238 patients (136 M,102 F; mean age, 58.6±16.8 y) who underwent IVCF placement and retrieval at a single academic center from 2013-2017. Variables assessed were placement indication, filter type, fluoroscopy time, dwell time, and placement and retrieval differences over time and between services (interventional radiology [IR] or vascular surgery [VS]).

RESULTS

We identified 233 IVCF placements and 44 retrievals from 2013-2017. IVCF placement for classic indications increased compared to extended or prophylactic indications (85% in 2013 vs 96% in 2017). There was an increase in the percent of filters retrieved (17% in 2013 vs 30% in 2015) and the percent of filters placed and retrieved by the same service (13% in 2013 vs 28% in 2015). Filter dwell time decreased over the years ($p<0.0001$). The percent of IVCF placed by IR increased with time (76% in 2013 vs 92% in 2016) and decreased for VS (24% in 2013 vs 8% in 2016). IR preferred placing Bard Denali IVCF (53%) while VS preferred placing Optease IVCF (33%). IR used venograms for IVCF placement more often than VS (84% vs 16%, $p<0.0001$), while VS used intravascular ultrasound more often than IR (82% vs 18%, $p<0.0001$). Mean fluoroscopy time (min) was 3.8 [95%CI (2.6,4.9)] for IR IVCF placement and 1.4 [95%CI (1.0,1.8)] for VS IVCF placement ($p=0.001$). IVCF retrievals paralleled placement trends, with IR rates increasing (8% in 2013 vs 22% in 2016) and VS rates decreasing (27% in 2013 vs 0% in 2016) over time. The percentages of placed filters retrieved were similar between IR and VS. IVCF placed by IR had shorter dwell times compared to those placed by VS (median 503 vs 975 days, $p<0.05$).

CONCLUSION

Within four years at a single academic center, changes in IVCF placement and retrieval patterns over time and between services were observed. Increasing contribution of a single service may not only improve patient follow-up and oversight, but may also provide a more consistent patient experience, including the use of similar pre-procedure modalities and filter types.

CLINICAL RELEVANCE/APPLICATION

Single service placement and retrieval of IVC filters may lead to better patient follow-up and improve patient experience.

SSJ25-05 Transvenous Pulmonary Chemoembolization (TPCE) for Palliative and Neoadjuvant Treatment of Lung Metastases

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S503AB

Participants
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Presenter*) Nothing to Disclose
Ahmed i. Ahmed, MBCHB, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose
Duaa B. Thabet, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose
Mostafa A. El-Sharkaway, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose
Hossam M. Kamel, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose
Moritz H. Albrecht, MD, Frankfurt am Main, Germany (*Abstract Co-Author*) Speaker, Siemens AG
Nagy N. Naguib, MD, MSc, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose
Afaf A. Hassan, Assiut, Egypt (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate tumor response, local tumor control and patient survival after the treatment of pulmonary metastases using transvenous pulmonary chemoembolization (TPCE) in palliative and neoadjuvant intent.

METHOD AND MATERIALS

143 patients (mean: 56.7±13.4 years) underwent repetitive TPCE (mean: 5.8±2.9 sessions) between August 2004 and April 2017 for the treatment of unresectable lung metastases not responding to systemic chemotherapy. Patients had predominant lung metastases with bilateral lung involvement in 80.4% of the cases. Regional delivery of the chemotherapeutic agents was performed through selective catheterization of the tumor-supplying pulmonary arteries with subsequent injection of iodized oil and/or microspheres. Patients who underwent subsequent ablation (n=51) either for all lesions (complete) or for dominant lesions

(incomplete) were in the neoadjuvant group, and those who underwent TPCE alone were in the palliative group (n=92). The response was assessed according to the revised RECIST criteria.

RESULTS

Partial response was achieved in 11.9% (n=17), stable disease in 66.4% (n=95) and progressive disease in 21.7% (n=31). The mean survival time and time to progression were 24.5±1.7 and 7.5±0.5 months, respectively. The mean survival time was shorter for the palliative group (19.7±2 months) compared to the neoadjuvant group (30.1±2.6 months). The use of TPCE alone or with incomplete ablation had a significantly decreased 4.6-fold (p=0.002) and 3.1-fold (p=0.027) hazard of death in comparison with TPCE with subsequent complete ablation.

CONCLUSION

TPCE has the potential to improve local tumor control and to prolong survival with a neoadjuvant potential when combined with thermal ablation.

CLINICAL RELEVANCE/APPLICATION

Combined TPCE and thermal ablation therapy can improve local tumor control and survival versus TPCE alone.

SSJ26

Vascular Interventional (Spine and Bone Intervention)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: S502AB

IR MR MK VA

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Alexios Kelekis, MD, PhD, Athens, Greece (*Moderator*) Medical Advisory Board, BTG International Ltd; Medical Advisory Board, Merit Medical Systems, Inc; Research Grant, Mindray Medical

Sub-Events

SSJ26-01 CT Guided Pulsed Radiofrequency in Patients with Acute Low Back Pain and Sciatica: 1 Year Follow-Up versus Image-Guided Injection Only as Control Group

Tuesday, Nov. 27 3:00PM - 3:10PM Room: S502AB

Participants
Alessandro Napoli, MD, Rome, Italy (*Presenter*) Nothing to Disclose
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Fabrizio Andrani, MD , Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
Susan Dababou, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To determine the clinical impact of CT-guided Pulsed Radiofrequency in the management of pa-tients with acute or sub-acute neuro-radicular pain from lumbar disc herniation, refractory to pro-longed conservative treatment.

METHOD AND MATERIALS

We conducted a single center, prospective, randomized trial (1:1) in patients with acute or sub-acute neuro-radicular low back pain (EMG confirmed), refractory to usual care (conservative). Pulsed radiofrequency (pRF) treatment was performed using a 22-20 G needle-electrode with probe tip directed to the symptomatic dorsal root ganglion under CT guidance; E-pulsed radiofre-quency (Cosman G4) was administered for 10 min at 45V with constant local temperature of 42°C. Masking group received 1 to 3 sessions of CT-guided steroid injection on the same anatomi-cal target. Primary outcome was clinical efficacy measured with Visual Analogue Scale (VAS), Oswestry Disability Index (ODI) and Roland-Morris (RM) score for quality of life assessment; all questionnaires were obtained at baseline and at 1-week, 1-3-6 and 12-month follow-up. Analyses were performed on a per-protocol basis.

RESULTS

Of 260 patients enrolled, 128 patients received Pulsed Radiofrequency, 120 were treated with in-jection only strategy treatment. Median VAS scores decreased linearly in both groups; patients that received radiofrequency obtained greater significant overall improvement in pain and disabil-ity scores during the first year ($P<0.001$). Relief of leg pain was faster for patients assigned to pRF ($P<0.001$). Patients assigned to pRF also reported a faster rate of perceived recovery (hazard ratio, 1.97; 95% confidence interval, 1.72 to 2.22; $P<0.001$). The probability of perceived recovery after 1 year of follow-up was 95% in the pRF group and 61% in the injection only group. There were 6 patients considered partial responders that required a second PRF session. Eight pa-tients required further surgical management.

CONCLUSION

The 1-year outcomes demonstrated CT-guided Pulsed Radiofrequency superior to injection only strategy. pRF is an effective and repeatable percutaneous treatment option for patients with acute or sub-acute neuro-radicular low back pain.

CLINICAL RELEVANCE/APPLICATION

The results of this study are superior to those reported from literature for usual care strategies and injections and may avoid surgery for a substantial number of patients with sciatic disc com-pression.

SSJ26-02 Treatment of Osteoid Osteomas with Magnetic Resonance Guided Focused Ultrasound: Evaluation of the Prognostic Value of Post-Treatment Perfusion Differences for Pain Reduction and Bone Remodeling

Tuesday, Nov. 27 3:10PM - 3:20PM Room: S502AB

Participants
Hans Peter Erasmus, Rome, Italy (*Presenter*) Nothing to Disclose
Alessandro Napoli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Cristina Marrocchio, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Susan Dababou, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Roberto Scipione, MD , Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
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Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Magnetic Resonance guided focused ultrasound (MRgFUS) has proven a safe, feasible and effective treatment modality for osteoid osteoma (OO). To date, however, there are no proven factors to evaluate the patient's prognosis during /immediately after treatment. To address this question, this study evaluated the role of perfusion scans and the gained data to assess the likelihood of pain reduction and bone remodeling after treatment.

METHOD AND MATERIALS

A total of 42 consecutive patients with symptomatic osteoid osteomas were treated with MRgFUS from 2011 to 2018. MR (inc. perfusion scan) and CT scans of the lesion were acquired before and immediately after the treatment; follow-up MR and CT scans were acquired at 3, 6, 12, 24 and 36 months and 12 months, respectively. Visual Analog Scale (VAS) score was used to assess pain and was evaluated over the same time periods and, additionally, at 1 week post-treatment. 3 patients were lost during follow-up. Statistical analysis of the correlation with the perfusion data (namely, KTrans) was performed using Spearman's rho.

RESULTS

In the overall study, the mean age was 25 ± 13.5 years, and 77% of patients were male. 4 patients were retreated with MRgFUS. Mean pre-treatment VAS score was 8.4 ± 1.0 months and 0.6±1.4, 0.1±0.3, 0.1±0.3 0.1±0.2 and 0.1±0.2 at 3, 6, 12, 24 and 36 months, respectively. The median VAS dropped to 0 at 1 week from 8 before treatment and stayed there during the entire follow-up. Mean KTrans was 0.69±0.7 pre-treatment and 0.15±0.13, 0.20±.25, 0.12±0.1, 0.07±0.05, 0.13±0.08 and 0.1±0.08 immediately after treatment and at 3, 6, 12, 24 and 36 month follow-up. Spearman's rho showed a positive correlation for a >50% KTrans reduction and significant pain reduction, as well as for >90% KTrans reduction and both pain reduction and bone remodeling. Age appeared to be an additional factor with an inverse correlation to bone remodeling. No adverse events were recorded.

CONCLUSION

The current study demonstrated that KTrans could be a good prognostic tool to evaluate the patient's likelihood of pain remission and bone remodeling.

CLINICAL RELEVANCE/APPLICATION

In the future, evaluation of KTrans could allow for more reliable treatment efficacy and patient satisfaction after treatment of OO with MRgFUS.

SSJ26-03 O2-O3 Chemiodiscolysis: Any Issues for Spine Biomechanics? 5 Years MRI Imaging Follow Up

Tuesday, Nov. 27 3:20PM - 3:30PM Room: S502AB

Participants
Pierpaolo Palumbo, MD, L'Aquila, Italy (*Presenter*) Nothing to Disclose
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Simone Quarchioni, Laquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Maria Valeria Marcella Micelli, Laquila, Italy (*Abstract Co-Author*) Nothing to Disclose
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Luigi Zugaro, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Aldo Victor Giordano, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandra Splendiani, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

O2-O3 dyscolysis is a well-validated technique for the treatment of symptomatic lumbar disc herniation. Although it is a highly effective procedure, up to now there are only a few evidences about long-term changes on disc treated and on biomechanical changes of the lumbar spine "in toto" after O2-O3 dyscolysis treatment. Indeed, dehydration of a lumbar disc with subsequent volume loss could lead to the same alteration of a degenerative pathology. The purpose of our study was to compare long-term follow-up MR images of patients treated by O2-O3 dyscolysis and long-term follow-up MR images of patients affected by lumbar disc herniation treated without intradiscal administration of O2-O3

METHOD AND MATERIALS

We recalled 80 patients for an MRI follow-up treated in our department with O2-O3 mixture 5 years earlier; 40 patients treated

We recalled 80 patients for an MRI-follow-up treated in our department with O2-O3 mixture 5 years earlier. 40 patients treated with dyscolysis and the remaining 40 treated by intraforaminal injection of steroids only as the control group. We compared T2 sagittal and axial images of MR exams performed before the procedure and after 5 years during our follow-up imaging. In all patients in each affected level, we evaluated: disc height, disc area, disc protrusion beyond the vertebral posterior wall, the degree of disc degeneration (according to Pfirmann classification), degenerative changes in adjacent vertebral discs, endplate Modic changes, facet joint changes (Weishaupt classification)

RESULTS

Our analysis showed a significant decrease in disc height and protrusion (respectively mean of 15% and 37,42%) in patients treated with intradiscal O2-O3, despite a decrease of circumferences of 4,72%, differently from control group findings. There was no significant difference in the degree of disc degeneration between the two groups (even more pronounced in patients not treated by dyscolysis), as in both groups we found the same endplate changes (Modic) in about 20% of cases. Analysis of facet joint degeneration shows significant alteration according to Weishaupt classification in both groups, and no significant differences in comparison

CONCLUSION

Compared with control group, patient treated by O2-O3 dyscolysis didn't show significant difference in lumbar disc degeneration, despite a stable shrinkage of the disc herniation

CLINICAL RELEVANCE/APPLICATION

Our findings reveal that O2-O3 dyscolysis don't determine significant differences in biomechanical changes compared with the natural course

SSJ26-04 A Matched Case-Control Study of MR-Guided Focused Ultrasound (MRgFUS) versus CT-Guided Radiofrequency Ablation (RFA) for the Clinical Evaluation of Patients with Osteoid Osteoma

Tuesday, Nov. 27 3:30PM - 3:40PM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Roberto Scipione, MD , Rome, Italy (*Presenter*) Nothing to Disclose
Alessandro Napoli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
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Hans Peter Erasmus, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Cristina Marrocchio, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco Arrigoni, Coppito, Italy (*Abstract Co-Author*) Nothing to Disclose
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Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To examine and compare the clinical outcome of MR-guided focused ultrasound (MRgFUS) and CT-guided Radiofrequency Ablation (RFA) in patients with painful non-spinal osteoid osteoma (OO).

METHOD AND MATERIALS

Patients with clinical and radiological findings suggestive for OO were included in this multicenter study; eligible patients had pain scores >=4 (assessed with Visual Analogue Scale, VAS) and could safely undergo both MRgFUS and RFA. Vertebral locations were excluded as considered inaccessible by MRgFUS. Selected participants were assigned to receive either MRgFUS or RFA according to a matched case-control protocol; the two groups were homogeneous in terms of age, gender distribution, pain onset and pain level. Patients underwent periodical three-month follow-ups over a period of 1 year. Safety (rate of complications), clinical effectiveness (Visual Analogue Scale [VAS] pain score reduction) and durability (stability of results over time) of MRgFUS were assessed and compared between the two arms.

