103rd Scientific Assembly and Annual Meeting

November 26 to December 1
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BR011-EB-X

Role of the Imaging Methods for Evaluation of Residual Breast Tissue after Subcutaneous Mastectomy

All Day Room: NA Hardcopy Backboard

Participants
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TEACHING POINTS

The purpose of this exhibit is to discuss the role of the imaging methods for evaluation of residual breast tissue (RBT) after subcutaneous mastectomy through a literature review and illustrate with some cases of the institution. Although there is no consensus, thickness of the skin flap greater than 5 mm has been described in the literature as one of the indications for post mastectomy radiation therapy (RT), due to the greater risk of relapse.

TABLE OF CONTENTS/OUTLINE

1. Review the role of the imaging methods for evaluation of residual breast tissue (RBT) after subcutaneous mastectomy. 2. Overview imaging methods limitations and advantages for evaluation of RBT. 3. Background the oncology specialists`opinions regarding the indications of radiation therapy (RT) after subcutaneous mastectomy, the need for residual breast tissue evaluation and the residual amount of tissue considered acceptable in the context of an oncologic surgery. 4. Brief discussion about subcutaneous mastectomy as a less invasive surgical option for breast cancer treatment, risk factors for local recurrence and oncologic safety. 5. Provide some cases from an oncology reference center.

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BR012-EB-X

Let's Have an Interest of Extramammary Findings on Pre-Operative Breast MRI

All Day Room: NA Hardcopy Backboard

Participants
Hyerim Park, MD , Cheonan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

Today, breast Magnetic Resonance Imaging (MRI) is increasingly being used in work up of breast cancer patients. Breast MRI has high sensitivity, so it is useful in detection of malignancy and determine extent of breast cancer.In addition, other parts are also included on breast MRI; lungs, mediastinum, bone and the upper abdomen. Because the abnormalities detected on the above structures may influence the staging and provide a clue to systemic metastasis, which results in the change of treatment strategy. So we must pay attention not only breast and axilla, but also other structures included on breast MRI. The purpose of this presentation is to review the unexpected extramammary findings seen on the preoperative breast MRI with physics and pitfalls of breast MRI

TABLE OF CONTENTS/OUTLINE

General review - Physics and indication of breast MRI - Pitfall of breast MRI Malignant 1. Lung - Pulmonary metastasis from breast, Primay lung cancer, Pleural seeding 2. Hepatic metastasis from breast 3. Bone metastasis from breast Benign 1. Lung - RML collapse mimicking pleural metastasis , Pleural effusion 2. Mediastinum - Thymic cyst, thymoma 3. Liver - Hepatic cyst, Liver cirrhosis, Hemangioma 4. Bone - Rib fracture mimicking bone metastasis, Pectus excavatum,sternostomy d/t VSD 5. Others - Ascites, Chest wall lipoma

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BR105-ED-X

Pre-operative Breast MRI in Patients with DCIS: Is it Worth It?

All Day Room: NA Digital Education Exhibit

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Certificate of Merit

Participants
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TEACHING POINTS

Pre-operative breast MRI has been shown to detect additional significant ipsilateral and contralateral disease in patients with breast cancer. However, data on performance of staging breast MRI in patients with pure DCIS is less abundant and its utilization remains controversial. Recent experience at our institution provides evidence that pre-operative breast MRI in patients with pure DCIS continues to contribute valuable clinical information and detect otherwise occult ipsilateral and contralateral disease. 1) Discuss role of pre-operative breast MRI in patients with DCIS. 2) Review imaging features, pearls and pitfalls of detecting DCIS on breast MRI. 3) Discuss role of breast MRI in DCIS treatment decisions.

TABLE OF CONTENTS/OUTLINE

I. Background and literature review Performance of pre-operative breast MRI in breast cancer patients II. Imaging features of DCIS on breast MRI Enhancement and morphological differences between invasive and in situ carcinoma III. Utility of pre-operative breast MRI for DCIS Influence on treatment decisions IV. Illustrative Cases

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BR131-ED-X

Breast MRI: Lactation Tribulation

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

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TEACHING POINTS

During lactation: 1. To describe the pathophysiological changes of lactation 2. To identify effects of lactation on breast MRI sequences and upon cancer detection 3. To discuss gadolinium management considerations 4. To distinguish suspicious MR findings and discuss MR biopsy issues 5. To predict future MRI techniques that may become helpful for interpretation

TABLE OF CONTENTS/OUTLINE

1. Physiological and histological differences during lactation 2. Usual and unusual MR findings during lactation; 3. High risk breast cancer screening during lactation; Should screening MR be postponed? Gadolinium management relevant to lactation; 4. Palpable lumps that occur during lactation 5. MR biopsies: Risks, benefits, lidocaine 6. Known unknowns: How does lactation affect MR accuracy? What is the duration of lactation findings? 7. Investigations of diffusion MR and Spectroscopy

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BR137-ED-X

Supplemental Breast MRI Screening Based on Concepts about Progression Pathways of Development of Invasive Cancer from DCIS

All Day Room: NA Digital Education Exhibit

FDA Discussions may include off-label uses.

Participants
Takayoshi Uematsu, MD, PhD, Nagaizumi, Japan (*Presenter*) Nothing to Disclose
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TEACHING POINTS

Molecular data on breast cancer risk indicator and precursor lesions indicate that high-grade pathways and low-grade pathways exist, but not progressive dedifferentiaition. The new concepts of the two pathways with low-grade DCIS to low grade invasive cancer and high-grade DCIS to high-grade invasive cancer is important. With concerns for overtreatment of DCIS, considerable interest exists in identifying women at very low risk for progression to invasive cancer who can be spared standard therapy. MRI can help improve the ability to diagnose DCIS, especially high-grade DCIS. We will: 1. Discuss supplemental breast MRI screening based on concepts about progression pathways of development of invasive cancer from DCIS 2. Propose supplemental breast MRI screening with average risk of breast cancer.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Concepts about progression pathways of development of invasive cancer from DCIS 3. Mammographic features of DCIS 4. Calcifications and histopathological grade 5. Ultrasonographic features of DCIS 6. MRI features of DCIS 7. Enhancement pattern and histopathological grade 8. DWI and DCIS 9. Summary

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BR143-ED-X

3-Tesla MRI-Guided Biopsy Mini-Tutorial and Case Series: Experience at a Community Hospital Breast Center

All Day Room: NA Digital Education Exhibit

Participants
Leah H. Portnow, MD, Brooklyn, NY (*Presenter*) Nothing to Disclose
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TEACHING POINTS

1. Magnetic resonance imaging (MRI) is a highly sensitive and more and more common screening technique for the detection of breast cancer. 2. As mammographically and sonographically-occult or otherwise difficult-to-reach breast lesions are identified, MRI-guided biopsies are increasingly performed. 3. Performing MRI-guided biopsies on a 3-Tesla machine demonstrates high-sensitivity in lesion detection with higher quality images and better signal-to-noise ratio and resultant excellent biopsy efficacy.

TABLE OF CONTENTS/OUTLINE

Advantages and Disadvantages of 3T MRI vs 1.5 T MRI Accompanying Literature Survey Indications Biopsy Technique Mini-Tutorial/Overview MRI Imaging Protocol Targeting Method at our institution Multiple site targeting Pictorial Review Simple/straight-forward case, i.e. lateral approach Medial breast biopsies Bilateral breast biopsies Posterior breast biopsies near the chest wall Biopsies close to the nipple Pathology Papilloma Radial scars DCIS LCIS Carcinomas

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BR153-ED-X

Breast MRI Beyond the Breast: Incidental Findings

All Day Room: NA Digital Education Exhibit

Participants
Elena Bello, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
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TEACHING POINTS

• To remember that although breast MRI´s field of view focuses on breast parenchima many other structures are included, and the radiologist´s obligation to look at them. • To know the importance of incidental extra-mammary findings in breast MRI, specially in breast cancer patients, who in many cases do not undergo staging evaluation before surgery. • To review the most common, both benign and malignant extra-mammary findings in breast MRI. • To propose a systematic order to evaluate the images, a "checklist", so that no structure is overlooked.

TABLE OF CONTENTS/OUTLINE

1.The locator sequence: your best friend. 2.Other sequences, what to look at in each sequence. 3.Benign findings. Ascendent aorta aneurism. Pleural and cardiac effusion. Pericardial cysts. Vertebral body crush. Vertebral body haemangiomas. Shoulder synovitis. Hepatic cysts. Hepatic haemangiomas. Intercostal nerve Schwannomas. 4.Malignant findings. Lung nodules, both prymary lung neoplasm and metastases. Bone metastases: in sternum, ribs, vertebral bodies. Spinal cord metastases. Hepatic metastases. 5.The checklist we propose to evaluate the images before focus on the breast.

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BR159-ED-X

Radiological-Pathological Correlation of Rare Breast Tumors and Tumor-like Lesions

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS

Generally speaking, the breast is an organ in which few different types of leions appear. The most common breast lesions is, as we all know, ductal carcinoma (invasive or non-invasive). Therefore, the main role of the diagnostic radiology for breasts is just detection of breast cancers. Therefore, we radiologists are embassed when we ancounter rare breast lesions. In this presentation we will present the following two issues. 1. Clinical manifestation of rare breast tumors and tumor-like lesions 2. Pathological-Radiological correlation of rare breast tumors and tumor-like lesions

TABLE OF CONTENTS/OUTLINE

1. Benign tumors/tumor-like lesions 1-1. Adenoma of nipple / 1-2. Giant cell tumor / 1-3. Hamartoma / 1-4. Phyllodes tumor 2. Malignant tumors 2-1. Angiosarcoma / 2-2. Collision tumor of fibroadenoma and ductal carcinoma / 2-3. Encapsulated papillary carcinoma / 2-4. Mucinous carcinoma / 2-5 Secretory carcinoma / 2-6 Solid papillary carcinoma / 2-7 Small cel carcinoma / 2-8 Triple negative carcinoma 3. Miscellaneous

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BR171-ED-X

Optimize Image Quality in Breast RM: A Pictorial-Based Guide for Residents

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit
Identified for RadioGraphics

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TEACHING POINTS

Describe common artifacts and image quality issues encountered in clinical breast MR images. Ilustrate several examples of patient-related and technical artifacts, with helpful suggestions to help optimize images and avoid misinterpretation.

TABLE OF CONTENTS/OUTLINE

A breast MR imaging examination performed for potencial cancer diagnosis is technically demanding, requiring knowledge about artifacts and pitfalls that can potentially limit interpretation of the images by masking or simulating disease. Common artifacts seen at breast MR imaging include motion, suboptimal fat suppression, metallic susceptibility, radiofrequency noise, and chemical shift. Improper positioning of the breasts can also cause a malignancy to be missed. Through the use of several examples , we will demostrate these patient-related and technical artifacts, describe their causes, and discuss troubleshooting techniques to reduce or eliminate them. It is important for residents to monitor and help optimize imaging quality in breast RM in order to decrease suboptimal images and limit the need for repeat imaging studies.

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BR183-ED-X

Ultrafast Dynamic Contrast Enhanced (DCE) Breast MRI: A New Paradigm for Kinetic Analysis in the Era of Speedy MRI

All Day Room: NA Digital Education Exhibit

Participants
Maya Honda, Kyoto, Japan (*Presenter*) Nothing to Disclose
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TEACHING POINTS

Dynamic contrast enhanced (DCE) MRI with much shorter acquisition time has become available, allowing detailed analysis of time-intensity curve in the early phase. Ultrafast DCE MRI showed diagnostic performance comparable to those in standard kinetic analysis and can be a promising alternative to standard DCE MRI. In this exhibit we will compare various MR techniques, kinetic models, and parameters used for ultrafast imaging. Their diagnostic performances and pitfalls are illustrated with representative cases.

TABLE OF CONTENTS/OUTLINE

1. MR techniques in ultrafast DCE MRI: A. Pararell imaging techniques. B. View-sharing techniques. C. Compressed sensing techniques. D. Advantage and disadvantages of these techniques in comparison to standard DCE MRI. 2. New kinetic imaging models and parameters used in ultrafast imaging : A. Tofts model. B. Semi-quantitative wash-in curve parameters for initial up-slope: maximum slope, time to enhancement. C. Other new imaging parameters. D. Their relation to conventional kinetic curve analysis and diagnostic performance in breast lesions. 3. Pitfalls in ultrafast breast MRI: A. Slow-enhancing malignant lesions (false negatives): invasive lobular carcinoma, mucinous carcinoma. B. Fast-enhancing benign lesions (false positives): papillary lesions, atypical ductal hyperplasia.

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BR186-ED-X

Magnetic Resonance of Breasts: The Challenges of Fat Saturation in T2-Weighted DIXON, STIR and SPAIR Sequences

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS

The main type of cancer that causes the death of women in the world is breast cancer,it has been seen the importance of methods to prognosis and treatment that can reduce the mortality rate. Breast magnetic resonance imaging (MRI) assists in the diagnosis of breast lesions as well as in the targeting of biopsies of lesions that are poorly contemplated by ultrasound. Due to its rich composition in adipose tissue,efficient fat saturation techniques in breast MRI are important for the differentiation between healthy tissue and lesions. Our institution performs T2-weighted fat suppression techniques in breast MRI examinations,but it was observed the need to select an efficient technique to cancel the fat signal in situations of absence of homogeneity and different powers of the magnetic field. Among the possibilities,are cited the DIXON TSE (turbo spin echo),STIR (short time inversion recovery),SPAIR (spectral selective adiabatic inversion recovery),all T2-weighted.Our study analyzes the most efficient technique for fat saturation by means of qualitative and quantitative analyzes to verify the difference between the mammary tissues and the reduction of the fat signal intensity in the DIXON,STIR and SPAIR techniques in magnetic field with power of 3.0 tesla.

TABLE OF CONTENTS/OUTLINE

Breast magnetic resonance imaging;Fat saturation technique;T2-weighted image

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BR190-ED-X

MR Imaging Findings of Local Tumor Recurrence after Mastectomy

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS

The purpose of this exhibit is: 1. To analyze the imaging features of local recurrence of breast cancer after mastectomy at MRI. 2. To correlate the lesions: imaging and histological 3. To learn how to interpret the imaging aspects of tumor recurrence at MRI in these patients.

TABLE OF CONTENTS/OUTLINE

Pathological features of the lesions Age at diagnosis of recurrence Time between initial diagnosis and recurrence Type of mastectomy and reconstruction Local of recurrence Thickness of the skin flap Presence of visible fibroglandular tissue on MRI Imaging findings of the lesions

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BR192-ED-X

Inflammatory/Infectious Mastitis: Findings on Magnetic Resonance Imaging

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS

Teaching Points1. MRI provides more detail on possible deep involvement and can reveal signs of inflammation of underlying muscles and chest structures.2. MRI has the ability to detect lymphadenopathy of the internal mammary lymph nodes that is difficult to detect via ultrasound.3. Breast inflammation can arise from a variety of etiologies, some of which can be difficult to diagnose4. MRI is important to evaluate response to treatment to rule out the possibility of inflammatory carcinoma

TABLE OF CONTENTS/OUTLINE

Table of contents/outlineOverview: Imaging of Inflammatory/infectious mastitisRisk factors for nonpuerperal breast infectionsClinical manifestations of infectious / inflammatory mastitisTypes of mastitisContribution of magnetic resonance imaging to elucidate difficult cases and the true extent of inflammatory/infectious mastitisDifferential diagnosisPictorial review: MRI findings in most frequent types of inflammatory / infectious mastites

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BR198-ED-X

Magnetic Resonance Imaging (MRI) Features of Breast Mucinous Carcinoma with Histological Correlation

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS

Review the epidemiology and key features to diagnose mucinous carcinoma of the breast.Describe the main imaging characteristics of mucinous carcinoma at MRI.Describe the main histological characteristics of mucinous carcinoma.Describe the correlation of histological findings and MRI features.

TABLE OF CONTENTS/OUTLINE

Review of epidemiology and pathophysiology of breast mucinous carcinoma.Present the MRI findings of mucinous carcinoma found in our Breast Imaging.Department archive.Present the histological features from mucinous carcinoma from our Institution archive.Present the correlation of histological findings and MRI.Summary and conclusion.

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BR201-ED-X

Spectrum of Magnetic Resonance Imaging in the Tuberculosis of Breast: Systematic Review of Cases

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS

1. Breast tuberculosis is very rare site of extra pulmonary tuberculosis 2.It commonly affects women of reproductive age group 3.Commonly present as lump,it is often indistinguishable from the carcinoma as these mass also hard,irregular and can be fixed to chest wall 4. It can present as ulcerative lesion over skin of the breast with discharging sinus. 5.It is classified in the nodulocaseous tubercular mastitis,disseminated tubercular mastitis or tubercular breast abscess.6.Accurate diagnosis is very important for treatment plan 7. Mammography is of limited value as it is difficult to differentiate it from carcinoma breast on mammography.8.MRI is useful modality with dynamic CEMR and DWI helps in the differentiate it from Ca breast 9: MR Spectroscopy can be useful in the lesion and give lipid /lactate peak s/o tubercular lesion.

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1.Introduction 2.Detail literature on clinical presentation and imaging findings 2: Radiological Appearance of tuberculous mastitis (Mammography,Ultrasonography and MRI). 3 Spectrum of MRI findings in the tuberculous mastitis 4. Differential diagnosis which discuss pyogenic abscess, idiopathic granulomatous and malignant mastitis with biopsy proven cases.5.Limitations 6.Conclusion

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BR204-ED-X

Magnetic Resonance Imaging (MRI) Features of Breast-Invasive Lobular Carcinoma with Histological Correlation

All Day Room: NA Digital Education Exhibit

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TEACHING POINTS

Review the epidemiology and key features to diagnose breast invasive lobular carcinomas. Describe the main imaging characteristics of invasive lobular carcinomas at MRI. Describe the main histological characteristics of invasive lobular carcinomas. Describe the correlation of histological findings and MRI features.

TABLE OF CONTENTS/OUTLINE

Review of epidemiology and pathophysiology of breast invasive lobular carcinomas; Present the MRI findings of invasive lobular carcinomas found in our Breast Imaging Department archive; Present the histological features from invasive lobular carcinomas from our Institution archive; Present the correlation of histological findings and MRISummary and conclusion

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BR207-ED-X

Magnetic Resonance Imaging Features of Breast Intraductal Papillomas

All Day Room: NA Digital Education Exhibit

Participants
Miwa Matsukuma, Ube, Japan (*Presenter*) Nothing to Disclose
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TEACHING POINTS

to characterize MRI fetres of intraductal papillomas to distinguish solid and cystic mass of intraductal papiloma from malignancy

TABLE OF CONTENTS/OUTLINE

morphology and enhancement pattern is similar in intraductal papilloma to malignancy we are presenting : caracteristic findings of diagnostic imaging classitying the MRI of intradctal papillomas could be useful for understanding their pathologic background

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BR210-ED-X

Incidental Sternal Lesions in Breast MRI of Cancer Patients

All Day Room: NA Digital Education Exhibit

FDA Discussions may include off-label uses.

Participants
David Durany Lara, Badalona, Spain (*Presenter*) Nothing to Disclose
Ma Carmen Sanchez, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

-To depict sternal lesions detected in breast MRI studies of invasive carcinoma staging or breast MRI follow-up of BI-RADS 3 lesions. - To learn the criterion of malignancy for bone metastatic lesions when analyzing MRI, such as available malignant histological study, lesions that increased in size in their follow up, finding other metastatic bone lesions detected in the bone scintigraphy or other complementary scans available such as staging CT or MRI of the spine, etc... - To take into consideration some prognostic factors of breast cancer in each lesion and focus on the presence of axillary ganglion metastases, size of primary tumor, hormone receptors, immunohistochemical profile (if available) and presence of node metastasis in the internal mammary chain.

TABLE OF CONTENTS/OUTLINE

- Overall number of sternal lesions detected. - Caracteristics in MRI secuences of the lesions. - Other features: localization, unique/ multiple, size of lesions, accompanying factors, ... - Classification (metastasis, benign, indetermined).

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

VI105-ED-X

MR Angiography of Deep Inferior Epigastric Arteries Before Free Flap Breast Reconstruction

All Day Room: NA Digital Education Exhibit

Awards
Cum Laude

Participants
Vivian T. Mai-Tran, MD, New York, NY (*Presenter*) Nothing to Disclose
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Joseph Dayan, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Babak Mehrara, New York, NY (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

1) Review benefits of imaging for preoperative planning. 2) Review vascular anatomy. 3) Discuss variables for perforating artery selection. 4) Quiz format with cases to choose the dominant or most appropriate perforator.

TABLE OF CONTENTS/OUTLINE

- Relevance of DIEP flap breast reconstruction - Alternatives: ultrasound and CTA - Review MRA protocol - Review relevant anatomy - Variables: size, location, course, and length - Sample cases in quiz format: multiple cases to determine dominant perforator and discussion of the better option for surgery

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
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VI172-ED-X

Evaluation of Vascular Thoracic Outlet Syndrome Using Time-resolved MR Angiography

All Day Room: NA Digital Education Exhibit

Participants
Shafik N. Wassef, MD, Coralville, IA (*Presenter*) Nothing to Disclose
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TEACHING POINTS

Thoracic outlet syndrome (TOS) is caused by compression of either the subclavian vessels (vascular TOS) or brachial plexus (neurogenic). Neurogenic TOS is the most common form; venous TOS due to subclavian vein compression is the second most common; and arterial TOS is the rarest from. Vascular TOS can lead to pulmonary embolism, venous gangrene, primary effort thrombosis, digital ischemia and stroke. Therefore early diagnosis and treatment is important. The diagnosis of TOS is made by history, physical exam, which includes provocative tests, radiography, electrodiagnostic tests, brachial plexus neurography, duplex studies and conventional digital subtraction angiography. Recently Time-Resolved 3D MR Angiography (TR-MRA) has been shown to be an excellent noninvasive alternative to DSA. Provocative arm positions can be employed to determine the presence and degree of vascular compression and associated complications. TR-MRA is useful to identify postoperative complications such as restenosis or residual vascular compression. For arterial TOS studies the contralateral arm is injected with undiluted gadolinium-based contrast agent (GBCA). For the venous TOS study the ipsilateral arm is injected with GBCA diluted 1:10 in saline.

TABLE OF CONTENTS/OUTLINE

Definition Etiology of TOS Clinical presentation Radiologic features

SSA03

Cardiac (Anatomy and Function)

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

CA CT MR

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

FDA Discussions may include off-label uses.

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

Sub-Events

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

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

Participants
Sonja Sudarski, MD, Mannheim, Germany (*Presenter*) Nothing to Disclose
Johannes Budjan, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Holger Haubenreisser, Mannheim, Germany (*Abstract Co-Author*) Speaker, Siemens AG Speaker, Bayer AG
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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Ursula Reiter, Graz, Austria (*Abstract Co-Author*) Nothing to Disclose
Michael H. Fuchsjaeger, MD, Graz, Austria (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

All LV and LA volumes decreased during inspiratory breath-hold, EDV, ESV and LAVmax significantly (EDV, 136±28 ml vs. 131±31 ml, p=0.04; ESV, 62±17 ml vs. 59±17 ml, p=0.01; SV, 74±15 ml vs. 67±17 ml, p=0.21; LAVmax, 86±18 ml vs. 80±18 ml, p<0.01; LAVmin, 46±13 ml vs. 46±13 ml, p=0.57; LAVbc, 63±16 ml vs. 62±16 ml, p=0.35). PER was not altered during breath-hold (-410±83 ml/s vs. -416±95 ml/s; p=0.38), diastolic filling rates significantly decreased (PFRE, 334±88 ml/s vs. 299±97 ml/s; p<0.01; PFRA: 283±81 ml/s vs. 259±82 ml/s; p<0.01). LATEF (47±6% vs. 43±8%, p<0.01) and LAPEF (27±5% vs. 22±6%, p<0.01) significantly decreased during inspiratory breath-hold whereas EF (55±6% vs. 55±6%, p=0.22) and LACEF (27±6% vs. 27±7%, p=0.52) did not reveal significant differences. Correlations between breathing and breath-hold parameters ranged from r=0.66 for LACEF to r=0.87 for LAVmin and EF.

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
Hui Chen, Beijing, China (*Presenter*) Nothing to Disclose
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

The mean heart rate variation was 38% ± 22.8 (range: 11 - 122). A total of 609 cine slices were evaluated in each Group (mean number of slices per patient = 8.6 ± 1.9). The average number of slices with mis-triggering artefacts per patient was higher in Group 1 than in Group 2 (4.5 ± 2.9 vs 0.1 ± 0.5, $p<0.0001$). The European CMR registry standardized artefact score was lower in Group 2 than in Group 1 (1.0 ± 1.2 vs 2.37 ± 1.2 respectively, $p<0,0001$). Subjective image quality score was improved in Group 2 compared to Group 1 (3.3 ± 0.9 vs 2.7 ± 1.0 respectively, $p=0.0002$).

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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Young-Hoon Kim, MD,PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

SSA08

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

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

GI MR

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

Participants

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

Sub-Events

SSA08-01 Gastrointestinal Keynote Speaker: LIRADS Update

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

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

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

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

Awards
Student Travel Stipend Award

Participants
Hersh Sagreiya, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose
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Amir Borhani, MD, Pittsburgh, PA (*Abstract Co-Author*) Consultant, Guerbet SA; Author, Reed Elsevier
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PURPOSE

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

METHOD AND MATERIALS

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

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Awards
Student Travel Stipend Award

Participants
Cheng W. Hong, MD, MS, San Diego, CA (*Presenter*) Nothing to Disclose
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

This study provides further validation for the use of LI-RADS and its ancillary. Although the majority of observations remained stable on follow-up imaging, the imaging outcomes of LR-2, LR-3, and LR-4 observations differ substantially.

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

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

Participants
Chansik An, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sieun Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jin-Young Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Myeong-Jin Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
Evan Johnson, MD, New York, NY (*Presenter*) Nothing to Disclose
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Cristina H. Hajdu, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

Honored Educators

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

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

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

Participants
Qingqing Chen, Hangzhou, China (*Presenter*) Nothing to Disclose
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Awards
Student Travel Stipend Award

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

SSA10

Genitourinary (Functional Renal Imaging and Contrast Issues)

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

CT GU MR

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

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

Sub-Events

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

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

Participants
Jennifer S. McDonald, PhD, Rochester, MN (*Presenter*) Research Grant, General Electric Company
Robert J. McDonald, MD, PhD, Rochester, MN (*Abstract Co-Author*) Consultant, General Electric Company; Investigator, General Electric Company
Eric E. Williamson, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
David F. Kallmes, MD, Rochester, MN (*Abstract Co-Author*) Research support, Terumo Corporation Research support, Medtronic plc Research support, Sequent Medical, Inc Research support, Benvenue Medical, Inc Research support, General Electric Company Consultant, General Electric Company Consultant, Medtronic plcConsultant, Johnson & Johnson

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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Awards
Student Travel Stipend Award

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

PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
Tobias Getzin, MD, Hannover, Germany (*Presenter*) Nothing to Disclose
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Frank K. Wacker, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

Obstruction

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

Participants
Genwen Hu, MD, Shenzhen, China (*Presenter*) Nothing to Disclose
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

A convenient, rapid CT GFR measurement without additional radiation dose

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

Honored Educators

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

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

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

Participants
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Loic Boussel, MD, Lyon, France (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To perform quantitative dynamic iodine and gadolinium renal perfusion imaging in vivo using spectral photon-counting computed tomography (SPCCT)

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
Wenwei Shi, Beijing, China (*Presenter*) Nothing to Disclose
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Jing Zhang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

Sunday, Nov. 26 12:05PM - 12:15PM Room: E351

Participants
Octavia Bane, PhD, New York, NY (*Presenter*) Nothing to Disclose
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

SSA11

Genitourinary (Renal and Adrenal Imaging)

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

CT GU MR

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

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

Sub-Events

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

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

Participants
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Marco Armbruster, Munich, Germany (*Abstract Co-Author*) Co-founder, QMedify GmbH
Maximilian F. Reiser, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Dirk-Andre Clevert, MD, Muenchen, Germany (*Abstract Co-Author*) Speaker, Siemens AG; Speaker, Koninklijke Philips NV; Speaker, Bracco Group; Speaker, Samsung Electronics Co, Ltd;

PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

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PURPOSE

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

METHOD AND MATERIALS

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

characteristic (ROC) analyses were created.

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

A total of 152 lesions (size range, 1-16 cm; average 3 cm) in 143 patients (107 men, 36 women; age-range, 31-94 years; average, 63 years) were included in the final analysis. Follow-up studies were performed from 6 to 118 months (average 28 months). Seven of 152 lesions (4.6%) progressed to Bosniak category III or IV on follow-up studies in one month to 4 years (average 20 months). Three of those were surgically removed, all of them diagnosed as malignant renal cell carcinoma (one clear cell and two papillary subtypes). Follow-up after surgery ranged from 16 to 30 months (average 24 months) and there was no evidence of recurrence or metastasis. From the remaining, one patient with Bosniak category III lesion had concomitant hepatocellular carcinoma and the renal lesion showed stability in one year-follow-up; one patient with Bosniak category IV lesion had advanced age (86 years) and the renal lesion also showed stability in one year-follow-up; and two patients lost follow-up in our institution.

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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SSA13

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

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

ER MR MI NR

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

FDA Discussions may include off-label uses.

Participants

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Sub-Events

SSA13-01 Molecular Imaging Keynote Speaker: Imaging of Neuroinflammation

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

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

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

Participants
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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

Sunday, Nov. 26 11:05AM - 11:15AM Room: S504CD

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PURPOSE

MR DSC-PWI and DWI are advanced imaging techniques investigating glioblastoma hemodynamic and tumor cellularity abnormality in vivo. The purpose of this study is to evaluate and compare the association between genomic biomarkers and imaging parameters derived from MR DSC-PWI and DWI, and their prognostic value in predicting overall survival time (OS) in patients with newly diagnosed glioblastomas.

METHOD AND MATERIALS

Forty-one cases (mean age is 62.32±12.09) with new pathology confirmed glioblastomas were enrolled in this study. The mean, maximal relative cerebral blood volume (rCBV) ratio, mean apparent diffusion coefficient (ADC) and minimal ADC of the enhancing tumor (rCBVmean, rCBVmax, ADC mean and ADCmin), maximal rCBV ratio and minimal ADC of peri-enhancing tumor area (rCBVperi-tumor and ADCperi-tumor) were measured. The association between imaging parameters and Ki-67 labelling index, isocitrate dehydrogenase (IDH), mammalian target of rapamycin (mTOR), and EGFR was assessed, the Cox regression was used to evaluate their implication on OS.

RESULTS

There were 40 cases without IDH mutation, and there was no significant between ADC parameters and genomic biomarkers ($p>0.05$). In contrast, the rCBVmax had significant association with mTOR, ($p=0.047$), the rCBVperi-tumor was significantly associated with mTOR after adjustment of gender and EGFR. The Cox regression analysis showed that rCBVperi-tumor and age were the two strongest predictors of OS (hazard ratio= 1.29 and 1.063; $p=0.003$ and 0.005 respectively). The rCBVperi-tumor had better area under the curve than other imaging parameters and genomic biomarkers in ROC analysis, combination of rCBVperi-tumor and age improved the predication of OS with specificity of 78.9% and sensitivity of 81.8%.

CONCLUSION

This comparison study showed significant radiogenomics association between quantitative rCBV parameters and mTOR-EGFR pathway biomarkers, and rCBVperi-tumor had better prognostic value than genomic biomarkers and ADC parameters, which may suggest the tumor angiogenesis is moderated by mTOR-EGFR pathway plays more important role in tumor progression in patients with primary glioblastoma, and the genomics mechanism related with tumor cellularity changes may be more complicated.

CLINICAL RELEVANCE/APPLICATION

This study showed that rCBVperi-tumor had better prognostic value than genomic biomarkers alone, these radiogenomics findings will be useful in developing new target therapy.

SSA13-04 Roles of Elevated 20-HETE in the Breakdown of Blood Brain Barrier and the Severity of Brain Edema in Experimental Traumatic Brain Injury

Sunday, Nov. 26 11:15AM - 11:25AM Room: S504CD

Participants
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PURPOSE

Breakdown of the blood brain barrier (BBB) is a secondary injury following traumatic brain injury (TBI) and can lead to the development of brain edema. However, the factors that contribute to the disruption of the BBB and increase the severity of brain edema in TBI remain to be elucidated. The inhibition of 20-hydroxyeicosatetraenoic acid (20-HETE) synthesis by HET0016 has been suggested as a strategy to decrease brain edema. The present study aimed to investigate whether the elevated production of 20-HETE in cerebral tissue may contribute to BBB breakdown and increase the severity of brain edema in rats with TBI.

METHOD AND MATERIALS

BBB permeability was quantified using dynamic contrast-enhanced magnetic resonance imaging and brain edema was measured according to brain water content. Superoxide production in injured tissue was also assessed. Liquid chromatography-mass spectrometry was used to evaluate 20-HETE production in injured tissue. Western blot analysis was used to assess the expression of occludin, zonula occludens (ZO)-1, matrix metalloproteinase (MMP)-9, and proteins of the c-Jun N-terminal kinase (JNK) pathway.

RESULTS

A total of 3, 24 and 72 h following the induction of TBI, 20-HETE levels, BBB permeability and brain edema were identified to be increased, accompanied by an increase in superoxide production. Conversely, superoxide dismutase levels, in addition to the total antioxidative capability were decreased. In addition, the expression of MMP-9 and proteins of the JNK pathway was upregulated, whereas the expression of occludin and ZO-1 was observed to be suppressed. These results suggested that 20-HETE may aggravate BBB disruption following TBI, via enhancing the expression of MMP-9 and tight junction proteins. Furthermore, oxidative

stress and the JNK signaling pathway may be involved in BBB dysregulation.

CONCLUSION

In conclusion, the results of the present demonstrated that the production of 20-HETE was increased in cerebral tissue following traumatic injury, thus suggesting that it may contribute to the compromise of BBB integrity and the development of brain edema.

CLINICAL RELEVANCE/APPLICATION

This study was to explore the mechanism for the compromise of blood brain barrier integrity and the development of brain edema following traumatic brain injury. Furthermore, clinically, we could find another reason and tool to solve the problem of disruption of blood brain barrier afer traumatic brain injury.

SSA13-05 Multimodal PET and MR Imaging With Pathologic Confirmation Detects Axonal and Synaptic Preservation After Paclitaxel Administration for Repeat Concussive Brain Injury in Mice

Sunday, Nov. 26 11:25AM - 11:35AM Room: S504CD

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PURPOSE

PET and MR imaging have been proposed as biomarkers to evaluate repeat concussive brain injury (rcTBI) clinically. In this study, we hypothesized that imaging could be used in mice to detect axonal and synaptic injury from rcTBI as well as response to therapeutic intervention by paclitaxel.

METHOD AND MATERIALS

Mice received repeat concussive controlled cortical impact (rcCCI) one impact/day for five days (n=15) or sham CCI (n=8). Intranasal PTX (0.6 mg/kg; n=6) or saline (SAL) (n=9) was administered only after first CCI. Diffusion tensor imaging (DTI) was acquired on 14T as a 4 shot EPI, TR/TE=500/16.482ms, 30 diff directions, Max bval=6477.26849710899 s/mm2. Fractional anisotropy (FA) was compared using manual ROIs as well as FSL tract-based spatial statistics (TBSS). Glucose metabolism was assed via SUV corrected 18F-flurodeoxyglucose (FDG) PET imaging as a biomarker for synaptic activity. At 45 days, brains were evaluated for pathologic evidence of axonal injury (silver stain) and synaptic loss (PSD-95) in the external capsule and hippocampus respectively.

RESULTS

FA in the external capsule was decreased in rcTBI by 17% compared to SHAM (0.21±0.01 vs 0.25±0.01, p<=0.05) and extensive areas of white matter injury were seen by TBSS. However, PTX-rcCCI was not significantly different from SHAM or SAL-rcCCI with either analysis. With silver stain, axonal degeneration was seen in cortical white matter of the external capsule in 5/6 SAL-rcCCI but not PTX-treated (n=0/5). A single, dystrophic axon was observed in 1/8 shams. The SAL-rcCCI showed significantly decreased brain FDG uptake, which was "normalized" in PTX mice. Whole brain SUVs, were 120.5±30.1, 90.3±18.7 and 129.2±23.0, for SHAM, SAL- and PTX-rcCCI respectively, p<=0.05. In SAL-rcCCI, hippocampal PSD-95 immunofluorescence was reduced compared to both SHAM and PTX.