RESULTS

112 patients (M: 61; F: 51) were enrolled and assigned to MRgFUS or RFA. In the RFA arms, 2 complications were recorded (1 skin burn, 1 infection at the skin entry site); no treatment-related complications were observed in the MRgFUS arm. No statistically significant difference was recorded between the two arms in terms of efficacy: a complete clinical response (VAS 0) was obtained in 50 patients treated with MRgFUS (89.3%) and in 52 patients treated with RFA (92.9%) at 3-month follow-up ($p>0.05$). Clinical results were stable over the whole period of follow-up, and no pain recurrence was recorded in both groups.

CONCLUSION

MRgFUS has shown similar clinical results compared to RFA in the management of OO, with the advantage of complete safety. MRgFUS is limited to non-spinal locations.

CLINICAL RELEVANCE/APPLICATION

MRgFUS non-invasiveness provides relevant advantages in the treatment of this impairing disease affecting mostly young population: no ionizing radiation, no incisions or needles, and no complications.

SSJ26-05 The Role of Multi-Modal Analgesic Cocktail for Pain Control in Patients Undergoing Microwave Ablation

Tuesday, Nov. 27 3:40PM - 3:50PM Room: S502AB

Awards

Student Travel Stipend Award

Participants
Melvin Omodon, MD, Boston, MA (*Presenter*) Nothing to Disclose
Rafael Vazquez, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Raul N. Uppot, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

There has been significant advancement in techniques and outcomes in various aspects of interventional radiology with much emphasis on radiological procedural advances and innovations. However research in pain management of these patients has taken a back seat. Procedures such as microwave ablation may result in significant post procedural pain and increased opioid use. There have been significant advances in the treatment of pain and enhancing recovery which may be applicable to interventional radiology patients. The goal of this study is to compare post procedural pain in patients who received regular monitored anesthesia care during microwave ablation to those who received a multimodal analgesic cocktail (consisting of Gabapentin, Toradol and Dexamethasome) prior to microwave ablation. A secondary goal is to familiarize the audience with the Enhanced Recovery After Surgery protocols offered by anesthesia.

METHOD AND MATERIALS

A retrospective analysis was performed on 34 patients who underwent microwave ablation for liver and renal cancer with anesthesia services. The patients were in either of 3 groups: (1) standard monitored anesthesia care, (2) multimodal analgesic cocktail only (with Toradol, Gabapentin and Dexamethasome) and (3) combination of regional block and multimodal analgesics. Post procedure pain scores and opioid consumption (dilaudid and oxycodone) were recorded.

RESULTS

Multimodal pre-procedural cocktail consisting of Gabapentin, Toradol and Dexamethasome is associated with decreased pain and opioid consumption in the immediate post-procedure recovery.

CONCLUSION

Patients undergoing liver and renal microwave ablation receiving the multimodal analgesic cocktail generally have less pain scores using the visual analogue scale. They also required less immediate post procedural anesthesia.

CLINICAL RELEVANCE/APPLICATION

This multimodal cocktail consisting of Gabapentin, Toradol and Dexamethasome is associated with decreased pain and opioid consumption post microwave ablation

SSJ26-06 Histologic Diagnosis of Incidentally Discovered Parotid Lesions: Should Biopsy Be Pursued?

Tuesday, Nov. 27 3:50PM - 4:00PM Room: S502AB

Participants
Sarah N. Eberson, MD, Houston, TX (*Presenter*) Nothing to Disclose
Hassan Al-Balas, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Zeyad A. Metwalli, MD, Bellaire, TX (*Abstract Co-Author*) Nothing to Disclose
David Sada, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Purpose: With increased utilization of imaging in evaluation of head and neck conditions, there has been an increase in the detection of incidental parotid lesions. This study compares the pathology of incidentally discovered parotid lesions to a cohort of symptomatic parotid lesions.

METHOD AND MATERIALS

Materials and Methods: A single institution retrospective review of all patients who underwent percutaneous biopsy of parotid lesions between January 2010 and December 2017 was performed. 143 patients were identified and divided into two groups: patients with symptomatic parotid lesions and patients with incidentally detected parotid lesions. Patient demographics, lesions characteristics and final histologic diagnosis were recorded and compared between the two groups. Histologic diagnosis in resected lesions was considered the final diagnosis in patients who underwent parotidectomy.

RESULTS

Results: Of the 143 study patients, 64 (44.8%) had symptomatic parotid lesions and 79 (53.2%) had incidentally discovered parotid lesions. Histologic diagnosis in the symptomatic group included 27 Warthin tumors (42%), 7 pleomorphic adenomas (11%), 3 intra-parotid lymph nodes (5%) and 27 (42%) with miscellaneous pathology (mucoepidermoid carcinoma, sialadenitis, lymphoepithelial lesion, oncocytoma and equivocal pathology). Histologic diagnosis in the incidental group included 34 Warthin tumors (43%), 14 pleomorphic adenomas (18%), 5 intra-parotid lymph nodes (6%) and 26 (33%) with miscellaneous pathology. There was no significant difference in final histologic diagnosis between the two groups ($p = 0.34$).

CONCLUSION

Conclusion: Incidentally detected asymptomatic parotid lesions have a similar histologic profile to symptomatic lesions and tissue diagnosis is warranted.

CLINICAL RELEVANCE/APPLICATION

Clinical Relevance: The distribution of histologic diagnoses of incidentally discovered parotid lesions is similar to that of symptomatic lesions and tissue diagnosis should be pursued.

MSAS34

The Importance of Radiographer Led Research: Growing the Evidence Base (Sponsored by the Associated Sciences Consortium) (Interactive Session)

Tuesday, Nov. 27 3:30PM - 5:00PM Room: S105AB

RS

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

Participants

Charlotte Beardmore, MBA, London, United Kingdom (*Moderator*) Nothing to Disclose
Dimitris Katsifarakis, MSc, London, United Kingdom (*Moderator*) Nothing to Disclose

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Sub-Events

MSAS34A The Impact of Radiographer Led Research: A Case Study from the UK

Participants

Richard Evans, London, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the value of 'radiographer led' research within clinical imaging services. 2) To understand the steps required in developing a local research strategy. 3) To understand how to examine opportunities and barriers within your clinical environment to help support effective research.

ABSTRACT

As Health Care Professionals, radiographers and technologists are encouraged to put the patient at the centre of everything we do. In the UK, the Society and College of Radiographers (SCoR) state that this level of care should be based on up to date evidence that is of a high quality, using research to meet the needs of the patient. This drive to encourage research is also mirrored by the Allied Health Professions Federation (AHPF), who have published a strategy with one of its key goals focussed on the impact of research methods and evaluation on population outcome. Historically, research undertaken by radiographers in the UK has been minimal. In 2015, a review of contributors to the journal for The European Federation of Radiographer Societies found that of 239 contributing author affiliations, only 22 were represented by UK hospitals. Factors restricting engagement with research could be due to a lack of research experience and confidence among radiography practitioners and technologists, and a culture where research is not seen as a priority. In busy departments; time, lack of role models, difficulties in back filling roles and resistance to change, along with ever increasing imaging demands, have led to further barriers in undertaking research. The question remains as to how we bridge the gap between embedding research in all levels of radiographic practice and current clinical research activity? The purpose of this presentation will be to focus on our research journey within a UK radiography department. We will share how we overcame barriers through collaboration and establishing a local research strategy to facilitate our research ideas. As a result, we will demonstrate how this led to achieving successes regarding the positive impact of research, both on our patients and staff.

MSAS34B Shifting the Paradigm of Medical Imaging: How Imaging Can Drive Innovations in Patient Care (A Canadian Experience)

Participants

Paul Cornacchione, BSC, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the benefits of an integrated project management team within medical imaging. 2) Share the impact that a medical imaging department and extended practice roles can have in driving patient care. 3) Highlight the use of data in developing and monitoring initiative outcomes.

MSCC34

Case-based Review of Nuclear Medicine: PET/CT Workshop-Advances in PET (In Conjunction with SNMMI) (Interactive Session)

Tuesday, Nov. 27 3:30PM - 5:00PM Room: E450B

BQ CT NM

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

FDA Discussions may include off-label uses.

Participants
Samuel E. Almodovar-Reteguis, MD, Orlando, FL (*Director*) Nothing to Disclose
Katherine A. Zukotynski, MD, Ancaster, ON (*Director*) Nothing to Disclose
Chadwick L. Wright, MD,PhD, Lewis Center, OH (*Moderator*) Nothing to Disclose

Sub-Events

MSCC34A Somatostatin Receptor PET & Therapy

Participants
Thomas A. Hope, MD, San Francisco, CA (*Presenter*) Research support, General Electric Company

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LEARNING OBJECTIVES

1) Define the role of somatostatin receptor (SSTR) PET in patients with neuroendocrine tumors (NETs). 2) Compare the use of conventional imaging and SSTR PET in staging NETs. 3) Explain the mechanism of SSTR based peptide receptor radionuclide therapy (PRRT).

ABSTRACT

Neuroendocrine tumors (NET) are unique in that they overexposes the somatostatin receptor (SSTR). This can be leveraged in imaging by labelling somatostatin analogs with radiation to image the location of tumors. DOTATATE is a SSTR analog, that when labeled with Gallium-68 can be used to image neuroendocrine tumors with very high sensitivity and specificity. It is important to remember that although SSTR PET using Ga68 DOTATATE is very effective, conventional imaging using either CT or MRI will remain the most common imaging modality for NET patients over time. Beyond imaging, SSTR analogs can be labeled with beta emitters than can be used therapeutically. Most commonly DOTATATE is labeled with Lutetium-177. This was studied prospectively in a randomized controlled trial (NETTER-1 trial), which demonstrated significant improvement in radiographic progression free survival. These results led to the FDA approval of this therapy in 2018.

MSCC34B Fluciclovine/PSMA PET

Participants
Andrei Iagaru, MD, Emerald Hills, CA (*Presenter*) Research Grant, General Electric Company

LEARNING OBJECTIVES

1) List some of the molecular imaging targets that are used in prostate cancer. 2) Understand underlying biology and mechanism of action for some of the new PET radiopharmaceuticals in prostate cancer. 3) Discuss patterns of prostate cancer appearance when using some of the new PET radiopharmaceuticals.

ABSTRACT

Data from the American Cancer Society suggests that prostate cancer will continue to be the leading cancer diagnosis in men with 164,690 estimated new cases and will have the second highest mortality (after lung cancer) with 29,430 estimated deaths for 2018 in the United States. Initial and subsequent treatment of prostate cancer may involve surgery, radiation therapy, hormonal therapy, chemotherapy, or a combination of these. Additional molecular pathways in prostate cancer lead to the identification of new targets that may be amenable to diagnostic and therapeutic intervention with novel agents. Areas of interest for the Nuclear Medicine and Molecular Imaging community include mainly aminoacid analogues (Fluciclovine) and the prostate specific membrane antigen (PSMA), but also gastrin releasing peptide receptors (GRPR).

MSCC34C Response Assessment

Participants
David A. Mankoff, MD, PhD, Philadelphia, PA (*Presenter*) Speaker, Koninklijke Philips NV; Consultant, General Electric Company; Advisory Board, RefleXion Medical Inc; Consultant, Blue Earth Diagnostics Ltd; Research Funded, Siemens AG; Advisory Board, ImaginAb, Inc; Spouse, Owner, Trevarx

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LEARNING OBJECTIVES

1) List applications of molecular imaging as a cancer biomarker. 2) Describe clinical setting for which molecular imaging response approaches are applicable. 3) Discuss investigational agents being investigated for response assessment and early results.

ABSTRACT

This talk will review molecular imaigng approaches for cancer, considering molecular imaging as a cancer biomarker to guide treatment decisions and evaluate therpaeutic repsonse. Examples form recent or ongoing multi-center trials will be presented as exmaples of possible future clinical role for molecular imaigng cancer biomarkers.

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/ David A. Mankoff, MD, PhD - 2013 Honored EducatorDavid A. Mankoff, MD, PhD - 2018 Honored Educator

MSES34

Essentials of Musculoskeletal

Tuesday, Nov. 27 3:30PM - 5:00PM Room: S100AB

MK

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

Sub-Events

MSES34A Identifying Lyme and Scurvy

Participants
Bethany U. Casagranda, DO, Pittsburgh, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the history of Lyme disease and scurvy. 2) Identify MSK manifestations of Lyme disease and scurvy utilizing multiple modalities. 3) Explain the appropriate clinical scenarios for adding Lyme disease and scurvy to the differential diagnosis.

ABSTRACT

as above

MSES34B Commonly Missed Fractures

Participants
Leon Lenchik, MD, Winston-Salem, NC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Develop an approach for detecting commonly missed fractures.

MSES34C Imaging of the Diabetic Foot

Participants
William B. Morrison, MD, Philadelphia, PA (*Presenter*) Consultant, AprioMed AB; Patent agreement, AprioMed AB; Consultant, Zimmer Biomet Holdings, Inc; Consultant, Samsung Electronics Co, Ltd; Consultant, Medical Metrics, Inc

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william.morrison@jefferson.eduandTwitter:@morrisonMSK

LEARNING OBJECTIVES

1) Understand the pathoetiology of diabetic foot ulceration and infection. 2) Know the imaging findings associated with diabetic pedal infection. 3) Be aware of imaging pitfalls and the mimickers of infection in the diabetic foot.

ABSTRACT

Imaging of the foot in patients with diabetes can be challenging. Modalities and imaging protocol will be discussed in addition to use of MRI contrast agents. Imaging findings will be reviewed, particularly geared toward diagnosis of osteomyelitis in patients with ulceration. Imaging pitfalls and mimickers of infection will also be discussed. Differentiation from Charcot arthropathy will be reviewed. New research will be presented with suggested guidelines and tips for accurate ddiganosis. .

MSRO39

BOOST: Gastrointestinal-eContouring

Tuesday, Nov. 27 4:30PM - 5:30PM Room: S104B

GI OI RO

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants

Edward Y. Kim, MD, Seattle, WA (*Coordinator*) Nothing to Disclose
Mary U. Feng, MD, San Francisco, CA (*Presenter*) Self: Consultant, Varian, Inc and RefleXion Medical Inc; Spouse (Felix Feng, MD), Advisory Boards Dendreon, Janssen, Bayer, Sanofi, Ferring, EMD Serono, Medivation/Astellas, Blue Earth Diagnostics, Progenics; Spouse, honorarium Clovis
Smith Apisarnthanarax, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Ryan O'Malley, MD, Seattle, WA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

apisarn@uw.edu

Mary.feng@ucsf.edu

LEARNING OBJECTIVES

1) Review radiotherapy contouring and treatment planning techniques for liver tumors. 2) Discuss challenges in radiotherapy target definition across multiple imaging modalities. 3) Highlight important aspects of radiologic anatomy applied to treatment of liver tumors.

RC401

Occupational Lung Disease (Interactive Session)

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E450A

CH CT

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

Participants
Cristopher A. Meyer, MD, Madison, WI (*Moderator*) Investor, Elucent Medical; Consultant, NIOSH Certified B-reader

For information about this presentation, contact:

cmeyer2@uwhealth.org

LEARNING OBJECTIVES

1) State the radiographic and CT findings of silicosis, CWP, and asbestos-related lung disease. 2) Always consider beryllium exposure when faced with an interstitial lung disease with features of sarcoidosis. 3) Describe the importance of expiratory imaging in the identification of small airway disease. 4) Identify clues to exposure history when interpreting HRCTs for interstitial lung disease.

ABSTRACT

Despite increased safety measures, workers remain at risk for occupational exposures. Silicosis, coal workers' pneumoconiosis, and asbestos-related lung disease continue to affect workers because of ongoing exposures in the workplace, long latency between exposure and disease, and changes in mining techniques. Immune-mediated diseases such as chronic hypersensitivity pneumonitis and chronic beryllium disease may also result from workplace exposure. Airway-centered occupational lung diseases are often the subtlest and may required expiratory imaging for recognition. This session will review these categories of occupational lung disease and conclude with a case-based session that emphasizes specific findings that may alert the interpreting radiologist to the possibility of occupational lung disease when faced with an unknown HRCT for interstitial lung disease.

Sub-Events

RC401A Classic Dusts: Asbestos, Silica, and Coal

Participants
Jeffrey P. Kanne, MD, Madison, WI (*Presenter*) Research Consultant, PAREXEL International Corporation;

For information about this presentation, contact:

jkanne@uwhealth.org

LEARNING OBJECTIVES

View learning objectives under main course title.

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/ Jeffrey P. Kanne, MD - 2012 Honored EducatorJeffrey P. Kanne, MD - 2013 Honored Educator

RC401B Occupational Lung Disease: The Other Guys (Beryllium, Hard Metal, Aluminum, Siderosis)

Participants
Sudhakar N. Pipavath, MD, Mercer Island, WA (*Presenter*) Adjudicator, Gilead Sciences, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

Honored Educators

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RC401C Airway Related Interstitial Lung Disease and Emerging Occupational Lung Disease

Participants
Christian W. Cox, MD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC401D HRCT Patterns of Occupational Lung Disease: Case-Based

Participants
Cristopher A. Meyer, MD, Madison, WI (*Presenter*) Investor, Elucent Medical; Consultant, NIOSH Certified B-reader

LEARNING OBJECTIVES

View learning objectives under main course title.

RC402

What's New from the Radiology Residency Review Committee

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S503AB

ED

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Felicia Davis, Chicago, IL (*Presenter*) Nothing to Disclose
James C. Anderson, MD, Portland, OR (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To provide updates from the Review Committee for Diagnostic Radiology. 2) To provide updates from ACGME. 3) To provide updates on the Interventional Radiology Residency.

RC403

Nonischemic Cardiomyopathies: New Role of Cardiac MRI

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E350

CA MR

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

FDA Discussions may include off-label uses.

Participants
Charles S. White, MD, Baltimore, MD (*Moderator*) Consultant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) To recognize MRI appearance of the most common right ventricular cardiomyopathies.2) To describe the phenotypic spectrum of morpho-funcitional and tissue abnormalities of hypertrophic cardiomyopathy. 3) To review different faces and phases of the disease reflecting its natural history. 4) To analyze critical role of CMR tissue characterization of the differential diagnoses of hypertrophic CMPs, from phenotype to genotype. 5) To review T1 and T2 tissue mapping variations in different clinical scenarios. 6) To analyze prognostic implications of CMR in HCM. 7) Describe the relevant clinical findings of patients with restrictive cardiomyopathy. 8) Define the role of cardiac MR (CMR) in the evaluation of patients with restrictive cardiomyopathy. 9) Discuss the different patterns of myocardial enhancement and other ancillary imaging findings as they relate to narrowing the differential diagnosis in patients with restrictive cardiomyopathy. 10) Identify the different forms of Dilated Cardiomyopathies (DCM). 11) Apply the most common Cardiac Magnetic Resonance (CMR) techniques to differentiate between the various DCM etiologies. 12) Assess the Pros & Cons of different CMR techniques for the DCM evaluation.

Sub-Events

RC403A Arrhythmogenic and other Right Ventricular Cardiomyopathies

Participants
Karen G. Ordovas, MD, San Francisco, CA (*Presenter*) Advisor, Arterys Inc

For information about this presentation, contact:

karen.ordovas@ucsf.edu

LEARNING OBJECTIVES

1) To recognize MRI appearance of the most common right ventricular cardiomyopathies.

RC403B Role of MRI in Hypertrophic Cardiomyopathy

Participants
Marco Francone, MD,PhD, Rome, Italy (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

marco.francone@uniroma1.it

LEARNING OBJECTIVES

1) To describe the phenotypic spectrum of morpho-funcitional and tissue abnormalities of hypertrophic cardiomyopathy. 2) To review different faces and phases of the disease reflecting its natural history. 3) To analyze critical role of CMR tissue characterization of the differential diagnoses of hypertrophic CMPs, from phenotype to genotype. 4) To review T1 and T2 tissue mapping variations in different clinical scenarios. 5) To analyze prognostic implications of CMR in HCM.

RC403C Restrictive Cardiomyopathy and Amyloidosis

Participants
Daniel Vargas, MD, Aurora, CO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

daniel.vargas@ucdenver.edu

LEARNING OBJECTIVES

1) Describe the relevant clinical findings of patients with restrictive cardiomyopathy. 2) Define the role of cardiac MR (CMR) in the evaluation of patients with restrictive cardiomyopathy. 3) Discuss the different patterns of myocardial enhancement and other ancillary imaging findings as they relate to narrowing the differential diagnosis in patients with restrictive cardiomyopathy.

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RC403D Role of MRI in Dilated Cardiomyopathies

Participants
Matthias Gutberlet, MD, PhD, Leipzig, Germany (*Presenter*) Speaker, Siemens AG; Speaker, Koninklijke Philips NV; Speaker, Bayer AG; Speaker, Bracco Group; Author, Thieme Medical Publishers, Inc

LEARNING OBJECTIVES

1) Identify the different forms of Dilated Cardiomyopathies (DCM). 2) Apply the most common Cardiac Magnetic Resonance (CMR) techniques to differentiate between the various DCM etiologies. 3) Assess the Pros & Cons of different CMR techniques for the DCM evaluation.

RC404

Interpretation of Musculoskeletal Radiographs: A Forgotten Art

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E353C

MK

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

Participants
Mini N. Pathria, MD, San Diego, CA (*Director*) Nothing to Disclose

For information about this presentation, contact:

llenchik@wakehealth.edu

LEARNING OBJECTIVES

1) Obtain appropriate radiographs, AP, lateral and obliques. Oblique views are essential as certain fractures may be visible only on this projection. 2) Certain fractures and dislocations are notorious for being overlooked. Know these injuries and be certain to identify or exclude them. 3) Be aware of the potential for satisfaction of search and the potential of diagnostic oversights in certain injuries. Once such an injury is noted look closely for the commonly associated injury. 4) When the clinical diagnosis is not apparent or uncertain on the initial radiographs, do not hesitate to obtain CT or MRI to confirm or exclude an injury. 5) Understand that the location and pattern of pelvic injury varies with patient demographics and injury mechanism. 6) Recognize subtle radiographic findings indicating pelvic injuries that are easily overlooked. 7) Understand the role of advanced cross-sectional imaging in occult fractures, complex bony injury, and soft tissue trauma. 8) Familiarize the radiologist with radiographic imaging pitfalls in the lower extremity and subtle radiographic findings indicating disease. 9) Provide advanced cross-sectional imaging correlation of the radiographic findings. 10) Provide a logical framework in radiologic evaluation of bone tumors. 11) To recognize the importance and use of radiographs in evaluation of bone tumors in differential diagnosis. 12) To recognize various pattern of bone destruction and matrix mineralization.

Sub-Events

RC404A Upper Extremity

Participants
Lee F. Rogers, MD, Tucson, AZ (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Obtain appropriate radiographs, AP, lateral and obliques. Oblique views are essential as certain fractures may be visible only on this projection. 2) Certain fractures and dislocations are notorious for being overlooked. Know these injuries and be certain to identify or exclude them. 3) Be aware of the potential for satisfaction of search and the potential of diagnostic oversights in certain injuries. Once such an injury is noted look closely for the commonly associated injury. 4) When the clinical diagnosis is not apparent or uncertain on the initial radiographs, do not hesitate to obtain CT or MRI to confirm or exclude an injury.

Active Handout:Lee Frank Rogers

http://abstract.rsna.org/uploads/2018/18000815/Handouts Upper ExtremityRC404A.pdf

RC404B Pelvis and Hip

Participants
Mini N. Pathria, MD, San Diego, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand that the location and pattern of pelvic injury varies with patient demographics and injury mechanism. 2) Recognize subtle radiographic findings indicating pelvic injuries that are easily overlooked. 3) Understand the role of advanced cross-sectional imaging in occult fractures, complex bony injury, and soft tissue trauma.

Active Handout:Mini Nutan Pathria

http://abstract.rsna.org/uploads/2018/18000816/Pelvis and Hip Xrays Forgotten Art RC404B.pdf

RC404C Lower Extremity

Participants
Zehava S. Rosenberg, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Familiarize the radiologist with radiographic imaging pitfalls in the lower extremity and subtle radiographic findings indicating disease. 2) Provide advanced cross-sectional imaging correlation of the radiographic findings.

Honored Educators

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RC404D Bone Tumors

Participants
Mark D. Murphey, MD, Silver Spring, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Provide a logical framework in radiologic evaluation of bone tumors. 2) To recognize the importance and use of radiographs in evaluation of bone tumors in differential diagnosis. 3) To recognize various pattern of bone destruction and matrix mineralization.

ABSTRACT

This discussion focuses on the radiologic assessment of solitary and polyostotic lesions of bone with pathologic correlation. Recognition of the patterns of bone destruction on radiographs and their implication on differential diagnosis is emphasized. Identifying the patterns of matrix mineralization either chondroid or osteoid and the impact on diagnostic considerations is also discussed. Take Home Message 1. The radiographic appearance of bone lesions allows an appropriate differential diagnosis by reflecting the biologic activity of the underlying pathologic process. 2. Radiographic assessment of the solitary bone lesion is imperative to direct appropriate patient management. 3. Recognition of 'don't touch' lesions is an important role for the radiologist.

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RC405

Neuroradiology: Small Tricks to Avoid Big Misses (Interactive Session)

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E451A

NR PD

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

Participants
James G. Smirniotopoulos, MD, Silver Spring, MD (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

james.smirniotopoulos@nih.gov

Sub-Events

RC405A Newborn and Pediatric Brain

Participants
Bruno P. Soares, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

bruno.soares@jhmi.edu

LEARNING OBJECTIVES

1) Develop an evaluation pattern for brain MRI in neonatal encephalopathy. 2) Identify clinical and imaging findings suggestive of an inherited neurometabolic disorder. 3) Apply practical imaging criteria to classify pediatric cystic posterior fossa anomalies.

RC405B Postoperative Spine

Participants
Falgun H. Chokshi, MD, Marietta, GA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the imaging appearance of the post operative spine hardware and soft tissues. 2) Understand the consequences of various post-operative complications seen in imaging. 3) Know modality specific limitations of post-operative spine imaging.

RC405C Acute Hemorrhage

Participants
Michael Iv, MD, Stanford, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

miv@stanford.edu

LEARNING OBJECTIVES

1) Recognize causes and mimics of acute subarachnoid hemorrhage. 2) Differentiate between etiologies of acute parenchymal hemorrhage. 3) Describe the importance of specific imaging features in predicting clinical outcome in various settings of acute hemorrhage.

RC405D Disorders of CSF Circulation

Participants
Timothy J. Amrhein, MD, Cary, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the characteristic brain and spine imaging findings in spontaneous intracranial hypotension. 2) To describe the characteristic brain imaging findings in Chiari 1 malformation. 3) To describe the characteristic brain imaging findings in idiopathic intracranial hypertension. 4) To identify key imaging features allowing one to differentiate between these different CSF-related pathologies.

RC406

Do You Know Your Head & Neck Anatomy? (Interactive Session)

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S402AB

HN NR

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

For information about this presentation, contact:

shatzkes@hotmail.com

GENERAL INFORMATION

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC406A Temporal Bone Anatomy

Participants
Richard H. Wiggins III, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Richard.Wiggins@hsc.utah.edu

LEARNING OBJECTIVES

1) Understand best imaging modalities and practices for temporal bone imaging. 2) Recognize important temporal bone anatomy. 3) Describe important temporal bone imaging critical points.

Honored Educators

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RC406B Skull Base Anatomy

Participants
C. Douglas Phillips, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

dphillips@med.cornell.edu

LEARNING OBJECTIVES

At the conclusion of this session, the attendee will be able to view the skull base with improved confidence. It is expected the attendee will be able to:1. Understand the normal anatomy of the skull base2. Recognize and identify normal skull base foramina on CT and MR3. Gain confidence in differentiating pathologies of the skull base

ABSTRACT

As a part of this interactive session, the attendee will be presented normal anatomy of the skull base and will have the opportunity to respond to questions regarding the bone, soft tissues, vascular and neural structures at the skull base.

RC406C Larynx/Hypopharynx Anatomy

Participants
Hugh D. Curtin, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Hugh_Curtin@meei.harvard.edu

LEARNING OBJECTIVES

1) The participant will be able to idenify the ventricle on axial and coronal images. 2) The participant will be able to identify the structures of the hypopharynx on CT. 3) The participant will be able to describe the contents and tissues of the paraglottic space.