CONCLUSION

Both DTI and FDG-PET detected brain alterations in white matter structure and glucose metabolism from repeat concussive injury. However, only FDG-PET confirmed that PTX resulted in improvement when pathology indicated both synaptic loss AND axonal injury were prevented with PTX. DTI may not be sensitive enough or may have more inherent variability to detect treatment-related benefit in rcTBI. Further research is needed to distinguish these factors.

CLINICAL RELEVANCE/APPLICATION

Establishment of brain imaging biomarkers is of critical importance to research and therapeutic development for traumatic brain injury.

SSA13-07 Evolution of Diffusion in Hematoma and Perihematoma after Experimental Intracerebral Hemorrhage by 7.0 T DTI

Sunday, Nov. 26 11:45AM - 11:55AM Room: S504CD

Awards
Student Travel Stipend Award

Participants
Chunhua Wang, MD, Chengdu, China (*Presenter*) Nothing to Disclose
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PURPOSE

To characterize experimental hematoma and perihematoma using diffusion tensor imaging (DTI) and compare the feature of diffusion with that of histology after intracerebral hemorrhage (ICH).

METHOD AND MATERIALS

Twenty-nine male SD rats injected with 40 μL autologous blood in the right basal ganglia underwent 7.0 T MR with T2WI (additional day 0, D0) and DTI sequences at days 1 (D1), 3 (D3), 7 (D7), 14 (D14), 21 (D21), and 28 (D28). HE, Iba1, and glial fibrillary acidic protein staining was performed after brain fixation. Hematoma volume at D0 was measured by T2WI images. Mean diffusivity (MD), axial diffusivity, and radial diffusivity were measured by DTI images. Abnormal MD volumes were delineated manually by MD maps.

RESULTS

The mean hematoma volume was 14.78 μL at D0. The main patterns of diffusivity changes in the ipsilateral basal ganglia after ICH on MD maps visually included relative central hyper-value zone (rCEVZ; MD at D1: 9.54 ± 2.57 x 10-4mm2/s), relative hypo-value zone (rOVZ; MD at D1: 6.94 ± 0.96 x 10-4mm2/s), and relative peripheral hyper-value zone (rPEVZ; MD at D1: 9.61 ± 0.59 x 10-4mm2/s). The rCEVZ corresponded to the area with not only heterogeneous erythrocytes and serum at D1, D3, and D7, but also necrosis of brain parenchyma at D1 and D3. The rOVZ corresponded to the area with vasogenic and cytotoxic edema at D1, D3 and D7, neutrophil accumulation at D3 and D7, microglia proliferation from D3 to D28, and astrocyte proliferation from D7 to D28. The rPEVZ corresponded mainly to the area with cytotoxic and vasogenic edema at D1, D3 and D7, also with glial cell proliferation from D3 to D28. Volumes of abnormal diffusion at D1 and D3 were significantly greater than the hematoma volume at D0 (both $p < 0.001$). The rCEVZ volumes at D1, D3, and D7 were significantly lower than hematoma volume at D0 (all $p < 0.001$). The rOVZ and rPEVZ volumes peaked at D1 and D3, respectively.

CONCLUSION

The results imply diffusion changes in hematoma and perihematoma after ICH involve complex pathological alterations including blood components, cytotoxic and vasogenic edema, and cellular accumulation and proliferation.

CLINICAL RELEVANCE/APPLICATION

This research exhibit evolution of diffusion in hematoma and perihematoma with histological basis, which is useful to explain the diffusion changes in patients after intracerebral hemorrhage.

SSA13-08 Amide Proton Transfer-Weighted MRI Signal As a Novel Imaging Marker for Prediction of MGMT Promoter Methylation Status in Glioblastoma

Sunday, Nov. 26 11:55AM - 12:05PM Room: S504CD

Participants
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PURPOSE

Methylated O6-methylguanine-DNA methyltransferase (MGMT) promoter fosters longer survival in patients with Glioblastoma (GBM) who receive alkylating agents due to the reduced counteraction of alkylating chemotherapy. However, the MGMT methylation status test primarily relies on the invasive surgical procedure. Amide proton transfer-weighted (APTW) imaging is a novel molecular MRI technique that gives contrast mainly based on endogenous cellular proteins. This study aimed to investigate whether MGMT methylation status in GBM is correlated to APTW imaging features.

METHOD AND MATERIALS

Patients with suspected GBM underwent routine and APTW MR sequences at 3T prior to surgery. The MGMT methylation status was assessed with immunohistochemical stain and verified by methylation-specific polymerase chain reaction. APTW images were calculated using MTRasym(3.5ppm). The maximum and minimum (APTWmax and APTWmin), the average (APTWave), and the heterogeneity (APTWhet = APTWmax - APTWmin) of APTW signal intensities were obtained using the contralateral normal brain area as normalization.

RESULTS

Eleven patients with GBM were confirmed as MGMT promoter methylated, and the remaining seven patients were confirmed as unmethylated. Most GBMs with unmethylated MGMT demonstrated heterogeneous, strong hyperintensity on APTW images (A), while most GBMs with methylated MGMT showed heterogeneous, moderate APTW hyperintensity (B). The unmethylated MGMT group has significantly higher APTWmax (3.46 ± 0.49% vs. 2.67 ± 0.59%); APTWave (2.90 ± 0.37% vs. 2.28 ± 0.47%); APTWmin (2.31 ± 0.27% vs. 1.90 ± 0.42%); and APTWhet (1.15 ± 0.33% vs. 0.77 ± 0.23%) than the methylated MGMT group, all $p < 0.05$ (C). APTWmax and APTWave had the highest area under the curve (0.857) and accuracy (90.4 %) in differentiating GBMs with methylated MGMT from unmethylated MGMT GBMs (D).

CONCLUSION

Our early results suggest that GBMs with different MGMT methylation statuses are associated with distinguishable APTW imaging

features. The APTW signal is a valuable imaging biomarker for identifying MGMT methylation status of GBMs, which is of paramount importance for the management of alkylating agent chemotherapy.

CLINICAL RELEVANCE/APPLICATION

Preoperative APTW imaging signal has the potential to non-invasively predict the MGMT promoter methylation status in patients with GBM. APTW signal may serve as a surrogate imaging maker for identifying the MGMT promoter methylation status preoperatively.

SSA13-09 Lipopolysaccharide Endotoxemia Results in Secondary Neuroinflammation and Deposition of Amyloid Beta and Phosphorylated Tau in the Rat

Sunday, Nov. 26 12:05PM - 12:15PM Room: S504CD

Participants
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PURPOSE

Amyloid-Beta (AB) plaque deposition occurs in Alzheimer's disease as well as aging and other neurodegenerative disorders. Soluble AB may increase in response to neuroinflammation. Sepsis results in short and long term neurocognitive impairment in many patients. The objective was to determine whether acute systemic endotoxemia results in secondary neuroinflammation with consequent AB plaque and p-tau deposition in the brain.

METHOD AND MATERIALS

Male Sprague Dawley rats received an IP injection of 10 mg/kg of E. Coli lipopolysaccharide (LPS) to mimic sepsis. IL-1B, IL-6 and TNFA were measured by ELISA in whole brain homogenates of LPS-injected and control rats. Soluble AB and p-tau proteins in brain homogenates were measured by immunoblotting. Cortical AB plaques were quantified by immunostaining and morphologically characterized by confocal microscopy. Microglial density was quantified by Iba1 immunostaining. At 72 h post LPS administration, rats were injected intravenously with 18F-flutemetamol and the resultant brain uptake was quantified by digital autoradiography of cryomicrotome slices.

RESULTS

Endotoxemia resulted in increased cytokines in the brain, particularly IL-1B (7.8 fold increase over controls at 24h, $p < .0001$). Cortical microglial density was 1.9-fold higher LPS-injected rats than controls ($p < .001$). Compared to controls, systemic LPS produced significant brain increases of soluble AB (1.98-fold increase, $p < .01$) and p-tau (2-fold increase, $p < .01$) and a progressive accumulation of AB aggregates, which were morphologically similar to diffuse plaques. There was no significant difference in uptake of 18F-flutemetamol in the cerebral white matter (corpus callosum) in the brains of LPS-treated vs. control rats. The cerebral cortical activity was 2.02 fold higher in LPS than control rats ($p < .01$), a difference that was visually appreciable.

CONCLUSION

LPS endotoxemia causes secondary neuroinflammation and elevations in cytokines, soluble AB, p-tau and AB plaques in the brain, and cortical deposition of 18F-flutametamol. Whether these findings eventually resolve or are associated with neurocognitive impairment are as of yet unknown.

CLINICAL RELEVANCE/APPLICATION

18F flutemetamol PET could provide a mechanism to study the effects of systemic inflammatory conditions on the brain, the pathogenesis of which may involve the accumulation of AB.

SSA14

Science Session with Keynote: Musculoskeletal (Lower Extremity)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S406A

CT MK MR

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

Participants
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Sub-Events

SSA14-01 Musculoskeletal Keynote Speaker: Update on Lower Extremity Imaging

Sunday, Nov. 26 10:45AM - 10:55AM Room: S406A

Participants
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SSA14-02 CT Texture Analysis of Acetabular Subchondral Bone Can Discriminate Between Normal and Cam Positive Hips in Femoroacetubular Impingement

Sunday, Nov. 26 10:55AM - 11:05AM Room: S406A

Participants
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PURPOSE

Cam-type femoroacetabular impingement (FAI) has been associated with early degenerative change of the hip. The purpose of this study was to assess whether texture analysis could determine microscopic changes in the architecture of acetabular subchondral bone prior to the development of macroscopic structural damage on CT.

METHOD AND MATERIALS

This was an IRB-approved, retrospective case-control study analyzing CT images obtained in subjects with and without cam-type deformities of the proximal femur. Subjects with cam deformity were further subdivided into asymptomatic cam and symptomatic cam-FAI groups. There were a total of 68 patients: 19 controls, 26 asymptomatic cam, and 23 symptomatic cam-FAI. All subjects underwent CT scan of the pelvis. The subchondral bone of the entire acetabulum was contoured manually as a volume of interest (VOI) on the sagittal images for each patient using ImageJ ®. 3D histogram texture features (mean, variance, skewness and kurtosis) were evaluated for each patient using MaZda software. Groupwise differences (controls, asymptomatic cam, and symptomatic cam patients) were initially investigated for each feature using Kruskal-Wallis tests. Subsequently, differences between controls and either asymptomatic or symptomatic cam deformities were assessed using Mann-Whitney U tests with post-hoc Bonferroni correction for multiple comparisons.

RESULTS

Both asymptomatic and symptomatic cam-FAI hips demonstrated significantly higher values of texture variance compared to normal controls (p=0.002, p=0.003), but significantly lower values of skewness (p=0.005, p=0.002) and kurtosis (p=0.003, p=0.004) compared to normal controls. There were no differences in texture profile between asymptomatic cam and symptomatic cam-FAI hips.

CONCLUSION

Hips with cam deformities demonstrated increased variance, decreased skewness, and decreased kurtosis compared to normal control subjects. These findings suggest that 3D histogram texture features extracted from CT images can detect differences in subchondral bone architecture between controls and those with cam deformities, regardless of the patient's symptom status.

CLINICAL RELEVANCE/APPLICATION

Changes in texture profile of asymptomatic cam hips is as pronounced as that of symptomatic cam-FAI hips. This may facilitate identification of patients at risk of developing hip dysfunction due to altered biomechanics conferred by the bone changes.

SSA14-03 Variability of MRI Reporting in Proximal Hamstring Avulsion Injury

Sunday, Nov. 26 11:05AM - 11:15AM Room: S406A

Participants
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PURPOSE

Quantification of tendon retraction is paramount in management of proximal hamstring avulsions, impacting the decision to perform surgery and the type of incision used. However, variability in the measurement landmark used on the broad ischial tuberosity origin, and difficulty in locating the proximal tendon stump may lead to significant variability in measured retraction. The purpose of our study was to survey musculoskeletal (MSK) radiologists and orthopedic surgeons on the ischial tuberosity landmark used in hamstring avulsion, and the clinical impact of MRI measurements and report content.

METHOD AND MATERIALS

Two survey instruments were created. One survey was sent by email to members of the Society of Skeletal Radiology (SSR), querying the preferred ischial tuberosity landmark, perceived difficulties in quantifying retraction, and the impact of the radiology report on clinical decision making. A similar survey, with added questions on the impact of imaging findings, was posted onto the American Orthopaedic Society for Sports Medicine (AOSSM) website and sent by email to orthopedic colleagues.

RESULTS

A total of 218 MSK radiologists (SSR members), and 33 orthopedic surgeons completed the survey. The conjoint tendon origin was the most common proximal landmark used for both orthopedic surgeons (66.7%) and radiologists (47%) in complete hamstring avulsion. For 71% of orthopedic surgeons, the radiology report impacts the decision to perform surgery, and for 45%, the report impacts the incision used. 36% of orthopedic surgeons report overestimation of measurements in radiology reports due to differences in landmarks used for measurement, while 27% report underestimation. 43% of radiologists report difficulty in determining location of the retracted tendon, and 31% report difficulty determining the ischial tuberosity landmark for measurement.

CONCLUSION

Differences in the ischial tuberosity landmark used, and difficulty in locating the proximal tendon stump may lead to variability in measured tendon retraction in proximal hamstring avulsion, and may alter the decision to perform study and the type of incision used.

CLINICAL RELEVANCE/APPLICATION

Differences in the ischial tuberosity landmark used, and difficulty in locating the proximal tendon stump may lead to variability in measured tendon retraction in cases of proximal hamstring avulsion, and may significantly impact surgical management.

SSA14-04 Does Labral Size and Tear Pattern Differ Between FAI Patients with Femoral Retrotorsion Compare to Increased Femoral Antetorsion?

Sunday, Nov. 26 11:15AM - 11:25AM Room: S406A

Participants
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PURPOSE

In patients with femoroacetabular impingment (FAI) femoral retrotorsion and increased femoral antetorsion (FT) contribute to an unknown degree to the bony conflict. Hence the role of de-/rotational osteotomies is yet to be defined in FAI patients. In hip dysplasia, cam and pincer FAI the labrum shows distinct tear patterns. By contrast, the impact of femoral retrotorsion and increased FT on labral tear patterns and labral size is currently unclear. Our aim was to compare (1) labral size and (2) tear pattern between hips with femoral retrotorsion and increased FT.

METHOD AND MATERIALS

After IRB approval for this retrospective study the institutional MR database (2011-2016; 620 hips) was reviewed for direct MR arthrographies (3.0T) in FAI hips with femoral retrotorsion (30° FT, 71 hips). Groups were comparable for age, acetabular version and coverage (LCE between 22° and 39°). Additionally to the multiplanar standard protocol, axial images including the distal femoral condyles for measurement of FT and 2D radial PD-w images using the femoral neck axis as center of rotation were obtained. On each half o'clock position (30° intervals per slide gap) the labral cross sectional area (CSA, mmSquared) was measured circumferentially with OSIRIX® software. Labrum tear pattern was described as follows: intact, degeneration, intersubstance tear, intrasubstance tear. CSA was compared with unpaired t-tests and labrum tear pattern was compared with chi-square test between the groups ($p<0.05$).

RESULTS

(1) Labral CSA was significantly decreased from 7.30 to 4.30 o'clock in hips with femoral retrotorsion compared to hips with increased FT ($p<0.05$).(2) Prevalence of intrasubstance tears was significantly higher anteriorly (1.30 to 3 o'clock position; $p<0.05$) in hips with increased FT compared to hips with femoral retrotorsion.

CONCLUSION

Labral size and tear pattern differ between FAI patients with femoral retrotorsion compared to increased FT. A hypotrophic labrum in hips with femoral retrotorsion may reflect an anterior impingement. Higher prevalence of anterior intrasubstance labrum tears

could result from instability in hips with increased FT.

CLINICAL RELEVANCE/APPLICATION

Systematic assessment of labrum size and tear pattern in patients with FAI can help to define the role of additional femoral de-/rotational osteotomies in FAI patients.

SSA14-05 Comparison of a Fast 5-minute Knee MRI Protocol with a Standard Knee MRI Protocol: A Multi-institutional Multireader Study

Sunday, Nov. 26 11:25AM - 11:35AM Room: S406A

Participants
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PURPOSE

The purpose of this study was to compare the diagnostic performance of a 5-minute knee MRI protocol with parallel imaging to that of a standard knee MRI protocol.

METHOD AND MATERIALS

100 3T MRIs of 100 patients (mean age, 38.8 years) and 50 1.5T MRIs of 46 patients (mean age, 46.4 years), consisting of 5 fast multiplanar 2D FSE sequences using parallel imaging and 5 standard sequences, performed at 2 academic centers from January 2015 to July 2016 were retrospectively reviewed by 4 MSK radiologists. Agreement between fast and standard MRI readings (interprotocol agreement) and agreement of standard MRI readings (intraprotocol agreement) when evaluating menisci, ligaments, cartilage and bone was compared for interchangeability. Additional comparisons between fast and standard MRI with regards to frequency of major findings and sensitivity and specificity in 51 patients who underwent surgery were tested for significant differences.

RESULTS

Interreader agreement with fast MRI was very similar to interreader agreement with standard MRI (83.0-99.5% across structures) with no excess disagreement (<=1.1%; 95% CI, -4.2% to 3.8% across structures). Frequency of major findings (1.1-22.4% across structures) reported on fast and standard MRI were not significantly different ($p >= 0.215$ across structures) except more ACL tears were reported on fast MRI ($p=0.021$) and more cartilage defects were reported on standard MRI ($p<0.001$). Sensitivities (59-100% across structures) and specificities (73-99% across structures) of fast and standard MRI were not significantly different for meniscal and ligament tears (95% CI for difference, -0.08 to 0.08). For cartilage defects, fast MRI was slightly less sensitive (95% CI for difference, -0.125 to -0.01) but slightly more specific (95% CI for difference, 0.01 to 0.5) than standard MRI.

CONCLUSION

A fast 5-minute knee MRI using parallel imaging is interchangeable with and has similar accuracy to a standard knee MRI for evaluating internal derangement of the knee.

CLINICAL RELEVANCE/APPLICATION

A fast 5-minute knee MRI would be helpful to improve efficiency and patient throughput when MRI availability is limited and increase patient comfort and exam tolerability in patients with claustrophobia and pain.

SSA14-06 Does Cartilage Repair Surgery Prevent Progression of Knee Degeneration? A Quantitative Control-matched MRI Study

Sunday, Nov. 26 11:35AM - 11:45AM Room: S406A

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PURPOSE

To assess, whether cartilage repair surgery (CR) for treatment of focal cartilage defects at the knee prevents progression of degenerative changes on MRI in a longitudinal follow-up.

METHOD AND MATERIALS

A total of N=32 individuals with focal cartilage defects at the knee received baseline and 6-year follow-up MRI studies. Preoperative MRIs of n=16 individuals (12 male, 4 female) who received CR surgery were matched with n=16 baseline MRIs of individuals from the

Osteoarthritis Initiative (OAI) with initially morphologically identical cartilage defects (control group without surgery; 6 male, 6 female). Morphological knee abnormalities were assessed using Whole-Organ-Magnetic-Resonance-Imaging-Scores (WORMS), AMADEUS scores and MOCART scores. Mean values, mean differences and standard deviations (SD), paired t-tests and multiple regression models were used for statistical analyses.

RESULTS

In both groups, focal cartilage defects were found at the femoral condyle in 8/16 cases and at the patella in 8/16 cases. Total WORMS scores (mean difference±SD, -4.7±10.2, P=0.085) and cartilage scores for the affected knee compartment (-0.3±1.5, P=0.378) were not significantly different between the two groups at baseline. The increase of total WORMS scores during identical follow-up times (CR patients: 5.7±2.3 years; OAI: 5.6±1.4 years) was significantly more severe in individuals that did not receive surgery (P<0.001). Cartilage defects at the affected (P<0.001) and opposing compartment (P=0.029) showed a more severe progression in the non-operated cohort (Figure 1). For patients that received CR, the mean preoperative AMADEUS score was 48.1±15.8 and the mean postoperative MOCART score was 77.5±18.9. In control subjects from the OAI, cartilage T2 relaxation times increased from 32.4±2.5ms at baseline to 34.5±2.3ms at follow-up (P=0.002).

CONCLUSION

Since patients with CR showed significantly less progression of cartilage defects and of degenerative MRI changes at the knee (WORMS scores) than an initially identical control cohort from the OAI in a 6 year follow-up, CR may prevent progression of early osteoarthritis.

CLINICAL RELEVANCE/APPLICATION

This MR imaging pair-matched study supports the assumption, that osteochondral transplantation prevents progression of cartilage defects and early osteoarthritis at the knee in a mid-term follow-up.

SSA14-07 Weight-Bearing Digital Tomosynthesis of Foot/Ankle Arthritis: Comparison to Radiography and Simulated Weight-Bearing Computed Tomography

Sunday, Nov. 26 11:45AM - 11:55AM Room: S406A

Participants
Alice S. Ha, MD, Seattle, WA (*Presenter*) Research Grant, General Electric Company
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PURPOSE

Foot/ankle arthritis is common and debilitating. Weight-bearing radiography remains the gold standard in evaluating alignment, but overlapping bones or hardware limit evaluation for arthritic bony detail. We hypothesized that digital tomosynthesis (DTS) can provide reliable quantitative alignment values like radiography with its weight-bearing capability and good qualitative arthritic details like computed tomography (CT) with its plane-by-plane images.

METHOD AND MATERIALS

In this IRB-approved prospective study, adult patients with foot/ankle pain and arthritis referred for simulated weight-bearing CT were recruited to undergo weight-bearing radiography and DTS. Four readers independently evaluated radiography and DTS images in randomized orders for foot/ankle alignment and severity of osteoarthritis for each joint (e.g., joint space narrowing, osteophytes, subchondral cyst). Two readers performed consensus reading of CT. Radiography was considered the gold standard for foot alignment and CT for osteoarthritic details. Agreement between modalities was assessed using the intraclass correlation coefficient (ICC) (quantitative variables) and Cohen's kappa (qualitative variables).

RESULTS

46 patients (24 men; mean age 54 years) with a total of 91 ankles were included. Trauma (67%), osteoarthritis (52%), and congenital deformity (41%) were the most common prior conditions. All joints were less obscured when seen with DTS or CT (4-11%) when compared to radiography (14-34%, p<0.001). For quantitative measurements of foot alignment (Table 1), DTS had moderate to good agreement with radiography, which was significantly better than CT in most cases. For qualitative osteoarthritic details of the tibiotalar joint (when not obscured), agreement was moderate to good for most features, with kappa ranging from 0.47 to 0.62 between radiography and CT and from 0.48 and 0.63 between DTS and CT.

CONCLUSION

DTS leads to less obscuration of joints than radiography and provides reliable weight-bearing quantitative foot/ankle alignment values when compared to radiography and osteoarthritic bony details when compared to CT.

CLINICAL RELEVANCE/APPLICATION

Digital tomosynthesis allows for tomographic characterization of foot/ankle arthritis while weight-bearing with comparable details to CT with less cost and radiation.

SSA14-08 Intravoxel Incoherent Motion (IVIM) Imaging of Exercised Induced Hemodynamics Response in Achilles Tendon

Sunday, Nov. 26 11:55AM - 12:05PM Room: S406A

Participants
Xiang He, PhD, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Kenneth T. Wengler, MS, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Dharmesh Tank, MD, Stony Brook, NY (*Presenter*) Nothing to Disclose
Elaine S. Gould, MD, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
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Monitoring Board, Histogenics Corporation
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PURPOSE

Achilles tendon (AT) microcirculation plays a crucial role in tendon degeneration and repair. Intravoxel incoherent motion (IVIM) MRI has been applied in skeletal muscle hemodynamics by exercise. However, the application of IVIM to tendons is challenged by the short T2/T2* (~7 ms) and long TE (~50-80 ms) typically required. In this study, we utilized a stimulated-echo based short TE (<20 ms) tendon diffusion protocol (ste-RESOLVE) to study hemodynamic response in the Achilles tendon following exercise in healthy subjects, to provide a springboard to aid in our understanding of the role of hypovascularity in tendinopathy.

METHOD AND MATERIALS

Seven healthy subjects were recruited for this IRB approved study. After baseline tendon IVIM imaging at magic angle, subjects were instructed to perform 5 minutes of standardized heel-raise exercises outside the scanner immediately prior to re-imaging. The tendon diffusion coefficient (D), pseudo-diffusion coefficient (D*), and perfusion fraction (fp) were calculated using standard bi-exponential fit. D*× fp was used as an indicator of blood flow, while fp was used as an indicator of blood volume.

RESULTS

The pre-exercise measured fp and D*x fp were 2.81±1.09% and 17.45±10.81 respectively. The post-exercise measured fp and D*x fp were 4.96±1.23% and 40.52±23.27 respectively. The relative increase in tendon blood volume and tendon perfusion was 87.11% and 227.41%, respectively.

CONCLUSION

This study evaluated the feasibility and robustness of a ste-RESOLVE-based IVIM protocol. We expect that our estimated IVM parameters in control subjects may serve as a baseline for subsequent studies on patients with clinical and subclinical Achilles tendinosis. We hope that this technique can now be used to monitor tendon healing and repair and assess the potential risk of rupture in diseased tendons.

CLINICAL RELEVANCE/APPLICATION

This study established the feasibility of using ste-RESOLVE IVIM protocol to measure exercise induced hemodynamics changes in Achilles tendon.

SSA14-09 Ankle Syndesmosis Measurements Using Four-Dimensional Computed Tomography: Correlation with Symptoms and Imaging Signs of Tibiotalar Osteoarthritis

Sunday, Nov. 26 12:05PM - 12:15PM Room: S406A

Awards
Student Travel Stipend Award

Participants
Nima Hafezi Nejad, MD, MPH, Baltimore, MD (*Presenter*) Nothing to Disclose
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Shadpour Demehri, MD, Baltimore, MD (*Abstract Co-Author*) Research support, General Electric Company; Research Grant, Carestream Health, Inc; Consultant, Toshiba Corporation;

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PURPOSE

Four-Dimensional CT (4DCT) can be used for the kinematic assessment of peripheral joints during active motion. Nevertheless, evidence regarding the use of 4DCT for the assessment of ankle pain and instability is limited. Our objective was to evaluate the correlation between CT-derived indices of ankle syndesmosis during active plantar-dorsiflexion motion and patient reported symptoms as well as imaging features of tibiotalar osteoarthritis (OA).

METHOD AND MATERIALS

This is an IRB approved HIPAA complaint, retrospective analysis of a group of prospectively recruited patients in our 4DCT study. Eight patients with chronic, unilateral signs and symptoms of ankle pain and instability referred for advanced imaging evaluation, were included in this study. Bilateral 4DCT was performed using a 320-row detector CT scanner (Aquilion one, Toshiba Medical Systems) during active motion from complete dorsiflexion to plantar flexion (0.5 sec. temporal resolution). Two previously defined indices of ankle syndesmosis were measured by a fellowship trained foot & ankle surgeon: 1.Syndesmotic Anterior Distance (SAD), 2.Syndesmotic Translation (ST). Tibiotalar OA was assessed using Kellgren-Lawrence (KL) grading. Reliability of the selected indices was confirmed in our previous study. Imaging examinations were interpreted by a musculoskeletal radiologist with 8 years of

experience.

RESULTS

There was a significant difference in the overall SAD measurements between asymptomatic (median centimeters (interquartile range): 0.37 (0.33 - 0.47)) and symptomatic (0.30 (0.26 - 0.38)) ankles. Unlike ST measurements (change in motion: -0.03 (-0.13 - 0.00) P:0.027), SAD measurements were not a function of ankle motion and tibiocalcaneal angle. Changes in SAD measurements from dorsiflexion to plantar flexion were significantly correlated with the tibiotalar OA severity, defined by KL grades (point biserial correlation coefficient: -0.688, P:0.003)

CONCLUSION

SAD does not change significantly during ankle dorsi/plantar flexion and is associated with the presence of symptoms and imaging features of osteoarthritis.

CLINICAL RELEVANCE/APPLICATION

Our study represents one of the very few kinematic assessments of ankle syndesmosis using 4DCT examination. Changes in SAD, but not ST measurements are independent of tibiocalcaneal angle. Increased changes in SAD during dorsiflexion and plantar flexion motion are correlated with clinical and imaging features of tibiotalar OA.

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SSA15

Musculoskeletal (Bone Marrow and Neoplasms)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S406B

BQ CT MR MK

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

Participants
Jeffrey J. Peterson, MD, Neptune Beach, FL (*Moderator*) Nothing to Disclose
Matthew D. Bucknor, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSA15-01 Comparison of Qualitative and Quantitative CT and MRI Parameters for Monitoring of Longitudinal Spine Involvement in Patients with Multiple Myeloma

Sunday, Nov. 26 10:45AM - 10:55AM Room: S406B

Participants
Christopher Kloth, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Wolfgang M. Thaiss, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Hendrik Ditt, Forchheim, Germany (*Abstract Co-Author*) Employee, Siemens AG
Sebastian Werner, Tuebingen, Germany (*Presenter*) Nothing to Disclose
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Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Marius Horger, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the diagnostic performance of CT-based quantification of skeletal changes using a dedicated post-processing subtraction tool by comparison with standard-CT reading and MRI for longitudinal disease monitoring in multiple myeloma.

METHOD AND MATERIALS

Included were 31 consecutive myeloma patients (17 male; mean age, 59.20 ± 8.08y) who underwent who underwent 154 repeated examinations consisting of whole-body MRI (n=76) and whole-body reduced-dose MDCT (n=78) at our institution between June 2013 and September 2016. Nonenhanced reduced-dose whole-body-CT was performed using thin-collimation. We classified response according to standard CT-reading into progression (new or enlarging osteolyses) vs. stable/ response (no change). Quantitative CT was performed on subtraction maps created for the entire axial skeleton. Results were classified into progressive disease (PD), stable (SD) and response (partial + complete, PR/CR). On MRI, bone marrow manifestations were evaluated by qualitative image analysis (number/size) on coronal T1w-TSE, T2*w and STIR. Standard-of-reference was the hematological laboratory (M-gradient).

RESULTS

Hematological response categories were: CR(n=14/47, 29.7%), PR(2/47, 4.2%), SD(16/47, 34.0%) vs. PD(15/47/29.9 %). Standard-CT classification yielded PD (25.5%) and SD/PR/CR (74.5%) whereas quantitative CT classified 12 (25.5%) PD, 26 (55.3%) SD and 9 (19.2%) PR/CR. Qualitative MRI classified 14 (29.7%) PD, 16 (34%) SD and 17 (36.3%) PR/CR. Quantitative MRI measured in focal lesions yielded no significant change in T1/T2/T2* or ADC signal intensity between baseline and FU whereas at non-focally involved skeletal sites, signal intensity changes on T2w/T2* and ADC reached significance only in stable disease ($p<0.001$). Changes in mean/min/max HU values in bone on CT did not correlate significantly with changes in measured MRI values.

CONCLUSION

Imaging response monitoring using CT can be improved by using quantitative parameters for evaluation of focal lesions whereas for MRI only qualitative parameters prove reliable.

CLINICAL RELEVANCE/APPLICATION

The use of longitudinal bone subtraction maps for therapy response monitoring in MBD improves diagnostic accuracy by focusing the reader's attention solely on the bone changes that have occurred within the control interval, ignoring all other myriads of bone lesions staying unchanged.

SSA15-02 Quantification of Bone Marrow Adipose Tissue Using Off-the-shelf Gradient Echo MR Imaging

Sunday, Nov. 26 10:55AM - 11:05AM Room: S406B

Participants
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PURPOSE

To determine the feasibility of fast and widely available, Quantitative Gradient-Echo (QGRE) MRI for quantification of bone marrow adipose tissue (MAT) using, state of the art, SE-Dixon Quantitative Chemical Shift Imaging (QCSI) as a reference standard. Subsequently we aimed to determine age and gender specific differences in marrow fat fractions (FF) of the spine and femur.

METHOD AND MATERIALS

L3-5 FF of 11 patients with Gaucher disease (GD) were measured using both a QGRE sequence (scan time 1 minute) and our SE-Dixon QCSI sequence (scan time 21 minutes), on the same day, on a Siemens 1.5 Tesla MRI-scanner (Avanto). QGRE FF of the spine (C1-L5) and both femora were measured in 40 healthy subjects (median age: 51 years; range: 23-76; 26 males). Regions of interest covering the individual vertebral bodies were drawn on sagittal images. Coronal images of femora were acquired and divided into 3 regions of interest: proximal metaphysis, diaphysis and distal metaphysis. During post processing a multi peak fat model was used for fitting.

RESULTS

In GD, L3-5 QCSI and QGRE MRI, FF showed good agreement (intra class correlation coefficient L3-5: 0.80 (95% CI 0.32-0.95, $p<0.001$). In healthy subjects, QGRE spinal FF increased from cranial to caudal: mean FF(±SD): 36.1% (±9.9), 37.9% (±8.1) and 43.4% (±9.5) for the cervical, thoracic and lumbar spine respectively (linear mixed model: $p<0.001$). QGRE median femoral FF increased from proximal to distal: 83.8% (interquartile range: 76.6-88.0%), 89.7% (80.8-94.7%) and 95.0% (93.7-95.7%) for the proximal metaphysis, diaphysis and distal metaphysis respectively (Friedman test: $p<0.001$). In female subjects there was a strong correlation between age and femoral or spinal FF ($\rho=0.73$, $p= 0.01$ and $\rho=0.90$ $p<0.001$ respectively), while in male subjects only spinal FF was correlated with age (spine: $r=0.45$, $p=0.02$, femur: $r=0.04$ $p=0.84$).

CONCLUSION

QGRE MRI is a fast, accurate and widely available, alternative for QCSI and allows quantification of MAT of the spine and femora with high spatial resolution. Gender and age specific differences in MAT should be taken in account when interpreting marrow FF.

CLINICAL RELEVANCE/APPLICATION

High vertebral MAT is associated with low bone mineral density and increased fracture risk. Accurate MAT quantification is necessary for the evaluation of MAT as a potential imaging biomarker.

SSA15-03 3T Chemical Shift Encoded MRI for Bone Marrow Adipose Tissue Composition Assessment

Sunday, Nov. 26 11:05AM - 11:15AM Room: S406B

Participants
Dimitri Martel, PhD, New York City, NY (*Presenter*) Nothing to Disclose
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PURPOSE

Chemical Shift Encoded MRI (CSE-MRI) allows separation and quantification of water and fat in images. Recent improvements in such methods also allow assessment of fat composition, which may serve as a potential biomarker of osteoporosis. Our purpose is to apply such a method in the proximal femur bone marrow to assess subregional fat quantity and composition in a population of pre and post- menopausal women.

METHOD AND MATERIALS

This study had institutional review board approval and written informed consent was obtained. A multi gradient echo sequence at 3T (scan time = 3:32min) was used to acquire images of both hip of n=7 pre (25.75 +/- 3.58y) and n=6 post-menopausal women (59.83 +/- 3.58y). Using a dedicated reconstruction workflow we quantitatively assessed fat composition in bone marrow adipose tissue (bMAT) as depicted in figure 1. Using k-mean clustering, separation within bMAT of regulated (rMAT) and constitutive marrow adipose tissue (cMAT) was achieved. Regions of interest were draw in the: femoral head (FH), femoral neck (FN), Ward's triangle (WT), greater trochanter (GT), and proximal shaft (PS). The Mann-Whitney non-parametric test was used to compare results between groups.

RESULTS

Within bMAT of FN/WT, patients compared to controls demonstrated: higher SFA (+18.8%/32.1%) and lower PUFA (-30.6%/-

49.7%) and MUFA (-15.6%/-8.61%) (p<0.05 for all). Within rMAT of the FH, FN, WT, and GT patients compared to controsl demosntrated: higher SFA (+17.4%/+31.3%), lower PUFA (-38.3%/-59.5%), and lower MUFA (-8.3%/-25.1%) (p<0.05 for all). Within cMAT of FN and WT, patients compared to controls demontrated: higher SFA (+9.7%/+18.8%) and lower PUFA (-22.7%/-33.3%) and MUFA (-6.2%, FN only) (p<0.05 for all).