ABSTRACT

The session will discuss the anatomy of the larynx and hypopharynx with particular emphasis on structures and landmarks that are key assessing lesions of the larynx. Particularly important are identifying the level of the ventricle in axial and coronal planes as well

as describing the structure and contents of the paraglottic space. The supraglottis is above the ventricle and contains mostly fat laterally and anteriorly. The thyroarytenoid muscle fills much of the paraglottic space at the level of the true cord. The fat to muscle transition indicates the level of the ventricle. The subglottis has very little tissue separating the airway from the inner cortex of the cricoid. Distinguishing ossified and non-ossified cartilage is important as it bears on separating cancer from normal cartilage The hypopharynx can be separated into sublites that include the pyriform sinuses, posterior wall and post-cricoid area.

RC407

Use of Iodinated and Gadolinium-based Contrast Media 2018: Is Your Clinical Practice Up to Date?

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E351

GU SQ

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

FDA Discussions may include off-label uses.

Participants
Richard H. Cohan, MD, Ann Arbor, MI (*Moderator*) Co-author, Wolters Kluwer nv
Richard H. Cohan, MD, Ann Arbor, MI (*Presenter*) Co-author, Wolters Kluwer nv
Benjamin Mervak, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose
Matthew S. Davenport, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Jay K. Pahade, MD, New Haven, CT (*Presenter*) Consultant, General Electric Company
Robert J. McDonald, MD,PhD, Rochester, MN (*Presenter*) Consultant, General Electric Company; Research Grant, General Electric Company; Consultant, Bracco Group

For information about this presentation, contact:

matdaven@med.umich.edu

rcohan@umich.edu

LEARNING OBJECTIVES

1) To review current management recommendations regarding contrast material administration, including what to do in patients who have had allergic-like reactions and who require reinjection, current thoughts concerning the risks of contrast induced nephrotoxicity, safety profiles of the various gadolinium-based contrast agents, and the most recent observations of long-term gadolinium retention in the body.

ABSTRACT

1. Premedication: Is it worthwhile? (Benjamin Mervak - University of North Carolina) During this talk, the attendee will learn the common indications for premedication and premedication regimens; the degree to which premedication reduces the incidence of subsequent reactions, the likelihood of breakthrough reactions, and the costs of premedication. 2. CIN: Does it exist? If not, why are we trying so hard to prevent it (Matthew Davenport - University of Michigan) During this talk, the literature calling into question the existence of CIN will be reviewed and the necessity of prophylaxis in patients who are more likely to develop acute kidney injury will be discussed. 3. Choosing an MRI contrast agent: Differences among gadolinium-based MR contrast agents with updates on nephrogenic systemic fibrosis (NSF) and renal function screening recommendations (Jay Pahade - Yale University) During this talk the learner will become familiar with various properties of the different available gadolinium based contrast agents, and advantages/disadvantages of their use with respect to patient safety. An update on NSF and renal function screening prior to gadolinium based contrast agent administration will also be provided. 4. Gadolinium Deposition in the Brain: What does this mean and what should we do about it ? (Robert McDonald - Mayo Clinic). During this talk, results of recent research demonstrating gadolinium retention in the body, including the brain will be reviewed. The potential clinical implications of such retention will be discussed, along with a description of future research that needs to be performed in this area.

RC408

Emergency Ultrasound Pitfalls

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S102CD

ER GU OB US VA

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

Participants
Leslie M. Scoutt, MD, New Haven, CT (*Moderator*) Speaker, Koninklijke Philips NV

For information about this presentation, contact:

leslie.scoutt@yale.edu

LEARNING OBJECTIVES

1) Describe the role of US and how to avoid common pitfalls in the diagnosis of patients presenting with acute scrotal and adnexal pain. 2) Discuss common US pitfalls in the evaluation of patients presenting with abdominal and RUQ pain. 3) Discuss how to recognize and avoid common pitfalls in US diagnosis of acute vascular pathology. 4) Describe the optimal US approach to the evaluation of emergent pathology presenting in the second trimester of pregnancy.

ABSTRACT

This course will review common pitfalls in US evaluation of patients presenting for emergent care. Emphasis will be placed on recognizing and avoiding common technical errors and errors in scanning technique that could effect image interpretation and cause pitfalls in diagnosis. The session will specifically focus on the role of US in the evaluation of testicular, ovarian, RUQ, vascular and second trimester OB pathology that is commonly encountered in the emergency setting.

Sub-Events

RC408A Testicular and Ovarian Ultrasound Pitfalls

Participants
Leslie M. Scoutt, MD, New Haven, CT (*Presenter*) Speaker, Koninklijke Philips NV

For information about this presentation, contact:

leslie.scoutt@yale.edu

LEARNING OBJECTIVES

1) Discuss the diagnostic US criteria and common pitfalls as well as how to avoid them in the US diagnosis of testicular torsion, epididymitis and testicular rupture. 2) Describe the ultrasound features and common pitfalls in the US diagnosis of ovarian torsion, hemorrhagic cysts and pelvic inflammatory disease.

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RC408B Ultrasound Pitfalls in the RUQ and Abdomen

Participants
Oksana H. Baltarowich, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

oksana.baltarowich@jefferson.edu

LEARNING OBJECTIVES

1) Improve diagnostic images by paying attention to sonographic technique. 2) Improve awareness how to avoid technical pitfalls in the emergency setting.

RC408C Vascular Ultrasound Pitfalls

Participants
John S. Pellerito, MD, Manhasset, NY (*Presenter*) Research Grant, General Electric Company

LEARNING OBJECTIVES

1) Recognize important technical errors that impact diagnosis. 2) Identify common errors in interpretation that will improve diagnosis. 3) Gain insights to improve the quality and accuracy of vascular examinations.

RC408D Second Trimester Ultrasound Pitfalls

Participants
Mariam Moshiri, MD, Bellevue, WA (*Presenter*) Grant, Koninklijke Philips NV; Author with royalties, Reed Elsevier

LEARNING OBJECTIVES

1) Learn requirements for an accurate second trimester ultrasound survey. 2) Learn how to Q/A the images obtained to avoid missing abnormalities. 3) Learn how to avoid common pitfalls while evaluating images and avoid over-call or under-call of abnormalities.

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RC409

Imaging of the Colorectum

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E352

CT GI MR

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

Participants
Judy Yee, MD, Bronx, NY (*Moderator*) Research Grant, EchoPixel, Inc; Research Grant, Koninklijke Philips NV;

LEARNING OBJECTIVES

1) Apply the results of recent research to the performance of CT colonography. 2) Improve basic knowledge and skills relative to the performance of CT colonography. 3) Assess the potential of technical advancements to improve the performance of CT colonography. 4) To understand the target lesion for colorectal cancer screening using CT Colonography and what should be reported. 5) To identify common and uncommon pitfalls on 2D and 3D CT Colonography images. 6) To review the serrated pathway to the development of colorectal cancer and how the use of oral contrast can help to identify sessile serrated polyps on CT Colonography. 7) Review briefly MRI Technique and Anatomy. 8) Highlight Structured Reporting Template for MRI of rectal cancer. 9) Discuss essential features to be included in MRI report. 9) Review briefly MRI Technique and Anatomy. 10) Highlight Structured Reporting Template for MRI of anorectal fistula. 11) Discuss essential features to be included in MRI report.

Sub-Events

RC409A CT Colonography Technique Update

Participants
Courtney C. Moreno, MD, Suwanee, GA (*Presenter*) Researcher, General Electric Company;

For information about this presentation, contact:

courtney.moreno@emoryhealthcare.org

LEARNING OBJECTIVES

1) Apply the results of recent research to the performance of CT colonography. 2) Improve basic knowledge and skills relative to the performance of CT colonography. 3) Assess the potential of technical advancements to improve the performance of CT colonography.

Honored Educators

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RC409B CT Colonography: Strategies for Success

Participants
Judy Yee, MD, Bronx, NY (*Presenter*) Research Grant, EchoPixel, Inc; Research Grant, Koninklijke Philips NV;

LEARNING OBJECTIVES

1) To understand the target lesion for colorectal cancer screening using CT Colonography and what should be reported. 2) To identify common and uncommon pitfalls on 2D and 3D CT Colonography images. 3) To review the serrated pathway to the development of colorectal cancer and how the use of oral contrast can help to identify sessile serrated polyps on CT Colonography.

RC409C MRI Rectal Cancer Including Structured Reporting

Participants
Kartik S. Jhaveri, MD, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review briefly MRI Technique and Anatomy. 2) Highlight Structured Reporting Template for MRI of rectal cancer. 3) Discuss essential features to be included in MRI report.

RC409D MRI Anorectal Fistulas Including Structured Reporting

Participants
Mukesh G. Harisinghani, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review briefly MRI Technique and Anatomy. 2) Highlight Structured Reporting Template for MRI of anorectal fistula. 3) Discuss essential features to be included in MRI report.

RC410

Neck Sonography: TI-RADS, Parathyroids, and Other Masses

Tuesday, Nov. 27 4:30PM - 6:00PM Room: N227B

HN NR US

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

Sub-Events

RC410A Implementing ACR TI-RADS: A Practical Guide

Participants
Franklin N. Tessler, MD, Birmingham, AL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ftessler@uabmc.edu

LEARNING OBJECTIVES

1) Explain the background, rationale, and structure of the ACR TI-RADS risk stratification system for thyroid nodules. 2) Understand how to implement ACR TI-RADS in their practice.

ABSTRACT

ACR TI-RADS is a points-based risk stratification system for thyroid nodules based on their ultrasound appearance in five categories. In this presentation, I will provide the background and rationale for the development of ACR TI-RADS and review its approach and structure. I will also provide tips and pitfalls for implementing the system in a radiology practice.

RC410B Performance Characteristics of ACR TI-RADS with Illustrative Cases

Participants
William D. Middleton, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To use the ACR TI-RADS to guide management of thyroid nodules that are being evaluated with ultrasound.

RC410C Parathyroid Imaging: Techniques and Controversies

Participants
Mitchell E. Tublin, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Define both the rationale for preoperative imaging of patients with primary hyperparathyroidism and recent controversies in treatment. 2) List the strengths and weaknesses of current imaging methods employed for parathyroid localization. 3) Optimize ultrasound technique to increase imaging accuracy.

RC410D Other Neck Masses

Participants
Mary C. Frates, MD, Sharon, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mfrates@bwh.harvard.edu

LEARNING OBJECTIVES

1) Recognize the various sonographic appearance of masses that occur in the neck, not related to the thyroid or parathyroid glands. 2) Understand how to use the clinical and sonographic features of a neck mass to narrow the differential diagnosis.

RC411

PET/CT and SPECT/CT in Movement Disorders, Epilepsy, and Dementia

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S504CD

NR CT NM

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

FDA Discussions may include off-label uses.

Sub-Events

RC411A Dopamine Transporter Scans and Movement Disorders

Participants
Vani Vijayakumar, MD, Ridgeland, MS (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

vvijayakumar@umc.edu

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

RC411B 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.

ABSTRACT

Medically refractory epilepsy is now often treated surgically. A holistic multidisciplinary review of the patient preoperatively helps to optimize outcome. FDG PET and perfusion SPECT imaging are an integral part of the evaluation. Both imaging techniques are reviewed in context of the multidisciplinary evaluation. Imaging findings, pearls, and pitfalls of each are reviewed using case examples.

URL

http://abstract.rsna.org/uploads/2018/16002150/RC411B%20Imaging%20for%20Epilepsy%20Thaggard.pdf

Active Handout:Anson Lee Thaggard

http://abstract.rsna.org/uploads/2018/16002150/RC411B Imaging for Epilepsy Thaggard.pdf

RC411C **PET Imaging for Dementia**

Participants
Phillip Kuo, MD,PhD, Tucson, AZ (*Presenter*) Author, MD Training at Home; Research Grant, Astellas Group; Consultant, Endocyte, Inc; Consultant, General Electric Company; Education Grant, General Electric Company; Speakers Bureau, Eli Lilly and Company; Consultant, inviCRO, LLC; Consultant, Imaging Endpoints; Consultant, Progenics Pharmaceuticals, Inc

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.

RC412

Peripheral Artery Disease: CTA and MRA

Tuesday, Nov. 27 4:30PM - 6:00PM Room: N230B

CT MR VA

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

Participants
Constantino S. Pena, MD, Miami, FL (*Moderator*) Speakers Bureau, Cook Group Incorporated; Speakers Bureau, Medtronic plc ; Speakers Bureau, W. L. Gore & Associates, Inc; Speakers Bureau, Penumbra, Inc; Speakers Bureau, Terumo Corporation; Speakers Bureau, Merit Medical Systems, Inc; Advisory Board, C. R. Bard, Inc; Advisory Board, Boston Scientific Corporation;
Konstantin Nikolaou, MD, Tuebingen, Germany (*Moderator*) Advisory Panel, Siemens AG; Speakers Bureau, Siemens AG; Speaker Bureau, Bayer AG

For information about this presentation, contact:

konstantin.nikolaou@med.uni-tuebingen.de

Sub-Events

RC412A Interventional Procedure Planning: Role for CTA and MRA

Participants
Constantino S. Pena, MD, Miami, FL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Speakers Bureau, Medtronic plc ; Speakers Bureau, W. L. Gore & Associates, Inc; Speakers Bureau, Penumbra, Inc; Speakers Bureau, Terumo Corporation; Speakers Bureau, Merit Medical Systems, Inc; Advisory Board, C. R. Bard, Inc; Advisory Board, Boston Scientific Corporation;

LEARNING OBJECTIVES

1) Understand the value of peripheral CTA and MRA. 2) Discuss the benefits of CTA in comparison to MRA in the treatment of PAD. 3) Comprehend the importance of MRA sequences to highlight particular details in peripheral MRA. 4) Understand the importance of image reconstruction for peripheral CTA and MRA.

RC412B Peripheral CTA

Participants
Konstantin Nikolaou, MD, Tuebingen, Germany (*Presenter*) Advisory Panel, Siemens AG; Speakers Bureau, Siemens AG; Speaker Bureau, Bayer AG

For information about this presentation, contact:

Konstantin.Nikolaou@med.uni-tuebingen.de

LEARNING OBJECTIVES

1) Describe techniques for acquisition, reconstruction, and image interpretation of peripheral CTA 2) Discuss available data and evidence-based results for peripheral CTA, and expected impact on patient care 3) Compare advantages and drawbacks of lower extremity CTA in comparison to other imaging modalities and diagnostic tools for arterial occlusive disease.