CONCLUSION

CSE-MRI can separate bMAT into rMAT/cMAT and detect sub-regional variation and differences in proximal femur fat composition and quantity in pre-post menopausal subjects in clinically feasible scan times.

CLINICAL RELEVANCE/APPLICATION

Chemical Shift Encoded MRI allows to assess bone marrow fat quantity and composition and allows discrimination between bone marrow adipose tissues in pre/post menopausal women.

SSA15-04 Quantification of Vertebral Bone Marrow Fat: Comparison of Six-Echo Modified Dixon with Single-Voxel MR Spectroscopy

Sunday, Nov. 26 11:15AM - 11:25AM Room: S406B

Participants
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Sung Hwan Hong, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Sun Jeong Moon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare lumbar vertebral bone marrow fat-signal fractions obtained from six-echo modified Dixon sequence (6-E mDixon) with fractions from single-voxel MR spectroscopy (MRS) in patients with low back pain

METHOD AND MATERIALS

Vertebral bone marrow fat-signal fractions were quantified by modified Dixon with six-echoes and single-voxel MRS measurements in 23 patients. The point-resolved spectroscopy (PRESS) sequence was utilized for localized single voxel-MRS (TR = 3000 msec, TE = 35 msec, and total scan time = 1 minute 42 seconds). A 2×2×1.5 mm3 voxel was placed within the L3 vertebral body. The bone marrow fat spectrum was characterized based on the magnitude of measurable fat peaks and an a priori knowledge of the chemical structure of triglycerides. The imaging-based fat-signal fraction results were then compared to the MRS-based results.

RESULTS

There was a strong correlation between modified Dixon and MRS-based fat-signal fractions (slope = 0.842, r2 = 0.869, p < 0.001) (Figure 1). With Bland-Altman analysis, 91.3% (21/23) of data points were within the limits of agreement (Figure 2). Bland-Altman plots showed a slight but systematic error of modified Dixon based fat-signal fraction, which showed a prevailing underestimation of small fat-signal fractions and overestimation of high fat-signal fractions

CONCLUSION

Given its excellent agreement with single voxel-MRS, modified Dixon with six echoes can be used for visual and quantitative evaluation of vertebral bone marrow fat in daily practice.

CLINICAL RELEVANCE/APPLICATION

6-E mDixon allows equally accurate in quantifying vertebral bone marrow fat content as MRS and is potentially suitable for fat quantification in vertebral bone marrow

SSA15-05 Quantitative Standardization of Bone Marrow Imaging of Normal Vertebrae in Adults Using Dual-Source Dual-Energy CT Virtual Noncalcium Technique

Sunday, Nov. 26 11:25AM - 11:35AM Room: S406B

Participants
Hong Wang JR, Jinan, China (*Presenter*) Nothing to Disclose
Jiayang Fang, Jinan, China (*Abstract Co-Author*) Nothing to Disclose
Dexin Yu, Jinan, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the characteristics of bone marrow imaging and obtain the quantitative standard values of normal vertebrae in adults using dual-energy CT virtual noncalcium (VNCa).

METHOD AND MATERIALS

A total number of 200 cases who took physical examination were recruited to receive thoracolumbar spine imaging with dual-source dual-energy CT between August and November 2016. The CT values of bone marrow of T3-L5 vertebrae body were measured by using VNCa technique. Then on the basis of the measured CT values of vertebral body, four segments including T3-T5, T6-T9, T10-L1 and L2-L5 with approximative CT values were divided. The differences in such measurement parameters between different ages and genders were analyzed. Meanwhile, the average of the radiation dose of the scanning range was recorded.

RESULTS

The CT values of bone marrow in thoracic and lumbar vertebrae in young women were -27.76HU and -37.56HU, higher than those of older women with -37.80HU and -45.45HU (P<0.05). The CT values of the thoracic and lumbar vertebrae were -30.73HU and -33.74HU, which were significantly higher than those of the aged male with -46.07HU and -44.68HU (P<0.05). However, there were

no significant differences of the CT values of bone marrow in thoracic and lumbar vertebrae between the groups regarding gender (P>0.05). The measured CT values of bone marrow were negatively correlated with age (r=-0.4,P=0), while no significant correlation with sex (r=0.08,P=0.252). The average CT values of bone marrow of four segments were significant higher in younger cases between different age groups (P<0.05) and there were no significant differences of the average CT values of bone marrow between the groups regarding gender (P>0.05). In addition, the mean dose of the radiation was 8.33 mSv, which was 62.13% lower than that of the second generation dual source CT radiation.

CONCLUSION

VNCa bone marrow imaging with dual-source dual-energy CT of the quantitative CT value in normal thoracic and lumbar is more stable, and can provide an objective quantitative standard value for vertebral disease diagnosis.

CLINICAL RELEVANCE/APPLICATION

Dual-source dual-energy CT VNCa technique can provide quantitative standard of normal bone marrow which is helpful for the diagnosis of bone marrow lesions rather than using MRI as standard.

SSA15-06 Differential Diagnosis of Osteoblastic Metastases in Patients with Breast and Lung Cancer Using Dual-Energy Spectral CT Imaging

Sunday, Nov. 26 11:35AM - 11:45AM Room: S406B

Participants
Shaowei Zheng, Dalian, China (*Presenter*) Nothing to Disclose
Jing Chen, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Ai Lian Liu, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Weisheng Zhang, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Yijun Liu, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the diagnostic efficacy of dual-energy spectral CT in the evaluation of osteoblastic metastases (OBMs) in patients with breast cancer or lung cancer.

METHOD AND MATERIALS

17 patients with lung cancer and 21 patients with breast cancer underwent plain and contrast-enhanced CT scans of the thorax, abdomen or spine with dual-energy spectral imaging mode. The osseous metastases were at least 1cm in diameter with a relatively homogeneous density and the final diagnosis of was based on imaging and long-term clinical follow-up. The 140kVp polychromatic images and 11 sets of virtual monochromatic spectral images (40-140keV) for spectral CT in the plain (P), arterial phase (A) and venous phase (V) were evaluated. Regions of interest (ROI) were placed on the osteoblastic metastases covering 2/3 of the lesion and avoiding the bone cortex. The attenuation (CT value) of lesions was measured in all phases, and the increase in CT value (IV) was calculated as [IVAP=CTA-CTP; IVVP=CTV-CTP]. Independent sample t-test was used to compare the attenuation values of polychromatic and monochromatic spectral images. Receiver operator characteristic analysis was performed to compare the area under curve (AUC) for the differentiation of OBMs in patients with breast cancer and lung cancer.

RESULTS

65 OBMs (lung cancer: 38, breast cancer: 27) were confirmed. The CT value (CTP(140kVp), CTA(140kVp) and CTV(140kVp)) and enhancement (IVAP(140kVp) and IVVP(140kVp)) from the conventional 140kVp imaging did not show any significant difference between the two types of OBM, neither did the CT values from VMS images (p > 0.05). However, the enhancement value in venous phase (IVVP) from all monochromatic levels (40-140keV) showed significant difference between the two types of OBM (all p<0.05). Using 14.99HU as a threshold value for IVVP(110 keV), we obtained an AUC of 0.793 for differentiating OBMs from lung cancer(4.81± 17.40 HU) and breast cancer(35.32±46.10 HU), with a sensitivity of 0.778 and a specificity of 0.763.

CONCLUSION

Virtual monochromatic spectral imaging is superior to 140kVp images for the differentiation of OBMs from lung cancer and breast cancer.

CLINICAL RELEVANCE/APPLICATION

Dual-energy spectral CT can be used to help determine the primary source of bone metastasis.

SSA15-07 MRI and PET-CT Imaging Features of MPNST, Borderline and Benign Neurofibromas: Is it Possible to Anticipate Malignant Transformation?

Sunday, Nov. 26 11:45AM - 11:55AM Room: S406B

Awards
Student Travel Stipend Award

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PURPOSE

-To describe which imaging features are characteristic of benign neurofibromas (BPNST) and which of Malignant Peripheral Nerve Sheath Tumors (MPNST) in patients with and without neurofibromatosis (NF) -To determine which MRI and PET-CT features are characteristic of borderline neurofibromas in NF -To determine if after the first malignant transformation, there is an increased frequency of malignant transformation in other neurofibromas. -To compare imaging features of BPNST and MPNST in patients with and without NF

METHOD AND MATERIALS

This is a retrospective study including patients with pathologically confirmed BPNST or MPNST between 2009 and 2016 who also had an MRI and/or PET-CT done before surgery. Patients characteristics: 60 tumors from 41 patients were included in our study, 19 males and 22 females. 26 patients had a genetically confirmed Neurofibromatosis and 15 patients did not have NF. Among these 60 tumors, 36 were considered BPNST and 24 MPNST. This data could be further divided into patients with and without NF. Imaging characteristics: An MRI previous to the diagnosis was available in all cases. More than one MRI was available in 23 tumors. PET-CT was performed in 20 tumors. MRI assessment: MRIs were reviewed retrospectively by 2 radiologists for the study of: Location, size, cystic/necrotic content, hemorrhage, margins, neighbouring structures, T1/T2 heterogenicity, T1/T2 signal, split-fat/target sign, DWI, ADC, enhancement pattern and edema. Pathology: All the tumors were included in Tissue arrays with a subgroup of 30 potential biomarkers selected.

RESULTS

-Significant differences between MPNST and neurofibromas were found in size, enhancement, perilesional edema, and necrotic areas. Borderline neurofibromas seem to share some of these imaging features, this could help radiologists to differentiate them from other BPNST. -PET-CT is a highly sensitive and specific for the diagnosis of MPNST (SUVmax range=3.77-6.35; mean SUVmax values=5.09). -The first malignant transformation increases the likelihood of degeneration within other neurofibromas.

CONCLUSION

MRI and PET-CT could help to differentiate neurofibromas,borderline neurofibromas and MPNST in NF patients.

CLINICAL RELEVANCE/APPLICATION

This scientific presentation could help radiologists to foresee which tumors will degenerate to MPNST as well as it could help NF patients to avoid multiple surgeries and aggressive treatments

SSA15-08 Retrospective Comparison of MRI Characteristics Distinguishing Lipomas and Well-differentiated Liposarcomas With and Without MDM2 or CDK4 Oncogene Amplification Testing

Sunday, Nov. 26 11:55AM - 12:05PM Room: S406B

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To analyze the MRI characteristics that distinguish lipomas from well-differentiated liposarcomas (WDL). Additionally, to compare the MRI characteristics between lipomas tested or not tested for MDM2 or CDK4 oncogene amplification and WDL tested or not tested for MDM2 or CDK4 oncogene amplification.

METHOD AND MATERIALS

A IRB-approved retrospective review of 115 patients with histologically proven lipomatous tumors was performed. Patients were grouped into lipomas and WDL based on histology, with or without oncogene testing. All patients underwent MRI imaging evaluating for size, location, percentage similar to host adipose tissue, thin or thick septations, nodularity, and enhancement. The associations between these features and tumor diagnoses were analyzed. Additionally, the associations between these features and oncogene testing between subgroups was explored. $P < .05$ was considered to indicate a statistically significant difference.

RESULTS

Of the 115 patients, 57 were classified as lipomas and 58 as WDL. Of the 57 lipomas, 24 had MDM2/CDK4 testing performed (negative). Of the 58 WDL, 28 had oncogene testing (positive). The mean age for the group with lipomas was 50 +/- 20 years and 60 +/- 14 years for the group with WDL (p=0.002). 46% of the group with lipomas was male and 52% for the group with WDL. The WDL group was more likely have a mass of larger size (p<0.001) and in a location other than the lower extremity (p=0.004) when compared to the lipoma group. There were no other statistically significant differences in the other imaging features. In the lipoma sub-group, lipomas tested for oncogene amplification were more likely to be larger (p<0.001) and demonstrate enhancement (p=0.03) when compared with lipomas not tested. The comparison between WDL tested for oncogene amplification and those not tested did not demonstrate statistically significant MRI characteristics.

CONCLUSION

While some of the imaging features of lipomas and WDL overlap, the WDL group was more likely to be of larger size and in a location other than the lower extremity. Additionally, negative oncogene testing has possibly increased the number of larger and/or enhancing lipomatous tumors that are characterized as lipomas.

CLINICAL RELEVANCE/APPLICATION

It is challenging to definitively characterize lipomatous tumors based on imaging. The use of oncogene testing for lipomatous tumors has altered imaging features associated with lipomas versus WDLs.

SSA15-09 CT Temporal Subtraction Method for Detection of Sclerotic Bone Metastasis in the Thoracolumbar Spine: JAFROC Observer Study

Sunday, Nov. 26 12:05PM - 12:15PM Room: S406B

Participants
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PURPOSE

Although CT is a routine imaging modality to survey many types of cancer, bone metastases are often missed at CT because of their subtle findings. We have developed a new temporal subtraction (TS) method in order to significantly reduce misregistration artifacts on the subtraction images in successive thoracic CTs, and have shown that TS can improve the diagnostic accuracy of lung nodules. However, the performance of TS for the detection of the bone metastasis has not been clarified. The purpose of this study is to assess the effectiveness of a CT-TS methods for radiologist's performance in sclerotic metastasis detection in the thoracolumbar spine.

METHOD AND MATERIALS

Twenty pairs of standard-dose 1mm-thick CT and their TS images in patients with sclerotic bone metastasis and 20 pairs of those in patients without bone metastasis were used for an observer performance study. A total of 137 lesions were identified as the reference standard of actionable lesions (sclerotic metastasis newly appeared or increased in size) by two musculoskeletal radiologists. Eight radiologists (four attending radiologists and four radiology residents) participated in this observer study. Ratings and locations of "lesions" determined by the observers were utilized for assessing the statistical significance of differences between radiologists' performances without and with the CT-TS images in JAFROC analysis. The statistical significance of differences in the reviewing time was determined by use of a two-tailed paired Student's t test.

RESULTS

The average figure-of-merit (FOM) values for all radiologists increased to a statistically significant degree, from 0.856 without the CT-TS images to 0.884 with the images (P=.037). The average sensitivity for detecting the actionable lesions was improved from 60.7 % to 72.5 % at a false-positive rate of 0.15 per case by use of the CT-TS images. The average reading time with CT-TS images was significantly shorter than that without (150.6 seconds vs. 166.5 seconds, P=.004).

CONCLUSION

The use of CT-TS would improve the observer performance for the detection of the sclerotic bone metastasis in the thoracolumbar spine.

CLINICAL RELEVANCE/APPLICATION

A CT temporal subtraction method can sufficiently assist not only the radiologists' diagnostic accuracy but also their interpretation time for the detection of sclerotic bone metastasis in the thoracolumbar spine.

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SSA17

Neuroradiology (Brain Tumors: Beyond the Frontier)

Sunday, Nov. 26 10:45AM - 12:15PM Room: N228

MR NR

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

FDA Discussions may include off-label uses.

Participants
Shinji Naganawa, MD, Nagoya, Japan (*Moderator*) Nothing to Disclose
Christopher T. Whitlow, MD, PhD, Winston-Salem, NC (*Moderator*) Nothing to Disclose

Sub-Events

SSA17-01 Non-invasive Prediction of Isocitrate Dehydrogenase (IDH) Genotype in Grade-II Gliomas with Amide Proton Transfer-Weighted (APTw) MR Imaging

Sunday, Nov. 26 10:45AM - 10:55AM Room: N228

Participants
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PURPOSE

Mutations in isocitrate dehydrogenase (IDH) genes are associated with favorable prognosis in patients with gliomas. Compared to oncogenic HRAS IDH1-wild type glioma cells, global downregulation of protein expression in mutant IDH1-driven glioma cells was found. Amide proton transfer-weighted (APTw) imaging is a molecular technique that gives contrast based in large part on endogenous cytosolic proteins and peptides. This study is to test the hypothesis that APTw signal is a surrogate imaging maker for identifying IDH mutation status preoperatively.

METHOD AND MATERIALS

Patients with suspected low-grade glioma were scanned at 3T clinical MRI scanner. APTW images were calculated using MTRasym(3.5ppm). Operative tissue samples were processed IDH1-R132H evaluation, which was performed by IHC and DNA sequencing, as described previously. Quantitative APTw parameters obtained from multi-ROI-based (maximum and minimum) and whole-tumor histogram-based (mean, variance, skewness, kurtosis, slop, 10th percentile, 50th percentile, 90th percentile, and peak) APTw metrics were compared between IDH-mutant and IDH-wildtype groups. Mann-Whitney test was used to evaluate the difference of APTw parameters between two glioma groups, and the receiver-operator-characteristic (ROC) analysis was used to assess the APTw diagnostic performance.

RESULTS

27 patients fulfilled eligibility criteria were recruited. Seven cases were diagnosed as IDH-wildtype grade-II gliomas, and 20 cases as IDH-mutant grade-II gliomas. The maximum and minimum APTw values based on multiple regions of interest, as well as the whole-tumor histogram-based mean and 50th percentile APTw values were significantly higher in the IDH-wildtype gliomas than in the IDH-mutant groups, corresponding to the areas under the ROC curves of 0.80, 0.91, 0.75, and 0.75 respectively, in predicting the IDH mutation status.

CONCLUSION

IDH-wildtype lesions were associated with relatively high APTw signal intensities, compared with IDH-mutant lesions. APTw imaging has the potential for discriminating IDH genotypes in grade-II gliomas non-invasively.

CLINICAL RELEVANCE/APPLICATION

The APTw signal could be a valuable imaging biomarker by which to identify IDH1 mutation status in grade-II gliomas without surgery, which could provide supplementary information about the diagnosis.

SSA17-02 MGMT Promoter Methylation Assessment of Glioblastoma Using Three-Dimensional Texture Features

of Multimodal MRI

Sunday, Nov. 26 10:55AM - 11:05AM Room: N228

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PURPOSE

O6-methylguanine methyl transferase (MGMT) gene promoter status are significant for treatment strategy and prognosis prediction of patients with glioblastoma(GBM). We aimed to verify that texture features derived from multimodal magnetic resonance images (MRI) may be potential for noninvasive and well-repeatable detection of MGMT promoter methylation status.

METHOD AND MATERIALS

Total 73 patients with GBM were enrolled (35 and 38 with and without MGMT promoter methylation, respectively). For each patient, volumes of interest (VOIs) were delineated on ten MRI modalities or parametric maps. Three-dimensional (3D) grey-level co-occurrence and curvature co-occurrence matrix (GLCM and GLGCM) textural features were extracted from each VOIs. Then the support vector machine (SVM) based feature selection and classification strategies were proposed to firstly obtain an optimal feature subset and then verify and improve its capacity to identify whether the patient was with MGMT promoter methylation or not, corresponding receiver operating characteristic (ROC) curve were depicted.

RESULTS

Total 420 3D GLCM and GLGCM features were extracted from ten MRI modalities/parametric maps for each of the 73 patients. After feature selection, 23 features were determined as the optimal feature subset, and the accuracy, sensitivity, specificity and area under ROC curve for identifying MGMT promoter methylation reached to 82.19%, 83.78%, 80.56% and 0.9204, respectively. In optimal subset, features derived from structure and perfusion modalities contributed more in detecting MGMT promoter methylation of GBM, comparing with those derived from diffusion modalities.

CONCLUSION

In this study, an optimal subset of 23 features was selected and its classification performance indicated that they may be a potential imaging biomarkers for predicting MGMT promoter methylation status.

CLINICAL RELEVANCE/APPLICATION

1. For patients with glioblastoma, MGMT promoter status assessment is crucial because MGMT methylation is associated with better prognosis and chemotherapy response. 2. The proposed radiomics approach based on multimodal MRI has the potential to accurately assess the MGMT promoter status before clinical intervention. 3. Texture features derived from structure and perfusion modalities contributed more to MGMT promoter methylation detection of patients with glioblastoma, comparing with those derived from diffusion modalities

SSA17-03 Texture Analysis of Quantitative Apparent Diffusion Coefficient Maps to Differentiate Between High-Grade Gliomas and Metastatic Brain Tumor

Sunday, Nov. 26 11:05AM - 11:15AM Room: N228

Awards
Student Travel Stipend Award

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PURPOSE

To evaluate the diagnostic value of texture parameters of Apparent Diffusion Coefficient(ADC) maps to differentiate between High-grade gliomas(HGG) and brain metastasis(METS)

METHOD AND MATERIALS

The ADC maps of the Diffusion Weighted Images of 82 patients of which 50 were pathologically confirmed with HGG and 32 with METS were recorded using ADW 4.6 workstation Functool2 software. Using Omnikinetics Software,3D merged Region Of Interests images of intratumoral and peritumoral regions were delineated. The texture parameters namely First order parameters including MIN, MAX, MI , skewness, kurtosis, MD, RD, VVS, RMS, uniformity, VC; Grey-level co-occurence matrix parameters inlcuding energy, entropy, correlation, IDM, CP and Grey-level run length maxia parameters including GLN, RLN , LGLRE, HGLRE, SRLGLE, SRHGLE, LRLGLE and LRHGLE were reported. Shapiro-Wilk test for normality and independent sample t-test (parametric) and Mann-Whitney u test(non-parametric) were carried out for statistical analysis(spss 20.0). Logistic regression tests were used to evaluate

independent risk factors. ROC curve tests were performed to calculate AUC, cut-off values, sensitivity and specificity.

RESULTS

1) VC (p=0.009), VVS (p=0.013), RMS(p=0.000), RD (p=0.042), correlation(p=0.016), energy(p=0.000), Entropy(p=0.000), GLN (p=0.009), RLN (p=0.005), LGLRE (p=0.023), SRLGLE (p=0.030), LRLGLE (p=0.000) and LRHGLE (p=0.000) between HGG and METS are statistically significant. 2) Mean±S.D. values of MIN, MAX, MI, MD, skewness, Kurtosis, VC, RMS, uniformity, RD, entropy, correlation, IDM, CP, GLN, RLN, HGLE, SRHGLE and LRHGLE of HGG are higher than METS. 3) Logistic regression tests suggest VC(p=0.009), VVS(p=0.010), RMS(p=0.000), GLN(p=0.010)and RLN(p=0.005) to contribute significantly to accurate prediction as independent risk factors with a joint model prediction accuracy of 93.9%. 4) ROC curve analysis shows AUC=0.955, 0.684, 0.672, 0.671, 0.663, 0.659 & 0.634 and sensitivity = 91.8%, 81.6%, 77.6%, 67.3%, 75.5%, 79.6%& 67.3% for entropy, RLN, VC, GLN, VVS, correlation & RD respectively.

CONCLUSION

Texture analysis parameters of quantitative ADC maps based on entire tumor serves as good differentiating diagnostic indices of HGG and METS.

CLINICAL RELEVANCE/APPLICATION

Whole Tumor ADC map differentiation of HGG and METS (appear similar on CT/MR imaging but follow different treatment protocols) using texture analysis can improve treatment and therapeutic response.

SSA17-04 Detection of 2-Hydroxyglutarate Using Spectral Editing MRS in Patients with IDH Mutant Gliomas

Sunday, Nov. 26 11:15AM - 11:25AM Room: N228

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PURPOSE

To assess the diagnostic accuracy of in vivo MRS for the detection of the tumor specific imaging marker D-2-hydroxyglutarate (2-HG) produced by IDH mutant gliomas.

METHOD AND MATERIALS

We prospectively enrolled 14 preoperative patients with grade II or III diffuse gliomas. Each patient underwent an MR examination which included a spectral editing MRS (MEGA-PRESS) to edit the 2-HG Ha resonance at 4.02 ppm, dynamic contrast-enhanced (DCE) imaging and multi-b value diffusion-weighted imaging on a 3T MR scanner. Automatic shimming was performed using the vendor's pre-scan shimming routines. Parameters for the MEGA-PRESS sequence were: TR=2000ms, TE=60ms, 64 acquisitions, voxel size=8 cm3, duration=4.5min. The 2HG Ha resonance of the substracted MEGA-PRESS spectra was analyzed using jMRUI v5.2. Plasma volume (Vp) and volume transfer constant (Ktrans) were calculated from DCE-imaging. Apparent diffusion coefficient (ADC) values were obtained from diffusion-weighted imaging. A radiologist blinded to the IDH status placed multiple small region-of-interests on the Vp, Ktrans and ADC maps. The maximum Vp/Ktrans and the minimum ADC values were kept for each patient ("hot spot analysis"). Following the biospy or surgical resection, a neuropathologist determined the grade and type of glioma using the 2016 WHO classification. IDH mutation status was identified via immunohistochemical detection of IDH1 R132H.

RESULTS

Of the 14 patients, there were 7 with grade III anaplastic astrocytomas, 4 with grade III anaplastic oliodendrogliomas, 2 with grade II astrocytomas and 1 patient with grade II oligodendroglioma. Ten patients harbored the IDH mutations and 4 patients were IDH wild-type. For the detection of 2-HG, MRS had a 40% sensitivity, 100% specificity, 100% postitive predictive value and 40% negative predicitve value. From the hot-spot analysis, there was no significant difference between Vp, Ktrans and ADC values between IDH mutant and wild-type gliomas (P=0.88, P=0.06 and P=0.78 respectively).

CONCLUSION

Spectral eding MRS can detect 2-HG in patients with IDH mutant gliomas with high specificity. In the future, the sensitivity of this technique may be improved by using a larger voxel size, increasing the number of acquisitions or performing manual shimming.

CLINICAL RELEVANCE/APPLICATION

Spectral editing MRS can be used to preoperatively detect IDH mutant positive status in patients presenting with a newly suspected glioma.

SSA17-05 Non-Invasively Detecting Isocitrate Dehydrogenase 1(IDH1) Mutation Using Non-Gaussian Diffusion MR Imaging in Lower-Grade Gliomas: Primary Results

Sunday, Nov. 26 11:25AM - 11:35AM Room: N228

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PURPOSE

To explore the feasibility of non-invasively detecting the status of isocitrate dehydrogenase 1 (IDH1) mutation using non-Gaussian diffusion MR imaging in lower-grade gliomas (LGG) including grade2and grade 3.

METHOD AND MATERIALS

Ninety cases with pathologically confirmed lower-grade glioma (WHO grade2:n=64;WHO grade 3:n=26) were enrolled in this prospective study, who performed the uniformed imaging protocol of T1WI, T2WI, T2-Flair , DWI with 2 b values (0, 1000 s/mm2) and 22 b values (<=5000 s/mm2), and contrast-enhanced T1WI (CE-T1WI),respectively. Based on the results of the immunohistologic chemistry staining, the IDH1 status was divided into two groups of mutated-type (IDH1mut) and wild-type (IDH1wild) for each grade. In tumor regions, ADC (apparent diffusion coefficient) and stretched exponential-derived intravoxel heterogeneity index a were extracted to make comparisons between two groups of IDH1mut and IDH1wild for each grade. ROC curve analyses were used to compare the capability of differentiating gliomas of IDH1mut from IDH1wild.

RESULTS

64 grade2gliomas were divided into two groups of IDH1mut (n=41) and IDH1wild (n=23), and 26 grade 3 gliomas were divided into two groups of IDH1mut (n=8) and IDH1wild (n=18). In grade2gliomas, there were significantly increased values of ADC (mm2/s) and a for groups of IDH1mut than IDH1wild (ADC: [1.33±0.322] vs. [1.09±0.232] for IDH1mut (t=3.316, P=0.003) ;a: [0.87±0.054] vs. [0.82±0.050] for IDH1wild (t=3.788, P=0.000). In grade 3, the value of a significantly increased for groups of IDH1mut than IDH1wild (a:[0.83±0.042] for IDH1mut vs. [0.77±0.051] for IDH1wild with P value of 0.008) and no significant difference was shown for ADC ([1.04±0.313] for IDH1mut vs. [0.95±0.154] for IDH1wild with P value of 0.476. ROC analyses showed diagnostic ability of IDHmut for in both grades of gliomas and ADC had the diagnostic ability of IDHmut in grade2gliomas.

CONCLUSION

Non-Gaussian-derived parameter a may identify the status of IDH1 mutation in LGGs with better performance than ADC. In LGG, the water molecules behave more inhomogeneously in groups of IDH1wild than IDH1mut.

CLINICAL RELEVANCE/APPLICATION

The patients with IDH-mutated gliomas can survive much longer than those with IDH non-mutated. Especially for those patients who want conservative treatment and refuse biopsy, they can benefit a lot from non-invasive integrative diagnosis.

SSA17-06 In Vivo Characterization of Macrophages in Adult High Grade Gliomas Using Ferumoxytol-Enhanced MRI

Sunday, Nov. 26 11:35AM - 11:45AM Room: N228

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PURPOSE

Macrophages are a key component of tumor-associated inflammation and play a significant role in angiogenesis, progression, and metastasis as well as in tumor response to therapy. Ferumoxytol-enhanced MRI (feMRI) has been widely used for macrophage imaging in preclinical studies but not in the clinical neuro-oncology setting. The purpose of our study is to establish feMRI as a noninvasive imaging biomarker of macrophages in adults with high grade gliomas (HGGs).

METHOD AND MATERIALS

In this IRB-approved prospective pilot study at an academic institution, adults with newly diagnosed and recurrent HGGs were enrolled. Each patient had an intravenous ferumoxytol infusion (5 mg/kg) and a subsequent MRI (including QSM and R2* maps) performed at least 16 hours later. Two different sites were chosen within each tumor on feMRI for intraoperative sampling. Each sample acquired was stained with a mix of Prussian Blue, CD68, CD163, and GFAP to determine the location of iron and number of iron-containing macrophages per 20 hpf. Using saved images from surgery and Osirix software, ROIs were reproduced at the sampled sites and in the corpus callosum (to normalize the values for each patient) on QSM and R2* maps. Pearson correlation coefficient/regression analysis was used to determine the relationship between QSM and R2* values and number of iron-containing macrophages present.

RESULTS

8 patients (mean age: 58.6 years, range 32-74 years, 5:3 females:males) with HGGs (5 glioblastomas, 1 gliosarcoma, 1 anaplastic astrocytoma, and 1 anaplastic oligodendroglioma) were included in the analysis. On histopathology across all patients, iron particles were only found in CD68+/CD163+ macrophages; none were found elsewhere including GFAP+ glial/astrocytic cells. There were strong, positive correlations that were statistically significant between both the normalized susceptibility (QSM) and R2* values and the number of iron-containing macrophages (r=0.73, p=0.002, for both analyses).

CONCLUSION

Ferumoxytol-enhanced MRI can be used to detect and quantify macrophages in high grade gliomas, with increasing QSM and R2* values strongly correlating with increasing number of iron-containing macrophages.

CLINICAL RELEVANCE/APPLICATION

Ferumoxytol-enhanced MRI with QSM and R2* correlates well with iron-containing macrophages in brain tumors, and this tool can be used as a noninvasive imaging biomarker of tumor-related inflammation.

SSA17-07 Quantitative Study Noninvasively Prediction of Glioma IDH1 Gene Status by APT Combined with ASL Imaging

Sunday, Nov. 26 11:45AM - 11:55AM Room: N228

Participants
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PURPOSE

The purpose of this part was to explore whether amide proton transfer (APT) and arterial spin labeling imaging (ASL) helped to noninvasively detect isocitrate dehydrogenase 1 (IDH1) gene status in glioma.

METHOD AND MATERIALS

Patients who suspected glioblastoma underwent APT and ASL examination from December 1, 2014 to October 31, 2016, were prospectively collected. MTRasym (3.5 ppm) values (APT values) and CBF values were measured in the tumor parenchyma region. As the lesional CBF value normalized by contralateral cerebellar hemisphere, the normalized CBF was calculated according to the formula nCBF = CBF tumor / CBF cerebellum. All of the patients had the pathological diagnosis and anti-IDH1 R132H antibody immunohistochemical results. The differences between wild type and mutant IDH1 were analyzed by independent sample t test. The receiver operating characteristic curve (ROC) is used to describe the discriminant image parameters. Calculate the cutting value and sensitivity, specificity.logistics regression analysis combined with the effective parameters of APT and ASL to calculate the overall correct prediction rate.

RESULTS

There were 90 patients with both APT and ASL data. In low-grade glioblastoma, the APT and nCBF values of wild-type IDH1 gene were higher than those of IDH1 mutant group ($p = 0.027$, $p<0.001$). The area under the ROC curve were 0.802, 0.844, when the cutoff was APT = 1.35 (%) and nCBF = 1.74, the sensitivity was 97%, 81.80%, the Specificity was 60.2% and 62.2%. In the high-grade glioma group, the APT and CBF values of IDH1 gene-type glioma were higher than those of IDH1 mutant. The difference was statistically significant ($p = 0.004$, $p = 0.005$); The area under the ROC curve was 0.695 and 0.712, respectively. When the cut value was APT = 3.24 (%), the sensitivity and specificity were 67.4% and 72.2%, respectively. In low-grade glioblastoma, Logistics regression combined with APT values and nCBF values to obtain the overall correct prediction rate is 78.7%; High grade glioma group, combined APT value and CBF value to obtain the overall correct prediction rate is 86.8%.

CONCLUSION

APT and ASL provide a valuable new method for the noninvasive diagnosis of the IDH1 gene state of brain glioma, and the combination of APT and ASL can improve the overall prediction rate of glioma IDH1 gene.

CLINICAL RELEVANCE/APPLICATION

no

SSA17-08 Establishing the Optimal Volumetric Threshold for Determining Progressive Disease in Patients with Recurrent Glioblastoma

Sunday, Nov. 26 11:55AM - 12:05PM Room: N228

Awards
Student Travel Stipend Award

Participants
Renske Gahrmann, MD, Rotterdam, Netherlands (*Presenter*) Nothing to Disclose
Martin van den Bent, Rotterdam, Netherlands (*Abstract Co-Author*) Research support, F. Hoffmann-La Roche Ltd Speaker, F. Hoffmann-La Roche Ltd
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PURPOSE

Response to treatment in glioblastoma (GBM) is currently measured in 2D. Volumetric methods are potentially more reliable and accurate for assessing progressive disease (PD), but the optimal threshold for assessment for progression has not been established. We investigated the influence of using different thresholds for determining PD for both enhancing and non-enhancing (FLAIR) lesions to predict overall survival (OS) in recurrent GBM.

METHOD AND MATERIALS

Patients were recruited from a phase II-trial (n=148) in which treatment with lomustine and/or bevacizumab was given in first recurrent GBM. Total volume of enhancing and FLAIR lesions was measured separately using Brainlab semi-automated software. Percentage change in volume from baseline to first and second follow-up (6 and 12 weeks) was calculated. The effect of new lesions and of using different thresholds (10-40%) for determining PD was determined with cox regression analyses.

RESULTS

Due to missing MRI-data (3D T1w post-contrast and/or FLAIR-images), a varying number of patients were excluded from the analyses at 6 and 12 weeks (table). Patients with a new lesion at first follow-up (n=12) had significantly worse OS: hazard ratio (HR)=7.63, p<.001. These patients were further not included in the volumetric threshold analyses. At first follow-up, the highest HR was found using 20% increase as a threshold: HR=1.68 (p=.033) for enhancing (n=111) and HR=2.26 (p=.004) for FLAIR lesions (n=90). The presence of a second follow-up scan was associated with significantly improved OS (n=148): HR=3.23, p<.001. At second follow-up, HRs were somewhat higher than at first follow-up, both compared with baseline: HR=1.98 (p=.003) for enhancing (n=109) and HR=2.624 (p<.001) for FLAIR (n=92) lesions.

CONCLUSION

A 20% increase in enhancing or FLAIR volume best predicts OS at 6 weeks follow-up. When change in volume is measured at 12 weeks follow-up, predictions of OS improved, with lower thresholds (10-15%) showing the best results. A 3-month endpoint could therefore be considered in phase II studies on recurrent glioblastoma.

CLINICAL RELEVANCE/APPLICATION

Volumetric tumor measures in glioblastoma could increase accuracy over the current 2D assessment. We investigate the optimum volumetric threshold for determining progressive disease.

SSA17-09 Diffusion Weighted Imaging of Intracranial Hemangiopericytomas

Sunday, Nov. 26 12:05PM - 12:15PM Room: N228

Awards
Student Travel Stipend Award

Participants
Alex El-Ali, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
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PURPOSE

Intracranial Hemangiopericytomas (IHP) are aggressive dural based tumors which are difficult to differentiate from more benign meningiomas. Herein we present the largest series of IHPs to date focusing on MR imaging characteristics to differentiate these tumors from meningiomas.

METHOD AND MATERIALS

Multicenter retrospective review of institutional pathology databases/PACS for cases of IHP (WHO Grade II and III) and meningiomas (WHO Grade I and WHO grade II) from 2005-2016 was performed. Patients without relevant pre-operative MR imaging (T1, T2, DWI and post-contrast T1) were excluded. Imaging evaluation consisted of volumetric analysis, ADC value assessment on diffusion-weighted sequences, and qualitative imaging assessment (T1, T2 and contrast enhancement and presence of flow voids). ADC values were assessed using ROIs (100mm diameter) in the most homogeneous portions of the tumors. ADC values of normal appearing contralateral white matter were used to calculate the ADC-tumor/ADC-white matter ratio. Groups were compared using an unpaired two-tailed student's t-test and one way ANOVA.

RESULTS

Of the 26 patients identified with histologically confirmed IHP, 21 had relevant pre-operative MR imaging for review (14 WHO Grade II, 7 WHO Grade III) and comprised the study population. 48 patients with histologically confirmed WHO Grade I (25) and WHO Grade II (23) meningiomas had relevant pre-operative MR imaging for review and comprised the control population. The study population was 63% male (avg age, 53, range: 22-78) and control population was 52% male (avg age, 55, 20-69). Most IHPs demonstrated flow voids (71%), an uncommon finding in meningiomas (4%) (p<0.01). 57% of IHP tumors demonstrated significantly elevated (ADC-tumor/ADC-normal WM >1.1) ADC ratios. Average ADC-tumor/ADC-WM ratio was 1.26 for IHPs compared to 1.09 for meningiomas (p=0.08). A significant difference between IHPs (ratio:1.26) and WHO Grade I Meningiomas (ratio:1.05) was apparent (p=0.04).

CONCLUSION

This series is the largest to date evaluating the MR imaging characteristics of IHPs. Our findings suggest that IHPs demonstrate

This series is the largest to date evaluating the MR imaging characteristics of IHPs. Our findings suggest that IHPs demonstrate increased diffusivity relative to meningiomas (p=0.08) . The difference is most pronounced between IHPs and WHO grade I meningiomas (p=0.04).

CLINICAL RELEVANCE/APPLICATION

DWI may be a useful diagnostic tool for the radiologist to suggest the diagnosis of intracranial hemangiopericytoma on preoperative MR imaging.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
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SSA19

Neuroradiology (Dots and Dashes: Image Analysis in Neuroradiology)

Sunday, Nov. 26 10:45AM - 12:15PM Room: N230B

MR NR

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

FDA Discussions may include off-label uses.

Participants
Aaron S. Field, MD, PhD, Madison, WI (*Moderator*) Research Grant, General Electric Company
Max Wintermark, MD, Lausanne, Switzerland (*Moderator*) Advisory Board, General Electric Company;

Sub-Events

SSA19-01 Enhancing the T1-weighted Template: Tissue Probability Maps and Gray Matter Labels of the IIT Human Brain Atlas

Sunday, Nov. 26 10:45AM - 10:55AM Room: N230B

Participants
Xiaoxiao Qi, BS,BEng, Chicago, IL (*Presenter*) Nothing to Disclose
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PURPOSE

The IIT Human Brain Atlas contains anatomical, DTI, HARDI templates, probabilistic gray matter (GM) labels, probabilistic connectivity-based white matter (WM) labels, and major fiber-bundles of the young adult human brain. The purpose of this work was to enhance the quality of the T1-weighted template, tissue probability maps, and GM labels of the IIT Human Brain Atlas.

METHOD AND MATERIALS

The same T1-weighted data from the 72 healthy volunteers included in the previous version of the IIT Human Brain Atlas (v.4.1) were used in the construction of the new resources. The T1-weighted image-volume of each participant was transformed from native space to the space of the existing T1-weighted template. Then, the volumes were normalized following two constraints, one for the intensity, and one for the transformation. The spatial transformations generated above were combined to a single transformation, which was then applied to the corresponding data for each participant: raw T1-weighted data, raw segmented tissue masks (GM, WM, and CSF), and raw segmented labels (90 cortical and subcortical regions). Next, the T1-weighted data from all participants were averaged to generate the new T1-weighted template. New tissue probability maps, probability maps for each label and a confidence index map for the GM labeling were also generated and compared to those of the existing atlas.

RESULTS

The new T1-weighted template is of higher sharpness (according to the high spatial frequency content), and has lower noise than the existing template. The new tissue probability maps exhibit better definition of GM, WM, and CSF than the existing ones. The new GM labels show greater confidence in GM labeling.

CONCLUSION

In this work, the T1-weighted template, tissue probability maps and GM labels of the IIT Human Brain Atlas were substantially enhanced. The IIT Human Brain Atlas with its comprehensive set of resources located in the same space, are expected to increase the accuracy of multi-modal studies, as well as conventional investigations on brain macrostructure.

CLINICAL RELEVANCE/APPLICATION

The enhanced IIT Human Brain Atlas is expected to increase the accuracy of multi-modal MRI studies.

SSA19-02 Synthetic Contrast Enhancement Map Using Post-Contrast MR Quantification Only

Sunday, Nov. 26 10:55AM - 11:05AM Room: N230B

Participants
Marcel Warntjes, Linkoping, Sweden (*Presenter*) Employee, SyntheticMR AB
Anders Tisell, Linkoping, Sweden (*Abstract Co-Author*) Nothing to Disclose
Ida Blystad, MD, Linkoping, Sweden (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Administration of Gadolinium contrast medium is an important diagnostic tool to detect blood-brain-barrier damage. In clinical practice the use of GD, however, is time-consuming because both a native and post-contrast image must be acquired. It is possible to omit the native image, but this reduces diagnostic confidence, especially for anatomically complex areas. For quantification of GD-enhancement image registration is challenging. The purpose of this study was to investigate the possibility to synthesize a GD-enhancement map solely from the post-GD image, using quantitative MRI.

METHOD AND MATERIALS

In brain parenchyma there is a relation between proton density PD and the longitudinal R1 relaxation rate. For every 1% decrease of PD signal, the R1 increases with 0.03 s-1 (3T). This relation is affected when GD contrast media is present in the tissue, since R1 increases, while PD remain the same. A simultaneous measurement of post-GD PD and R1 therefore provides means of calculating the difference in R1 due to GD compared to the expected native R1 based on the PD values. For 10 patients with malignant glioma grade 4, MR quantification was performed both before and after contrast administration. The acquisition was a MAGiC sequence on a GE 750 3T system with a scan time of 6 minutes. Post-processing was performed using SyMRI 8.0 (SyntheticMR, Sweden). The two image stacks were registered using in-plane transformation. The R1 maps were subtracted to obtain the true GD-enhancement map. This was correlated with the synthetic GD-enhancement map, created using the post-GD R1 and PD maps only.

RESULTS

Linear regression of the true and synthetic GD-enhancement map for the 10 subjects showed a mean slope of 1.15±0.21 and mean intercept of 0.02±0.14. The Pearson correlation coefficient was 0.856±0.05.

CONCLUSION

The study shows that it is possible to synthesize a GD-enhancement map based on a post-GD MR quantification sequence only.

CLINICAL RELEVANCE/APPLICATION

A GD-enhancement map based on a post-GD acquisition only may permit omission of a native T1W, resulting in a substantial time saving. Without time pressure for GD uptake, it may even lead to lower GD doses.

SSA19-03 Correlation of Quantitative Analysis on Three-Dimensional Fluid-Attenuated Inversion Recovery (3D-FLAIR) and Contrast-Enhanced FLAIR with Auditory Test in Meniere's Disease

Sunday, Nov. 26 11:05AM - 11:15AM Room: N230B

Participants
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Dae Young Yoon, MD, Kangdong-Gu, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

This study was aimed to assess the prognostic value of quantitative analyses of cochlear signal intensity(SI) using Three-Dimensional Fluid-Attenuated Inversion Recovery (3D-FLAIR) MRI and Contrast-Enhanced (CE)- FLAIR MRI, and designed to correlate cochlear ROI with degree of hearing decrease in patients with Meniere's disease.

METHOD AND MATERIALS

132 patients underwent 3 Tesla (3T) MRI of the temporal area for MD over 3-year period. 3D-FLAIR sequence imaging and CE-FLAIR were included on temporal MRI. Signal intensity was measured by drawing region of interest (ROI) in membranous labyrinth of cochlea and quantitatively analyzed. Measured cochlear signal intensity was compared with available clinical findings, speech audiometry and pure tone audiometry test (PTA). Patients had typical results of auditory testing for Meniere's disease.

RESULTS

There was statistical significance of patient's sex with 3D-FLAIR ($p < .05$) and CE-FLAIR ($p < .01$). Cochlear ROI in symptomatic ear side showed significant statistical significance on both FLAIR and enhanced FLAIR ($p < .0001$). There was statistical significance of increase of cochlear SI on 3D-FLAIR and CE-FLAIR with pretreatment PTA of hearing loss ($P < .0001$). There was no statistical significance between prognosis and cochlear SI of FLAIR and CE-FLAIR. There was no statistical significance of PTA change with contrast enhancement index and contrast enhancement ratio. The optimal cut off value of SI increase on FLAIR was 20.8 (sensitivity, 64%; specificity, 66%; AUC, 72.9) and on enhanced FLAIR was 30.4 (sensitivity, 66%; specificity, 68%; AUC, 72.8) between asymptomatic ear and symptomatic ear.

CONCLUSION

Quantitative analysis of ROI on MR imaging data does not confer a benefit to predict the prognosis of Meniere's disease. However, increased signal intensity and inner ear enhancement of 3D FLAIR are helpful diagnostic markers for Meniere's disease.

CLINICAL RELEVANCE/APPLICATION

Increased cochlear ROI on 3D-FLAIR and enhanced FLAIR MRI provide an ideal diagnostic evidences in the sudden sensory neural hearing loss patients.

SSA19-05 Can MR Textural Analysis Improve Detection of Extracapsular Nodal Spread in Patients with Oral Cavity Cancer: A Feasibility Study

Sunday, Nov. 26 11:25AM - 11:35AM Room: N230B

Awards
Student Travel Stipend Award

Participants
Russell Frood, MBBCh, Leeds, United Kingdom (*Presenter*) Nothing to Disclose
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PURPOSE

To explore the utility of MR texture analysis (MRTA) for detection of extracapsular nodal spread (ECS) in oral cavity squamous cell carcinoma (SCC).

METHOD AND MATERIALS

30 patients with node-positive oral cavity SCC treated surgically in a single center were evaluated. 15/30 (50%) had pathologic evidence of ECS. 2 experienced radiologists independently reviewed baseline MRI blinded to histology. Presence/absence of MR features associated with ECS (flare sign, irregular capsular contour; local infiltration; nodal necrosis) were agreed in consensus. Regions of interest (ROI) encompassing largest nodal cross-sectional area were defined on T2 and post-contrast T1-weighted images. First-order texture parameters (entropy, skewness and kurtosis) were extracted from the ROIs using proprietary software (TexRAD) with fine (2mm), medium (4 mm) and coarse (6 mm) filters. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of MR predictors of ECS were compared with histology as gold standard. MRTA performance in predicting ECS was assessed using paired t-test. Areas under the curve (AUC) calculated by receiver operating characteristics (ROC) analysis and optimal threshold were calculated for texture parameters.

RESULTS

Sensitivity, specificity, PPV and NPV (%) for MR predictors were: flare sign 85.7, 93.3, 85.7, 93.3; irregular capsular contour 53.3, 86.7, 80, 65; local infiltration 26.7, 86.7, 66.7, 54.2; nodal necrosis 73.3, 46.7, 57.9, 63.6. Nodal entropy had a statistically significant correlation with ECS on T2 imaging independent of filtration level, highest with coarse nodal entropy (N6, $p = 0.02$). AUC for entropy N6 was 0.77, sensitivity 73.3%, specificity 80%, PPV 76.7%, NPV 73.3% with a threshold > 6.12.

CONCLUSION

First-order texture parameters (entropy) extracted from T2-weighted MRI may improve ECS prediction in oral cavity SCC.

CLINICAL RELEVANCE/APPLICATION

Extracapsular nodal spread (ECS) is associated with adverse prognosis in oral cavity squamous cell carcinoma and may alter planned treatment. MR texture analysis may increase pre-treatment detection of ECS but requires further validation.

SSA19-06 Multiresolution Texture Processing of T2-weighted MRI May Reveal Lesion Pathology in Multiple Sclerosis

Sunday, Nov. 26 11:35AM - 11:45AM Room: N230B

Participants
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PURPOSE

Focal lesions remain the hallmark pathology of multiple sclerosis (MS), however, MRI lesion burden correlates only modestly to patient disability due to the lack of lesion specificity. We hypothesize that advanced image post-processing techniques can help extract latent lesion pathology from standard MR images.

METHOD AND MATERIALS

1.5:T T2-weighted MR images acquired from 5 postmortem multiple sclerosis patients were post-processed using advanced texture analysis. Histologically proven lesion types were examined by severity: active or chronic active (demyelinated with variable inflammation), versus pre-active (inflammation only) or shadow plaques. A total of 13 lesions and 20 controls were used in a classification experiment, with a subsample of the ventricles included for comparison.Using the polar Stockwell transform, we generated two spectral density maps for each of the 10x256x256 pixels in the data set: one radial and one angular. Borrowing from the chemometrics literature, we used principal component analysis to estimate the dominant textures in the dataset. Anatomical features, control white matter, and MS lesions were hypothesized to be realizations of these textures. Using quadratic discrimination analysis, we categorized regions of interest based on 7 of these dominant textures (99.9% of variance).

RESULTS

Our results indicate that different lesion subtypes show distinct MRI texture (Fig.:1), which also differs from the surrounding tissue. Overall, our method was 88% accurate (212/240) in classifying the pathological severity of tissue types.

CONCLUSION

This pilot study suggests that novel image analysis techniques have the potential to detect the type of lesion pathology concealed in clinical MRI. Lesions with both demyelination and inflammation showed different texture than lesions with either pathology alone.

CLINICAL RELEVANCE/APPLICATION

This new technique can be applied to patient images routinely collected in clinical practice, and has the potential to advance our ability to monitor disease progression and treatment response.

SSA19-07 Radiomics Features of MR Imaging as Prognostic Factors in Locally Advanced Head and Neck Squamous Cell Carcinoma

Sunday, Nov. 26 11:45AM - 11:55AM Room: N230B

Participants
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PURPOSE

Radiomics refers to the comprehensive quantification of tumor phenotypes by applying a large number of quantitative image features. The current study was to identify pre-treatment T2-weighted imaging (T2WI)-based radiomics as prognostic factors in patients with locally advanced head and neck squamous cell carcinoma (HNSCC).

METHOD AND MATERIALS

This study consisted of 119 patients with stage III- IVb HNSCC. A total of 485 radiomics features were extracted. Least absolute shrinkage and selection operator (LASSO) regression model was used for data dimension reduction and feature selection. Association between the radiomics signature and overall survival (OS) was explored. Further validation of the radiomics signature as an independent biomarker was performed by using multivariate Cox regression. Multivariate models were built for overall survival (OS) using only clinical factors, and combined clinical factors and pretreatment radiomics signature. To quantify the incremental value of the radiomics signature to the traditional staging system and other clinical factors, Harrell's C-index was measured.

RESULTS

Clinical factors of sex and AJCC stage were statistically associated with OS of patients, respectively. The radiomics signature, which consisted of 7 selected features, was significantly associated with OS, independent of clinical risk factors ($P<0.001$). Incorporating the radiomics signature with sex and stage resulted in better performance (C-index: 0.70; 95% confidence interval [CI]: 0.63, 0.76) for the prediction of OS than using sex and stage alone (C-index: 0.63; 95% CI: 0.54, 0.73) ($P=0.003$).

CONCLUSION

The radiomics signature is an independent biomarker for OS estimation of patients with locally advanced HNSCC. Combination of the radiomics signature with clinical factors significantly improves the predictive performance of clinical factors alone.

CLINICAL RELEVANCE/APPLICATION

The current study was to explore the potential of pre-treatment T2-weighted imaging (T2WI)-based radiomics as prognostic factors in patients with locally advanced head and neck squamous cell carcinoma (HNSCC). A 7-feature-radiomics signature was developed proved to be an independent biomarker for OS estimation of patients with locally advanced HNSCC. Combination of the radiomics signature with clinical factors significantly improves the predictive performance of clinical factors alone.

SSA19-08 Fusion MR Imaging: A Fast One Stop Shopping Tool for Diagnosis and Characterization of Vestibular and Intralabyrinthine Schwannomas

Sunday, Nov. 26 11:55AM - 12:05PM Room: N230B

Participants
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Nour-Eldin A. Nour-Eldin, MD,PhD, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To prove the technical feasibility of fusing heavily T2-weighted 3D turbo spin-echo (SPACE) and contrast-enhanced T1-weighted 3D (MPRAGE) datasets and to determine reading time to final diagnosis and diagnostic accuracy in patients with suspected

vestibular or intralabyrinthine schwannomas.

METHOD AND MATERIALS

53 patients were evaluated. Two radiologists specialized in ENT with 10 and 14 years of experience evaluated 3D T2 and post Gd T1 images and fusion sequences in consensus as the reference standard. For the evaluation of reading time and diagnostic accuracy two groups of two less experienced radiologists (residents in 3rd-4th year of training) were formed. Group 1 evaluated 3D T2 and Gd T1 images seperately, group 2 read the fused images only. Image quality was assessed based on a 5-point-scale (1 = highest confidence to 5 = diagnosis not possible). Interobserver agreement was calculated using Cohen`s kappa.

RESULTS

Fused images yielded significantly faster reading times (39.5 ± 28.5 s vs. 67.5 ± 34.5 s; p <= 0.001) compared to conventional separate reading of both 3D T2 and T1 sequences in all cases. Image quality of fused images was rated significantly better by all readers (p <= 0.05) with higher diagnostic accuracy (fusion images: sensitivity 100%; specifity 90-100% vs. conventional group: sensitivity 100%; specifity 88-94%). Interobserver agreement according to recognized lesion was excellent (0.87-1.0).

CONCLUSION

Fused images of high-resolution 3D heavily T2-weighted and contrast-enhanced T1-weighted images allow for faster detection and more precise characterization of vestibular and intralabyrinthine schwannomas.

CLINICAL RELEVANCE/APPLICATION

The possibility of displaying the fluid-filled architecture of the cerebellopontine angle and the inner ear by 3D T2-weighted MR imaging combined with contrast enhanced T1-weighted MPRAGE is helpful to improve radiologist workflow and increase diagnostic accuracy and efficiency to detect even small targets that are difficult to delineate especially in the inner ear in usual examination.

SSA19-09 CT Imaging of Periocular Metallic Foreign Bodies Can be Improved by Artifact Reduction Software

Sunday, Nov. 26 12:05PM - 12:15PM Room: N230B

Participants
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Keirnan Willett, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
John H. Woo, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Computed tomography (CT) is the standard of care for the assessment of ocular and orbital trauma, however, streak artifacts due to retained metallic foreign bodies (FB) can limit the utility of CT. We hypothesize that implementation of metal artifact reduction techniques could improve image quality and diagnostic confidence for a diverse group of interpreters regardless of experience or specialty.

METHOD AND MATERIALS

Ten cases of retained periocular metallic foreign bodies which were noted on CT scan were identified retrospectively from a large urban trauma center. Post-acquisition images were processed with metal streak artifact reduction (MAR) software. The change in the severity of the metal streak artifact was assessed quantitatively by 1) the size of the artifact and 2) the standard deviation of pixel intensities along a path surrounding the foreign body. For subjective assessment, radiologists (4), ophthalmologists (4) and oculoplastic specialists (3) used a Likert scale to grade images on 6 different clinically relevant criteria.

RESULTS

The standard deviation of pixel intensity for a path surrounding the FB as well as the area of the streak artifact was decreased in all cases (p<0.001, paired t-test). Human grading of overall confidence in diagnosis and severity of metallic streak was improved with MAR (p<0.001, Wilcoxon signed-rank test). Similarly, the confidence of assessment of specific structures - including identification of FB, extra-ocular muscles, optic nerve, ruptured globe and orbital fracture -- was improved after MAR (p<0.001, Wilcoxon signed-rank test) but to various degrees in each case.

CONCLUSION

Postprocessing metal artifact reduction algorithms in computed tomography of the orbit can improve image quality by decreasing streak artifact as well as increase interpreter confidence in assessing vital anatomical structures in cases of orbital trauma.

CLINICAL RELEVANCE/APPLICATION

Metal artifact reduction algorithms in computed tomography has potential benefits in improving diagnostic accuracy and confidence in periocular trauma cases.

SSA22

Physics (MR: Applications)

Sunday, Nov. 26 10:45AM - 12:15PM Room: S405AB

MR PH

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

Participants
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Stephen J. Riederer, PhD, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

SSA22-01 Reproducibility of GABA in Occipital Lobe in Healthy Subjects Employing Mega-press at 3T

Sunday, Nov. 26 10:45AM - 10:55AM Room: S405AB

Participants
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Zhuwei Zhang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Chao Ma, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the reproducibility of γ-aminobutyric acid (GABA) in occipital lobe of normal subjects at 3T.

METHOD AND MATERIALS

Spectroscopic data were acquired from occipital lobe region in 16 normal adult volunteers (9 males and 7 females; mean age: 23.5±1.3) using J-editing technique and MEGA-PRESS pulse sequence (the sequence was developed on the platform of Siemens MR system, TR/TE=2000 ms /68 ms, VOI=25×25×25 mm3, BW=1200 Hz, Measurements=320, the editing pulses applied at 1.9 ppm or 7.5 ppm in an interleaved manner) at a 3T scanner, and each subject scanned twice (duration between scans: 7 days). The GABA data divided into three groups, Visit1, for the first scan, Visit2, for the second scan, and Visit1&2, for the first and second scans, respectively. The reproducibility of GABA was assessed by the GABA+/NAA ratio, coefficient of variation (CV) and t-test.

RESULTS

The mean GABA+/NAA ratio in the two scans of each subject was ranged from 0.179 to 0.283 (Fig. 1), during which the CVs were below 10% in eleven subjects. The mean GABA+/NAA ratios of different groups were similar, and with the CVs below 15% (Tab. 1). The t-test result showed that the two scans of all subjects had no significant difference (p=0.480). The mean GABA+/NAA ratio of male group were higher than that of female group, however, the CVs of male group were lower than that of female group (Tab. 2). In addition, the t-test results also suggested that the two scans of both the two groups had no significant difference (p=0.280, p=0.973). However, significant difference was found in the mean GABA+/NAA ratios between the two groups (p=0.022).

CONCLUSION

The measurements of GABA in occipital lobe demonstrated a good reproducibility in healthy volunteers with J-editing technique and MEGA-PRESS pulse sequence at 3T, and the mean relative concentration is higher in male than that in female.

CLINICAL RELEVANCE/APPLICATION

Detection of GABA in occipital lobe demonstrated a good reproducibility in healthy volunteers with J-editing technique and MEGA-PRESS pulse sequence is recommended in the evaluation of human brain GABA concentration.

SSA22-02 Quality Assurance of Diffusion Weighted Imaging: Comparison of a New ACR Phantom Based Method with the QIBA Method

Sunday, Nov. 26 10:55AM - 11:05AM Room: S405AB

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Quality Assurance (QA) of diffusion weighted imaging (DWI) as recommended by the RSNA Quantitative Imaging Biomarkers Alliance (QIBA) requires a special ice water phantom that is not widely available and difficult to prepare. The ACR phantom, however, is available in many clinical MRI facilities and used for weekly QA. Therefore, it would be beneficial to develop a DWI QA procedure based on the ACR phantom (ACR DWI QA) that can be integrated into the weekly QA. The purpose of this work is to develop such a method and compare with the QIBA method.

METHOD AND MATERIALS

QIBA DWI QA was performed according to QIBA protocol (http://qibawiki.rsna.org/). For ACR DWI QA, the following adjustments were made: TR=5000ms due to a shorter T1, and averages of 2, 2, 4 and 8 for b=0, 500, 900 and 2000 s/mm2 to improve the SNR. The temperature of the ACR phantom was measured pre-/post-scan with a laser thermometer [Dr. Meter IR-20] (accuracy<1°C). Comparison of QIBA and ACR DWI QA was performed on two different scanners: 1) a Siemens 3T Prisma using a 20ch head&neck coil and 2) a GE 3T MR750 using an 8ch head coil. Apparent Diffusion Coefficient (ADC) maps were generated by the built-in software on the scanners. The mean ADC value in three different ROIs as shown in fig. 1 were averaged and compared against the theoretical value described by Holz et al. 2000 (PCCP) at the measured temperature to determine the deviation of ADC.

RESULTS

The mean deviation of ADC based on ACR DWI QA was 0.89% (SD±0.71%) for scanner 1 and 2.55% (SD±0.62%) for scanner 2. For QIBA DWI QA, they were 0.61±0.63% and 2.59±0.39%, respectively. The measured ADC with ACR DWI QA was highly reproducible and the deviation was consistent with QIBA DWI QA.

CONCLUSION

A new DWI QA method based on the ACR phantom was shown to be reproducible and able to detect similar ADC deviation as the QIBA DWI QA method. The new method is simpler and more feasible for the clinical environment although it is limited to one ADC value and correction for phantom temperature could be an additional source of error.

CLINICAL RELEVANCE/APPLICATION

Development of a DWI QA procedure using the ACR phantom would allow any ACR accredited institution to implement a DWI QA as a part of the weekly QA without additional phantoms or preparation.

SSA22-03 Modulation Transfer Function of Clinical Brain 3D-FLAIR Sequence

Sunday, Nov. 26 11:05AM - 11:15AM Room: S405AB

Participants
Juha Peltonen, MSc, Espoo, Finland (*Presenter*) Nothing to Disclose
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PURPOSE

Typically, image quality in magnetic resonance imaging is evaluated either quantitatively from quality control (QC) phantom images or subjective observer based evaluation of clinical images. However, the phantom-based quality measurements may not fully represent the quality of actual clinical images. An important image quality metrics among image noise and contrast is spatial resolution. In medical imaging, spatial resolution is often characterized by the modulation transfer function (MTF) at a known boundary. It describes the image contrast content at different spatial frequencies. We have developed a method to characterize image resolution by measuring MTF directly from clinical brain volumes obtained with 3D-FLAIR sequence.

METHOD AND MATERIALS

Edge profiles are extracted from a brain surface and direction-dependent MTFs are calculated. First, the original 3D-FLAIR volume is segmented using Statistical Parameter Mapping (Wellcome Trust Centre for Neuroimaging, University College London, UK). The brain mask is further trimmed with an in-house MATLAB (The Mathworks Inc., Natick, MA, USA) application. A mesh grid is fitted onto the mask volume using MATLAB-based open source toolbox iso2mesh. A typical brain surface grid includes from 150 000 to 250 000 triangular polygons. Voxel gray values and distances from the grid are then recorded within cylindrical volumes perpendicular to each polygon face and intersecting the polygon center. Each resulting edge spread function (ESF) is filtered according to predetermined acceptance criteria and the accepted ESFs are centered on the detected edge. Resulting ESFs are averaged, differentiated and Fourier transformed to obtain direction-dependent MTFs.

RESULTS

The developed method was able to determine brain surface direction-dependent MTFs from clinical 3D-FLAIR volumes. Resolution trend curves were calculated over a period of nine months.

CONCLUSION

The developed method provides a quantitative tool for measuring MTF directly from clinical 3D brain images. The MTF can be used to the compare spatial resolution in image volumes obtained with different sequence parameters and scanners. The method can be also applied on-line to follow daily image quality to detect technical or patient related issues.

CLINICAL RELEVANCE/APPLICATION

The calculation of clinical MRI volume MTF provides a quantitative tool for protocol optimization or evaluating and comparing scanners or sequences.

SSA22-04 Characteristics of MRI Patents Approved by the US Patent and Trademark Office in 2016

Sunday, Nov. 26 11:15AM - 11:25AM Room: S405AB

Participants
Sushma Gaddam, MD, New York, NY (*Presenter*) Nothing to Disclose
Gregory Lemberskiy, MSc, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Andrew B. Rosenkrantz, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To use data regarding MRI patents approved by the U.S. Patent and Trademark Office (USPTO) in 2016 to characterize recent trends in MRI technical development and innovation.

METHOD AND MATERIALS

The USPTO website was searched for all patents with an issue date in 2016 and a patent abstract containing the phrase "magnetic resonance". Patent characteristics available on the website were recorded. Patent assignees were manually characterized as having an industry or academic affiliation. An MRI physicist reviewed the abstracts to classify patents' themes. Observations were summarized using standard descriptive statistics.

RESULTS

A total of 423 MRI-related patents were approved by the USPTO in 2016. Of these, a total of 29% had 1 inventor, 24% had 2 inventors, and 47% had >=2 inventors (maximum of 10 inventors). The mean interval between patents being filed and awarded was 1389 ± 559 days (range, 559 to 1,327 days). The most common countries of patents' first assignee were: USA (40%), Germany (24%), Netherlands (10%), Japan (10%), and Korea (4%). There were 14 additional countries (each <2%). A total of 3% of patents included multiple assignees having different countries (most common collaborators being USA and Germany). Patents' 1st assignee had an industry affiliation in 76% vs. an academic affiliation in 21% (4% were indeterminate). A total of 3% of patents had industry-academia collaboration. Patents' most common themes were: coils (n=77), sequence design (n=65), and non-coil scanner hardware (n=41). These top themes were similar for USA, international, and industry based patents; however, for academic based patents, the most common themes were: sequence design, reconstruction, and exogenous agents. Less common themes included: image analysis, post-processing, spectroscopy, relaxometry, diffusion, motion correction, radiation therapy, implants, wireless devices, and PET/MRI.

CONCLUSION

The majority of MRI-related patents approved by the USPTO in 2016 were filed by non-U.S. inventors. A large majority had an industry affiliation; minimal industry-academic collaboration was observed. Patents from industry and academic inventors had distinct top focuses: hardware and software, respectively.

CLINICAL RELEVANCE/APPLICATION

Awareness of the most recent years' MRI patents may provide insights into forthcoming clinical translations and help guide ongoing research and entrepreneurism.

SSA22-05 SI-traceable Imaging Phantoms for MRI

Sunday, Nov. 26 11:25AM - 11:35AM Room: S405AB

Participants
Stephen E. Russek, PhD, Boulder, CO (*Presenter*) Nothing to Disclose
Michael Boss, PhD, Boulder, CO (*Abstract Co-Author*) Nothing to Disclose
Kathryn E. Keenan, PhD, Boulder, CO (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To develop primary calibration structures for MRI that have precisely defined properties traceable to the International System of Units (SI). Properties include T1 and T2 proton-spin relaxation times, apparent water diffusion coefficients (ADC), resolution, and geometric distortion. In addition to the primary measurands, the properties of the phantom structure, including dielectric constant, conductivity, and magnetic susceptibility must be determined to fully understand and model MRI-based measurements.

METHOD AND MATERIALS

A suite of MRI phantoms have been designed, fabricated, and commercialized including a system phantom, a diffusion phantom and a breast phantom. These phantoms include paramagnetic solutions for T1 T2 arrays, polymer solutions for ADC calibration, fiducial spheres for geometric distortion, and fat/tissue mimics. The properties of phantom materials are determined through temperature-controlled variable-field NMR, imaging on a MRI metrology scanner, electromagnetic properties measurements, and SQUID magnetometry.

RESULTS

Rigorous but pragmatic definitions of parameters for the major MRI biomarkers have been developed. SI traceable measurement protocols for T1, T2 and ADC and initial measurements have been completed. SI-traceable measurements, with the associated certificates, are expected within 12 months. The phantoms are currently being used at clinical research sites to evaluate new faster quantitative imaging techniques, to homogenize images across scanners, and to develop quality control recommendations for clinical trials evaluating diffusion-based imaging for cancer detection/monitoring. These initial uses have indicated that it is necessary to guarantee phantom-parameter accuracy and stability of 2%.

CONCLUSION

As medical imaging improves with increased reliance on qualitative measurement of critical biomarkers, there is an increasing need for more rigorous calibration structures with the associated SI-traceable measurement of their properties. We have developed a suite of phantoms and associated measurement structure to supply this need.

CLINICAL RELEVANCE/APPLICATION

These phantoms have been used to validate new, faster quantitative imaging techniques such as MR fingerprinting, homogenize scan protocols across different scanner types, assess the change in performance of scanners due to upgrades, assess advanced diffusion imaging protocols in cancer studies and traumatic brain injury diagnosis.

SSA22-06 Display Color in the Interpretation of Apparent Diffusion Coefficient Maps for Prostate Cancer

Sunday, Nov. 26 11:35AM - 11:45AM Room: S405AB

Awards
Student Travel Stipend Award

Participants
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Silvia Lucarini, MD,PhD, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Color visualization is prevalent in functional and molecular imaging, the source of most reported imaging biomarkers. Color display selection varies across imaging departments because no guidelines are available and no study has evaluated reader consistency using visualization approaches. In prostate patients, water movement restriction areas in apparent diffusion coefficient (ADC) maps correlate with significant cancer. Inconsistency in quantification and localization reported could result in suboptimal patient management. We report radiologist consistency in detection of prostate lesions to determine the effect of color visualization approaches on diagnostic performance.

METHOD AND MATERIALS

Nine trained readers interpreted 165 single-slice cases, each reading sets of 55 images in 3 separate sessions using a different color scale: gray (G), hot-iron (H), and the inverted rainbow scale (iR). The standard RGB display mode was used for H and iR sessions and the GSDF mode was selected for G. Five readers repeated sessions with iR and H in GSDF mode. Readers used a 0-100 scale to rate their confidence in the presence of a malignant tumor. For cases scored above 50, readers were asked to mark the lowest ADC value within the detected lesion. Pixel values and coordinates were recorded.

RESULTS

The area under the receiver-operating-characteristic curve (AUC) was compared across color scales. Obtained AUCs were 0.79, 0.77 and 0.80 (SE = 0.03) for G, H and iR, respectively, demonstrating a small improvement in detection performance when using iR. A tendency for higher detection sensitivity was observed for RGB setting compared to GSDF for H and iR. Inconsistencies on lesion quantification and localization were non-significant across scales. These results significantly differ from those in a similar study for ischemic lesion detection in myocardial perfusion CT where performance was up to 0.1 AUC units higher using G.

CONCLUSION

Differences in quantification and localization consistency were non-significant. Further investigation is necessary to determine if color affects other diagnostic tasks.

CLINICAL RELEVANCE/APPLICATION

Our findings suggest a small non-significant impact of color for prostate lesion detection in ADC maps, disagreeing with a significant color effect observed in a similar study performed on a different modality.

SSA22-07 Quantitative Estimation of CSF Flow Using MRI Phase Contrast Technique to Assess the Postoperative Outcome of Chiari 1 Malformation with Syringohydromyelia

Sunday, Nov. 26 11:45AM - 11:55AM Room: S405AB

Participants
Rajesh Kumar Vartharajaperumal, MBBS, DMRD, Coimbatore, India (*Presenter*) Nothing to Disclose

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PURPOSE

To quantify the postoperative outcome of chiari 1 malformation using CSF flow study. To evaluate the efficacy of surgery and to assess the prognosis in the early postoperative period.

METHOD AND MATERIALS

Fifty patients with chiari 1 malformation with syringohydromyelia who are ideal candidate for surgery were subjected to MRI brain and spine and CSF flow analysis using MR phase-contrast technique. Region of interest was kept at the level of aqueduct and assessed the positive peak velocity , negative peak velocity and flow . All patients underwent posterior fossa decompression

surgery. Post operative velocity and flow measurements of all patients were taken. We compared the pre and post operative flow volume and velocity.

RESULTS

Of the 50 patients, 36 patients showed significant change in the velocity and flow in the early postoperative period and had resolution of clinical signs and symptoms during follow up. 10 patients showed mild changes in flow and velocity in the early postoperative period with partial recovery of symptoms during follow up and in 4 patients , there is minimal change in velocity and flow during early postoperative period with persistence of symptoms during follow up.

CONCLUSION

Patients with significant changes in flow and velocity in the early postoperative period will have better clinical recovery when compared to patients with minimal change.