RC412C Peripheral MR Angiography

Participants
James C. Carr, MD, Chicago, IL (*Presenter*) Research Grant, Astellas Group; Research support, Siemens AG; Speaker, Siemens AG; Advisory Board, Guerbet SA

RC412D Interventional Complications: Role for CTA and MRA

Participants
Charles Y. Kim, MD, Durham, NC (*Presenter*) Consultant, Merit Medical Systems, Inc; Consultant, Cook Group Incorporated

For information about this presentation, contact:

charles.kim@duke.edu

LEARNING OBJECTIVES

1) Understand endovascular aneurysm repair with endografts 2) Describe types of endoleaks and associated implications 3) Discuss current methods for optimal detection endoleaks with CTA and MRA, with understanding of advantages and disadvantages

ABSTRACT

Imaging of endoleaks has evolved over the past two decades, to include a multitude of techniques with CTA and MRA. While national guidelines for post-EVAR surveillance are relatively unidimensional, it is important for the practicing radiologist to understand the spectrum of available CT and MR techniques for detection of endoleaks, along with the advantages and disadvantages to each approach.

RC414

Morbidity and Mortality

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E353A

IR

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

FDA Discussions may include off-label uses.

Participants
Eric J. Hohenwalter, MD, Milwaukee, WI (*Moderator*) Nothing to Disclose
Brian S. Funaki, MD, Chicago, IL (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

eho@mcw.edu

Sub-Events

RC414A Oncologic M & M

Participants
Eric J. Hohenwalter, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To explain common errors leading to M&M in non-vascular intervention. 2) To develop a contingency plan for complications which occur in non vascular intervention.

RC414B Memorable M & M Cases

Participants
Alan H. Matsumoto, MD, Charlottesville, VA (*Presenter*) Grant, W. L. Gore & Associates, Inc; Grant, Medtronic plc; Grant, Cook Group Incorporated; Grant, IBM Corporation; Data Safety Monitoring Board, W. L. Gore & Associates, Inc; Data Safety Monitoring Board, Endologix, Inc; Data Safety Monitoring Board, Boston Scientific Corporation; Data Safety Monitoring Board, Penumbra, Inc; Data Safety Monitoring Board, Proteon Therapeutics, Inc; Data Safety Monitoring Board, Vascular Medcure; Stockholder, Koninklijke Philips NV; Stockholder, BrightWater Medical; Advisory Board, Boston Scientific Corporation; Advisory Board, Vascular Medcure; Advisory Board, Proteon Therapeutics, Inc; Advisory Board, BrightWater Medical;

LEARNING OBJECTIVES

1) Understand how errors in judgment 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.

RC414C Vascular M & M

Participants
John A. Kaufman, MD, Portland, OR (*Presenter*) Advisory Board, Argon Medical Devices, Inc; Medical Advisory Board and Owner, Bio2Medical; Consultant, Cook Group Incorporated; Consultant, NOvate Medical Technologies; Owner, Veniti, Inc;

LEARNING OBJECTIVES

1) Identify arterial and venous vascular complications. 2) Describe management of the complications. 3) Discuss strategies to avoid complications.

RC414D Nonvascular M & M

Participants
Brian S. Funaki, MD, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To list common errors which lead to complications in non-vascular interventions.

RC415

The Neoadjuvant Patient

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E353B

BR MR

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

Participants
Jessica W. Leung, MD, Houston, TX (*Moderator*) Scientific Advisory Board, Hologic, Inc; Speakers Bureau, Hologic, Inc; Speakers Bureau, FUJIFILM Holdings Corporation

For information about this presentation, contact:

JWLeung@MDAnderson.org

zuleyml@upmc.edu

LEARNING OBJECTIVES

1) To discuss three clinically significant areas involving care of the breast cancer patient undergoing neoadjuvant therapy. 2) To apply in everyday clinical practice the principles and conclusions learned.

Sub-Events

RC415A Ongoing Trials

Participants
Jessica W. Leung, MD, Houston, TX (*Presenter*) Scientific Advisory Board, Hologic, Inc; Speakers Bureau, Hologic, Inc; Speakers Bureau, FUJIFILM Holdings Corporation

For information about this presentation, contact:

JWLeung@MDAnderson.org

LEARNING OBJECTIVES

1) To learn the design of some of the ongoing clinical trials involving care of the breast cancer patient receiving neoadjuvant therapy. 2) To describe the imaging components of these trials.

RC415B Evaluation of the Axilla

Participants
Steven P. Poplack, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the key US criteria that are predictive of axillary lymph node metastases. 2) Appraise the accuracy of axillary US. 3) Describe the role of axillary US in the surgical management of the axilla after neoadjuvant treatment.

RC415C Role of MR

Participants
Eric L. Rosen, MD, Denver, CO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the role of Breast MRI in identifying candidates for Neoadjuvant Chemotherapy. 2) Discuss published data regarding the ability of Breast MRI to assess response to Neoadjuvant Chemotherapy. 3) Identify and review both the predictive and prognostic ability of Breast MRI in patients receiving Neoadjuvant Chemotherapy. 4) Identify advances in MRI likely to enhance its already established role in evaluating breast cancer patients receiving neoadjuvant Chemotherapy.

RC416

Developing Competency in Non-Clinical Professional Roles in Radiology and Medicine (Sponsored by the RSNA Professionalism Committee)

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S502AB

ED PR

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, Guerbet SA; Patent agreement, Nemoto Kyorindo Co, Ltd;
Ronald L. Eisenberg, MD, JD, Boston, MA (*Presenter*) Nothing to Disclose
Stephen Chan, MD, Closter, NJ (*Presenter*) Nothing to Disclose
Suresh K. Mukherji, MD, Northville, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rleisenb@bidmc.harvard.edu

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

All radiologists have undergone many years of training in clinical radiology, with most individuals having also participated in research and educational activities during their postgraduate training and post-residency careers. 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 years of training and experience, many individuals in the field of radiology are called upon to participate in professional activities for which they have 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 the aggregate, pursuit of these non-clinical activities is also essential for enhancing the overall image of all radiologists as relevant, connected, and integral to the practice of modern medicine, and for demonstrating radiologists to be contributing, functional members of society. So, what are these important non-clinical professional roles, and how does a radiologist develop the acumen to act satisfactorily in a non-clinical professional role which requires a different type of expertise and brings a new 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

RC417

Emerging Technology: 3D Joint Imaging

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S505AB

MR MK

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

FDA Discussions may include off-label uses.

Participants
Avneesh Chhabra, MD, Dallas, TX (*Moderator*) Consultant, ICON plc; Author with royalties, Wolters Kluwer nv; Author with royalties, Jaypee Brothers Medical Publishers Ltd

For information about this presentation, contact:

avneesh.chhabra@utsouthwestern.edu

LEARNING OBJECTIVES

1) Gain knowledge of 3D techniques and segmentation approaches in the domain of musculoskeletal MRI. 2) Assess the current role of 3D imaging in musculoskeletal pathologies. 3) Gain knowledge of emerging roles of 3D isotropic imaging in bone modeling and multiplanar evaluation of internal derangements.

Sub-Events

RC417A 3D MRI of Rotator Cuff and Shoulder Joint

Participants
Soterios Gyftopoulos, MD, Scarsdale, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Soterios.Gyftopoulos@nyumc.org

LEARNING OBJECTIVES

1) To describe how 3D imaging technology can better characterize and quantify anterior shoulder instability bone injuries and rotator cuff pathology.

RC417B 3D MRI of Knee Menisci and Bone Modeling

Participants
Avneesh Chhabra, MD, Dallas, TX (*Presenter*) Consultant, ICON plc; Author with royalties, Wolters Kluwer nv; Author with royalties, Jaypee Brothers Medical Publishers Ltd

For information about this presentation, contact:

avneesh.chhabra@utsouthwestern.edu

LEARNING OBJECTIVES

1) Gain knowledge of optimal 3D isotropic MRI technique for knee meniscus and bone evaluation. 2) Learn how to create meniscus and cruciate specific reconstructions using 3D MRI. 3) Learn how to evaluate meniscus tears and describe their longitudinal extent with arthroscopy correlations.

RC417C 3D MRI of Ankle and Foot

Participants
Jan Fritz, MD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG; Scientific Advisor, Siemens AG; Scientific Advisor, Alexion Pharmaceuticals, Inc; Speaker, Siemens AG

For information about this presentation, contact:

jfritz9@jhmi.edu

LEARNING OBJECTIVES

1) To apply current techniques and acquisition strategies for isotropic 3D MRI of the ankle and foot. 2) To review the diagnostic performance and comparative accuracy of 3D MRI of the ankle and foot. 3) To illustrate strengths and limitations of 3D MRI of the ankle and foot.

RC417D 3D MRI of Hyaline Cartilage

Participants
Richard Kijowski, MD, Madison, WI (*Presenter*) Research support, General Electric Company; Consultant, Boston Imaging Core Lab,

LLC

For information about this presentation, contact:

rkijowski@uwhealth.org

LEARNING OBJECTIVES

1) To classify the different types of three-dimensional sequences currently available to evaluate articular cartilage. 2) To compare the advantages and disadvantages of two-dimensional and three-dimensional sequences for evaluating articular cartilage. 3) To discuss the literature comparing the diagnostic performance of two-dimensional and three-dimensional sequences for evaluating articular cartilage. 4) To discuss the literature comparing the diagnostic performance of different three-dimensional sequences for evaluating articular cartilage.

RC417E 3D Rheumatology MRI

Participants
Parham Pezeshk, MD, Dallas, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review spondyloarthropathies, the burden of disease and the importance of early diagnosis to initiate treatment to avoid irreversible complications. 2) Discuss the challenges of diagnosis and approach to interpret the MR imaging to narrow the differential diagnosis. 3) Review imaging findings of SpA such as enthesis, sacroiliitis, Romanus lesion, Anderson lesion, fatty metaplasia lesions, sacroiliitis, and ankyloses. 4) Discuss the utilization of specific MRI sequences and 3D imaging to improve the diagnostic yield of MR imaging in the diagnosis of SpA. 5) Case presentation of selected examples of pathologies showing incremental value of MR imaging over conventional imaging techniques.

RC418

Tips, Tricks and Pitfalls in Body Oncological Imaging: Experts Tell All

Tuesday, Nov. 27 4:30PM - 6:00PM Room: N229

CT MR OI US

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

Participants
Roya Sohaey, MD, Portland, OR (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify ultrasound features that differentiate between benign and malignant disease, particularly in the female pelvis. 2) Recommend specific scanning techniques and protocols for difficult cases, including use of ultrasound contrast. 3) Develop imaging strategies to enable the radiologist to make a diagnosis with ultrasound and ultrasound only. 4) To discuss newer MRI techniques that are now applied for body oncologic imaging that allows faster, better or more accurate disease diagnosis. 5) To highlight the applications and pitfalls of diffusion-weighted imaging for assessing upper abdominal cancers, peritoneal involvement, pelvic disease and bone marrow involvement (whole body MRI). 6) To survey the applications and limitations of motion insensitive radial-acquisition MR techniques for dynamic contrast enhanced imaging for cancer evaluation. 7) Review the statistics and incidence of common cancers in USA. 8) Discuss the role of CT in oncology practice and value of following optimal oral and IV contrast media protocols. 9) Offer pearls and solutions to overcome the limitations of CT and emerging role of new CT technology.

Sub-Events

RC418A US

Participants
Roya Sohaey, MD, Portland, OR (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify ultrasound features that differentiate between benign and malignant disease, particularly in the female pelvis. 2) Recommend specific scanning techniques and protocols for difficult cases, including the use of ultrasound contrast. 3) Develop imaging workup strategies for specific clinical situations in the abdomen and pelvis. 4) Review specific diagnosis strategies for imaging of non-obstetrical pathology in the pregnant patient.

ABSTRACT

The course will focus on benign and malignant masses that mimic each other, particularly in the area of gynecology but also involving the abdomen.Emphasis is placed on the importance of knowing patient history and using good ultrasound technique, including contrast, in order to make accurate diagnoses with ultrasound. However, at times, further imaging and tissue sampling is necessary. The participant will be encouraged to 'push the envelope' with ultrasound-guided diagnosis rather than use ultrasound as a 'screening tool', particularly in the female pelvis. In addition, we will review non-obstetrical diagnoses in pregnant patients. The radiologist is often called upon by maternal-fetal-medicine providers to guide imaging in this vulnerable population.

Active Handout:Roya Sohaey

http://abstract.rsna.org/uploads/2018/16000398/Body Onc 2018 Ultrasound RC418A.pdf

RC418B CT

Participants
Helen C. Addley, MRCP, FRCR, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

helenclareaddley@hotmail.co.uk

LEARNING OBJECTIVES

1) Explore the integral roles of CT in oncology from routine staging and follow up to problem solving tool. 2) Highlight the radiological reporting features that set apart a specialist report from a standard report. 3) Discuss challenging cases from the gynecological tumor board of cancer center.

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/ Helen C. Addley, MRCP, FRCR - 2013 Honored Educator

RC418C MRI

Participants
Dow-Mu Koh, MD,FRCR, Sutton, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss newer MRI techniques that are now applied for body oncologic imaging that allows faster, better or more accurate disease diagnosis. 2) To highlight the applications and pitfalls of diffusion-weighted imaging for assessing upper abdominal cancers, peritoneal involvement, pelvic disease and bone marrow involvement (whole body MRI). 3) To survey the applications and limitations of motion insensitive radial-acquisition MR techniques for dynamic contrast enhanced imaging for cancer evaluation.

RC420

The Role of Molecular and Functional Imaging in Radiation Oncology

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S403B

HN MI NR NM PD RO

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

Participants
Nina A. Mayr, MD, Seattle, WA (*Moderator*) Nothing to Disclose

Sub-Events

RC420A The Role of Molecular/Functional Imaging for Radiotherapy in Lymphoma

Participants
Stephanie A. Terezakis, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the significance of molecular/functional imaging in guiding the management of both Hodgkin's and non-Hodgkin's lymphomas. 2) Interpret functional imaging as it relates to treatment response and radiation planning. 3) Determine how to Incorporate PET and CT imaging in delineating radiation treatment volumes utilizing ISRT principles.