CLINICAL RELEVANCE/APPLICATION

Improved CSF velocity and flow in the early postoperative period is useful in anticipation of symptomatic improvement and useful in assessing the efficacy of surgery and long term prognosis.

SSA22-08 Non-ECG-gated and Non-enhanced MR Venography in Arrhythmia

Sunday, Nov. 26 11:55AM - 12:05PM Room: S405AB

Participants
Jun Isogai, MD, Asahi, Japan (*Presenter*) Nothing to Disclose
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Jun Kaneko, Hasuda, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To selectively visualize lower extremity varicose veins in arrhythmia patients without contrast media by the use of a free-ECG-gating Flow-Sensitive Black Blood (FSBB) technique.

METHOD AND MATERIALS

A FSBB technique doesn't need an ECG-gating and allows b values to be adjusted in increments of 0.1 value as one-tenth of usual 1 value. A protocol optimization was performed on 20 healthy volunteers while they changed their lower limb position up and down in the supine or seated position. Subsequently, the revised FSBB protocol parameters were applied to 25 arrhythmia patients of varicose veins with difficulty in diagnosis on usual ECG-gated MRA techniques. All the studies were performed on a 1.5T MRI system (EXCELART Vantage XGV Toshiba) equipped with a SPEEDER torso coil. FSBB imaging was performed as follows; T2*-weighted 3D gradient echo sequence, b value; 0.1-0.4, and typical scan time; 5 min. The performance of FSBB on the lower extremity venous systems was assessed for the image contrast as compared with the other unenhanced ECG-gated MRA techniques.

RESULTS

The scan time of FSBB was almost equal to that of time-of-flight (TOF) and half-Fourier FSE MRA (FBI) using usual ECG-gating techniques. Unenhanced MRA showed excellent depiction of complex venous plexus and age-related vasodilatation while changing their lower limb positions, especially in their legs lowered on seated position. FSBB provided an excellent anatomical depiction of tortuous varicose veins in arrhythmia patients as a dynamic imaging.

CONCLUSION

FSBB technique is independent of ECG-gating and allows exam integrity even in arrhythmia patients and can consequently shorten exam time, so it may provide a valuable procedure for diagnosis of peripheral vascular imaging. Selective visualization of varicose sources in arrhythmia patients without contrast media is of increasing significance for an interventional procedure in our aging population.

CLINICAL RELEVANCE/APPLICATION

Visualization of the lower limb venous systems of arrhythmia patients without contrast material is quite difficult using conventional unenhanced MR angiography. FSBB imaging is a new clinical tool with the use of MR susceptibility difference between tissue and vessels. It has been proven to be useful for brain imaging. In this study, we extended the application of FSBB to the lower extremity veins to investigate if FSBB could provide an additional benefit beyond the brain.

SSA22-09 Advanced Fat Suppression Techniques for Off-Center Upper Extremity MSK MRI on 3T Scanners

Sunday, Nov. 26 12:05PM - 12:15PM Room: S405AB

Participants
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CONCLUSION

Field sensitive sequences like Spectral FS techniques can have fat suppression inhomogeneities, signal loss and blurring due to gradient pulsing and higher order eddy currents with off-center scans on 3T. Depending on patient position, the FS sequence parameters may need to be adjusted to minimize these effects.

Background

3T MR scanners provide high quality MR images, better SNR and resolution in shorter scan times. However, fat suppression on 3T is challenging for wrist and elbow MSK scans; specifically, off-center scans with small FOV. We observed inhomogeneous fat suppression, non-patient-motion related ghosting/ blurring and poor SNR on 3T for off-center scans using traditional spectral fat suppression (FS). The same protocols on iso-center scans produced excellent image quality.

Evaluation

Multiple phantom and wrist scans were performed on volunteers to determine the source for poor image quality. Mapping of the B1 (RF) field, static B0 field and the dynamic B0 field with the body coil and wrist coil were performed. Qualitative and quantitative comparisons were made with the spectral FS sequence with changes in gradient pulsing. Scan parameters were changed to maximize SNR with complete and uniform fat suppression while maintaining small FOV and high resolution requirements.

Discussion

Analysis showed that the primary source of inhomogeneous FS and lower SNR for off-center scans on 3T was higher order eddy currents (dynamic B0 field) due to gradient pulsing. No static B0 or B1 (RF) field inhomogeneities were found to be contributing to the issues. Changing the gradient pulsing changed the FS results, further confirming that errors observed were dynamic in nature. Swapping the phase or reversing the polarity of the phase encoding direction for right vs. left MSK scans, depending on the patient position (head or feet first, right or left, supine or prone) helped improve the image quality for off-center scans in terms of SNR and signal uniformity. STIR and SPAIR sequences were not evaluated due to image contrast differences from traditional sequences. But DIXON water images were chosen to be a backup if traditional off-center FS with eddy-current compensation failed.

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VSPD11

Pediatric Series: Neuroradiology

Sunday, Nov. 26 10:45AM - 12:15PM Room: E451B

MR NR PD

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

Participants
Manohar M. Shroff, MD, Toronto, ON (*Moderator*) Nothing to Disclose
Erin S. Schwartz, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

VSPD11-01 MR Imaging of the Term Neonatal Brain

Sunday, Nov. 26 10:45AM - 11:05AM Room: E451B

Participants
Manohar M. Shroff, MD, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review causes of neonatal encephalopathy and common clinical presentations. 2) Discuss 'how to' optimize neonatal MRI technique for the brain and suggest a standardized protocol. 3) Describe patterns of hypoxic-ischemic encephalopathy in the term neonate. 4) Briefly review possible differential diagnosis and medico-legal implications.

ABSTRACT

Magnetic resonance imaging (MRI) is an important tools in identifying the etiology of neonatal encephalopathy as well as in predicting long-term outcomes. MRI is now the main imaging method for defining the extent of neonatal brain injury. This presentation will review how to optimize MR techniques to determine the cause of encephalopathy in the newborn. The neonatal brain is largely unmyelinated and is undergoing maturation rapidly. It is important understand normal appearances of neonatal brain on MRI and to be familiar with the spectrum of imaging features in ischemic and non-ischemic neonatal encephalopathy. Hypoxic ischemic injury (HII) is one of the most common causes of neonatal encephalopathy and imaging appearances are influenced by the stage of maturation of the neonatal brain, severity as well as duration of ischemic insult and treatment given, such as hypothermia. Conceptually, hypoxic ischemic injury at birth has been differentiated into prolonged intermittent hypoxic ischemic injury due to ischemia occuring over a prolonged time and a severe acute or profound hypoxic ischemic injury (HII) often associated with a sentinel acute event. In the prolonged intermittent hypoxic injury, the cerebral white matter is more dominantly involved, whereas in the severe acute hypoxic injury, deep grey matter structures are involved. Imaging characteristics of HII in term neonates can be also subdivided based on the severity of injury (severe versus mild to moderate [partial] asphyxia). In practice one often sees a spectrum of injury, and Barkovich et al have published a useful MR scoring system to diagnose and rate the severity of injury secondary to HII. In addition to having a normal appearance, infants with suspected HII may have 4 predominant patterns of injury: watershed, basal ganglia, total, or focal-multifocal injury. Injury involving the deep grey matter structures,often portends a worse prognosis. In medico-legal situations, an attempt is often made to time HII, based on MRI patterns. It is important to understant that MRI findings alone cannot time the insult within hours or minutes around the time of birth. Timing is best done using and co-relating MRI findings along with all other evidence that is available. The radiologist must also be familiar with other causes of neonatal encephalopathy, such as stroke, trauma, infections, congenital disorders and inborn errors of metabolism.

VSPD11-02 Resolution Dependence of Brain Metabolic MRI in Neonates

Sunday, Nov. 26 11:05AM - 11:15AM Room: E451B

Participants
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Christopher Golden, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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Hanzhang Lu, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Cerebral metabolic rate of oxygen (CMRO2) is an important biomarker of neural development and brain tissue viability in neonates, but non-invasive techniques to measure it in neonates have been lacking. In this work, we optimized a novel MRI method to evaluate CMRO2 in neonates by studying its dependence on spatial resolution.

METHOD AND MATERIALS

Theory: Previously we have demonstrated the proof-of-principle of a novel method based on the Fick Principle to quantify CMRO2, i.e., CMRO2=CBF·(Ya-Yv)·Ca, where CBF is cerebral blood flow measured by phase-contrast (PC) MRI, Ya is arterial oxygenation measured by pulse-oximetry, Yv is venous oxygenation measured by T2-Relaxation-Under-Spin-Tagging (TRUST), and Ca is the

well-established blood's oxygen carrying capacity. In this work, we aimed to optimize the TRUST and PC MRI techniques in neonates. TRUST MRI: In 9 healthy neonates, we compared the TRUST scans with 4 in-plane resolutions, 1.25, 1.5, 1.9 and 2.5 mm. We assessed the coefficient of variance (CoV) of the TRUST signal and a goodness-of-fit index, ΔR2, across the resolutions. PC MRI: In 3 healthy neonates, we compared the PC MRI scans with 3 in-plane resolutions, 0.3, 0.4 and 0.5 mm, and 3 numbers of averages, 3. 6 and 9 averages. We compared the CoV of CBF across the resolution and number of averages, respectively.

RESULTS

TRUST MRI: The 1.25mm resolution showed higher CoV ($p<0.03$) and ΔR2 ($p<0.07$) than the other resolutions. No significant differences in CoV and ΔR2 were found among the other 3 resolutions, although ΔR2 of 2.5mm is slightly lower than that of 1.5mm ($p=0.10$). Considering the trade-off between CoV and ΔR2, 1.9mm resolution is recommended for TRUST MRI in neonates. PC MR: The 3 resolutions showed no significant difference in CoV. More neonates are being scanned. The PC scan with 3 averages showed higher CoV than 6 averages ($p=0.087$) and 9 averages ($p=0.004$). Considering the trade-off between scan time and precision, 6 averages is recommended for PC MRI in neonates.

CONCLUSION

Our results suggested the used of 1.9mm resolution for TRUST MRI and 6 averages for PC MRI in neonates. These optimizations may lead to the accurate quantification of neonatal CMRO2 in 4 minutes without using any exogenous tracer or contrast agent.

CLINICAL RELEVANCE/APPLICATION

The optimized TRUST and PC MRI techniques can be used for the quantification of neonatal CMRO2, the functional biomarker in several neonatal brain injury and diseases.

VSPD11-03 Detection of 'Silent' Abnormalities in the Deep Gray Matter Nuclei of Neonates with Punctate White Matter Lesions by Magnetic Resonance Spectroscopy

Sunday, Nov. 26 11:15AM - 11:25AM Room: E451B

Participants
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Chao Jin, Xian, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Punctate white matter lesions (PWML) are common in neonates and represent as hyperintensity on T1WI and hypointensity on T2WI in the periventricular white matter. In this study, the deep gray matter in PWML neonates without abnormality on conventional MRI and with possibility of injury would be considered as 'silent' lesions. The aim of this study is to explore whether there exist the 'silent' abnormalities in the deep gray matter nuclei in PWML neonates by magnetic resonance spectroscopy (MRS).

METHOD AND MATERIALS

42 neonates with PWML and 54 control neonates (no abnormality on conventional MRI) who underwent GE 3.0T MRS imaging were enrolled. The PWML neonates with gray matter lesions (i.e. hypoxic ischemic encephalopathy, bilirubin encephalopathy and hemorrhage) were excluded. Axial 2D MRS was performed with the point-resolved spectroscopy sequence (PRESS) (echo time/repetition time, 144ms/1000ms) through the basal ganglia. The peak areas ratios of Cho/Cr, NAA/Cho and NAA/Cr in bilateral lenticular nucleus and thalamus were calculated. Independent sample t test was performed to investigate the differences of metabolite ratios between PWML and control groups.

RESULTS

Demographics of neonates with PWML and control groups were shown in Table 1. There were no significantly differences in gestational age, postmenstrual age, postnatal age at scan, birth weight and gender between two groups($p>0.05$). Figure 1, NAA/Cho ratio of both two regions in PWML group were significant lower than those in control group ($p<0.05$), and this difference of NAA/Cr ratio only in thalamus ($p<0.05$), while no differences of Cho/Cr ratio between PWML and control group were found in both two regions.

CONCLUSION

In the PWML neonates, the variations of metabolite ratios in MRS demonstrated a 'silent' abnormalities in the deep gray matter.

CLINICAL RELEVANCE/APPLICATION

The treatment strategies should target at both white and gray matter to prevent the neurologic deficits in the neonates with punctate white matter lesions.

VSPD11-04 To Evaluate the Role of F 18 FDG PET-CT in Evaluation of Temporal Lobe Epilepsy

Sunday, Nov. 26 11:25AM - 11:35AM Room: E451B

Participants
Sikandar M. Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

PURPOSE

18F-fluorodeoxyglucose (18F-FDG) has been used for localization of epileptogenic foci in cases of temporal lobe epilepsy. The aim of this study was to evaluate the glucose metabolic activity using 18F-FDG PET-CT imaging in patients with epilepsy.

METHOD AND MATERIALS

Thirty five pediatric epilepsy patients who underwent 18F-FDG PET-CT, magnetic resonance imaging (MRI) and electroencephalography (EEG) examinations were respectively included. Fifteen age-matched controls were included. 18F-FDG PET-CT was done after injecting FDG contrast .Images were analyzed by using visual assessment combined with statistical parametric mapping (SPM) analysis. Absolute asymmetry index (|AI|) were calculated in patients with regional abnormal glucose metabolism.

RESULTS

There was significant changes in the visual assessment combined with SPM analysis of 18F-FDG PET images detected more patients with abnormal glucose metabolism compared to the visual assessment only. The |AI| significantly positively correlated with seizure frequency ($P < 0.001$), but negatively correlated with the time since last seizure ($P < 0.01$) in patients with abnormal glucose metabolism. The only significant contributing variable to the |AI| was the time since last seizure, both in patients with hypo-metabolism ($P = 0.001$) and hyper-metabolism ($P = 0.005$). Higher values of |AI| were found in the drug-resistant compared to the seizure remission in patients with either hypo-metabolism ($P < 0.01$) or hyper-metabolism ($P = 0.209$). In the post 1-year follow-up PET studies, significant change of |AI| (%) was found in patients with clinical improvement compared to those with persistence or progression ($P < 0.01$).

CONCLUSION

18F-FDG PET imaging with visual assessment combined with SPM analysis could provide cerebral glucose metabolic profile in non-surgical epilepsy patients. |AI| is more useful for evaluation of clinical severity and progress in these patients. Patients with a prolonged period of seizure free may have more subtle (or no) metabolic abnormalities on PET. The clinical value of PET might be enhanced by timing the scan closer to clinical seizure(s).

CLINICAL RELEVANCE/APPLICATION

FDG PET-CT has important role in evaluation of Epileptogenic focus in temporal lobe epilepsy .

VSPD11-05 Functional Magnetic Resonance Imaging Analysis of N-Back Working Memory Paradigm in Adolescents with Temporal Lobe Epilepsy

Sunday, Nov. 26 11:35AM - 11:45AM Room: E451B

Participants
Rupa Radhakrishnan, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
Thomas Maloney, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Avani Modi, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Shari Wade, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Angela Combs, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Jennifer Vannest, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

rupa.rad@gmail.com

PURPOSE

Working memory is an important substrate of executive function dealing with storage, processing and manipulation of information. Adolescents with epilepsy are at risk for working memory deficits, which could lead to learning difficulties and poor academic outcomes. In this study, we compare functional magnetic resonance imaging (fMRI) correlates of working memory in adolescents with epilepsy versus healthy controls.

METHOD AND MATERIALS

29 adolescents (13 to 17y) with MRI non-lesional epilepsy and 20 matched healthy controls were prospectively recruited. Participants performed an N-back fMRI task (block design 2-back versus 0-back condition), and neuropsychological measures of working memory(Digit Span from the Wechsler Intelligence Scale). General linear model approach was used to create group activation maps contrasting 2-back vs0-back for epilepsy and control groups and both groups combined (initial threshold $Z > 3.71$, corrected for multiple comparisons to $p<0.05$). Functionally defined regions of interest (ROIs) were defined based on clusters of combined group activation. For each participant, mean Z-score values for fMRI activation were derived for each ROI. We examined correlations between mean Z-score in each ROI and Digit Span scaled scores.

RESULTS

For the N-back fMRI task, significant activation was observed in bilateral middle frontal and parietal regions, bilaterally, anterior cingulate cortex, and inferior parietal/occipital cortex and frontal operculum/insula bilaterally in both controls and epilepsy groups. There were no significant differences in group activation. Mean Digit Span scores in those with epilepsy (8.7) and controls (11.8) was significantly different ($p=0.0009$). Digit Span scaled scores correlated significantly with N-back fMRI activation in the left frontal pole ($r =0.53$, $p=0.013$), left frontal operculum/insula ($r=0.53$, $p= 0.015$) and left parieto-occipital region ($r= 0.48$, $p= 0.034$) in controls, which was not seen in adolescents with epilepsy.

CONCLUSION

There is a relationship between Digit Span performance scores and left frontal and left parieto-occipital activation on the N-back fMRI task in controls, but not in adolescents with epilepsy suggesting an atypical pattern of working memory processing in pediatric epilepsy.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates working memory deficits, and altered pattern of working memory processing in adolescents with epilepsy.

VSPD11-06 Mutual Information Improves Quantification of Cerebral Network Architecture in Children with Focal Epilepsy

Sunday, Nov. 26 11:45AM - 11:55AM Room: E451B

Participants

Wei Zhang, PhD, Houston, TX (*Presenter*) Nothing to Disclose
Viktoria Muravina, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Robert Azencott, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Lynn Chapieski, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Zili David Chu, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Michael J. Paldino, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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PURPOSE

Metrics of brain network architecture derived from resting-state fMRI have been shown to provide physiologically meaningful markers of IQ in children with epilepsy. However, traditional measures of functional connectivity (FC), specifically correlation, assume gaussianity of the joint distribution between BOLD time courses; this assumption may not be valid. Mutual information (MI) is an alternative measure of FC which has shown promise in the study of complex networks due to its ability to characterize non-linear associations. We therefore aimed to compare network metrics derived from mutual information-defined FC to those derived from traditional correlation in terms of their capacity to predict patient-level IQ.

METHOD AND MATERIALS

Patients were retrospectively identified with: 1. Focal epilepsy; 2. Resting state fMRI; 3. Full scale IQ by a neuropsychologist. Brain network nodes were defined by anatomic parcellation. Parcellation was performed at three different node sizes, resulting in networks containing approximately 350, 750, or 1500 nodes. Whole-brain, weighted graphs were then constructed according to the pair-wise connectivity between nodes. In the traditional condition, edges (connections) between each pair of nodes were defined as the absolute value of the Pearson correlation coefficient between their BOLD time courses. In the mutual information condition, edges were defined as the mutual information between time courses. The following metrics were then calculated for each weighted graph: clustering coefficient, modularity, characteristic path length, and global efficiency. A machine learning algorithm was then used to predict the IQ of each individual based on their network metrics. Prediction accuracy was assessed as the percent variation explained for each condition.

RESULTS

Twenty-six patients met criteria (age: 4-18 yrs). Percent variance explained for each condition is presented in Table 1. Over all network sizes, network metrics derived from mutual information-defined FC outperformed the use of traditional correlation.

CONCLUSION

Mutual information-defined functional connectivity captured features of the brain network relevant to brain function better than traditional methods.

CLINICAL RELEVANCE/APPLICATION

Optimizing the capacity to predict cognitive phenotypes at the patient-level is a necessary step toward the clinical utility of network-based biomarkers.

VSPD11-07 Advanced Imaging of Pediatric Epilepsy

Sunday, Nov. 26 11:55AM - 12:15PM Room: E451B

Participants
Erin S. Schwartz, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Improve knowledge of advanced imaging techniques, including magnetoencephalography and hybrid PET-MR imaging, for evaluating and guiding treatment of pediatric patients with medically refractory epilepsy.

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RC104

Emerging Clinical Applications in Musculoskeletal Imaging

Sunday, Nov. 26 2:00PM - 3:30PM Room: S406B

CT MR 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, Boston, MA (*Director*) Nothing to Disclose

For information about this presentation, contact:

mtorriani@mgh.harvard.edu

LEARNING OBJECTIVES

1) To familiarize attendees with emerging imaging techniques in musculoskeletal imaging and their practical application in the clinical setting. 2) Topics include: MR spectroscopy of the musculoskeletal system, MR neurography, novel MR imaging techniques and pulse sequences, dual-energy computed tomography, and imaging of sarcopenia.

Sub-Events

RC104A Spectroscopy in Clinical Practice

Participants
Martin Torriani, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mtorriani@mgh.harvard.edu

LEARNING OBJECTIVES

1) MR spectroscopy allows for metabolic characterization of musculoskeletal tissues and has shown promise in applications such as characterization of tumors and body composition. 2) This lecture will focus on technical aspects to successfully obtain and interpret MR spectroscopy data in a clinical setting and outline clinical applications of this technique.

RC104B Neurography in Clinical Practice

Participants
Laura M. Fayad, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

lfayad1@jhmi.edu

LEARNING OBJECTIVES

1) Understand the importance of peripheral nerve imaging to routine clinical practice. 2) Identify common sports-related peripheral neuropathies. 3) Learn useful MRI features of peripheral nerve injury. 4) Improve knowledge regarding MRI techniques used for assessing the peripheral nervous system.

RC104C MRI Sequences You May Want to Try

Participants
Michael P. Recht, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the basic principles of fast imaging techniques such as parallel imaging, compressed sensing and machine learning reconstruction and show how they can be applied to musculoskeletal imaging.

RC104D Clinical Applications of Dual Energy CT

Participants
Carl S. Winalski, MD, Cleveland, OH (*Presenter*) Institutional service agreement, Medical Metrics, Inc; Institutional service agreement, BioClinica, Inc ; Institutional service agreement, PAREXEL International Corporation ; Institutional service agreement, CartiHeal Ltd; Shareholder, Pfizer Inc; Spouse, Shareholder, General Electric Company

For information about this presentation, contact:

winalsc@ccf.org

LEARNING OBJECTIVES

1) Review the applications of dual-energy computed tomography currently used in clinical practice through case examples.

RC104E Sarcopenia in Clinical Practice

Participants
Leon Lenchik, MD, Winston-Salem, NC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

llenchik@wakehealth.edu

LEARNING OBJECTIVES

1) Discuss the transition of sarcopenia from the research environment to clinical practice.

RC105

Next-Generation Neuroradiology: Techniques & Applications

Sunday, Nov. 26 2:00PM - 3:30PM Room: N227B

NR MR

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

FDA Discussions may include off-label uses.

Participants
Srinivasan Mukundan, MD, PhD, Durham, NC (*Moderator*) Institutional research support, Siemens AG; Institutional research support, Toshiba Medical Systems Corporation; Consultant, Toshiba Medical Systems Corporation;

LEARNING OBJECTIVES

1) Describe the 3 processes involved in the creation of brain MR elastograms. 2) Classify focal brain lesions based on their viscoelastic properties and brain adhesion measured by slip interface imaging. 3) Explain the future role of brain MR elastography in differentiating diffuse neurologic diseases including the common causes of dementia. 4) Understand the limitations of current diagnostic algorithms for intracranial vascular disease. 5) Understand the techniques, applications and value of intracranial vessel wall imaging. 6) Understand future directions of vessel wall imaging. 7) Understand recent developments in simultaneous MR/PET imaging of the brain. 8) Evaluate outstanding technical challenges, including MR attenuation correction, image-derived arterial input functions, and workflow. 9) Review the role of simultaneous MR/PET for common neurologic diseases, such as dementia, cerebrovascular disease, and tumors.

SAM

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Sub-Events

RC105A Clinical 7T Brain MRI

Participants
Jeroen Hendrikse, MD, Utrecht, Netherlands (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe where 7 Tesla MRI can have added value in clinical neuroradiology. 2) Show the clinical added value of 7 Tesla MRI for the detection of small infarcts on high resolution 3D FLAIR sequences, the detection of small pituitary lesions with pre and post contrast 3DT1 MRI sequences and the detection of intracranial atheroslerosis with black blood vessel wall MRI sequences before and after contrast. 3) Explain the future directions of clinical 7 Tesla MRI and the importance of contrast-to-noise ratio (CNR) above signal-to-noise ratio (SNR).

RC105B MR/PET in the Brain

Participants
Greg Zaharchuk, MD, PhD, Stanford, CA (*Presenter*) Research Grant, General Electric Company; Consultant, General Electric Company;

LEARNING OBJECTIVES

1) Understand recent developments in simultaneous MR/PET imaging of the brain. 2) Evaluate outstanding technical challenges, including MR attenuation correction, image-derived arterial input functions, and workflow. 3) Review the role of simultaneous MR/PET for common neurologic diseases, such as dementia, cerebrovascular disease, and tumors.

RC105C MR Elastography: Palpating the Brain

Participants
John Huston III, MD, Rochester, MN (*Presenter*) Stockholder, Resoundant, Inc; Royalties, Resoundant, Inc

For information about this presentation, contact:

jhuston@mayo.edu

LEARNING OBJECTIVES

1) Describe the three processes involved in the creation of brain MR elastograms. 2) Classify focal brain lesions based on their viscoelastic properties and brain adhesion measured by slip interface imaging. 3) Explain the future role of brain MR elastography in differentiating diffuse neurologic diseases including the common causes of dementia.

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RC112

Principles and Applications of 4D Flow MRA

Sunday, Nov. 26 2:00PM - 3:30PM Room: S103CD

VA MR

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

FDA Discussions may include off-label uses.

Participants

James C. Carr, MD, Chicago, IL (*Moderator*) Research Grant, Astellas Group; Research support, Siemens AG; Speaker, Siemens AG; Advisory Board, Guerbet SA
Ahmed M. Gharib, MBChB, Bethesda, MD (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand basic principles of 4D flow MRI data acquisition. 2) Identify different variants of 4D flow sequences. 3) Explain methods for the 3D visualization and quantification of cardiovascular flow data acquired by 4D flow MRI. 4) To know components required to implement clinically 4D flow. 5) To know types of clinically relevant data that can be extracted from 4D flow. 6) Become familiar with approaches to integrating 4D flow into clinical protocols. 7) Review clinical scenarios where 4D flow may aid in the management of patients with cardiac and aortic disease. 8) Assess current data on emerging clinical applications of 4D flow in the chest. 9) Review 4D Flow-derived parameters that show promise for risk stratification. 10) Understand the underlying principles of phase velocity MRA. 11) Be familiar with the currently available methods for phase velocity MRA. 12) Be familiar with important applications and examples of phase velocity MRA. 13) Understand current limitations and pitfalls associated with phase velocity MRA. 14) Be familiar with emerging applications of 4D flow MRI in the abdomen. 15) Develop a clinical protocol to generate 4DFlow images of the intracranial circulation. 16) Recognize the flow features of intracranial arterial stenosis and aneurysms. 17) Apply 4DFlow to precisely define AVM hemodynamics. 18) Develop an integrated approach to venous outflow assessment.

SAM

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Sub-Events

RC112A Technical Principles and Solutions

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

LEARNING OBJECTIVES

1) Understand basic principles of 4D flow MRI data acquisition. 2) Identify different variants of 4D flow sequences. 3) Explain methods for the 3D visualization and quantification of cardiovascular flow data acquired by 4D flow MRI.

ABSTRACT

The intrinsic motion sensitivity of magnetic resonance imaging (MRI) can be used acquire and quantify blood flow. 4D flow MRI can be employed to encode blood flow velocities along all dimensions and offers the possibility to acquire spatially registered information on three-directional blood flow simultaneously with the 3D anatomic data within a single examination. As a result, 4D flow MRI permits the assessment of three-directional blood flow with full volumetric coverage of cardiac chambers or cardio- or neurovascular regions of interest such as the thoracic aorta or the large cerebral arterial and venous system.A benefit compared to traditional imaging techniques is related to the possibility to visualize cardiac and vascular hemodynamics and retrospectively quantify blood flow at any location of interest. In addition to the 3D visualization of complex cardiac and vascular flow patterns, quantitative flow analysis can provide quantitative information on the impact of cardio- or neurovascular pathologies on altered hemodynamics associated withthe presence of cardio- and neurovascular disease. The presentation will1) Introduce methodological aspects related to the measurement of 3D blood in the human body based on 4D flow MRI;2) Illustrate the potential of 4D flow MRI for the 3D visualization and quantification of cardiovascular hemodynamics;3) Provide examples of clinically relevant questions and how 4D flow can be used to improve cardiovascular diagnostics.

RC112B Clinical Workflow and Implementation

Participants
Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Presenter*) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;

LEARNING OBJECTIVES

1) To know components required to implement clinically 4D flow. 2) To know types of clinically relevant data that can be extracted from 4D flow. 3) Become familiar with approaches to integrating 4D flow into clinical protocols.

ABSTRACT

4D flow is a time resolved volumetric phase contrast MRI technique. This presentation will cover essential components required to

4D flow is a time resolved volumetric phase contrast MRI technique. This presentation will cover essential components required to implement 4D flow in a clinical setting, review types of clinically relevant data that can be extracted from 4D flow, and present several approaches to integrating 4D flow into clinical MRI protocols. Essential components include a pulse sequence and post-processing software. Data that can be extracted includes blood flow, cardiovascular function, and anatomy. Protocols can be greatly simplified with 4D flow, enabling a decoupling of image acquisition and interpretation, thereby enhancing efficiency of patient, technologist, and radiologist time.

RC112C Chest Applications

Participants
Michael D. Hope, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

michael.hope@ucsf.edu

LEARNING OBJECTIVES

1) Review clinical scenarios where 4D flow may aid in the management of patients with cardiac and aortic disease. 2) Assess current data on emerging clinical applications of 4D flow in the chest. 3) Review 4D Flow-derived parameters that show promise for risk stratification.

ABSTRACT

We will focus on the emerging applications of multidimensional MR flow imaging (4D Flow) in the chest. The techniques and hemodynamic biomarkers that we will discuss can be applied broadly throughout the cardiovascular system. Two key issues must be addressed when considering these applications: 1) clear advantages over conventional imaging and 2) matching advanced imaging capabilities with clinical questions that change the management of patients with cardiac and aortic disease. The goal is to provide a unique understanding of how abnormal flow promotes or exacerbates disease. This understanding, in turn, could allow patients to be risk-stratified based on flow, guide medical therapy, and identify new pathways to target with drug therapy and patients that may benefit from early intervention.

RC112D Abdominal Applications

Participants
Scott B. Reeder, MD, PhD, Madison, WI (*Presenter*) Institutional research support, General Electric Company; Institutional research support, Bracco Group; Founder, Calimetrix, LLC; Shareholder, Elucent Medical

LEARNING OBJECTIVES

1) Understand the underlying principles of phase velocity MRA. 2) Be familiar with the currently available methods for phase velocity MRA. 3) Be familiar with important applications and examples of phase velocity MRA. 4) Understand current limitations and pitfalls associated with phase velocity MRA. 5) Be familiar with emerging applications of 4D flow MRI in the abdomen.

RC112E Cerebrovascular Applications

Participants
Patrick A. Turski, MD, Madison, WI (*Presenter*) Institutional Research support, General Electric Company

LEARNING OBJECTIVES

1) Develop a clinical protocol to generate 4DFlow images of the intracranial circulation. 2) Recognize the flow features of intracranial arterial stenosis and aneurysms. 3) Apply 4DFlow to precisely define AVM hemodynamics. 4) Develop an integrated approach to venous outflow assessment.

ABSTRACT

Accelerated 4DFlow MRI acquisition and reconstruction methods are now available to provide high resolution exams in clinically relevant imaging times. 4DFlow MRI not only provides images of vascular morphology but also acquires quantitative measurements of velocity throughout the imaging volume. Hemodynamic parameters such as flow volume, relative wall shear stress, streamlines, vorticity and pressure gradients can be derived from the velocity data. The combination of anatomical imaging, lumen visualization and physiological data derived from accelerated 4DFlow MRI augments the characterization of intracranial arterial stenosis, aneurysms, vascular malformations and dural sinus pathology. This presentation provides an update for radiologists interested in cerebrovascular applications of 4DFlow MRI.

RC115

Breast MR Imaging (Interactive Session)

Sunday, Nov. 26 2:00PM - 3:30PM Room: E353C

BR MR

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

Participants
Cherie M. Kuzmiak, DO, Chapel Hill, NC (*Moderator*) Nothing to Disclose

SAM

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Sub-Events

RC115A Scanning Wisely: MRI Protocols

Participants
Jean M. Seely, MD, Ottawa, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jeseely@toh.ca

LEARNING OBJECTIVES

1) Recognize and discuss the appropriate indications for breast MRI. 2) Understand the basic requirements to perform breast MRI. 3) Recognize the importance of good positioning to minimize artifacts that may lead to errors in interpretation. 4) Be aware of some advanced techniques in breast MRI.

ABSTRACT

Using a case-based approach, this interactive session will review the appropriate indications for breast MRI and basic requirements to perform quality breast MRI. It will highlight the importance of good positioning to improve interpretation and minimize artifacts associated with poor technique. An overview will also be provided of some recent advanced MRI techniques.

RC115B MRI BIRADS 3

Participants
Debra M. Ikeda, MD, Stanford, CA (*Presenter*) Scientific Advisory Board, Grail, Inc; Case Reviewer, Siemens Inc.

For information about this presentation, contact:

dikeda@stanford.edu

LEARNING OBJECTIVES

1) Improve basic knowledge of Breast MRI BIRADS Category 3 scientific literature. 2) Recognize and discuss the appropriate indications for Breast MRI BIRADS Category 3 selection. 3) Apply principles of BIRADS 3 Category literature to case examples for use in clinical practice.

ABSTRACT

Using a case-based approach, this session will provide an analysis of the Breast MRI BIRADS 3 scientific literature, and review appropriate and inappropriate use of the BIRADS 3 category. Using this knowledge, participants will be able to apply principles of Breast MRI BIRADS 3 lesion selection to avoid pitfalls of inappropriate BIRADS 3 assignment and misdiagnosis of cancers.

RC115C Challenging Cases

Participants
Eric L. Rosen, MD, Denver , CO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review a series of challenging breast MRI cases encountered in a busy breast imaging center, offering pragmatic evidence based recommendations while emphasizing appropriate BIRADS usage, a working knowledge of the updated AJCC breast cancer staging guidlines and attention to detail. At the end of this session the lerner will have a better understanding of breast cancer staging and the important clinical role MRI plays in the evaluation of both high risk patients, those with silicone implant augmentation, and those newly diagnosed with breast cancer

ABSTRACT

Using a case-based approach, this session will review a series of challenging MRI cases encountered in a busy academic practice, reviewing scenarios including high risk screening, implant evaluation, newly diagnosed and recourrent breast cancer . Appropriate

BIRADS usage, NCCN guidlines and AJCC staging guidelines will be addressed and illustrated to inform the lerner of important updates relevant to their practice to aviod diagnostic delays, blunders and misses.

RC117

Emerging Technology: PET/MRI - Opportunities and Challenges

Sunday, Nov. 26 2:00PM - 3:30PM Room: S504CD

MR NM

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

FDA Discussions may include off-label uses.

Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss opportunities of PET/MRI in clinical practice and research. 2) To discuss challenges of PET/MRI in clinical practice and research.

Sub-Events

RC117A PET/MRI: The Evolving Imaging Field of Structure and Function

Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the status of PET/MRI in clinical practice in 2017 and the opportunities and challenges in implementation.

RC117B PET/MRI Physics: The Opportunities and Challenges

Participants
Georges El Fakhri, PhD, Boston, MA (*Presenter*) Nothing to Disclose

RC117C PET/MRI Clinical Applications: Brain and Head and Neck

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

LEARNING OBJECTIVES

1) Review relevant clinical applications for PET/MR in the diagnostic work-up of disorders of the brain. 2) Review strengths of PET/MR for disorders of the head and neck. 3) Understand the value of different currently available tracers for neuroimaging and oncological applications. 4) Review challenges and limitations of PET/MR in brain/head&neck and expected future developments.

RC117D PET/MRI Clinical Applications: Body

Participants
Thomas A. Hope, MD, San Francisco, CA (*Presenter*) Research Support, GE Healhtcare

For information about this presentation, contact:

thomas.hope@ucsf.edu

LEARNING OBJECTIVES

1) Review common current applications for abdominopelvic oncologic PET/MRI, including hepatic malignancies, rectal cancer, and cervical cancer. 2) Understand the role of novel tracers in prostate cancer (PSMA PET) and neuroendocrine tumors (somatostatin receptor PET). 3) Present the current limitations and future advances in PET/MRI that will help increase the clinical acceptance and applicabilty of body PET/MRI.

RC117E PET/MRI Clinical Applications: Cardiac

Participants
Pamela K. Woodard, MD, Saint Louis, MO (*Presenter*) Research agreement, Siemens AG; Research, Eli Lilly and Company; Research, F. Hoffmann-La Roche Ltd; ; ; ; ;

For information about this presentation, contact:

woodardp@mir.wustl.edu

LEARNING OBJECTIVES

1) Discuss clinical cardiac PET/MR imaging applications; applications will include myocardial perfusion and viability, nonischemic

cardiomyopathy, and tumor assessment.

RC120

The Role of PET/MR Metabolic Imaging in Improving Oncology Outcomes

Sunday, Nov. 26 2:00PM - 3:30PM Room: E353A

MR NM RO

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

FDA Discussions may include off-label uses.

Participants
Christina I. Tsien, MD, Saint Louis, MO (*Moderator*) Speaker, Merck & Co, Inc

Sub-Events

RC120A PET Imaging of Metabolism and Downstream Targets

Participants
Kooresh I. Shoghi, PhD, St. Louis, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Highlight the significance of metabolic imaging. 2) Provide an overview of PET tracers for metabolic imaging. 3) Discuss the role and applications of metabolic imaging in translational research.

RC120B MR Imaging

Participants
Tammie S. Benzinger, MD, PhD, Saint Louis, MO (*Presenter*) Research Grant, Eli Lilly and Company; Investigator, Eli Lilly and Company; Investigator, F. Hoffmann-La Roche Ltd;

For information about this presentation, contact:

benzingert@WUSTL.EDU

LEARNING OBJECTIVES

1) State of the art MR measures of metabolism, applications to radiation oncology patients. 2) What can metabolic MR measures tell us about tumor biology in vivo? 3) What is the potential role of metabolic MR in treatment monitoring?

RC120C H/N and Prostate Cancer

Participants
Anca L. Grosu, MD, Freiburg, Germany (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe new developments of PET/MR Imaging for staging patients with primary and recurrent prostate cancer and to address possible implications for treatment planning. 2) Evaluate new developments of PET/MR Imaging for staging patients with H/N cancer and to address possible implications for treatment planning.

ABSTRACT

Staging has a crucial role in patients with prostate cancer, since it allows distinguishing between localized and disseminated disease. Reliable imaging is the door opener for local therapy approaches in patients with prostate cancer. In patients with H/N cancer the combination of MRI (perfusion) and PET/CT (hypoxia) information is able to detect therapy resistant subvolumes which correlate with treatment outcome. This talk will discuss new developments in Molecular/Functional Imaging for prostate cancer and H/N patients and the possible implications for radiation treatment planning.

RC120D CNS and Lung Cancer

Participants
Daniel R. Wahl, MD, PhD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand emerging metabolic imaging techniques for CNS malignancies and their clinical applications. 2) To understand emerging metabolic imaging techniquest for lung cancers and their clinical applications.

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RC129

MR Imaging of the Female Pelvis for Planning Fertility Preservation Therapy, and the Appearance of the Pelvis Post Therapy (An Interactive Session)

Sunday, Nov. 26 2:00PM - 3:30PM Room: S402AB

GU MR

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

Participants
Hero K. Hussain, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

Sub-Events

RC129A MR Imaging for Planning Fertility Preservation Therapy in Gynecologic Malignancies

Participants
Katherine E. Maturen, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kmaturen@umich.edu

LEARNING OBJECTIVES

1) Appreciate low risk imaging features of adnexal masses, supporting potential management with surveillance, cystectomy, or oophorectomy rather than complete surgical staging. 2) Recognize imaging features of non myoinvasive endometrial cancer, for both diagnosis and surveillance if managed conservatively. 3) Understand imaging guidelines supporting surgical choice of trachelectomy in cervical cancer.

Honored Educators

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

RC129B MR Imaging for Planning Fertility Preservation Therapy in Benign Gynecologic Diseases

Participants
Jessica B. Robbins, MD, Madison, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the spectrum of benign uterine and adnexal pathology. 2) Describe the fertility sparing procedures that can be performed for such conditions. 3) Explain the role of MRI in planning for these procedures.

RC129C MR Imaging of the Pelvis Post Therapy of Benign Gynecologic Conditions

Participants
Susan M. Ascher, MD, Washington, DC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Improve knowledge of therapies for symptomatic gynecologic conditions with a focus on leiomyomas treated with uterine artery embolization (UAE). 2) Provide an efficient protocol for MRI surveillance post treatment of benign gynecologic conditions. 3) Improve knowledge of the MRI appearance of the female pelvis post treatment to include features of success and failure.

RC129D MR Imaging of the Pelvis Post Therapy of Gynecologic Malignancies

Participants
Liina Poder, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

liina.poder@ucsf.edu

LEARNING OBJECTIVES

1) To become familiar with most current various treatment options for gynecologic malignancies as well as expected imaging appearance of post treatment female pelvis. 2) To understand the expected and some unexpected imaging appearances as well as common pitfalls.

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RC150

MR Imaging-guided Breast Biopsy (Hands-on)

Sunday, Nov. 26 2:00PM - 3:30PM Room: E260

BR MR

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

Participants
Amy L. Kerger, DO, Columbus, OH (*Presenter*) Nothing to Disclose
Rifat A. Wahab, DO, Cincinnati, OH (*Presenter*) Nothing to Disclose
Vandana M. Dialani, MD, Boston, MA (*Presenter*) Nothing to Disclose
Deepa Sheth, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Lara D. Richmond, MD, Toronto, ON (*Presenter*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Presenter*) Book contract, Cambridge University Press
Kirti M. Kulkarni, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Jill J. Schieda, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Jiyon Lee, MD, New York, NY (*Presenter*) Nothing to Disclose
Mitva J. Patel, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Amado B. del Rosario, DO, Columbus, OH (*Presenter*) Nothing to Disclose
Karla A. Sepulveda, MD, Houston, TX (*Presenter*) Nothing to Disclose
Jamie G. Giesbrandt, MD, Albuquerque, NM (*Presenter*) Nothing to Disclose
Wendi A. Owen, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Laurie R. Margolies, MD, New York, NY (*Presenter*) Nothing to Disclose
Mitra Noroozian, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Jeffrey R. Hawley, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Nikki S. Ariaratnam, MD, Voorhees, NJ (*Presenter*) Nothing to Disclose
Su-Ju Lee, MD, Cincinnati, OH (*Presenter*) Spouse, Stockholder, General Electric Company; Spouse, Stockholder, Siemens AG
Mai A. Elezaby, MD, Madison, WI (*Presenter*) Nothing to Disclose
Anika N. Watson, MD, New York, NY (*Presenter*) Nothing to Disclose
Alena Levit, MD, Rochester, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Explain why MR-guided breast biopsy is needed for patient care. 2) Identify relative and absolute contraindications to MR-guided breast biopsy. 3) Describe criteria for MR-guided breast biopsy patient selection. 4) Debate risks and benefits of pre-biopsy targeted ultrasound for suspicious MRI findings. 5) Understand the basic MR-guided biopsy procedure, protocol and requirements for appropriate coil, needle and approach selection. 6) Manage patients before, during and after MR-guided breast biopsy. 7) Define the benefits and limitations of MR-guided vacuum assisted breast biopsy. 8) Apply positioning and other techniques to challenging combinations of lesion location and patient anatomy for successful MR-guided biopsy.

ABSTRACT

This course is intended to provide basic didactic instruction and hands-on experience for MR-guided breast biopsy. Because of the established role of breast MRI in the evaluation of breast cancer through screening and staging, there is a proven need for MR-guided biopsy of the abnormalities that can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls and 6) practice audits. Participants will spend 30 minutes in didactic instruction followed by 60 minutes practicing MR-guided biopsy using provided phantoms. Various combinations of full size state-of-the-art breast MRI coils, biopsy localization equipment and needles from multiple different vendors will be available for hands-on practice. Some stations will have monitors loaded with targeting software. Expert breast imagers from around the world will be at each of 10 stations to provide live coaching, tips, techniques and advice.

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RCA13

Rectal MRI (Hands-on)

Sunday, Nov. 26 4:00PM - 5:30PM Room: S401AB

GI IN MR

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

Participants
David H. Kim, MD, Middleton, WI (*Presenter*) Co-founder, VirtuoCTC, LLC; Shareholder, Cellectar Biosciences, Inc; Shareholder, Elucent Medical;
Mukesh G. Harisinghani, MD, Boston, MA (*Presenter*) Nothing to Disclose
Marc J. Gollub, MD, New York, NY (*Presenter*) Nothing to Disclose
Courtney C. Moreno, MD, Suwanee, GA (*Presenter*) Nothing to Disclose
Raj M. Paspulati, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Gaiane M. Rauch, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose
Zahra Kassam, MD, London, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Critically evaluate the primary tumor to accurately place in the appropriate T category. 2) Apply specific criteria to determine regional lymph node status. 3) Recognize relevant anatomic landmarks used in Rectal MRI cancer staging to help determine management.

ABSTRACT

This workshop will be led by members of the Society of Abdominal Radiology Rectal Cancer Disease Focused Panel. This group helps set the interpretation standards for rectal cancer MRI in the United States. In this 1.5 hour Hands-on Workshop, the participants will have the opportunity to review a number of rectal staging MRI cases on stand-alone computers or on a personal mobile device. The selected cases are intended to give a broad overview of the common issues encountered in rectal cancer staging, including appropriately categorizing the correct T category of the tumor as well as determining regional lymph node status. The relevant anatomic relationships of the tumor with adjacent structures for surgical and potential neoadjuvant options will be emphasized. An interactive platform will allow participants to see overall class performance for questions posed by the expert reviewer. Each case will be reviewed after a short interval to allow a participant to form an opinion prior to the expert review. This workshop is intended to give a practical, hands-on approach to rectal cancer staging by MRI.

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SPSC20

Controversy Session: PET/MR: Is There Added Value in Oncology?

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

MR NM RO

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

Participants

Evis Sala, MD, PhD, New York, NY (*Moderator*) Nothing to Disclose
Marius E. Mayerhoefer, MD,PhD, Vienna, Austria (*Presenter*) Nothing to Disclose
Hebert Alberto Vargas, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the pros and cons of combined PET/MRI in oncology compared to PET and MRI performed separately. 2) Highlight potential indications where combined PET/MRI may provide added value in oncology patient. 3) Outline the cost implications and future directions.

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RCB21

Prostate MRI (Hands-on) Course will be repeated Monday, Tuesday, Wednesday and Thursday from 8am-10am

Monday, Nov. 27 8:00AM - 10:00AM Room: S401CD

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
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Siemens AG
Roel D. Mus, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Geert M. Villeirs, MD, PhD, Ghent, Belgium (*Presenter*) Nothing to Disclose
Marloes van der Leest, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Rianne R. Engels, Cuijk, Netherlands (*Presenter*) Nothing to Disclose
Renske L. van Delft, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Leonardo K. Bittencourt, MD, PhD, Rio De Janeiro, Brazil (*Presenter*) Investor, Healfies LLC
Joseph J. Busch, MD, Chattanooga, TN (*Presenter*) Nothing to Disclose
Baris Turkbey, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Daniel J. Margolis, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Antonio C. Westphalen, MD, Mill Valley, CA (*Presenter*) Scientific Advisory Board, 3DBiopsy LLC ; Research Grant, Verily Life Sciences LLC
Philippe A. Puech, MD, Lyon, France (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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Rianne.Engels@radboudumc.nl

renske.vandelft@radboudumc.nl

Lkayat@gmail.com

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 30 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. PLEASE NOTICE: Based on our experience we expect this course to be very popular. We only have 50 computers, and two spots per computer. Only the first 100 people will be accepted in the room. The front rows are reserved for beginners. In case you have experience with prostate MR: Please take a seat at the computers in the back of the room. We will not have space for any additional listeners this year. The coursebook can be found as handout to this course, please download it and take it with you on your tablet or other device.

Active Handout:Renske Lian van Delft

http://abstract.rsna.org/uploads/2017/16002000/Active RCB21.pdf

MSCM21

Case-based Review of Magnetic Resonance (An Interactive Session)

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

MR

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

Participants
Jorge A. Soto, MD, Boston, MA (*Director*) Royalties, Reed Elsevier

Sub-Events

MSCM21A MRI of the Brain

Participants
Korgun Koral, MD,MBA, Queens, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kkoral@northwell.edu

LEARNING OBJECTIVES

1) Become familiar with the normal changes in the appearance of the developing brain. 2) Increase confidence in recognizing normal changes that may mimic pathology in pediatric brain MRI. 3) Develop an algorithm for preoperative diagnosis of suprasellar and cerebellar brain tumors.

MSCM21B MRI of the Spine

Participants
Pia C. Maly Sundgren, MD, PhD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Becoming familiar with normal and abnormal findings in the spine. 2) Increase confidence in recognizing traumatic spine injuries. 3) Describe a range of pathologies in the spine and spinal cord.

MSCM21C MRI of the Pancreas

Participants
Jaroslaw N. Tkacz, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Become familiar with normal and abnormal appearance of the pancreas on routine MRI sequences. 2) Develop strategies to detect pathology involving the pancreas. 3) Increase confidence in diagnosis of cystic and solid pancreatic neoplasms.

MSCM21D MRI of the GI System

Participants
Hero K. Hussain, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the normal and abnormal appearances of the GI tract on MRI. 2) Discuss strategies to navigate the numerous MR sequences. 3) Describe a range of pathologies of the GI tract including the liver.

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MSMI21

Molecular Imaging Symposium: Basics of Molecular Imaging

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

BQ MI MR US

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

FDA Discussions may include off-label uses.

Participants
Zaver M. Bhujwalla, PhD, Baltimore, MD (*Moderator*) Nothing to Disclose
Jan Grimm, MD, PhD, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

MSMI21A MI Using Radioactive Tracers

Participants
Jan Grimm, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the various radio tracers and their applications in Molecular Imaging studies. 2) Understand in which situations to use which radio tracers, what to consider when developing the imaging construct and what controls to obtain for nuclear imaging studies. 3) Examples will contain imaging with small molecules, with antibodies and nanoparticles as well as with cells in order to provide the participants with examples how o correctly perform their imaging studies. 4) Most of the examples will be from the oncology field but their underlying principles are universally applicable to other areas as well.

ABSTRACT

Nuclear Imaging is currently the only true "molecular" imaging method utilized in clinic. It offers quantitative imaging of biological processes in vivo. Therefore, it is not surprising that it is also highly frequented in preclinical imaging applications since it is currently the only true quantitative imaging method. Multiple agents have been developed, predominantly for PET imaging but also for SPECT imaging.In this talk, we will discuss the application of radio tracers to molecular imaging and what to consider. Common pitfalls and mistakes as well as required measures to avoid these will be discussed. We will discuss various examples of imaging constructs, ranging from small molecules to antibodies, nanoparticles and even cells. In addition, the imaging modalities will also briefly discussed, including PET, SPECT and Cherenkov imaging.

MSMI21B MI MRI and MRS

Participants
Zaver M. Bhujwalla, PhD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To define the role of MRI and MRS in molecular and functional imaging and cover specific applications in disease processes. 2) The primary focus will be advances in novel theranostic approaches for precision medicine.

ABSTRACT

With an array of functional imaging capabilities, magnetic resonance imaging (MRI) and spectroscopy (MRS) techniques are valuable in obtaining functional information, but the sensitivity of detection is limited to the 0.1-1 mM range for contrast agents and metabolites, respectively. Nevertheless, MRI and MRS are finding important applications in providing wide-ranging capabilities to tackle key questions in cancer and other diseases with a 'molecular-functional' approach. An overview of these capabilities and examples of MR molecular and functional imaging applications will be presented with a focus on theranostic imaging for precision medicine.

MSMI21C Nanoparticles

Participants
Heike E. Daldrup-Link, MD, Palo Alto, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

heiked@stanford.edu

LEARNING OBJECTIVES

1) Understand important safety aspects of ultrasmall superparamagnetic iron oxide nanoparticles, which are used as contrast agents for magnetic resonance imaging. 2) Recognize the value of immediately clinically applicable iron oxide nanoparticles for cancer imaging. 3) Learn about intrinsic immune-modulating therapeutic effects of USPIO.

ABSTRACT

Amid recent concerns about nephrogenic sclerosis and gadolinium deposition in the brain, patients and physicians are questioning

the use of gadolinium chelates and are actively seeking alternatives. In North America, the iron supplement ferumoxytol has gained considerable interest as an MR contrast agent. Ferumoxytol is composed of superparamagnetic iron oxide nanoparticles with strong T1- and T2-relaxivities and therefore can be used "off label" to enhance soft tissue contrast on MR images. In fact, ferumoxytol was originally designed as an MR contrast agent, but was later developed for anemia treatment. Ferumoxytol (Feraheme) is increasingly being used for a varierty of MR imaging applications in North America. In parallel, the iron oxide nanoparticle compound ferumoxtran-10 (Sinerem/Combidex) has regained a surge of interest in Europe and is currently undergoing continued clinical development. As these agents are adopted by a new generation of radiologists, it is important to build on the many lessons learned from previous experience with other iron oxide nanoparticle compounds. This presentation will explain basic concepts of iron oxide nanoparticle safety, biodistribution and MR imaging patters and offer important practical insights for the use of these agents for clinical MR imaging. Open questions and research needs will be discussed as well.

MSMI21D Advances in Ultrasound Molecular Imaging

Participants
Katherine W. Ferrara, PhD, Davis, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Inform of clinical utility and safety of contrast enhanced ultrasound (CEUS) imaging. 2) Educate on current diagnostic and therapeutic approaches. 3) Introduce newer concepts for combined diagnostic and therapeutic applications.

ABSTRACT

Contrast-Enhanced Ultrasound (CEUS) provides a novel, multi-faceted approach to diagnostic imaging and localized drug/gene delivery systems. The value-added proposition of CEUS centers on the pillars of safety, effectiveness, and economics. Specifically, in the field of diagnostic imaging, 3D CEUS ultrasound technology challenges the established formats CT, MR, and PET. CEUS provides distinct advantages including real-time volumetric imaging, unparalleled spatial and temporal resolution, economies of scale and all without exposure to unnecessary, ionizing radiation. Our efforts to develop 3D and contrast-enhanced ultrasound imaging continues to provide academic leadership while advancing the clinical field of cardiovascular medicine, urology (prostate imaging), and cancer (monitoring and therapy). In the evolving field of the ultrasound therapeutics, CEUS provides a novel, localized delivery system for ethical drugs and nucleic acids; all effectively delivered without viral-mediated agents. Further, the global installed base of ultrasound along with the safety record and ease of patient access highlights the utility of CEUS as a truly competitive, therapeutic delivery modality.In April 1, 2016, the USA FDA approved CEUS for liver imaging in adults and children. This is likely to have a major, paradigm chage in healthcare in the USA.

MSMI21E Quantitative Imaging Biomarkers

Participants
Robert J. Gillies, PhD, Tampa, FL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify at least one method of quantitatively assessing anatomic tumor response. 2) Identify at least one method of quantitatively assessing metabolic tumor response using FDG PET. 3) Identify an MRI quantitative metric which is associated with cellularity of biological processes and which can be used in response assessments.

ABSTRACT

Radiology initially developed as an analog imaging method in which non quantitative data were interpreted in a "qualitative and subjective" manner. This approach has worked well, but modern imaging also is digital, quantitative and has the opportunity for more quantitative and objective interpretations. This lecture will focus on a few areas in which quantitative imaging is augmenting qualitative image assessments to lead to more precise interpretation of images. Examples of such an approach can include measuremental of tumor "metabolic" activity using formalisms such as PERCIST 1.0; methods of assessment of tumor size and volumes using the RECIST 1.1 and emerging formalisms and metrics of tumor heterogeneity, density, receptor density, diffusion, vascular permeability and elasticity using techniques incuding PET/SPECT, MRI, CT and ultrasound. With quantitative imaging, the opportunity to move from qualitative methods to precise in vivo quantitative pheontyping is a real one, with a quantitative "phenome" complementing other "omics" such as genomics. However, the quality of quantitation may vary and close attention to technical methodologies and process are required to have reliable and accurate quantitation. The RSNA QIBA effort will be briefly reviewed as one approach to achieve precise quantiative phenotyping. Examples of the use of quantitative phenotyping to inform patient management will be discussed.

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RC201

Imaging of Thoracic Neoplasms: Update 2017

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

CH CT MR OI

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

Participants
Edith M. Marom, MD, Ramat Gan, Israel (*Moderator*) Speaker, Bristol-Myers Squibb Company

For information about this presentation, contact:

edith.marom@gmail.com

jerasmus@mdanderson.org

LEARNING OBJECTIVES

1) Utilize MR for imaging lung cancer. 2) Evaluate tumor response. 3) Image thymoma. 4) Stage lung cancer with the 8th edition TNM staging.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC201A Advances in MR Imaging of Lung Cancer

Participants
Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Presenter*) Research Grant, Toshiba Medical Systems Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Fuji Pharma Co, Ltd; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Guerbet SA;

For information about this presentation, contact:

yosirad@kobe-u.ac.jp

LEARNING OBJECTIVES

1) Understand the appropriate MR sequence lung cancer for answering each clinical question. 2) Identify the clinical relevance of MR imaging as compared with other modalities in not only lung cancer, but also pulmonary nodule patients. 3) Recognize the potential of 3T MR system for new MR imaging of lung cancer.

ABSTRACT

Since the clinical application of MR imaging in thoracic diseases, numerous basic and clinical researchers reported technical advances in sequencing, scanners and coils, image acquisition and reconstruction techniques, contrast media utilization, and development of post-processing tools. Among these, MR imaging was considered a major new research and diagnostic tool for various pulmonary diseases, especially lung cancer. As a result, state-of-the art thoracic MR imaging now has the potential to be used as a substitute for traditional imaging techniques and/or play a complimentary role in patient management. In this lecture, I will 1) present the appropriate MR sequence of lung cancer for answering each clinical question, 2) identify the clinical relevance of MR imaging as compared with other modalities in not only lung cancer, but also pulmonary nodule patients, and 3) discuss the potential of 3T MR system for new MR imaging in lung cancer.

RC201B Evaluating Tumor Response

Participants
Tina D. Tailor, MD, Durham, NC (*Presenter*) Research support, General Electric Company

For information about this presentation, contact:

tina.tailor@duke.edu

LEARNING OBJECTIVES

1) Discuss the role of CT for tumor response assessment. 2) Discuss limitations for traditional CT response criteria, including WHO and RECIST. 3) Discuss therapy response in the setting of novel lung cancer therapies, including immunotherapy.

RC201C Imaging of Thymoma

Participants
Edith M. Marom, MD, Ramat Gan, Israel (*Presenter*) Speaker, Bristol-Myers Squibb Company

For information about this presentation, contact:

edith.marom@gmail.com

LEARNING OBJECTIVES

1) Identify an incidental thymoma. 2) Apply the most appropriate imaging modality for the evaluation of thymoma. 3) Assign the newly proposed TNM stage to a newly diagnosed thymoma.

URL

http://pubs.rsna.org/doi/figure/10.1148/rg.2017160096

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RC201D Lung Cancer Staging

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

For information about this presentation, contact:

travis.henry@ucsf.edu

LEARNING OBJECTIVES

1) List the changes to the 8th TNM system for lung cancer staging. 2) Interpret CT for lung cancer staging by providing relevant T, N, and M information to the referring clinician. 3) recognize pertinent positive and negative imaging findings that alter management of lung cancer patient.

Honored Educators

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RC203

Cardiac Imaging for Intervention Planning

Monday, Nov. 27 8:30AM - 10:00AM Room: S502AB

CA CT IR MR

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

FDA Discussions may include off-label uses.

Participants
Joe Y. Hsu, MD, Los Angeles, CA (*Moderator*) Nothing to Disclose

Sub-Events

RC203A Cardiac CT Acquisition - Protocol Optimization

Participants
Brian B. Ghoshhajra, MD, Waban, MA (*Presenter*) Consultant, Siemens AG; Consultant, Medtronic plc

RC203B Imaging of Cardiac Shunts

Participants
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

radprabhakar@gmail.com

LEARNING OBJECTIVES

1) Understand the role of imaging, particularly CT and MRI in the evaluation of cardiac shunts. 2) Learn the optimal imaging protocols for evaluating cardiac shunts. 3) Review the imaging appearances of several cardiac shunts. 4) Discuss the contribution of imaging prior to intervention of cardiac shunts.

Honored Educators

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RC203C The Role of Imaging Prior to TAVR and Mitral Interventions

Participants
Jonathon A. Leipsic, MD, Vancouver, BC (*Presenter*) Speakers Bureau, General Electric Company; Speakers Bureau, Edwards Lifesciences Corporation; Consultant, Heartflow, Inc; Consultant, Circle Cardiovascular Imaging Inc; Consultant, Edwards Lifesciences Corporation; Consultant, Neovasc Inc; Consultant, Samsung Electronics Co, Ltd; Consultant, Koninklijke Philips NV; Consultant, Arineta Ltd; Consultant, Pi-Cardia Ltd;

For information about this presentation, contact:

jleipsic@providencehealth.bc.ca

LEARNING OBJECTIVES

1) Discuss the evolving role of transcatheter interventions for aortic stenosis and mitral regurgitation. 2) Review the role of CT to help size the mitral and aortic annulus. 3) Discuss how CT be used to help improve clinical outcomes of patients undergoing transcatheter valvular interventions.

Honored Educators

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RC203D Cardiac MRI and CT for Arrhythmia Treatment

Participants
Stefan L. Zimmerman, MD, Ellicott City, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

stefan.zimmerman@jhmi.edu

LEARNING OBJECTIVES

1) Learn how non-invasive imaging with cardiac MRI and CT are used in the evaluation of patients with cardiac arrhythmias. 2) Know how CT and MRI datasets are used to assist intraprocedural mapping of cardiac structure in patients undergoing electrophysiologic ablation procedures. 3) Understand how MRI and CT can be used for imaging of the arrhythmia substrate and pre-procedural planning. 4) Comprehend the role of non-invasive imaging for sudden cardiac death risk stratification and ICD placement decisions in various cardiomyopathies.

Honored Educators

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RC204

Musculoskeletal Series: MRI of Root Joints - Hip and Shoulder

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

MR MK

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

FDA Discussions may include off-label uses.

Participants
Lynne S. Steinbach, MD, San Francisco, CA (*Moderator*) Nothing to Disclose
Miriam A. Bredella, MD, Boston, MA (*Moderator*) Nothing to Disclose
Marc H. Willis, DO, Houston, TX (*Moderator*) Nothing to Disclose
Robert S. Campbell, MBBCh, Liverpool, United Kingdom (*Moderator*) Nothing to Disclose
William B. Morrison, MD, Philadelphia, PA (*Moderator*) Consultant, AprioMed AB; Patent agreement, AprioMed AB; Consultant, Zimmer Biomet Holdings, Inc

For information about this presentation, contact:

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Sub-Events

RC204-01 Hip MRI Technique

Monday, Nov. 27 8:30AM - 8:55AM Room: E450A

Participants
William B. Morrison, MD, Philadelphia, PA (*Presenter*) Consultant, AprioMed AB; Patent agreement, AprioMed AB; Consultant, Zimmer Biomet Holdings, Inc

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Understand the different MR imaging protocols used for imaging the hip. 2) Be able to apply MRI techniques for diagnosis of hip pathology. 3) Appreciate different hip conditions that can be diagnosed using MRI.

ABSTRACT

Hip and groin pain can be related to intra-articular or extra-articular pathology, and it can be difficult even for an experienced subspeciaist surgeon to distinguish these conditions. MRI is an essential part of the diagnostic algorithm. Because of the multiplicity of clinical scenarios and conditions, there are a variety of MRI protocols that can be applied. This lecture will address the broad topic of MR imaging techniques for the patient with hip or groin pain.

RC204-02 Hip MRI Pitfalls

Monday, Nov. 27 8:55AM - 9:20AM Room: E450A

Participants
Scott D. Wuertzer, MD, MS, Winston-Salem, NC (*Presenter*) Nothing to Disclose

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swuertze@wakehealth.edu

LEARNING OBJECTIVES

1) Apply a systematic approach to evaluating hip MRI.2) Recognize normal osseous and soft tissue variants of the hip that can mimic pathology.3) Differentiate normal acetabular labral variants from labral tears.

RC204-03 Hip MRI: What the Surgeon Wants to Know

Monday, Nov. 27 9:20AM - 9:45AM Room: E450A

Participants
Miriam A. Bredella, MD, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Be familiar with challenging intra- and extra-articular hip pathology, important to the orthopedic surgeon. 2) Understand advanced MR imaging techniques to assess intra-articular hip pathology, esp. the chondrolabral junction. 3) Diagnose hip conditions that need to be identified prior to hip preservation surgery.

RC204-04 Supra- and Infratrochanteric Femoral Torsion Abnormalities and Its Association with Femoroacetabular Impingement and Hip Dysplasia

Monday, Nov. 27 9:45AM - 9:55AM Room: E450A

Awards
Trainee Research Prize - Resident

Participants
Benjamin Fritz, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
Susanne Bensler, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Michael Leunig, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Patrick Zingg, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Reto Sutter, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate a novel measurement technique for assessing the supra- and infratrochanteric component of femoral torsion, to establish reference values in healthy volunteers, and to compare supra- and infratrochanteric torsion in patients with hip dysplasia and femoroacetabular impingement.

METHOD AND MATERIALS

Femoral torsion was retrospectively assessed in 380 patients and 61 healthy volunteers by MRI: For assessing supra- and infratrochanteric torsion three measurement techniques (Kim-, simplified Kim-, and Centroid-method) were evaluated by two readers on 100 patients. The technique with the highest inter-reader reliability was selected to perform measurements on all patients and volunteers. Patients' supra- and infratrochanteric torsions were correlated to hip disorders diagnosed by specialized hip surgeons, and compared to reference values of healthy volunteers. Statistical analysis included the independent t-test, Mann-Whitney-U-test and the intraclass correlation coefficient (ICC).

RESULTS

The most reliable technique for measuring supra-/infratrochanteric torsion was the Centroid-method, with an ICC of 0.979. The supra-/infratrochanteric torsion of the volunteers was 31.5°±7.4° and -18.3°±9.9°, respectively. In comparison to volunteers, patients with hip dysplasia had significantly higher supra- and infratrochanteric torsion with 37.5°±10.3° ($P = 0.001$) and -9.6°±11.7° ($P < 0.001$), respectively, and patients with pincer-type FAI had significantly higher supratrochanteric torsion of 37.8°±8.0° ($P = 0.002$).

CONCLUSION

The supra- and infratrochanteric component of femoral torsion differs substantially between hip disorders: Patients with hip dysplasia have predominantly increased infratrochanteric torsion, while patients with pincer-type FAI have increased supratrochanteric torsion. Separate quantification of supra- and infratrochanteric torsion allows a more detailed analysis of hip disorders and may influence treatment planning.

CLINICAL RELEVANCE/APPLICATION

Distinguishing whether femoral torsion deformities originate at the femoral neck or the femoral shaft may influence on the choosing of the location of the osteotomy in patients in need of derotational surgery of the femur.

RC204-05 A Virtual Dynamic Model of the Hip: Utility for Surgical Planning In Patients with Femoroacetabular Impingement (FAI) and Correlation of Predicted Impingement with Preoperative Measures

Monday, Nov. 27 9:55AM - 10:05AM Room: E450A

Awards
Student Travel Stipend Award

Participants
Hamid Bagce, MD,PhD, New York, NY (*Presenter*) Nothing to Disclose
Thomas S. Lynch, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Tony T. Wong, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Develop a virtual dynamic model of the hip that allows for optimal surgical planning in patients with femoroacetabular impingement (FAI).

METHOD AND MATERIALS

An IRB-approved retrospective search yielded 14 patients with FAI (Mean±SD age: 25±8.5 yrs) who received CT scans and underwent arthroscopy from 10/5/16 to 3/17/17. Clinical data included presurgical maximal hip flexion, alpha angle, lateral center edge angle, femoral version, acetabular version and the total depth of osteoplasty (femoral+acetabular) resected at surgery. Using custom-written MATLAB software, DICOM data were interpolated over an equal-axes three-dimensional volume and segmented. Femoral head rotation was programmed to either a user-specified limit or to the point of femoroacetabular impact. To test model validity, virtual maximal hip flexion was compared to patients' actual maximal hip flexion. To simulate functional impingement, the

model hip was flexed 90° and internally rotated 40°. The corresponding depth (mm) of osseous overlap was recorded as the amount of virtual osteoplasty required to restore physiologic motion. Applied test statistics included paired t-test (t), Pearson correlation (r) and Bartlett's test of equal variance (X2).

RESULTS

Model validity testing demonstrated no significant difference (t=-0.78, p=0.44) and a significant correlation (r=0.67, p=0.009) between virtual (Mean±SE: 109.6±6.1°) with actual (104±2.8°) maximal hip flexion. There was no significant correlation between the depth of virtual osteoplasty required to restore normal motion with alpha angle (r=0.27, p=0.35), lateral center edge angle (r=-.02, p=0.96), or femoral (r=-0.51, p=0.06) or acetabular version (r=-0.46, p=0.10). There was no significant difference in means (t=0.18, p=0.86) but a significant difference in variances (X2=35.0, p<0.001) of total osteoplasty depth resected at surgery (6.6±0.2 mm) compared to the depth recommended by the model (6.3±1.5 mm).

CONCLUSION

A virtual dynamic hip model provides quantitative impingement data far more valuable than conventional radiologic parameters and would allow for optimal individually-tailored surgical planning in patients with FAI.

CLINICAL RELEVANCE/APPLICATION

A virtual dynamic model of the hip provides invaluable detailed impingement data, with the goal of optimizing surgery and improving postsurgical functional outcomes in patients with FAI.

RC204-06 Can a 3D 'Pseudo-CT' MRI Sequence replace CT for Preoperative Evaluation of Femoroacetabular Impingement?

Monday, Nov. 27 10:05AM - 10:15AM Room: E450A

Participants
Albair Guirguis, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Naveen Subhas, MD, Cleveland, OH (*Presenter*) Research Grant, Siemens AG
Nancy A. Obuchowski, PhD, Cleveland, OH (*Abstract Co-Author*) Research Consultant, Siemens AG Research Consultant, QT Ultrasound Labs Research Consultant, Elucid Bioimaging Inc
James Rosneck, Garfield Heights, OH (*Abstract Co-Author*) Nothing to Disclose
Wadih Karim, RT, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Ryan Goodwin, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Kavitha Yaddanapudi, MD, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Joshua M. Polster, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In the preoperative evaluation of femoro-acetabular impingement (FAI), both MRI and CT are often obtained for evaluation of soft tissue and bone anatomy, respectively. The purpose of this study was to determine if the addition of a 3D MRI sequence post-processed to simulate a CT, a "pseudo-CT" MRI sequence, could be used instead of CT to evaluate bone anatomy in FAI patients.

METHOD AND MATERIALS

Acetabular version and alpha angles were independently and blindly measured by 4 readers in 40 hips of 20 patients (mean age, 26 years) who had both a pelvis CT and MRI which included a 3D gradient-echo two-point Dixon sequence post-processed to simulate a CT scan. The need to perform an acetabuloplasty and/or femoroplasty were assessed by 2 orthopedic surgeons who independently and blindly reviewed the 2D images and 3D volume rendered models created from the CT and pseudo-CT MRI sequence. The agreement between readers using MRI and CT (interprotocol agreement) was compared to the agreement when readers were only using CT (intraprotocol agreement) for interchangeability (i.e. substituting MRI for CT can result in no more than a 5% excess disagreement).