RC420B The Role of Molecular/Functional Imaging for Radiotherapy in Pediatric Cancers

Participants
Ralph P. Ermoian, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List 3 non-central nervous system pediatric diseases in which functional imaging is standard of care for staging. 2) Describe how functional imaging plays a role in assessing response to therapy in two non-central nervous system disease. 3) List two emerging uses for functional imaging in pediatric tumor treatment and response assessment.

RC420C The Role of Molecular/Functional Imaging for Radiotherapy in Head and Neck Cancer

Participants
Minh T. Truong, MBBS, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Role of Molecular/Functional Imaging in the diagnosis and staging of Head and Neck Cancer (HNC). 2) Integrating Molecular/Functional Imaging into Radiotherapy Simulation and Planning. 3) Interpretation of Treatment Response to Chemoradiotherapy. 4) Molecular/Functional Imaging as a Biomarker for Patient Quality of Life and Survival.

RC420D The Role of Molecular/Functional Imaging for Radiotherapy in CNS Tumors

Participants
Anca L. Grosu, MD, Freiburg, Germany (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Amino-acids PET (AA-PET) for tumor detection and differentiation between tumor and treatment-related changes in brain gliomas. 2) Comparison between AA-PET and mpMRI for radiation treatment planning in brain tumors. 3) New concepts for target volume delineation in brain tumors.

RC421

Advances in CT: Technologies, Applications, Operations - CT Performance

Tuesday, Nov. 27 4:30PM - 6:00PM Room: N226

CT PH

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; License agreement, 12 Sigma Technologies; License agreement, Gammex, Inc
Lifeng Yu, PhD, Chicago, IL (*Coordinator*) Nothing to Disclose

ABSTRACT

CT has become a leading medical imaging modality, thanks to its superb spatial and temporal resolution to depict anatomical details. New advances have enabled extending the technology to depict physiological information. This has enabled a wide and expanding range of clinical applications. These advances are highlighted in this multi-session course. The course offers a comprehensive and topical depiction of these advances with material covering CT system innovations, CT operation, CT performance characterization, functional and quantitative applications, and CT systems devised for specific anatomical applications. The sessions include advances in CT system hardware and software, CT performance optimization, CT practice management and monitoring, spectral CT techniques, quantitative CT techniques, functional CT methods, and special CT use in breast, musculoskeletal, and interventional applications.

Sub-Events

RC421A Image Quality Characterization

Participants
Guang-Hong Chen, PhD, Madison, WI (*Presenter*) Research funded, General Electric Company Research funded, Siemens AG

LEARNING OBJECTIVES

1. Understand how to evaluate signal properties in CT; 2. Understand how to evaluate noise properties in CT; 3. Understand how to evaluate image quality by combining signal and noise properties in CT.

RC421B Performance Evaluation

Participants
Yakun Zhang, MS, Durham, NC (*Presenter*) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (*Presenter*) Research Grant, General Electric Company; Research Grant, Siemens AG; Advisory Board, medInt Holdings, LLC; License agreement, 12 Sigma Technologies; License agreement, Gammex, Inc

For information about this presentation, contact:

yakun.zhang@duke.edu

LEARNING OBJECTIVES

1) Understand the current standard for CT performance evaluation oriented towards operational performance. 2) Understand the measurement methods for task-based assessment of CT including resolution, noise, and detectability. 3) Understand the use of operational characteristics to monitor and optimize CT performance.

RC421C Performance Optimization

Participants
Justin B. Solomon, PhD, Durham, NC (*Presenter*) License agreement, Sun Nuclear Corporation; License agreement, 12 Sigma Technologies
Ehsan Samei, PhD, Durham, NC (*Presenter*) Research Grant, General Electric Company; Research Grant, Siemens AG; Advisory Board, medInt Holdings, LLC; License agreement, 12 Sigma Technologies; License agreement, Gammex, Inc

For information about this presentation, contact:

justin.solomon@duke.edu

LEARNING OBJECTIVES

1) To understand the principle of optimization in targeting specific levels of quality while constraining the mitigating factors. 2) To understand how imaging science and physics enables prospective optimization of imaging exams using phantoms and models. 3) To understand how retrospective analysis of patient image quality and dose can affirm and inform the optimization quality and process.

RC422

Dual Energy CT for Radiotherapy Applications

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S104A

CT PH RO

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

Participants
Kristy K. Brock, PhD, Houston, TX (*Moderator*) License agreement, RaySearch Laboratories AB

Sub-Events

RC422A Clinical Need for Dual Energy CT in Proton Radiotherapy

Participants
Jon J. Kruse, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn about calibration of Hounsfield Units for determination of relative stopping power for proton therapy planning. 2) Discuss potential sources of error in stopping power determination. 3) Describe treatment planning strategies to mitigate range uncertainties in proton therapy planning.

RC422B State of the Art in Dual Energy CT Technology

Participants
Jessica Miller, PhD, Madison, WI (*Presenter*) Research Grant, Siemens AG

LEARNING OBJECTIVES

1) Explain basic dual-energy CT principles. 2) Compare current dual-energy CT techniques and associated limitations.

ABSTRACT

With dual-energy computed tomography (DECT), an additional measurement is obtained, allowing for the reconstruction of supplementary information, such as relative electron density and effective atomic number information. The additional information gained through DECT has potential to aid in several aspects of the radiation therapy process, including improving dose calculation accuracy for proton therapy. This course will discuss the basic principles of DECT and compare different vendor solutions for acquisition of DECT images.

RC422C Technical Challenges in the Integration of Dual Energy CT into Radiotherapy Treatment Planning

Participants
Jon J. Kruse, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Compare range uncertainty to other sources of dosimetric error in proton therapy. 2) Observe clinical examples of range variation in proton therapy.

RC423

Making Patients and Staff Safer in Interventional Procedures

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S403A

IR PH SQ

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

FDA Discussions may include off-label uses.

Participants
William F. Sensakovic, PhD, Scottsdale, AZ (*Coordinator*) Speaker, Bayer AG; Research Grant, Mazor Robotics Ltd; Founder, Telerad Physics Teaching, LLC
Thaddeus A. Wilson, PhD, Madison, WI (*Coordinator*) Nothing to Disclose

For information about this presentation, contact:

wfsensak@gmail.com

LEARNING OBJECTIVES

1) Describe cataract and cancer risks associated with typical interventional radiology procedures and workload. 2) Develop and assess institutional policies for implementing radiation dose tracking and auditing in the interventional setting.

Sub-Events

RC423A Patient Doses (in lab) and Patient Dose Management

Participants
Stephen Balter, PhD, New York, NY (*Presenter*) Speakers Bureau, MAVIG, GmbH

LEARNING OBJECTIVES

1) Understand how in-lab radiation displays and post-procedure radiation use data can be used to optimize patient safety.

RC423B Staff Protection: Cataract and Potential Cancers

Participants
Madan M. Rehani, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain the results from the studies among interventionalists and support staff on eye lens opacities and comprehend the risks. 2) Identify the evidence or lack thereof of cancer risk among interventionalists. 3) Identify the protective measures for staff in interventional suites.

Active Handout:Madan M. Rehani

http://abstract.rsna.org/uploads/2018/18001938/Rehani _RSNA_Cataract _Cancers RC423B.pdf

RC423C Dose Tracking and Audits: Institution-wide Program

Participants
Pei-Jan P. Lin, PhD, Richmond, VA (*Presenter*) Nothing to Disclose
Shelia Regan, RT,BS, Richmond, VA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

pei-jan.lin@vcuhealth.org

LEARNING OBJECTIVES

1) Learn how the 'event-by-event' RDSR data exported from the patient radiation dose monitoring and tracking (PRDMT) systems may be employed to better estimate the peak skin dose (PSD) from fluoroscopy equipment. 2) The estimated PSD is then classified into three 'alert level' which leads to a better patient care through a follow up process which will be described in detail at the presentation. 3) Identify establishment of a Clinical Radiation Safety Office (CRSO) to handle the technical aspect of PRDMT and administrative processes of 'documentation' and 'patient follow up' is the key to a successful patient care. 4) It is necessary to establish CRSO as an enterprise wide office to govern the entire process and functions provided by the CRSO. It is essential to learn that successful PRDMT requires both the 'organization' must be setup and it must be properly staffed with qualified 'personnel'.

ABSTRACT

The internal organization structure is described in detail including the 'alert Levels' and what comes next upon receiving the alerts. The Clinical Radiation Safety Office (CRSO) established at VCU Medical Center plays major key rolls in (1) the patient radiation dose monitoring and tracking (PRDMT) and (2) follow up of patients who receved 'confirmed' peak skin dose that is required by the

Hospital Policy to follow post fluoroscopy examinations as part of VCU's patient care. The key is to establish a Clinical Radiation Safety Office which manage the technical aspect of PRDMT and follow up of patients process. In other words, an institutinal, enterprise wide organization must be created to handle the total patient care for patients who received high dose radiation which could result in deterministic injury.

Active Handout:Pei-Jan Paul Lin

http://abstract.rsna.org/uploads/2018/18001939/2018 RSNA Meeting RC423C.pdf

RC424

Paleoradiology: A Case Study Approach to Mummies of the World

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E260

OT

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

FDA Discussions may include off-label uses.

Participants
Sahar Saleem, MD, Cairo, Egypt (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

saharsaleem1@gmail.com

LEARNING OBJECTIVES

1) Identify paleoradiology as a radiology subspecialty where medical imaging methods are used to document and collect data about human remains (skeletons and mummies) and artefacts from antiquity. 2) Recognize the value of different clinical imaging modalities as non-invasive methods for investigating ancient mummies and objects. 3) Discuss the advantages of radiography in the field setting verses transporting the material to an imaging facility. 4) List the types of data that can be acquired in a field radiography study. 5) Describe how the advances in technology have facilitated paleoradiology. 6) Apply a schematic analysis for CT study of a mummy. 7) Differentiate Egyptian from Peruvian mummies and other world mummies. 8) Understand how differences in mummification practices can be revealed using radiology reflect cultural changes. 9) Recognize the value of paleoradiology in diseases detection and adding knowledge about the origin of diseases. 10) Appreciate how the desiccation of human tissue affects the applicability of imaging modalities, designing protocols, and the interpretation findings.11) Recognize that the data provided by CT studies of mummies and related objects in a museum can be used to complete the museum's data-base, support conservation processes, and arrange exhibitions. 12) Recognize the importance of interdisciplinary collaboration in paleoradiology, involving imaging technologists, radiologists, bioarchaeologists, imaging physicists, museologists, conservators and other experts with interests in this diverse field.

Sub-Events

RC424A Paleoradiology: Imaging of the Past

Participants
Sahar Saleem, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

saharsaleem1@gmail.com

LEARNING OBJECTIVES

View learning objectives under main course title.

RC424B The Mummies of Ancient Egypt

Participants
Sahar Saleem, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

saharsaleem1@gmail.com

LEARNING OBJECTIVES

View learning objectives under main course title.

RC424C The Mummies of Ancient Peru

Participants
Andrew J. Nelson, PhD, London, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

Active Handout:Andrew John Nelson

http://abstract.rsna.org/uploads/2018/18003133/Hand Out for - Paleoradiology RC424C.pdf

RC424D Mummies from Around the World

Participants
Gerald J. Conlogue, RT, Hamden, CT (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC424E Multidisciplinary Practice in Paleoradiology

Participants
Andrew J. Nelson, PhD, London, ON (*Presenter*) Nothing to Disclose
Gerald J. Conlogue, RT, Hamden, CT (*Presenter*) Nothing to Disclose
Sahar Saleem, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

saharsaleem1@gmail.com

LEARNING OBJECTIVES

View learning objectives under main course title.

RC425

Mini-course: Image Interpretation Science - Computational Perception

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S103AB

AI IN PH

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

Participants
Elizabeth A. Krupinski, PhD, Atlanta, GA (*Coordinator*) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (*Coordinator*) Research Grant, General Electric Company; Research Grant, Siemens AG; Advisory Board, medInt Holdings, LLC; License agreement, 12 Sigma Technologies; License agreement, Gammex, Inc

For information about this presentation, contact:

ekrupin@emory.edu

LEARNING OBJECTIVES

1) Provide an overview of the types and applications of CAD being developed and used today. 2) Summarize the evidence and controversies regarding clinical impact of CAD. 3) Describe future trends in CAD research.

ABSTRACT

Medical images constitute a core portion of the information physicians utilize to render diagnostic and treatment decisions. At a fundamental level, the diagnostic process involves two aspects - visually inspecting the image (perception) and rendering an interpretation (cognition). Key indications of expert interpretation of medical images are consistent, accurate and efficient diagnostic performance, but how do we know when someone has attained the level of training required to be considered an expert? How do we know the best way to present images to the clinician in order to optimize accuracy and efficiency? The advent of digital imaging in many clinical specialties, including radiology, pathology and dermatology, has dramatically changed the way that clinicians view images, how residents are trained, and thus potentially the way they interpret image information, emphasizing our need to understand how clinicians interact with the information in an image during the interpretation process. With improved understanding we can develop ways to further improve decision-making and thus improve patient care.

Sub-Events

RC425A AI in Clinical Radiology

Participants
Maryellen L. Giger, PhD, Chicago, IL (*Presenter*) Stockholder, Hologic, Inc; Shareholder, 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, Canon Medical Systems Corporation

For information about this presentation, contact:

m-giger@uchicago.edu

LEARNING OBJECTIVES

1) Become familiar with AI, including machine learning and deep learning methods, for use in radiology. 2) Become aware of the potential challenges involved when developing and applying AI to radiological interpretations. 3) Become familiar with some of the future potentials and plans for AI In radiology.

RC425B Intersection of Imaging Informatics and Perception

Participants
Katherine P. Andriole, PhD, Dedham, MA (*Presenter*) Research Grant, NVIDIA Corporation; Research Grant, General Electric Company; Research Grant, Nuance Communications, Inc; Advisory Board, McKinsey & Company, Inc

For information about this presentation, contact:

kandriole@bwh.harvard.edu

LEARNING OBJECTIVES

1) Provide a basic overview of Medical Imaging Informatics. 2) Describe ways in which an understanding of visual perception informs the development and use of Imaging Informatics data visualization tools. 3) Assess ways Imaging Informatics can impact image interpretation.