RESULTS

Interprotocol (74% within 5 degrees) and intraprotocol (72% within 5 degrees) agreement for acetabular version were nearly identical and interchangeable without significant excess disagreement. Interreader agreement with MRI for acetabular version was higher than with CT for all cutoff values. Interprotocol (45% within 5 degrees) and intraprotocol (44% within 5 degrees) agreement for alpha angle was poor with both CT and MRI but very similar. Interprotocol (55%) and intraprotocol (55%) agreement for the need to perform acetabuloplasty and/or femoroplasty was poor with both CT and MRI but nearly identical.

CONCLUSION

Acetabular version measurements, alpha angle measurements and surgical planning using a 3D "pseudo-CT" MRI sequence were similar with that using a CT suggesting that it could be used to replace CT in the preoperative evaluation of FAI.

CLINICAL RELEVANCE/APPLICATION

The use of a "pseudo-CT" MRI sequence to evaluate bone anatomy instead of CT in the preoperative evaluation of FAI could not only lower health care costs by eliminating the need for an additional test but avoid radiation exposure in this young patient population.

RC204-07 Shoulder MRI Technique

Monday, Nov. 27 10:15AM - 10:35AM Room: E450A

Participants
Robert S. Campbell, MBBCh, Liverpool, United Kingdom (*Presenter*) Nothing to Disclose

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Active Handout:Robert SD Campbell

http://abstract.rsna.org/uploads/2017/17000339/Active RC204-07.pdf

LEARNING OBJECTIVES

1) To understand the choice of image sequences for routine shoulder MR imaging. 2) To understand the choice of image planes for routine shoulde r MR Imaging. 3) To understand the limitations of routine shoulder MR protocols and to identify when protocols need to be modified. 4) To understand which additional sequences and image planes may be required to identify less common shoulder pathologies. 5) To understand when the use of alternative techniques such as MR arthrography are indicated.

RC204-08 Shoulder MRI Pitfalls

Monday, Nov. 27 10:45AM - 11:05AM Room: E450A

Participants
Lynne S. Steinbach, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

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lynne.steinbach@ucsf.edu

LEARNING OBJECTIVES

1) Review normal anatomy and variants in the bones of the glenohumeral joint that can simulate pathology. 2) Understand the normal variants of the labrum that can be mistaken for tears. 3) Avoid overcalling abnormalities in the rotator cuff and biceps tendons. 4) Recognize the significance of some cysts and bursae around the shoulder. 5) Reduce misinterpretation of expected postoperative findings.

LEARNING OBJECTIVES

1) Review normal anatomy and variants in the bones of the glenohumeral joint that can simulate pathology. 2) Understand the normal variants of the labrum that can be mistaken for tears. 3) Avoid overcalling abnormalities in the rotator cuff and biceps tendons. 4) Recognize the significance of some cysts and bursae around the shoulder. 5) Reduce misinterpretation of expected postoperative findings.

RC204-09 Inferior Glenohumeral Vertical Distance: A Novel Radiographic Marker Better Suited for Detection of Rotator Cuff Tears Involving the Infraspinatus Tendon

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

Participants
Mohammed Alfaqih, MD, Burlington, MA (*Presenter*) Nothing to Disclose
Shalin M. Soni, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Sebastian Flacke, MD, Burlington, MA (*Abstract Co-Author*) Consultant, BTG International Ltd Consultant, Surefire Medical, Inc Consultant, Koninklijke Philips BV Consultant, XACT Robotics
Yasir Andrabi, MD, MPH, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Dmitry Elentuck, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Robert J. French Jr, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the association between the radiographically determined inferior glenohumeral vertical distance (IGHVD) and rotator cuff tears (RCT) involving the infraspinatus (IS) tendon; and, compare the sensitivity and specificity of acromiohumeral distance (AHD) and IGHVD for RCT involving IS tendon.

METHOD AND MATERIALS

In this IRB approved retrospective study, 140 patients with MRI proven full thickness rotator cuff tear were included after they met the inclusion and exclusion criteria. The exclusion criteria include but not limited to any patient with isolated partial thickness tear. Patients were divided into two groups, Group A: patients with RCT involving full or partial IS tears, and Group B: RCT not involving IS. Shoulders MRI were evaluated by board certified musculoskeletal radiologists. Radiographs were analyzed blinded to MRI findings. IGHVD determined by measuring vertical distance from anatomical neck to inferior glenoid level in anteroposterior (AP) view; distance of more than 2mm was considered positive. AHD was assessed by measuring vertical interval between inferior border of acromion process and humeral head in (AP) view; distance less than 7 mm was considered positive. The correlation between increased IGHVD and presence of IS involvement was assessed. Sensitivity, specificity, PPV and NPV were compared between IGHVD and AHD in assessing IS tendon tear. Further subgroup analysis of Group A separating full and partial IS tears were performed.

RESULTS

Group A included 89 patients and Group B involved 51 patients. A strong association was found between IGHVD and rotator cuff tears involving infraspinatus tendon ($p < 0.001$). IGHVD was found to have increased sensitivity, PPV and NPV (66%, 92%, 60%, respectively) compared to AHD (20%, 85%, 40% respectively). The specificity of both was comparable (90% for IGHVD and 94% for AHD). Subgroup analysis included 54 patients with full thickness infraspinatus tear and 35 patients with partial infraspinatus tear. No statistically significant difference between these two groups in terms of IGHVD was found.

CONCLUSION

There is a strong association between radiographically determined IGHVD and infraspinatus tear and is more sensitive than AHD.

CLINICAL RELEVANCE/APPLICATION

Many non-pathological factors can decrease AHD, and increase the false positive rate. IGHVD has greater efficacy than AH in detecting rotator cuff tears that involve the infraspinatus tendon.

RC204-10 Usefulness of 3D T1 High-Resolution Isotropic Volume Excitation Sequence Obtained From Direct Shoulder MR Arthrography for the Diagnosis of SLAP and Bankart Lesions: Comparison with 2D Proton-Density Fat-Suppressed Sequence

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

Participants
Youngno Yoon, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Seong Jong Yun, Cheongwon-gun, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sun Hwa Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyeon Hwan Jo, Anyang, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Dong Hyeon Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jae Gwang Song, Cheongwon-gun, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jin Yang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Wook Jin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the diagnostic accuracy of three-dimensional T1 high-resolution isotropic volume excitation (3D-THRIVE) sequence obtained from direct shoulder magnetic resonance arthrography (MRA) for superior labral anterior-to-posterior (SLAP) and Bankart lesions compared to that of three plane (axial, coronal, sagittal) two-demensional proton-density fat-suppressed (2D-PD-FS) sequence.

METHOD AND MATERIALS

We retrospectively studied 84 patients who underwent direct shoulder MRA using 3D-THRIVE and 2D-PD-FS sequences. Arthroscopic finding was considered as reference standard. Quantitative image quality was evaluated in terms of the contrast-to-noise ratio (CNR) of the intra-articular (glenohumeral joint) signal by one physician. Qualitative image quality (subjective image noise and image sharpness) and radiologic diagnosis of SLAP (type I~IV) /Bankart lesions (cartilaginous vs. osseous) were separately assessed by two radiologists. Bankar variant lesions such as Perthes lesion were also considered as Bankart lesions. Both the 3D-THRIVE sequence and the 2D-PD-FS sequence were evaluated in random order. Wilcoxon rank sum tests, chi-square/Fisher's exact tests, and DeLong's tests were used to compare image quality and diagnostic performance between the two sequences. Inter-observer agreement was calculated using the an intraclass coefficient (ICC).

RESULTS

3D-THRIVE images had significantly higher CNR ($p<0.001$), and subjective ratings of image noise ($p=0.009$) and image sharpness ($p=0.039$) than 2D-PD-FS images ($p<0.001$). Although there was no difference in diagnostic accuracy for SLAP/Bankart lesions between 3D-THRIVE and 2D-PD-FS images ($p>=0.18$), 3D-THRIVE images had higher diagnostic performance (sensitivity, 93.0-97.2%; specificity, 95.8-100%; accuracy, 95.2-97.6%) with almost perfect agreement (ICC=0.898-0.942) when compared to 2D-PD-FS images (sensitivity, 86.1-91.7%; specificity, 93.8-95.8%; accuracy, 90.5-92.9%; agreement, ICC=0.782-0.858).

CONCLUSION

The diagnostic performance of imaging for the detection of SLAP and Bankart lesions might be improved with the use of 3D-THRIVE. In addition, 3D-THRIVE has the ability to be reconstructed freely without an additional scan.

CLINICAL RELEVANCE/APPLICATION

The use of 3D-THRIVE may be helpful in patients with SLAP and Bankart lesions, and may be routinely obtained during direct shoulder MRA.

RC204-11 Incidence of Rotator Cuff Tears in the Setting of Calcific Tendinopathy on MRI: A Case-Controlled Comparison

Monday, Nov. 27 11:25AM - 11:35AM Room: E450A

Participants
Nicholas M. Beckmann, MD, Houston, TX (*Presenter*) Nothing to Disclose
Michael Q. Tran, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Chunyan Cai, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Primary: Determine incidence and size of rotator cuff tears in patients with rotator cuff calcific tendinopathy diagnosed on MRI. Secondary: Compare incidence of MRI inflammatory changes between homogeneous and heterogeneous morphologies of calcific tendinopathy.

METHOD AND MATERIALS

Retrospective review of all patients with rotator cuff calcific tendinopathy (RCCT) diagnosed by MRI at our institution during a 5 year peroid (N=37). Retrospective review of an age, gender, and laterality matched cohort without RCCT (N=36) was performed for comparison of rotator cuff tear incidence. The presence of rotator cuff tear was compared between the two groups using Chi-square test with tear size and location being compared using Fisher's exact test. The RCCT group was subcategorized as homogenous (N=26) or heterogenous (N=11) calcifications. The presence of joint effusion, bursal effusion, soft tissue edema, and bone marrow edema was compared between these two subgroups using Fisher's exact test.

RESULTS

The incidence of rotator cuff tear in the RCCT and non-RCCT group was 30% and 42%, which was not statistically significant (p=0.2870). Only 36% (4 of 11) of rotator cuff tears in the RCCT group involved the same tendon as the calcific tendinopathy. Rotator cuff tear size approached statistical significance between the two groups with none of the RCCT group having full-thickness cuff tears and 33% of the non-RCCT group having full-thickness tears (p=0.0527). Heterogeneous calcifications (HTC) were associated with more inflammatory changes compared to homogeneous calcifications (HC). Moderate/severe soft tissue edema was present in 64% of HTC and 4% of HC (p=0.0005). Bone marrow edema was present in 18% of HTC and 0% of HC (p=0.0826). Moderate/large bursal was present in 27% of HTC and 4% of HC (p=0.0880).

CONCLUSION

Calcific tendinopathy is not associated with an increased incidence of rotator cuff tear, and calcific tendinopathy in the setting of shoulder pain likely confers a decreased incidence of full-thickness rotator cuff tear. Heterogeneous calcifications are associated with more soft tissue inflammation than homogeneous calcifications and likely represent the acute symptomatic phase of calcification.

CLINICAL RELEVANCE/APPLICATION

Calcific tendinopathy has low incidence of associated full-thickness rotator cuff tear, so a period of conservative theraphy should be considered prior to performing MRI to assess rotator cuff pathology.

RC204-12 Shoulder MRI: What the Surgeon Wants to Know

Monday, Nov. 27 11:35AM - 12:00PM Room: E450A

Participants
Jenny T. Bencardino, MD, Lake Success, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review common preoperative indications for cross sectional imaging with emphasis on MR imaging assessment of rotator cuff tears, long head of biceps tendon disease and anterior shoulder dislocation. 2) To identify different morphological variants of rotator cuff tears and treatment implications. 4) To review the indications for the use of bicipital tenodesis and tenotomy. 5) To review current methods for evaluation of bone loss in the setting of shoulder dislocation

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/ Jenny T. Bencardino, MD - 2014 Honored Educator

RC217

Emerging Technology: Imaging of Dementias

Monday, Nov. 27 8:30AM - 10:00AM Room: S505AB

CT MR NR NM

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

FDA Discussions may include off-label uses.

Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the value of FDG brain PET/CT in differentiating various dementias in cognitive decline. 2) To discuss the value of Amyloid brain PET/CT in patients with cognitive decline and Alzheimer's disease. 3) Understand which FDA approved MR techniques are currently available for improving differential diagnosis in patients with dementia. 4) Improve basic knowledge of how MR results correspond to clinical dementia phenotypes. 5) Discuss recent technological advances including applications of dynamic susceptability contrast (DSC) MR, arterial spin labelling (ASL) and resting state functional connectivity MRI (rs-fcMRI) in the setting of patients with dementia. 6) Describe the basic science principles behind tau PET/CT imaging. 7) Understand the utility of tau PET/CT imaging in neurodegenerative disease. 8) Identify the findings of a positive tau PET/CT scan.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC217A Imaging Dementias: FDG and Amyloid PET/CT

Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the value of FDG brain PET/CT in differentiating various dementias in cognitive decline. 2) To discuss the value of Amyloid brain PET/CT in patients with cognitive decline and Alzheimer's disease.

RC217B Imaging Dementias: MRI

Participants
Tammie S. Benzinger, MD, PhD, Saint Louis, MO (*Presenter*) Research Grant, Eli Lilly and Company; Investigator, Eli Lilly and Company; Investigator, F. Hoffmann-La Roche Ltd;

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benzingert@WUSTL.EDU

LEARNING OBJECTIVES

1) Understand which FDA approved MR techniques are currently available for improving differential diagnosis in patients with dementia. 2) Improve basic knowledge of how MR results correspond to clinical dementia phenotypes. 3) Discuss recent technological advances including applications of dynamic susceptability contrast (DSC) MR, arterial spin labelling (ASL) and resting state functional connectivity MRI (rs-fcMRI) in the setting of patients with dementia.

RC217C Imaging Dementias: Tau PET/CT

Participants
Val J. Lowe, MD, Rochester, MN (*Presenter*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Eli Lilly and Company; Advisory Board, Merck & Co, Inc

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vlowe@mayo.edu

LEARNING OBJECTIVES

1) Describe the basic science principles behind tau PET/CT imaging. 2) Understand the utility of tau PET/CT imaging in neurodegenerative disease. 3) Identify the findings of a positive tau PET/CT scan.

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RC229

MRI Safety Issue for Implants, Devices, and Contrast: Update 2017 (An Interactive Session)

Monday, Nov. 27 8:30AM - 10:00AM Room: E451A

MR SQ

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

FDA Discussions may include off-label uses.

Participants
Jeffrey C. Weinreb, MD, New Haven, CT (*Moderator*) Consultant, Bracco Group;

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LEARNING OBJECTIVES

1) Understand the various MRI issues that impact passive and active, implants and devices. 2) Define the terms applied to MRI labeling of implants and devices. 3) Appreciate the controversies that exist for certain implants and understand the latest labeling information for implanted medical products. 4) Describe current data about safety of gadolinium-based contact agents. 5) Compare the association of various GBCAs with NSF and gadolinium retention. 6) Review updated recommendations about use of gadolinium-based contrast agents. 7) Through case presentation format multiple common clinical scenarios will be presented that reflect potential MRI safety events.8) Best practices and literature will be reviewed to inform participants on how to best address these scenarios with an emphasis on MR and patient safety principles.

SAM

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Sub-Events

RC229A MRI Safety for Implants and Devices

Participants
Frank G. Shellock, PhD, Playa Del Rey, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the various MRI issues that impact passive and active, implants and devices. 2) Define the terms applied to MRI labeling of implants and devices. 3) Appreciate the controversies that exist for certain implants and understand the latest labeling information for implanted medical products.

RC229B Update on the Risks of Gadolinium-Based Contrast Agents

Participants
Jeffrey C. Weinreb, MD, New Haven, CT (*Presenter*) Consultant, Bracco Group;

For information about this presentation, contact:

jeffrey.weinreb@yale.edu

LEARNING OBJECTIVES

1) Describe current data about safety of gadolinium-based contact agents. 2) Compare the association of various GBCAs with NSF and gadolinium retention. 3) Review updated recommendations about use of gadolinium-based contrast agents.

RC229C Common Clinical MRI Safety Scenarios

Participants
Jay K. Pahade, MD, New Haven, CT (*Presenter*) Consultant, Precision Imaging Metrics, LLC

LEARNING OBJECTIVES

1) Through case presentation format multiple common clinical scenarios will be presented that reflect potential MRI safety events. 2) Best practices and literature will be reviewed to inform participants on how to best address these scenarios with an emphasis on MR and patient safety principles.

RC229D Questions and Answers

Participants
Frank G. Shellock, PhD, Playa Del Rey, CA (*Presenter*) Nothing to Disclose
Jay K. Pahade, MD, New Haven, CT (*Presenter*) Consultant, Precision Imaging Metrics, LLC
Jeffrey C. Weinreb, MD, New Haven, CT (*Presenter*) Consultant, Bracco Group;

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CS20

What We Need to Know, What We Need to Do: Presented by Northwest Imaging Forums, educational grant provided by Bracco Diagnostics, Inc

Monday, Nov. 27 9:00AM - 10:30AM Room: S101AB

PARTICIPANTS

Emanuel Kanal, MD, FACR, FISMRM, MRMD, AANG, Pittsburgh, PA; Robert J. McDonald, MD, PhD, Rochester, MN

PROGRAM INFORMATION

In an effort to provide Physicians and Technologists with current information and data to make informed decisions in their clinical settings, this symposium covers several areas. Gadolinium agents are not all the same with respect to relaxivity, efficacy and safety. We need to understand which Gadolinium agents on the US market are best for our patients based on crossover studies, safety, optimizing advancements, clinical experience and other peer review literature. Accreditation and CE Credit Statements: This program has been submitted for approval of 1.0 hour of Category A CE credit as designated by The Section for Magnetic Resonance Technologists (SMRT) RCEEM. This activity may be available in multiple formats or from different sponsors. ARRT regulations state that an individual may not repeat a live activity for credit if it was reported in the same or any subsequent biennium. Faculty and Planner Disclosures: In accordance with this policy, faculty and planners must disclose any financial relationships with commercial interests germane to program content. Additionally, in the event a conflict of interest (COI) does exist, it is the policy of NWIF to ensure that the COI is resolved in order to ensure the integrity of the CE activity. The planner has nothing to disclose.

CME

The Course does not offer CME credit

RSVP

http://www.nwifinvite.com/index.php/events/mri-symposium-at-rsna-chicago/

Sub-Events

CS20A **Gadolinium Retention: Safety versus Efficacy?**

Monday, Nov. 27 9:00AM - 9:35AM Room: S101AB

CS20B **Scientific Review of Gadolinium Safety: Balancing Evidence versus Hype**

Monday, Nov. 27 9:35AM - 10:10AM Room: S101AB

CS20C **Discussion**

Monday, Nov. 27 10:10AM - 10:30AM Room: S101AB

MSCM22

Case-based Review of Magnetic Resonance (An Interactive Session)

Monday, Nov. 27 10:30AM - 12:00PM Room: S100AB

MR

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

Participants
Jorge A. Soto, MD, Boston, MA (*Director*) Royalties, Reed Elsevier

Sub-Events

MSCM22A MRI of the Genitourinary System

Participants
Christine O. Menias, MD, Chicago, IL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

menias.christine@mayo.edu

LEARNING OBJECTIVES

1) Discuss MR imaging features of several GU cases in a case-based format. 2) Review imaging pitfalls and differential diagnoses of GU cases at MR imaging. 3) Pathology of the kidneys, bladder, seminal vesicles, testes, retroperitoneum , and adrenals will be discussed in a case based format.

ABSTRACT

MR imaging features of several GU entities will be discussed in a case based format. Differential diagnoses, and pitfalls will be addressed of the different GU entities. Renal, bladder, seminal vessicles , testes , retroperitoneum and adrenal gland pathologies will be reviewed

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/ Christine O. Menias, MD - 2013 Honored EducatorChristine O. Menias, MD - 2014 Honored EducatorChristine O. Menias, MD - 2015 Honored EducatorChristine O. Menias, MD - 2016 Honored EducatorChristine O. Menias, MD - 2017 Honored Educator

MSCM22B MRI of the Shoulder

Participants
Jim S. Wu, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the common conditions that lead to shoulder pain. 2) Recognize the MR features of conditions that cause shoulder pain.

ABSTRACT

The shoulder is a dynamic joint capable of a wide range of motion. Injuries to the shoulder are extremely commmon and it is important for the radiologist to understand the conditons that can affect the shoulder and their characteristic appearances on MRI.

MSCM22C MRI of the Knee

Participants
Donald L. Resnick, MD, Del Mar, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Illustrate the role of MRI in the assessment of internal derangements of the knee. 2) Stress the importance of knowledge of anatomy in correct diagnosis of these derangements. 3) Emphasize important points of differential diagnosis.

ABSTRACT

MRI of the knee is being used increasingly as the method of choice in the assessment of internal derangements of the knee. In this presentation, this role will be illustrated, with particular regard ot the menisci and ligaments, and points of differrential diagnosis will be stressed.

MSCM22D MRI of the Pediatric Disorders

Participants
Robert Orth, MD,PhD, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review common and not so common abnormalities. 2) Discuss differential diagnoses and characteristic imaging features. 3) Describe important historical and imaging features that allow differentiation.

SSC01

Cardiac (Non-ischemic Cardiomyopathy and Myocarditis)

Monday, Nov. 27 10:30AM - 12:00PM Room: S502AB

CA MR

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

FDA Discussions may include off-label uses.

Participants
Gautham P. Reddy, MD, Seattle, WA (*Moderator*) Researcher, Koninklijke Philips NV
Tina D. Tailor, MD, Durham, NC (*Moderator*) Research support, General Electric Company

Sub-Events

SSC01-01 Noninvasive Hematocrit Assessment for Cardiac MRI Extracellular Volume Fraction Quantification Using a Point of Care Device and Synthetic Derivation

Monday, Nov. 27 10:30AM - 10:40AM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Sean Robison, MBBS, Toronto, ON (*Presenter*) Nothing to Disclose
Gauri R. Karur, MBBS, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Rachel Wald, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Dinesh Thavendiranathan, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Andrew M. Crean, MD, Toronto, ON (*Abstract Co-Author*) Research support, sanofi-aventis Group
Kate Hanneman, MD, FRCPC, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate noninvasive measures of hematocrit (Hct) for cardiac MRI extracellular volume (ECV) quantification using a noninvasive point of care (POC) device and synthetic derivation, with laboratory Hct as the reference standard.

METHOD AND MATERIALS

In this prospective IRB approved study, 129 subjects (46% male, 47.4±13.4 years) underwent cardiac MRI T1 mapping at 1.5T (n=83) and 3T (n=46) using MOLLI (n=118) or ShMOLLI (n=11). Laboratory Hct values were obtained by venipuncture within 24 hours. Same day noninvasive hemoglobin values were acquired utilizing a POC device (Pronto-7, Masimo, Irvine, California, USA) with a 0.3 conversion to Hct. Three test-retest POC values were obtained in a subgroup of patients (n=44). Synthetic hematocrit was derived from pre-contrast blood pool R1 using previously published conversions in the subgroup at 1.5T. Left ventricular ECV was calculated based on pre- and post-contrast T1 values and input of laboratory Hct (ECV-lab), POC Hct (ECV-POC), and synthetic Hct (ECV-synthetic), respectively.

RESULTS

There was no significant difference between laboratory and POC Hct (0.397±0.050 vs. 0.395±0.047, p=0.532) or ECV (27.3±4.7 vs. 27.4±4.8, p=0.451) with excellent correlation between measures (Hct r=0.81, p=<0.001 and ECV r=0.92, p=<0.001). There was no significant difference between laboratory and synthetic Hct (0.395±0.031, p=0.073) or ECV (26.7±4.1, p=0.084) with good correlation between measures (Hct r=0.66, p=<0.001 and ECV r=0.90, p=<0.001). Bland-Altman analysis demonstrated minimal bias for ECV-POC (bias= -0.15%, 95%CI[-2.2, 2.3]) and ECV-synthetic (bias=0.22%, 95%CI[-1.82, 2.7]) compared to ECV-lab. Excellent diagnostic performance was achieved for ECV-POC (area under the curve (AUC) 0.909, 95%CI[0.840, 0.977]) and ECV-synthetic (AUC 0.852, 95%CI[0.734, 0.970]) for discriminating ECV-lab≥30%, with no significant difference in AUC between the two noninvasive measures (p=0.485). There was excellent test-retest agreement for ECV-POC (ICC 0.977, 95%CI[0.963, 0.987]).

CONCLUSION

Myocardial ECV calculated using noninvasive measures of Hct correlates strongly with conventionally calculated ECV using laboratory Hct values with minimal bias.

CLINICAL RELEVANCE/APPLICATION

Myocardial ECV derived from noninvasive measures of Hct is accurate and reproducible, eliminating the need for blood collection by venipuncture and potentially improving patient comfort and safety.

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 Educator

SSC01-02 Regional Ventricular Dysfunction Differs In Cardiac Sarcoidosis and Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy: Assessment by MRI Strain Analysis

Monday, Nov. 27 10:40AM - 10:50AM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Farnaz Najmi Varzaneh, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Mounes Aliyari Ghasabeh, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Anneline S. J. M. Te Riele, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Cynthia James, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Crystal Tichnell, MSc, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Brittney Murray, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Myocardial sarcoidosis is the most common 'missed' diagnosis in patients evaluated for arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C). The purpose of this study was to investigate the utility of left and right ventricular strain analysis by cardiac MRI (CMR) in distinguishing these two entities.

METHOD AND MATERIALS

68 patients who were consecutively screened for ARVD/C between 2009-2011 and fulfilled diagnostic criteria for ARVD/C were obtained by retrospective chart review. An additional 21 sarcoidosis who fulfilled 2014 Heart Rhythm Society consensus recommendations were identified from a review of consecutive patients who underwent CMR to screen for cardiac sarcoidosis during the same time interval. Regional and global systolic strain analysis was performed on cine SSFP CMR images (Myocardial Tissue Tracking, Toshiba). Global and segmental right ventricular (RV) and left ventricular (LV) longitudinal strains were measured on 4-chamber long axis views and circumferential strains on short-axis views. RV regional strain was divided into basal, mid, and apical segments. LV strain was analyzed according the standard 17 segment model.

RESULTS

Overall 47 men and 42 women were studied (mean age: 53±19 years). There were no significant differences in age and sex between the two groups. Sarcoidosis patients had significantly worse LV systolic longitudinal strain both globally (-16±6 vs -22±7, $p<0.001$) and in the basal septum (-11±8 vs -18±7, $p<0.001$). In contrast, ARVD patients had significantly worse RV systolic longitudinal strain both globally (-16±9 vs -20±8, $p=0.03$) and in the basal free wall (-23±7 vs -29±13, $p=0.03$). Similar differences between groups were seen for circumferential RV and LV systolic strain measures. There were no significant strain differences for the other segments of the RV and LV.

CONCLUSION

Regional and global longitudinal strain patterns are markedly different in patients with sarcoidosis versus ARVD/C as assessed by feature tracking CMR strain analysis.

CLINICAL RELEVANCE/APPLICATION

Sarcoidosis and ARVD/C have considerable overlap in clinical and imaging features. RV and LV strain analyses with CMR may provide additional information to help facilitate distinguishing these diseases when the diagnosis is unclear.

SSC01-03 Trastuzumab and Anthracycline-Induced Cardiotoxicity: Evaluation with Contrast-Enhanced T1 Mapping Cardiovascular Magnetic Resonance Imaging, and Histological Findings

Monday, Nov. 27 10:50AM - 11:00AM Room: S502AB

Participants
Kyungsun Nam, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Young Jin Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Sang A. Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Cardiotoxicity is a notorious adverse effect of anthracycline agents and trastuzumab. This study was designed to investigate serial

myocardial change owing to cardiotoxicity by using T1 mapping cardiovascular magnetic resonance imaging and cardiotoxicity rat models.

METHOD AND MATERIALS

Twenty-three rats were assigned to one of three groups (control group: n = 5, trastuzumab group: n = 8, trastuzumab + doxorubicin group: n = 10). These received one of the following treatment drug regimens administered intravenously through the tail vein: (1) saline control, 0.9% (n = 5), (2) trastuzumab, 8 mg/kg once a week, and (3) trastuzumab, 8 mg/kg followed by doxorubicin (2 mg/kg) once a week (n = 8). Cine, pre-contrast, and post-contrast T1 mapping sequences were performed by using a 9.4-T magnetic resonance scanner every 4 weeks after drug administration until 12 weeks. After 8 or 12 weeks, the hearts were processed for pathological analysis.

RESULTS

In normal control subjects, the measured ejection fraction (EF), native T1, and extracellular volume fraction (ECV) of the left ventricle were 72.05%, 1190 ms, and 15.03%, respectively. In the trastuzumab group, the EF, native T1, and ECV did not significantly change in accordance with the modeling time (4 vs. 8 vs. 12 weeks) as follows: EF, 68.02% vs. 66.19% vs. 68.53% (p = 0.131); native T1, 1235.8 vs. 1238.83 vs. 1198.63 ms (p = 0.323); and ECV, 16.12% vs. 17.96% vs. 18.55% (p = 0.609). In the trastuzumab + doxorubicin group, EF decreased significantly according to the modeling time (64.55% vs. 56.00% vs. 37.25%, p = 0.008), whereas native T1 and ECV increased in accordance with the modeling time (native T1: 1245.75 vs. 1238.02 vs. 1273.9 ms, p = 0.145; ECV: 15.85% vs. 22.12% vs. 25.15%, p = 0.034). Histological examination revealed, a mild interstitial edema in the left ventricular myocardium in the trastuzumab group (n = 4) and a significant myocardial fibrosis in the trastuzumab + doxorubicin group (n = 6).

CONCLUSION

T1 mapping CMR imaging may be the useful noninvasive monitoring method tool for anthracycline-associated and trastuzumab-associated cardiotoxicity owing to its comprehensive nature of myocardial tissue characterization.

CLINICAL RELEVANCE/APPLICATION

T1 mapping CMR imaging can demonstrate subclinical anthracycline-associated and trastuzumab-associated cardiotoxicity and is recommended as a useful noninvasive monitoring method.

SSC01-04 T2-Weighted Short Tau Inversion Recovery Image of Cardiac Magnetic Resonance Reflects Disease Activity of Cardiac Involvement of Sarcoidosis: Comparison with Conventional Methods

Monday, Nov. 27 11:00AM - 11:10AM Room: S502AB

Participants
Reina Tonegawa, MD,PharmD, Kumagaya-City, Japan (*Presenter*) Nothing to Disclose
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Fumiko Kimura, MD, PhD, Hidaka-Shi, Japan (*Abstract Co-Author*) Nothing to Disclose
Makoto Mutoh, Kumagaya-City, Japan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Accurate evaluation of disease activity of cardiac involvement of sarcoidosis (CIS) is critical for treatment planning. We investigated whether high signal intensity on T2-weighted short tau inversion recovery image (T2W-STIR-BB) of cardiac magnetic resonance (CMR) is useful in evaluating CIS activity.

METHOD AND MATERIALS

18F-fluorodeoxyglucose positron emission tomography(FDG-PET), CMR, 67Gallim-schintigraphy, echocardiogram, electrocardiogram (ECG) and biomarkers (angiotensin-converting enzyme, soluble interleukin-2 receptor, lysozyme) were obtained within 3 months for patients who met at least one major and one minor criterion of the 2016 guidelines of diagnosis of cardiac sarcoidosis by the Japanese circulation society that upgrade late gadolinium enhancement of CMR and positive uptake of FDG by the myocardium to major criteria. We measured the spleen to myocardium ratio (SMR) of signal intensity for quantitative analysis of T2W-STIR-BB, with SMR above 0.58 considered positive based on our previous investigation. We determined CIS activity based on positive uptake of FDG by the myocardium. Maximum standard uptake value (SUV-max) of 2.5 and above was defined as significant uptake of FDG.

RESULTS

Of 28 patients with CIS (14 men, 65.4±15.0 years), 17 demonstrated positive findings on FDG-PET (SUV-max, 5.11±3.51);19,on T2-STIR-BB (SMR, 0.64±0.13); three, on 67Gallium-schintigraphy; six, on biomarkers; and 20, on ECG. Sensitivity, specificity, accuracy, positive, and negative predictive values for diagnosing CIS activity using positive uptake of FDG by the myocardium as a gold standard were 87.5%, 60.0%, 76.9%, 77.8%, 75.0% for T2W-STIR-BB; 21.4%, 100.0%, 50.0%, 100.0% and 42.1% for 67Gallium-schintigraphy; 20.0%, 66.7%, 37.5%, 50.0%, and 33.3% for biomarkers and 78.6%, 30.8%, 55.6%, 55.0% and 57.1% for

ECG.

CONCLUSION

Although specificity was higher in 67Gallium schintigraphy, the sensitivity and accuracy of T2W-STIR-BB were better than those of 67Gallium schintigraphy, biomarkers and ECG findings. T2W-STIR-BB is more useful than conventional methods for evaluating disease activity in CIS.

CLINICAL RELEVANCE/APPLICATION

T2W-STIR-BB reflects disease activity of cardiac involvement of sarcoidosis with better accuracy compared with those of conventional methods and is recommended in the initial evaluation.

SSC01-05 Association of Imaging Markers of Diffuse Myocardial Fibrosis by CMR T1ρ Mapping and T1 Mapping with Myocardial Diastolic Function in Rhesus Monkeys with Spontaneous Type 2 Diabetes Mellitus

Monday, Nov. 27 11:10AM - 11:20AM Room: S502AB

Participants
Yu Zhang, Chengdu, China (*Presenter*) Nothing to Disclose
Fabao Gao, MD, PhD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Jie Zheng, PhD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the relationship of myocardial fibrosis and diastolic dysfunction in a rhesus monkey model with early type II diabetes mellitus. Imaging biomarkers of ECV and a new non-contrast myocardial fibrosis index were used to determine myocardial fibrosis content.

METHOD AND MATERIALS

A total of 19 male rhesus (14.27years±2.22years, 10.1kg±1.98kg) monkeys were studied. Fourteen of them were spontaneous type 2 diabetes mellitus (T2DM, FPG>104mg/dl, HbA1c: 4.5-7.3%). The other five controls (HC, FPG<90mg/dl) are matched in age, weight and gender. Blood biochemical examination was tested during the four-week acclimation. CMR protocol included: cine, T1ρ mapping (TR = 640 ms, TE = 1.45 ms, FA = 7, bandwidth = 1002 Hz/Px, FOV = 160mm x 160 mm, voxel size = 2.2 mm x 1.7 mm x 5.0 mm, slice thickness = 5 mm , spin-locking frequency (SLF) = 510 Hz or 0 Hz, time of spin-locking (TSL) = 10, 30, 50 ms),T1 mapping, and LGE. All images were acquired during a breath-hold time by turning off ventilation for 15-20 sec. Pre-T1, post-T1 and extracellular volume (ECV) values were acquired using software available in the MRI system. Myocardial fibrosis index (mFI), which is a new non-contrast myocardial fibrosis index calculated based on the dispersion characteristics of T1ρ, and absooute T1ρ values were calculated. Cardiac function was calculated using cine images. One heart was harvested from a diabetic monkey with diastolic dysfunction after imaging. HE and Masson staining were performed to confirm diffuse myocardial fibrosis.

RESULTS

Echocardiographic results show all 14 monkeys in T2DM have diastolic dysfunction (8 monkeys in T2DM is E/A<1,E'/A' >1; the other 6 in T2DM is E/A>1,E'/A' <1), whereas E/A>1,E'/A' >1 in all 5 controls. MRI results and the association between MRI marker for myocardial fibrosis and diastolic dysfunction shows in Table 1. For focal fibrosis, there was no evidence of regional late contrast enhancement in all animals. Histopathology showed that the myocardial extracellular space was widened with diffuse fibrosis with ECV = 37.46% and mFI =5.85 in this diabetic monkey.

CONCLUSION

CMR drevied myocardial fibrosis markers (ECV and mFI) are associated with diastolic dysfunction in T2DM monkeys but not an independent determiner for it.

CLINICAL RELEVANCE/APPLICATION

For diabetic cardiomyopathy therapy maybe we can target both myocardial fibrosis and diastolic at the same time.