RC425C Radiologist Interpretation in the Era of AI

Participants
Curtis P. Langlotz, MD,PhD, Menlo Park, CA (*Presenter*) Advisory Board, Nuance Communications, Inc; Shareholder, whiterabbit.ai; Advisory Board, whiterabbit.ai; Shareholder, Nines.ai; Consultant, Nines.ai; Shareholder, TowerView Health; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, Alphabet Inc;

LEARNING OBJECTIVES

1) Review the history of radiology reporting. 2) Describe the common pitfalls and mistakes in today's radiology reports. 3) Learn to improve the quality of radiology reports. 4) Assess how the radiology report will evolve in the era of artificial intelligence.

RC427

Objection! Medicolegal Issues for Today's Radiologist

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S404AB

HP

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
Jonathan Mezrich, MD, New Haven, CT (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

Jonathan.Mezrich@yale.edu

LEARNING OBJECTIVES

1) Be aware of common medico-legal issues involved in radiology. 2) Understand some issues involved in radiology related legal/employment contracts. 3) Have an awareness of tips to avoid malpractice exposure. 4) Understand the risks involved in failure to communicate unexpected findings. 5) Understand whether tort reform measures could reduce defensive medicine practices.

Sub-Events

RC427A Contract Law Basics: What a Radiologist Needs to Know When Signing His/Her First Employment Contract

Participants
H. Benjamin Harvey, MD, JD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand basic terms that are common to a radiology employment contract. 2) Describe potential pitfalls within a contract, i.e., non-compete, termination, compensation. 3) Discuss the leverage of a potential new hire in negotiating the terms of the contract.

RC427B Hiding in the Hedges: Tips to Minimize Your Malpractice Risk as a Radiologist

Participants
Jonathan Mezrich, MD, New Haven, CT (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Jonathan.Mezrich@yale.edu

LEARNING OBJECTIVES

1) Better understand the risks of malpractice inherent in radiology practice. 2) Be aware of several tips to incorporate into their daily practice to limit malpractice exposure.

RC427C Failure to Communicate Significant Unexpected Findings: Still a Malpractice Trap

Participants
Leonard Berlin, MD, Wilmette, IL (*Presenter*) Nothing to Disclose

RC427D Will Tort Reform Reduce Defensive Medicine? A Review of Empirical Evidence

Participants
Saurabh Jha, MD, Philadelphia, PA (*Presenter*) Speakers Bureau, Canon Medical Systems Corporation

For information about this presentation, contact:

saurabh.jha@uphs.upenn.edu

LEARNING OBJECTIVES

1) Understand the various types of Tort reform. 2) Understand the methods behind the empirical evaluation of tort reform. 3) Understand the empirical arguments for and against tort reform. 4) Appreciate the theoretical arguments for and against tort reform.

ABSTRACT

Will tort reform reduce defensive medicine and healthcare costs?

RC429

Imaging Cancer in the Cirrhotic Liver: What We Need to Know (Interactive Session)

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S404CD

GI MR OI

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

RC429A Imaging Cancer in the Cirrhotic Liver: The Essentials

Participants
Claude B. Sirlin, MD, San Diego, CA (*Presenter*) Research Grant, Gilead Sciences, Inc; Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Bayer AG; Research Grant, ACR Innovation; Research Grant, Koninklijke Philips NV; Research Grant, Celgene Corporation; Consultant, General Electric Company; Consultant, Bayer AG; Consultant, Boehringer Ingelheim GmbH; Consultant, AMRA AB; Consultant, Fulcrum Therapeutics; Consultant, IBM Corporation; Consultant, Exact Sciences Corporation; Advisory Board, AMRA AB; Advisory Board, Guerbet SA; Advisory Board, VirtualScopics, Inc; Speakers Bureau, General Electric Company; Author, Medscape, LLC; Author, Resoundant, Inc; Lab service agreement, Gilead Sciences, Inc; Lab service agreement, ICON plc; Lab service agreement, Intercept Pharmaceuticals, Inc; Lab service agreement, Shire plc; Lab service agreement, Enanta; Lab service agreement, Virtualscopics, Inc; Lab service agreement, Alexion Pharmaceuticals, Inc; Lab service agreement, Takeda Pharmaceutical Company Limited; Lab service agreement, sanofi-aventis Group; Lab service agreement, Johnson & Johnson; Lab service agreement, NuSirt Biopharma, Inc ; Contract, Epigenomics; Contract, Arterys Inc

For information about this presentation, contact:

csirlin@ucsd.edu

LEARNING OBJECTIVES

1) To understand the role of noninvasive imaging liver cancer screening, surveillance, diagnosis, staging, and treatment response assessment. 2) To review the process of carcinogenesis. 3) To understand that the differential diagnosis of malignant liver nodules includes HCC, cholangiocarcinoma, and hepatocholangiocarcinoma. 4) To understand the wide spectrum of lesions and pseudolesions that can be encountered in the cirrhotic liver.

RC429B Imaging Cancer in the Cirrhotic Liver: Diagnosis of Hepatocellular Carcinoma and Other Malignancies

Participants
An Tang, MD, Montreal, QC (*Presenter*) Research Consultant, Imagia Cybernetics Inc; Speaker, Siemens AG; Speaker, Eli Lilly and Company

For information about this presentation, contact:

an.tang@umontreal.ca

LEARNING OBJECTIVES

1) To review atypical forms of HCC in the cirrhotic liver. 2) To discuss malignancies other than HCC encountered in the cirrhotic liver. 3) To examine strategies to improve diagnosis in the cirrhotic liver.

ABSTRACT

Diagnosis of malignancy in the cirrhotic liver can be challenging, especially in the presence of architectural distorsion and innumerable cirrhotic (regenerative) nodules in the background liver. In this refresher course, we will review imaging features of atypical lesions in the cirrhotic liver, including mimickers of HCC, dysplastic nodules in transition to HCC, non-hypervascular HCC, infiltrative HCC, and other unusual forms. We will also discuss malignancy other than HCC, including cholangiocarcinoma, biphenotypic primary liver carcinoma (hepatocholangiocarcinoma), and metastases. We will review strategies to improve diagnostic accuracy in cirrhotic patients, including patient preparation, subtraction imaging, and contrast agents.

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/ An Tang, MD - 2018 Honored Educator

RC429C Imaging Cancer in the Cirrhotic Liver: Assessment of Response of Hepatocellular Carcinoma to Locoregional Therapy

Participants
Richard Kinh Gian Do, MD, PhD, New York, NY (*Presenter*) Consultant, Bayer AG

LEARNING OBJECTIVES

1) Recognize differences between locoregional therapies for HCC. 2) Compare response criteria used to evaluate HCC treatments. 3) Apply the LI-RADS Treatment Response Algorithm.

ABSTRACT

HCC can be treated by an increasing number of locoregional therapies, making assessment of treatment response increasingly challenging. This lecture will provide an overview of commonly used locoregional therapies and review the common post-treatment appearance of HCC. Comparisons between different response criteria for HCC will highlight challenges in their application to daily clinical practice. The LI-RADS Treatment Response Algorithm will be discussed in the context of existing response criteria and further illustrated with case examples.

RC429D Imaging Cancer in the Cirrhotic Liver: The Role of Hepatobiliary Contrast

Participants
William Masch, MD, Ann Arbor, MI (*Presenter*) Consultant for Bayer AG in 2017

LEARNING OBJECTIVES

1) To describe differences between hepatobiliary contrast and extra-cellular contrast. 2) To assemble a basic MRI protocol utilizing hepatobiliary contrast. 3) To explain possible indications for and advantages of hepatobiliary contrast-enhanced MRI for cancer diagnosis in patients with cirrhosis. 4) To identify limitations of hepatobiliary contrast-enhanced MRI for cancer diagnosis in patients with cirrhosis.

RC431

The New Standard of Care of Large Vessel Stroke is Endovascular: Is Your Radiology Practice Ready?

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S103CD

ER NR IR

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

Participants
Joshua A. Hirsch, MD, Boston, MA (*Moderator*) Consultant, Medtronic plc; Data Safety Monitoring Board, Johnson & Johnson; Consultant, Whale Imaging Inc;

LEARNING OBJECTIVES

1) Describe the diagnostic evaluation and decision making algorithms leading to urgent endovascular treatment of acute stroke. 2) Review endovascular techniques for the treatment of acute stroke from microcatheter set up to intra-arterial thrombolysis to mechanical thrombectomy. 3) Discuss case examples of endovascular treatment including patient selection, technique, and pitfalls.

ABSTRACT

Rapid advances in the evaluation, selection, treatment and management of the acute stroke patient necessitates an ongoing educational event highlighing the newest information, techniques and strategies for obtaining the best outcomes for our patients. In this session, all of these topics will be covered in a practical 'how to' and case based approach which is designed to help the practitioner implement best practices. The course is useful for those performing imaging, treatment or both. Analysis of the latest ongoing trials, devices and techniques will be presented. Endovascular tips and tricks will be discussed, as well as pitfalls in the treatment of these patients.

Sub-Events

RC431A Data, Data, Data: How Imaging Has Been Proven to Guide Endovascular Therapy

Participants
Ramon G. Gonzalez, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the physiological changes that occur in acute stroke patients with large vessel occlusions. 2) Identify the most important variables needed to select ischemic stroke patients for endovascular thrombectomy and the most reliable neuroimaging methods to identify these key variables. 3) Review the data that has shown that there is high variability in the growth of the ischemic core that makes possible the endovascular treatment of large vessel occlusion patients up to 24 hours after stroke onset. 4) Appreciate the large proportion of patients that are slow progressors (slow infarct growth) that may be transported for successful endovascular thrombectomy.

RC431B This is How I Do It: Practical Tips for Opening the Occlusion

Participants
Allan L. Brook, MD, Bronx, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the essential ischemic stroke physiology parameters that are essential in selecting patients for endovascular treatment of a large vessel occlusion. 2) Be familiar with the imaging methods that can measure ischemic stroke physiology parameters and their relative accuracy. 3) Use the best available evidence, recognize the optimal imaging approach to select patients with acute ischemic stroke for endovascular treatment.

RC431C Health Policy and Reimbursement RE: Stroke

Participants
Joshua A. Hirsch, MD, Boston, MA (*Presenter*) Consultant, Medtronic plc; Data Safety Monitoring Board, Johnson & Johnson; Consultant, Whale Imaging Inc;

LEARNING OBJECTIVES

1) Understand the essential ischemic stroke physiology parameters that are essential in selecting patients for endovascular treatment of a large vessel occlusion. 2) Be familiar with the imaging methods that can measure ischemic stroke physiology parameters and their relative accuracy. 3) Use the best available evidence, recognize the optimal imaging approach to select patients with acute ischemic stroke for endovascular treatment.

ABSTRACT

Properly selected patients with acute ischemic stroke caused by large vessel occlusion (LVO) may be effectively and safely treated endovascularly with modern thrombectomy devices. We have developed a high-precision imaging tool for selecting such patients. It is an experience and evidence-based clinical triage tool that uses advanced imaging to identify INDIVIDUAL patients most likely to benefit from endovascular stroke therapy. It was based on over a decade of using advanced imaging (CT, CTA, CT perfusion, DWI, MR perfusion) in acute stroke patients and a critical review of the literature and has been validated in clinical trials. The approach

focuses on answering the following key questions using modern imaging: 1. Is there a hemorrhage? Noncontrast CT 2. Is there an occlusion of the distal ICA and/or proximal MCA? CTA 3. Is irreversible brain injury below a specific threshold (e.g. <70ml)? DWI Perfusion imaging is not employed unless patients cannot undergo MRI, or they do not meet the criteria for intervention. Investigations to understand the reasons for the unsuitability of perfusion CT to substitute for DWI have revealed theoretical and practical shortcomings of CTP. A major problem is the low signal-to-noise (SNR) ratio of CT perfusion that results in a poor contrast-to-noise (CNR) ratio in severely ischemic brain. In a comparison between DWI and CTP in over 50 consecutive patients with LVA, Schaefer, et al. showed that the mean CNR of DWI was >4 while it was <1 for CTP derived CBF. The poor CNR results in large measurement error: using Bland-Altman analyses it was found that the 95% confidence interval was ~+/- 50 ml for ischemic lesion volume measurements in individual patients. The Cleveland Clinic adopted a nearly identical algorithm and their results were published. They reported that after the new algorithm was adopted, there was a ~50% reduction in mortality and a ~3-fold increase in good outcomes, despite a ~50% decrease in the number of procedures. A recent prospective observational trial at the MGH using stentrievers and this imaging approach demonstrated >50% favorable outcomes (mRS 0-2) that is similar to recent randomized clinical trials. However, only 3 patients were evaluated for every patient that was treated, a screening to treatment ratio that is much lower than in recently published clinical trials.1. Gonzalez RG, Copen WA, Schaefer PW, Lev MH, Pomerantz SR, Rapalino O, et al. The Massachusetts General Hospital acute stroke imaging algorithm: an experience and evidence based approach. Journal of neurointerventional surgery. 2013;5 Suppl 1:i7-12.2. Wisco D, Uchino K, Saqqur M, Gebel JM, Aoki J, Alam S, et al. Addition of hyperacute MRI AIDS in patient selection, decreasing the use of endovascular stroke therapy. Stroke; a journal of cerebral circulation. 2014;45(2):467-72.3. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet. 1986 Feb 8;1(8476):307-10.4. Schaefer PW, Souza L, Kamalian S, Hirsch JA, Yoo AJ, Kamalian S, Gonzalez RG, Lev MH. Limited reliability of computed tomographic perfusion acute infarct volume measurements compared with diffusion-weighted imaging in anterior circulation stroke. Stroke. 2015 Feb;46(2):419-24.

RC431D Q&A

Participants
Joshua A. Hirsch, MD, Boston, MA (*Presenter*) Consultant, Medtronic plc; Data Safety Monitoring Board, Johnson & Johnson; Consultant, Whale Imaging Inc;
Ramon G. Gonzalez, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose
Allan L. Brook, MD, Bronx, NY (*Presenter*) Nothing to Disclose

RC432

Why Diversity and Inclusion Matter: Beyond Gender and Ethnicity

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S504AB

LM

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

Participants
Yoshimi Anzai, MD, Salt Lake City, UT (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn what comes to our mind when you hear a word "diversity"2) To understand the fundamental value of diverse society or organization3) To discuss how we embrace diversity to enrich our culture

ABSTRACT

We have discussed many years or even decades that radiology lacks diversity. We are far from gender equity in radiology in the United States. Leaders in each academic institution are eager to recruit diverse future physician workforce to meet the goal of departmental or organizational diversity goal. We are so busy paying attention to such statistics, we often forget to remind ourselves why. Why we care about Diversity? Why diversity matters? Beyond gender, race, or sexual orientation, there are over twenty social identities that are used to characterize people, ie. married, smoker, tall, skinny, blond, democrat, and so on. Stereotyping is labeling people based on certain superficial appearance, which brings prejudice and premature judgment about people without deeply understanding each other. Studies have shown that more diverse organizations or having women or ethnic minority in the board grow faster and have better problem-solving skills than more homogeneous organizations. By working together with people who do not look like yourself, we foster more inclusive and empathetic culture, sparks creativity and innovation, and encourage "outside of the box" thinking within the organization.

Sub-Events

RC432A Why Diversity Matters

Participants
Yoshimi Anzai, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

yoshimi.anzai@hsc.utah.edu

LEARNING OBJECTIVES

1) To understand real benefits of creating diverse organization. 2) To demonstrate how a diverse team outperform a non-diverse team. 3) To learn the impact of diversity and inclusion to the organizational culture.

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/ Yoshimi Anzai, MD - 2014 Honored Educator

RC432B Pipeline and Mentorship

Participants
Derek L. West, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

RC432C Program Directors' Role in Embracing Diversity and Inclusion

Participants
Carolynn M. DeBenedectis, MD, Worcester, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

carolynn.debenedectis2@umassmemorial.org

LEARNING OBJECTIVES

1) To identify what groups are considered underrepresented in radiology. 2) Discuss why diversity and inclusion is so important for radiology's future. 3) Learn what program directors can do to reach out to these groups in order to foster their interest in radiology.

RC432D Multi-generational Workforce and Inclusive Culture

Participants
Carolyn C. Meltzer, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the intersectionality of generational issues and diversity in the workplace 2) Discuss the importance of unifying mission, values, and strategy in creating an inclusive culture 3) To explore the competitive advantage of cultivating an inclusive culture in radiology

RC432E **Q&A**

RC450

US for Thyroid Cancer: Diagnosis, Surveillance, and Treatment

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E261

NR US HN OI

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, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Sheila.Sheth@nyulangone.org

LEARNING OBJECTIVES

1) Describe the sonographic characteristics of thyroid nodules that are suspicious for malignancy. 2) Discuss the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. 3) Describe the indications for new genetic tests that may be performed on FNAs obtained from thyroid nodules with indeterminate cytology. 4) Describe the technique of US-guided biopsy of thyroid nodules and cervical lymph nodes in patients who have undergone thyroidectomy for thyroid cancer. 5) 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 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.

Active Handout:Sheila Sheth

http://abstract.rsna.org/uploads/2018/8001013/Syllabus Thyroid cancer RC450.pdf

RC452

Dynamic Musculoskeletal US: Clicks and Clunks of the Upper Extremity (Hands-on)

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E264

MK US

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

Participants

Viviane Khoury, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Jon A. Jacobson, MD, Ann Arbor, MI (*Presenter*) Research Consultant, BioClinica, Inc; Advisory Board, General Electric Company; Advisory Board, Koninklijke Philips NV; Royalties, Reed Elsevier
David P. Fessell, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Ghiyath Habra, MD, Troy, MI (*Presenter*) Nothing to Disclose
Joseph H. Introcaso, MD, Neenah, WI (*Presenter*) Nothing to Disclose
Kenneth S. Lee, MD, Madison, WI (*Presenter*) Grant, General Electric Company Research support, SuperSonic Imagine Research support, Johnson & Johnson Consultant, Echometrix, LLC Royalties, Reed Elsevier
Humberto G. Rosas, MD, Madison, WI (*Presenter*) Nothing to Disclose
Marnix T. van Holsbeeck, MD, Detroit, MI (*Presenter*) Minor stockholder, Koninklijke Philips NV; Minor stockholder, General Electric Company; Stockholder, MedEd3D; Grant, Siemens AG; Grant, General Electric Company;
Kambiz Motamedi, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Mark Cresswell, MBBCh, Vancouver, BC (*Presenter*) Research Consultant, RepliCel Life Sciences Inc; Investigator, RepliCel Life Sciences Inc; Consultant, Koninklijke Philips NV
J. Antonio Bouffard, MD, Detroit, MI (*Presenter*) Nothing to Disclose
Joseph G. Craig, MD, Detroit, MI (*Presenter*) Nothing to Disclose
Robert R. Lopez, MD, Cornelius, NC (*Presenter*) Nothing to Disclose
Girish Gandikota, MBBS , Ann Arbor, MI (*Presenter*) Nothing to Disclose
Marcos L. Sampaio, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Andrew J. Grainger, MRCP, FRCR, Leeds, United Kingdom (*Presenter*) Consultant, Levicept Ltd; Director, The LivingCare Group;
Philippe A. Peetrons, MD, Brussels, Belgium (*Presenter*) Research Consultant, Canon Medical Systems Corporation

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Identify anatomic structures which can impinge or move abnormally in the upper extremity causing pain during normal range of motion. 2) Describe the ultrasound anatomy and scanning technique for a dynamic examination of these lesions. 3) Position patients optimally for the dynamic evaluation of the upper extremity respecting ergonomics.

ABSTRACT

This course will demonstrate standardized techniques of performing the dynamic examination of upper extremity conditions that are only or best demonstrated dynamically. These include shoulder impingement syndrome, acromioclavicular joint instability, long head of biceps dislocation, medial elbow joint instability, extensor carpi ulnaris dislocation, median nerve movement, and trigger finger. In the first portion of the course, probe positioning will be demonstrated on a model patient with overhead projection during live scanning. In the second portion of the course, an international group of expert radiologists will assist participants in learning positioning and scanning of the shoulder, elbow, and wrist/ finger lesions described. An emphasis on dynamic maneuvers and ergonomic documentation of tissue dynamics will be taught. Participants will be encouraged to directly scan model patients.

Honored Educators

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RC453

Deep Learning-An Imaging Roadmap

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E451B

AI IN

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

FDA Discussions may include off-label uses.

Participants
Paula M. Jacobs, PhD, Bethesda, MD (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

Paula.Jacobs@nih.gov

LEARNING OBJECTIVES

1) Understand the framework of 'Deep Learning', Machine Learning, and Neural Net computer algorithms. 2) Comprehend what aspects of radiology practice are most amenable to machine learning deployment. 3) Understand the academic, commercial and clinical perspectives on how the field will likely develop and how NCI's Cancer Imaging Archive (TCIA) can accelerate development of this new technology.

ABSTRACT

Deep Learning,' an independent self-learning computational environment that uses multilayered computational neural nets, has generated considerable excitement (as well as concerns and misperceptions) in medical imaging. Deep learning computational techniques, such as convolutional neural networks (CNNs) generate multiple layer feature classifiers that extract disease relevant features from entire regions of medical images without the need for localization or pre-segmentation of lesions. Although CNNs require training on very large image datasets that encompass particular disease expressions, they can be diagnostically effective since no human input of segmentation features such as size, shape, margin sharpness, texture, and kinetics are required. But their immediate and future applicability as tools for unsupervised medical decision-making are, as yet, not well understood by most clinical radiologists. This overview session of Deep Learning will provide a clearer picture by presenters who are active in that field and who can clarify how the unique characteristics of Deep Learning could impact clinical radiology. It will address how radiologists can contribute to, and benefit from, this new technology. Topics of this multi-speaker session will cover: 1) the general principles of deep learning computational schemas and their mechanisms of handling image inputs and outputs. 2) new technology including hardware shifts in microprocessors from CPU's to GPU devices that offer significant computational advantages 3) how to ensure that Deep Learning results are consistently clinically relevant and meaningful including nodal element tuning and provability so as to assure medical care consistency and reproducibility. 4) how to develop and leverage datasets for deep learning on archives such as the NIH The Cancer Imaging Archive (TCIA) including requirements for input image dataset magnitude and completeness of disease spectrum representation. 5) how to embed essential non-imaging data needed as inputs, (e.g. EHR, outcome, cross-disciplinary metadata, and the data pre-processing required to make DICOM ready for Deep Learning. The presentations will be at a level understandable and relevant to the RSNA radiologist audience.

Sub-Events

RC453A Computer Science Deep Learning Research by the Academic Community

Participants
Fred W. Prior, PhD, Little Rock, AR (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the basic concepts of Machine Learning and Deep Learning and how they differ. 2) Gain insights into how these techniques are being used in quantitative imaging (Radiomic) research.

RC453B Commercial Development and Deployment of Deep Learning Technology

Participants
Abdul Hamid Halabi, Santa Clara, CA (*Presenter*) Developer, NVIDIA Corporation; Spouse, Employee, Covenant Pathology

RC453C Radiology Clinician Perspectives

Participants
Andrea G. Rockall, FRCR,MRCP, London, United Kingdom (*Presenter*) Speaker, Guerbet SA

LEARNING OBJECTIVES

1) Understand the differences between an algorithm that works in the lab and one that works in clinical practice. 2) Identify common weaknesses in study design that can lead to better apparent performance than might be realized in practice. 3) Recognize challenges in practical workflow that might impede clinical adoption of some tools.

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RC454

Enterprise Imaging for the Practicing Radiologist

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E263

IN

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

Participants
Christopher J. Roth, MD, Raleigh, NC (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the various descriptions of enterprise imaging, and their implications for radiologists. 2) Recognize the business needs driving enterprise imaging at health care organizations. 3) Appreciate the clinical, technical, governance, and financial challenges of enterprise imaging, and how radiologists can assist with solving them while leading local enterprise imaging initiatives.

Sub-Events

RC454A Clinical Challenges in Enterprise Imaging

Participants
Alex Towbin, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Grant, Guerbet SA; Grant, Siemens AG; Grant, Cystic Fibrosis Foundation; Consultant, Anderson Publishing, Ltd; Advisory Board, IBM Corporation; Advisory Board, KLAS Enterprises LLC;

For information about this presentation, contact:

alexander.towbin@cchmc.org

LEARNING OBJECTIVES

1) Describe the concept of an enterprise imaging archive. 2) Identify the unique challenges associated with incorporating non-DICOM images into an enterprise imaging archive.

ABSTRACT

Over the past 20 years, the field of radiology has built an impressive digital infrastructure, automating many portions of the imaging process from the time of order entry through image distribution. With the advent of small, low-cost, high quality digital cameras, other medical specialties have turned to imaging to visualize and document disorders yet, they have not implemented the same type of digital infrastructure as radiology. Today, thousands of medical images are obtained in hospitals each day. With the increasing reliance on imaging, there is a greater need to build systems and processes to obtain, store, and distribute these images across the enterprise so that health care providers can better care for their patients. Even though many of these problems have been solved in radiology, the solutions are not easily transferred to other specialties due to the differences in imaging hardware and the image acquisition workflow. The purpose of this talk is to describe the problems facing hospitals as they begin to build enterprise imaging archives and to discuss potential solutions to these problems.

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RC454B Technical Challenges in Enterprise Imaging

Participants
David A. Clunie, MBBS, Bangor, PA (*Presenter*) Owner, PixelMed Publishing LLC; Consultant, Carestream Health, Inc; Consultant, CureMetrix, Inc; Consultant, MDDX Research & Informatics; Consultant, General Electric Company; Consultant, Healthcare Tech Solutions; ;

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC454C Finance and Governance Challenges in Enterprise Imaging

Participants
Christopher J. Roth, MD, Raleigh, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Appreciate challenges with respect to enterprise-wide imaging governance and administration in a multi-specialty hospital or health system requiring systematic image capture, storage, metadata association, viewing, and exchange. 2) Learn how radiologists can take a leadership role in procurement, governance, infrastructure sharing and workflow design for specialties just beginning to store and use imaging.

RCA35

3D Printing Hands-on with Open Source Software: Introduction (Hands-on)

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S401AB

IN

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

Participants
Beth A. Ripley, MD, PhD, Seattle, WA (*Presenter*) Nothing to Disclose
Tatiana Kelil, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Michael W. Itagaki, MD, MBA, Lynnwood, WA (*Presenter*) Stockholder, Embodi3D, LLC
Anish Ghodadra, MD, New Haven, CT (*Presenter*) Advisory Board, axial3D Limited
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, MeBio ; Research collaboration, Boston Scientific Corporation; Consultant, Boston Scientific Corporation

For information about this presentation, contact:

beth.ripley2@va.gov

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/2018/14003455/RCA35 1.0 Intro to Open Source 3D Printing RCA35.pdf

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RCB35

Querying, Parsing, and Extracting DICOM Data: Basic Functionality with Real-World Use Cases and Applications (Hands-on)

Tuesday, Nov. 27 4:30PM - 6:00PM 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*) Co-founder, DexNote, LLC; Research Grant, NVIDIA Corporation; Advisor, BunkerHill Health, Inc
Ross W. Filice, MD, Chevy Chase, MD (*Presenter*) Co-founder, DexNote, LLC; Research Grant, NVIDIA Corporation; Advisor, BunkerHill Health, Inc
Simon Rascovsky, MD, MSc, Bogota, Colombia (*Presenter*) Director, Nucleus Health, LLC
Marc D. Kohli, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ross.w.filice@gunet.georgetown.edu

LEARNING OBJECTIVES

1) Learn how to use command line tools to query and retrieve studies from an archive. 2) Parse these studies to find useful DICOM elements and metadata. 3) Summarize metadata to gain insight into exams. 4) Extract pixel data and render jpegs or other file formats and even create movies or animated gifs.

Active Handout:Ross Warren Filice

http://abstract.rsna.org/uploads/2018/18001623/RSNA DICOM workshop RCB35.pdf

RCC35

Don't Let MACRA and MIPs Kill Your Practice: How To Optimize Your Participation

Tuesday, Nov. 27 4:30PM - 6:00PM Room: S501ABC

HP IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

Participants
David C. Levin, MD, Philadelphia, PA (*Moderator*) Consultant, HealthHelp, LLC; Board Member, Outpatient Imaging Affiliates, LLC
David C. Levin, MD, Philadelphia, PA (*Presenter*) Consultant, HealthHelp, LLC; Board Member, Outpatient Imaging Affiliates, LLC
Ezequiel Silva III, MD, San Antonio, TX (*Presenter*) Nothing to Disclose
J. R. Geis, MD, Fort Collins, CO (*Presenter*) Advisor, Koninklijke Philips NV;

For information about this presentation, contact:

david.levin@jefferson.edu

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.