SSC01-06 Quantitative Parameters Using Cardiovascular Magnetic Resonance for Differential Diagnosis of Cardiac Amyloidosis and Hypertrophic Cardiomyopathy: Comparison of Inversion Time to Native T1 and Extracellular Volume

Monday, Nov. 27 11:20AM - 11:30AM Room: S502AB

Participants
Min Jae Cha, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Boda Nam, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Na Jung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yiseul Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yeon Hyeon Choe, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to explore the quantitative CMR parameters such as inversion time (TI), native T1, and extracellular volume (ECV) for differential diagnosis between cardiac amyloidosis (CA) and hypertrophic cardiomyopathy (HCM).

METHOD AND MATERIALS

We included 46 patients with biopsy-confirmed CA and 22 consecutive patients with clinically diagnosed HCM from our CMR registry. Ten healthy subjects were also included for reference value. All patients underwent CMR examination using 1.5T system. T1 values were measured by drawing region of interest (ROI) in left ventricle (LV) septum and cavity on pre- and post-contrast T1 mapping to obtain native T1 and ECV values. TI values were also measured using same method on TI scouts images, which were acquired at 10 minutes after contrast injection. TI values were selected at nulling point of each LV septum and cavity. The interval of TI was calculated to show time difference of nulling points of LV septum and cavity. Comparison of continuous variables of three groups

was performed using Kruskal Wallis test. The diagnostic performance of TI interval for CA diagnosis was compared to native T1 and ECV using area under the receiving operating characteristics curve (AUC).

RESULTS

Native T1 values of CA, HCM, and control groups were significantly different (1176.35 ± 261.15 vs. 1060.62 ± 46.71 vs. 971.17 ± 68.67 ms, p <0.001). ECV values of three groups were significantly different (52.47 ± 14.73 ms vs. 26.94 ± 3.89 vs. 26.04 ± 4.83, p <0.001). The TI interval values of three groups were significantly different (-5.3 ± -0.9 vs. 62.9 ± 27.6 ± 83.9 ± 1.7 ms, p <0.001). On AUC analysis, the AUC values of TI interval and ECV were significantly different to that of native T1 for different diagnosis between CA and HCM (AUC: 0.924 vs. 0.821, p =0.035 in TI interval vs. native T1 and 0.941 vs. 0.821, p =0.008 in ECV vs. native T1). The diagnostic performance of TI interval was not inferior to that of ECV (AUC: 0.924 vs. 0.941, p =0.514).

CONCLUSION

The diagnostic performance of TI interval of LV septum and cavity shows superior that of native T1 and non-inferior to that of ECV for differential diagnosis between CA and HCM.

CLINICAL RELEVANCE/APPLICATION

The interval s of inversion time of LV septum and cavity can be quantitative CMR parameters for CA diagnosis without the need to obtain further mappings.

SSC01-07 Left and Right Ventricular Cardiac MRI T1 mapping at 3T Differentiates Anderson-Fabry Disease from Hypertrophic Cardiomyopathy

Monday, Nov. 27 11:30AM - 11:40AM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Gauri R. Karur, MBBS, MD, Toronto, ON (*Presenter*) Nothing to Disclose
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Andrew M. Crean, MD, Toronto, ON (*Abstract Co-Author*) Research support, sanofi-aventis Group
Kate Hanneman, MD, FRCPC, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare 3T cardiac MRI left ventricular (LV) and right ventricular (RV) T1 values in patients with Anderson-Fabry disease (AFD) and hypertrophic cardiomyopathy (HCM).

METHOD AND MATERIALS

In this prospective study, non-contrast cardiac MRI T1 mapping was performed at 3T using a modified Look-Locker inversion recovery (MOLLI) technique in patients with gene-positive AFD (n=14, 36% male, 43.36±15.06 years, 29% on enzyme replacement therapy) and HCM (n=25, 84% male, 49.48±12.11 years). Cine SSFP and late gadolinium enhancement (LGE) imaging were also performed. Same day hematocrit values were used for calculation of LV extracellular volume (ECV).

RESULTS

LV ejection fraction (p=0.950), LV mass (p=0.169), RV ejection fraction (p=0.472) and RV mass (p=0.626) were not significantly different between AFD and HCM. There was no statistically significant difference in the presence of non-hinge point LGE between AFD and HCM (57% vs. 79%, p=0.799). However, the presence of basal inferolateral LGE was more common in AFD compared to HCM (29% vs. 4%, p=0.028). Non-contrast myocardial T1 values (excluding areas of LGE) were significantly lower in AFD compared to HCM for both LV (1140.0±48.0ms vs. 1251.6±39.8ms, p<0.001) and RV (1234±82.6ms vs. 1331.5±131.6ms, p=0.020). LVECV did not differ significantly between AFD and HCM (24.5±1.9% vs. 24.1±3.0%, p=0.705). A non-contrast LV T1 cut-off value of ≤1190ms distinguished AFD from HCM with sensitivity 92% and specificity 96% (AUC 0.944, 95%CI [0.864, 1.00]). In a multivariable logistic regression model, LV non-contrast T1 values have independent value over other conventional imaging parameters (LV mass, basal inferolateral LGE, apical-basal muscle bundle and myocardial crypt) and age to differentiate AFD from HCM (OR 0.92, 95%CI [0.86, 0.99], p=0.019). In a nested logistic regression model with age and conventional imaging parameters, model fit is significantly improved by the addition of LV non-contrast T1 values (p<0.001).

CONCLUSION

Non-contrast cardiac MRI T1 values at 3T are significantly lower in patients with AFD compared to HCM and provide independent and incremental diagnostic value beyond traditional imaging features.

CLINICAL RELEVANCE/APPLICATION

Distinguishing myocardial hypertrophy related to AFD and HCM is a clinical and imaging challenge. Non-contrast T1 mapping provides incremental diagnostic value beyond traditional imaging features.

SSC01-08 Persistence of Late Gadolinium Enhancement in Imaging Post-Acute Myocarditis

Monday, Nov. 27 11:40AM - 11:50AM Room: S502AB

Participants
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PURPOSE

To demonstrate the persistence of late gadolinium enhancement (LGE) during follow-up cardiac magnetic resonance (CMR) in asymptomatic patients with previous acute myocarditis (AM), confirmed by CMR.

METHOD AND MATERIALS

Between 2008 to 2016 thirty-three consecutive patients with clinical and laboratory suspicion of AM were included in the study. They were referred for CMR after seven days from the beginning of the clinical examination. CMR was performed at 1.5T, using a standard protocol: SSFP sequences in cine mode; black blood STIR T2 sequences in the short ventricular axis; T1 sequences with and without gadolinium (DOTA) to study early enhancement and LGE (at least 10 minutes after contrast injection).

RESULTS

Patients were 31±11 y.o. (91% males). Thirty one (94%) had CMR-confirmed AM. All thirty-three (100%) patients initially had either patchy or diffuse subepicardial and/or transmural edema in the T2 sequences and LGE corresponding with the areas of edema. LGE was typically localized to the sub-epicardial region of the left ventricle (LV) and extended to a variable extent through the ventricular wall, inferolaterally and less frequently to the anteroseptal segments. Sometimes it was distributed in a multi-focal or diffuse way. Twenty were referred for follow-up CRM three or six months later. None of the patients had edema during follow-up CRM, but in sixteen (52%) LGE persisted. Four (13%) referred for repeat follow-up, three years after being diagnosed of AM still had LGE without symptoms.

CONCLUSION

There is not a perfect correlation between clinical conditions (including a complete recovery of the global cardiac functionality) of the patients and imaging post-myocarditis. This study confirms that the presence and the extent of LGE in CMR follow-up are not predictive of outcome in patients without severe hemodynamic compromise and a CMR-based diagnosis of AM.

CLINICAL RELEVANCE/APPLICATION

Sub-epicardial LGE is frequently (52%) observed in patients with previous AM and it is not associated with hemodynamic compromise or/and poor clinical conditions.

SSC01-09 Right Ventricular Hemodynamics in the Course of Acute Myocarditis: A Cardiovascular Magnetic Resonance Study

Monday, Nov. 27 11:50AM - 12:00PM Room: S502AB

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PURPOSE

Cardiac magnetic resonance (CMR) can detect inflammatory and functional myocardial alterations in patients suspected of having acute myocarditis. There is limited information regarding the degree of right ventricular involvement and the impact on right ventricular function over the course of the disease.

METHOD AND MATERIALS

69 patients with myocarditis underwent CMR during the acute stage of the disease (baseline) and after a mean 92.5 ± 50.4 days follow-up. The CMR protocol allowed for the assessment of standard Lake Louise criteria (T2 SI ratio, early gadolinium enhancement ratio, late gadolinium enhancement) and parameters of right and left ventricular function. Logistic regression analysis was used to find predictors of functional recovery upon follow-up.

RESULTS

All inflammatory parameters showed a considerable decrease over the course of the disease ($P>0.001$ for all parameters). Left (LV) and right ventricular (RV) function were significantly improved on follow-up CMR (LV function: 53.6 ± 12.8% vs. 61.3 ± 9.5%; $P<0.001$, RV function: 54.1 ± 10.0% vs. 59.4 ± 6.3%; $P<0.001$). On initial CMR, RV function was significantly correlated with the percentage of LV late gadolinium enhancement ($r= 0.255$; $P= 0.040$). 82.6% (57/69) of all patients had a recovery of myocardial function upon follow-up. Using logistic regression analysis, the presence of myocardial edema and baseline RV function were associated with functional recovery ($P<0.05$ respectively).

CONCLUSION

In this study, we found an association between a reduced RV function and the degree of myocardial inflammation. RV function improved during follow-up. These results indicate an inflammatory involvement of the right ventricle in acute myocarditis. It further appears that baseline RV function -like the presence of myocardial edema- seems to have a predictive value for functional recovery during the course of the disease.

CLINICAL RELEVANCE/APPLICATION

Right ventricular dysfunction can frequently be observed during the acute stage of myocarditis. RV functional impairment function might be useful as a new parameter for the prediction of functional recovery.

SSC04

Gastrointestinal (Rectal Cancer)

Monday, Nov. 27 10:30AM - 12:00PM Room: E353A

GI MR OI BQ

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

Participants
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Sub-Events

SSC04-01 Comparison in Prognosis of Patients with Rectal Cancer between Low- and High-Risk Group Defined by Magnetic Resonance Imaging (MRI)

Monday, Nov. 27 10:30AM - 10:40AM Room: E353A

Participants
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PURPOSE

To compare the prognosis of patients with rectal cancer between low- and high-risk group detected by MRI, who were treated by total mesorectal excision (TME) surgery and selective adjuvant chemoradiotherapy

METHOD AND MATERIALS

Patients with pathology-proven rectal adenocarcinoma and received TME surgery between January 2006 and December 2014 were included in this retrospective study. Patients who were treated with neoadjuvant chemoradiotherapy, and had other malignancies or distant metastasis were excluded. All included patients had been followed-up until December 2016. The risk factors detected by MRI were defined as: extramural depth of tumor invasion larger than 5mm for mid and upper tumor, intersphincteric space invasion for low tumor, extramural venous invasion (EMVI), circumferential resection margin (CRM) involvement. Patients were divided into low- and high-risk group based on the presence of risk factors. Kaplan-Meier method was used to compare the local overall survival (OS), disease-free survival (DFS), and local recurrence (LR) between two groups, and analyze the univariate influence of risk factors of OS, DFS and LR. A Cox proportional hazards regression model was constructed to figure out independent risk factors of OS, DFS and LR.

RESULTS

Sixty-five patients (35.1%) of whole cohort (185) were divided into low-risk group and 120 (64.9%) were divided into high-risk group. Significant difference was demonstrated between low- and high- risk group shown as 3-year actuarial OS (100% vs.87.8%), DFS (92.3% vs.55.7%) and LR (3.1% vs.10.4%). Compared with mrT and mrN, CRM was identified as the independent risk factor of OS (HR 4.70, 95% confidence interval (CI) 1.25-17.66), DFS (HR 2.44, 95%CI 1.24-4.81) and LR (HR 3.92, 95%CI 1.07-14.41) by using the Cox proportional hazards regression analysis. Moreover, EMVI was identified as the independent risk factor of DFS (HR 2.46, 95%CI 1.28-4.73).

CONCLUSION

For patients with rectal cancer, CRM and EMVI status preoperatively assessed by MRI are the most important factors in predicting local recurrence and long-term survival.

CLINICAL RELEVANCE/APPLICATION

Estimating the presence of risk factors by MRI preoperatively can help predict prognosis and make decision of whether patients need to receive neoadjuvant therapy before TME surgery.

SSC04-02 Comparison of Reduced Field-of-View Diffusion Weighted Imaging (DWI) and Conventional DWI Techniques in Assessment of Rectal Carcinoma at 3.0 T: Image Quality and Histological T Staging

Monday, Nov. 27 10:40AM - 10:50AM Room: E353A

Participants

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PURPOSE

To assess the image quality (IQ) and histological T staging of rectal cancer by comparison of reduced field-of-view (FOV) and full FOV DWI sequences at 3T.

METHOD AND MATERIALS

Eighty-one patients with rectal cancer received MR scan of both rFOV DWI and fFOV DWI sequences. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were quantitatively evaluated using paired T test. Two radiologists independently assessed the subjective IQ parameters including image sharpness, distortion, artifacts, lesion conspicuity and overall subjective IQ of both DWI sequences. Wilcoxon signed rank test was used to compare subjective IQ scores and tumor ADCs between DWI sequences. Mean tumor ADCs between DWI sequences were compared in relation to corresponding T staging of rectal cancer by utility of the spearman rank correlation analysis test.

RESULTS

CNR was significantly higher in rFOV DWI than in fFOV DWI (7.15±2.77 vs. 5.39±2.08, P<0.001). SNR was significantly higher in rFOV DWI than in fFOV DWI (44.17±11.01 vs. 34.76±13.30, P<0.001). The subjective IQ parameters of rFOV DWI sequence were rated superior to that of fFOV DWI sequence by both readers (P<0.001). There was no significant difference between mean tumor ADC values of rFOV and fFOV DWI sequences (0.991±0.121 vs. 0.100±0.126×10-3mm2/s, P=0.617). Apart from T1 stage, T staging of rectal cancer was correlated inversely with ADC values of rFOV DWI (r= -0.688, P<0.001) and fFOV DWI sequences (r= -0.641, P<0.001).

CONCLUSION

rFOV DWI sequence provided significantly higher image quality and lesion conspicuity than fFOV DWI sequence. Besides, both DWI sequences can be used for evaluation of histological T staging of rectal cancer.

CLINICAL RELEVANCE/APPLICATION

Image quality can be improved by utility of rFOV DWI sequence and is recommended as part of MR study for rectal cancer before total mesorectal excision(TME) surgery

SSC04-03 Colorectal Carcinoma: Ex Vivo Evaluation using q-Space Imaging and its Correlation with Histopathologic Findings

Monday, Nov. 27 10:50AM - 11:00AM Room: E353A

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PURPOSE

To determine the feasibility of ex vivo q-space imaging (QSI) as a method of evaluating the histologic grades of colorectal carcinomas and lymph node metastasis by colorectal carcinomas.

METHOD AND MATERIALS

Twenty colorectal specimens each containing a carcinoma and their resected lymph nodes were imaged with a 3-T MR imaging system equipped with a 4-channel phased-array surface coil. QSI data were obtained by using a spin echo-based single-shot echo-planar imaging sequence: repetition time, 10000 ms; echo time, 216 or 210 ms; field of view, 113 mm x 73.45 mm; matrix, 120 x 78; section thickness, 4 mm without intersection gaps; eleven b values ranging from 0 to 9000 s/mm2; and motion-probing gradients perpendicular to the colorectal wall. Mean displacement (MDP; in μm), zero-displacement probability (ZDP; in arbitrary unit [a.u.]), and kurtosis (K; in a.u.) were calculated from the displacement distribution profiles, and apparent diffusion coefficient (ADC) was also calculated from two b values (b = 0 and 500 s/mm2). The MR images were then compared with the histopathologic findings as the reference standard.

RESULTS

In all 20 colorectal carcinomas, the MDP was calculated as 8.85 ± 0.36 μm, ZDP 82.4 ± 6.2 a.u., K 74.4 ± 3.0 a.u., and ADC 0.219 ± 0.041 x 10-3 mm2/s. With the histologic grades (well, moderately, and poorly differentiated) of the colorectal carcinomas, the MDP (r = -0.829; P < 0.001) showed a significant inverse correlation and the ZDP (r = 0.810; P < 0.001) and K (r = 0.848; P < 0.001) showed a significant positive correlation, while the ADC (r = 0.104; P = 0.673) showed no significant correlation. Between metastatic lymph nodes and nonmetastatic lymph nodes, the MDP (10.3 ± 1.2 vs. 19.0 ± 2.0 μm; P < 0.01), ZDP (53.6 ± 16.1 vs. 26.2 ± 2.0 a.u.; P < 0.01), and K (61.0 ± 10.9 vs. 25.3 ± 2.7 a.u.; P < 0.01) showed significant differences, while the ADC (1.02 ± 0.38 vs. 1.39 ± 0.09 x 10-3 mm2/s; P = 0.095) showed no significant differences.

CONCLUSION

QSI provides useful diagnostic information for evaluating the histologic grades of colorectal carcinomas and lymph node metastasis by colorectal carcinomas.

CLINICAL RELEVANCE/APPLICATION

By using QSI for patients with colorectal carcinoma, we may have an effective tool to noninvasively diagnose the histologic grades of colorectal carcinomas and lymph node metastasis by colorectal carcinomas.

SSC04-04 Long-Term Follow-Up with MRI during a "Watch-And-Wait" Approach in Clinical Complete Responders after Chemoradiotherapy

Monday, Nov. 27 11:00AM - 11:10AM Room: E353A

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PURPOSE

A 'watch-and-wait' approach is emerging as an alternative to resection in rectal cancer patients with a clinical complete response (CR) after CRT. Follow-up consists of clinical examination, endoscopy and MRI. Limited data exists on what to expect on MRI during follow-up. Aim was to evaluate the morphology of the rectal wall in patients in the watch-and-wait programme and study its evolution during follow-up for watch-and-wait these patients.

METHOD AND MATERIALS

140 patients with a sustained complete response (i.e. no evidence of recurrence on sequential imaging and endoscopy±biopsy examinations) were analysed during follow up within the scope of a 'watch-and-wait' protocol. Patients underwent MRI (and clinical examination and endoscopy) 3-monthly in the first year and 6-monthly during the 2nd to 5th year. Two readers in consensus analysed the rectal wall morphology on the initial post-CRT scan and studied the evolution in morphology on the various sequential follow-up MRIs.

RESULTS

Median follow-up time was 18 months (range 6-82). A total of 801 MRIs were analysed (median 5, range 2-13 per patient). In 9% of patients the rectal wall completely normalised post-CRT. The other 91% showed a fibrotic remnant (64% minimal fibrosis limited to the bowel wall; 21% thick/mass-like fibrosis and 6% irregular/spicular fibrosis). In 92% the rectal wall morphology remained unchanged during long-term follow-up, in 4% initial fibrosis later developed into a normalised wall, in 4% the fibrosis slightly thickened (without evidence of recurrence).

CONCLUSION

In the vast majority of patients with a complete response residual fibrosis is present post-CRT, which remains unchanged during long-term follow-up in almost all patients. A completely normalised wall is observed in approximately 1 in 10 complete responders. These findings may serve as a reference and provide teaching for radiologists involved in the clinical follow-up of patients selected to undergo a watch-and-wait policy.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the evolution of the rectal wall is crucial to allow for safe use of a watch-and-wait approach in complete responders after CRT for rectal cancer.

SSC04-05 Use of Restaging Abdominopelvic CT after Neoadjuvant Chemoradiation Therapy in Patients with Nonmetastatic Locally Advanced Rectal Cancer

Monday, Nov. 27 11:10AM - 11:20AM Room: E353A

Participants
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PURPOSE

Neoadjuvant chemoradiation therapy (CRT) before surgery is current standard for locally advanced rectal cancer without distant metastasis, but it delays surgery for several months. We investigated if restaging abdominopelvic CT before surgery after CRT is beneficial given the time lag from the initial diagnosis.

METHOD AND MATERIALS

472 consecutive patients (M:F, 308:164; 62.2±11.8 years) who had newly diagnosed rectal cancer (T3 or N+ as assessed with MRI), no distant metastasis or any lesions that were not cleared of metastasis as evaluated with both CT and PET/CT, and no previous (during past 5 years) or concomitant cancers, underwent long-course CRT. Patients were reevaluated 4-6 weeks after CRT with rectal MRI and restaging abdominopelvic CT (n=231) or with rectal MRI alone (n=218). 23 patients dropped out. Diagnostic yield of the restaging CT for abdominopelvic metastasis was determined. The rate of overlooked abdominopelvic metastasis, defined as lesions that were unexpectedly found during rectal cancer surgery or developed early (within 6 months) after the surgery or CRT (for 8 patients followed without surgery), and the outcome of the overlooked lesions were compared between the two patient groups. Abdominopelvic progression-free survival (PFS) was compared between the two groups.

RESULTS

Diagnostic yield of restating CT was 2.2% (5/231), all of which were resected with curative intent. Restaging CT created false positives in three patients, causing unnecessary hepatic resection (n=1), RFA (n=1), and follow-up liver MRI (n=1). Restaging CT group had seven patients (3%) with overlooked abdominopelvic metastasis; four patients found during the surgery, three of whom could be operated with curative intent, and three patients as early postsurgical metastasis, one of whom was amenable to curative-intent treatment. The no CT group had seven patients (3.2%) with overlooked metastasis; all as early postsurgical metastasis, three of whom were amenable to curative-intent treatment. These rates did not significantly differ (P=1). Abdominopelvic PFS did not significantly differ between the two groups (P=.426).

CONCLUSION

Restaging abdominopelvic CT after CRT for locally advanced rectal cancer does not have a clear benefit due to its low yield, insufficient exclusion of metastasis, and unignorable risk of false-positives.

CLINICAL RELEVANCE/APPLICATION

This study recommends against restaging abdominopelvic CT after CRT for rectal cancer.

SSC04-06 PET/MRI in Patients with Pelvic Recurrence of Rectal Cancer: Technical Feasibility and First Clinical Experiences

Monday, Nov. 27 11:20AM - 11:30AM Room: E353A

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PURPOSE

Accurate diagnosis of pelvic recurrence of rectal cancer is crucial in determining further treatment, especially prior to surgical resection. So far, PET/MRI has not been widely used in this setting. The purpose of this study was to determine the value of PET/MRI in the pre-therapeutic staging and management of patients with pelvic recurrence of rectal cancer.

METHOD AND MATERIALS

Out of 57 patients with a history of rectal cancer who received PET/MRI between June 2011 and July 2016 at our institution, 34 patients were retrospectively enrolled in the study. 23 patients were excluded because they were lost to follow-up. One patient received two PET/MRIs, thus a total number of 35 examinations was included. Pelvic recurrence was confirmed either with histology (biopsy n=5, surgery n=21) or clinical and imaging follow-up (>6 months). Two blinded readers (1 radiologist, 1 nuclear medicine physician) interpreted the images in consensus. Pelvic lesions were assessed regarding FDG-uptake, morphology, contrast enhancement and diffusion restriction. Sensitivity, specificity, positive and negative predictive value as well as accuracy of PET/MRI were determined.

RESULTS

In 35 PET/MRIs 26 pelvic lesions were identified, out of which 25 were deemed suspicious for pelvic tumor recurrence. One lesion was thought to be a vesicovaginal fistula. 24 of the 25 lesions were confirmed as malignant. One patient was resected and had histologically proven pelvic recurrence without suspicious findings on PET/MRI. Changes in management due to PET/MRI findings were implemented in 2 patients (metastasis sacral nerve=1, penile metastasis=1), 83% of resected patients had histologically negative resection margins (R0). The sensitivity of PET/MRI in detecting recurrence was 96%, specificity 92%, positive/negative predictive value and accuracy were 96%, 92% and 95%, respectively.

CONCLUSION

PET/MRI demonstrates high sensitivity and specificity in the preoperative diagnosis and staging of pelvic recurrence in patients with rectal cancer.

CLINICAL RELEVANCE/APPLICATION

PET/MRI is a valuable tool in the preoperative diagnosis and staging of pelvic recurrence in patients with rectal cancer, aiding in achieving high rates of R0-resection.

SSC04-07 Interobserver Reproducibility in Assessing the Response after Neoadjuvant Chemoradiation Therapy for Locally Advanced Rectal Cancer Using Magnetic Resonance Tumor Regression Grade (mrTRG)

Monday, Nov. 27 11:30AM - 11:40AM Room: E353A

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PURPOSE

Methods to assess the response after neoadjuvant chemoradiation therapy (CRT) for locally advanced rectal cancer on post-CRT MRI have been proposed, of which magnetic resonance tumor regression grade (mrTRG) is seemingly most recognized. However, interobserver reproducibility of mrTRG has hardly been evaluated outside those who developed the mrTRG system. This study is to assess the interreader reproducibility of mrTRG externally.

METHOD AND MATERIALS

50 pairs of pre- and post-CRT (obtained 4-6 weeks after the finish of CRT) rectal MRI sets obtained in 50 patients (M:F, 36:14; 65.5±12.4 years), who were randomly chosen from a consecutive cohort of 439 patients who underwent long-course CRT for a newly diagnosed locally advanced rectal cancer (T3 or N+ stage as seen on pre-CRT MRI, no distant metastasis, and no other previous or concomitant cancers), were included. Before the study, three abdominal radiologists experienced with rectal MRI went through an educational session consisting of a review of 50 training cases collected outside the study cohort and reading of relevant articles. The three readers assessed the CRT response for this study using mrTRG (1 to 5) independently blinded to any other information than the history of CRT. We analyzed interreader reproducibility regarding the description of individual mrTRG (1 to 5) as well as regarding the binary interpretation of mrTRG1 and 2 (i.e., good response) vs. 3-5, using weighted kappa with linear weights and the conventional kappa, respectively. For mrTRG1 and 2 vs. 3-5, the proportional agreement was also obtained.

RESULTS

According to the consensus interpretation among the three readers, the mrTRG distribution in the study patients was 14% mrTRG1 (n=7), 26% mrTRG2 (n=13), 32% mrTRG3 (n=16), 28% mrTRG4 (n=14), and 0% mrTRG5. The weighted kappa for describing the individual mrTRG (1 to 5) was 0.62 overall and 0.60 to 0.62 for individual reader pairs. The kappa for mrTRG1 and 2 vs. 3-5 was 0.65 overall and 0.57 to 0.72 for individual reader pairs. The proportional agreement in interpreting mrTRG1 and 2 vs. 3-5 was 83% overall and 80-86% for individual reader pairs.

CONCLUSION

mrTRG showed a substantial interobserver reproducibility, which further supports its implementation for use in clinical practice and trials.

CLINICAL RELEVANCE/APPLICATION

mrTRG could be used fairly reliably in clinical practice and trials to guide further treatment after neoadjuvant CRT for rectal cancer.

SSC04-08 Assessing FDG-PET/3-T MRI after Preoperative Chemoradiotherapy for Rectal Cancer

Monday, Nov. 27 11:40AM - 11:50AM Room: E353A

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PURPOSE

To assess the accuracy of pelvic 3-T MRI and combined FDG-PET/3-T MRI (PET/MRI) in predicting pathological tumor and node (ypTN) stages, and to compare the accuracy of whole-body PET/MRI with thoraco-abdominal CT (CT) in predicting metastases (ypM) stage.

METHOD AND MATERIALS

This prospective study concerned 17 patients (16 male) with locally advanced rectal cancer who underwent preoperative chemoradiotherapy, PET/MRI and CT for staging purposes. PET/MRI included T2 and diffusion weighted images. Total mesorectal excision was the treatment of choice for 13 patients; the remainders were MRI node negative and underwent transanal local excision with at least 1-year endoscopic and pelvic MRI follow-up. Concurrent distant metastases were confirmed by surgery/biopsy or followed up with CT. One radiologist assessed pelvic MRI and CT images. Another radiologist and a nuclear medicine physician jointly assessed PET/MRI findings. All three were blinded to all other imaging and pathology results.

RESULTS

ypT was T0 in 4 patients, T1 in 3, T2 in 1, T3 in 7, and T4 in 2. ypN was positive in 5/17 cases, and metastases were detected in 3/17 patients. MRI and PET/MRI findings for ypT were concordant and correct in 11/17 patients (64.7%), concordant and incorrect

in 2/17 (11.8%), and discordant in 4/17 (23.5%), PET/MRI staging being correct in 2 cases. As for ypN staging, MRI and PET/MRI were concordant and correct in 14/17 patients (82.3%) and discordant in 3/17 (17.7%), with PET/MRI staging predicting ypN status in 2 cases. Two patients with metastases were diagnosed correctly, while PET/MRI misdiagnosed one case of a small lung metastasis.

CONCLUSION

Integrated whole-body PET/MRI improves the accuracy of ypTN staging, but is less accurate than CT in ypM staging. Further studies are needed, including efforts to refine PET/MRI by using specific sequences for the lung and intravenous gadolinium, to examine the role of this technique in monitoring distal cancer spread. If successful, it would be possible to combine local and distant rectal cancer staging in a single examination.

CLINICAL RELEVANCE/APPLICATION

FDG-PET/3-T MRI can be a useful tool for the whole-body staging (TNM) of patients with advanced rectal cancer after chemoradiotherapy.

SSC04-09 Tumor Heterogeneity MRI Features Improve Machine Learning-Based Prognostication in Patients with Metastatic Colon Cancer

Monday, Nov. 27 11:50AM - 12:00PM Room: E353A

Participants
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PURPOSE

Intra-tumor heterogeneity has been previously shown to be an independent predictor of patient survival. The goal of this study is to use machine learning to assess the role of quantitative MRI-based measures of intra-tumor heterogeneity as predictors of survival in patients with metastatic colorectal cancer.

METHOD AND MATERIALS

In this IRB-approved retrospective study, we identified 52 patients with stage 4 colon cancer who underwent MRI from 2007-2013 for liver metastasis evaluation. Patient survival data was available for up to 95 months. Standard clinical and pathologic prognostic variables were extracted from the medical record. The largest metastatic hepatic lesion was identified on portal venous phase T1-weighted fat-suppressed post-contrast images and manually segmented. A heterogeneity phenotype vector was extracted from each lesion by using quantitative texture analysis as a measure of spatial heterogeneity. Univariate regression analysis was used to assess for independent contribution of 32 extracted texture features to survival prediction. A linear support vector machine (SVM) machine learning technique was applied to the extracted heterogeneity phenotype vector and to the standard prognostic clinical and pathologic variables. The classifiers were trained and tested using 10-fold cross validation to avoid overfitting. ROC analysis and the area under the curve (AUC) were used to assess classification performance. Delong's test was used to assess for differences between ROC curves.

RESULTS

Mean survival time was 39±3.9 months for the study population. Tamura texture features, directionality, coarseness and contrast were independently associated with patient survival ($p<0.01$). The trained SVM model that included standard clinical and pathological prognostic variables resulted in an area under the ROC curve of 0.80. An SVM model that adds imaging-based heterogeneity features to the clinical and pathological variables resulted in improved model performance for survival prediction with an AUC of 0.98 ($p<0.001$).

CONCLUSION

MRI-based texture features improve the performance of standard clinical and pathological variables for predicting patient survival in metastatic colorectal cancer.

CLINICAL RELEVANCE/APPLICATION

Machine learning-based predictive models incorporating quantitative MRI heterogeneity features may improve prognostication and personalize treatment choices in patients with metastatic colon cancer.

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SSC05

Gastrointestinal (Small Bowel Imaging)

Monday, Nov. 27 10:30AM - 12:00PM Room: E451A

GI MR

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

Participants
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Sub-Events

SSC05-01 Development and Validation of simplified Magnetic Resonance Index of Activity (sMARIA)

Monday, Nov. 27 10:30AM - 10:40AM Room: E451A

Participants
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PURPOSE

MaRIA index is the most used Magnetic Resonance Enterography (MRE) index in clinical trials for luminal Crohn's disease (CD). However, a number of limitations had been recognized. The aim of this study is to develop and to validate a simplified and accurate Magnetic Resonance Index of activity (sMaRIA) for assessing activity and therapeutic response on patients with luminal CD.

METHOD AND MATERIALS

MRE data from 98 patients, including active and inactive disease on the colon and/or terminal ileum, from two prospective studies were re-analysed to develop the sMaRIA using endoscopy (CDEIS) as gold standard. Further analysis of responsiveness in a cohort of 48 patients who underwent MRE and endoscopy at screening and after 12 weeks of therapy with antiTNF or corticoids was performed. Comparison between MaRIA and sMARIA for detecting active/severe lesions and therapeutic response was performed.

RESULTS

Logistic regression analysis showed that wall thickness >3 mm, presence of edema, ulcers and fat stranding were independent predictors for assessing CD activity and were used as descriptors of sMaRIA. The sensitivities and specificities of sMaRIA at segment level for detecting active disease using a cutoff >=5 were 90% and 81% (AUC 0.91), and for detecting severe lesions at endoscopy (presence of ulcerations) using a cutoff >=10 were 85% and 92% (AUC 0.93). Correlation between sMaRIA and CDEIS was r=0.82 and with MaRIA r=0.91 (p<0.0001). Sensitivities and specificities of sMaRIA were no statistically significant different from MaRIA for detecting activity (p=0.07 and p=0.2 respectively) or for detecting severe lesions (p=0.5 and p=0.5 respectively). The sensitivity and specificity of sMaRIA for detecting endoscopic remission (CDEIS<3.5) using a cutoff<5 were 82% and 88% (AUC 0.88), and for detecting ulcer healing at endoscopy using a cutoff <10 were 64% and 96% (AUC 0.93).

CONCLUSION

The simplified MaRIA index is as accurate as the MaRIA for detecting active and severe inflammation, and also has high diagnostic accuracy for detecting therapeutic response. Main advantages over MaRIA includes simplicity, its calculation is less time consuming and accounts for missing segments.

CLINICAL RELEVANCE/APPLICATION

Simplified MaRIA index allows a fast and simple assessment of inflammation activity on CD by keeping high accuracy for both diagnosis and therapeutic response.

SSC05-02 Intravoxel Incoherent Motion Diffusion-weighted MRI Detection and Grading of Bowel Wall Fibrosis in Crohn's Disease

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

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PURPOSE

To determine the value of intravoxel incoherent motion (IVIM) diffusion-weighted MRI (DWI) for detecting and grading bowel wall fibrosis in adults with Crohn's disease (CD).

METHOD AND MATERIALS

17 adult patients (8 men, 9 women; mean age: 31.75 ± 8.58 years) with CD underwent pre-operative IVIM-DWI. The free-breathing IVIM-DWI was obtained using a single-shot spin-echo echo-planar imaging sequence with 13 b values (contains 0 - 2000 mm/s2) on a 3T MR system with eight-channel phased-array body coils. The perfusion-related fraction (*PF*), perfusion-related coefficient (*D**), and diffusion-related coefficient (*D*) of abnormal bowel segments were calculated using a bi-exponential model with constrained least squares algorithm. Mural fibrosis of the resected bowel segments was scored 0-3 histologically. The vessel density was assessed by immunohistochemistry using panendothelial cell antigen CD31.

RESULTS

In 77 surgical specimens sampled from 17 patients, the correlation between the *PF* values and histologic fibrosis scores was significantly inverse (r = -0.675, P<0.001). The *PF* values significantly decreased with increasing severity from mild, moderate, to marked fibrosis (P<0.001). ROC curve analysis showed high accuracy of *PF* values with an AUC of 0.885 (95% confidence interval: 0.79-0.97, P<0.001) for differentiating moderate-severe from mild bowel wall fibrosis. Using threshold *PF* value of 0.33, the sensitivity and specificity for differentiating between moderate-severe fibrosis and mild fibrosis were 95.50% and 81.80%, respectively. The *D* and *D** values were not significantly correlated with histological fibrosis. There was no significant association between IVIM parameters and vessel density.

CONCLUSION

Bowel wall fibrosis in CD correlates with perfusion rather than pure diffusion. The *PF* value decreases with severity and is useful to detect and grade fibrosis.

CLINICAL RELEVANCE/APPLICATION

Free-breathing IVIM-DWI without contrast administration is a potential biological marker of bowel perfusion and may be beneficial for treatment planning and monitoring bowel wall fibrosis of CD in adults.

SSC05-03 Towards Development of a CT Enterography Severity Score for Small Bowel Crohn's Disease

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

Awards
Student Travel Stipend Award

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PURPOSE

CT and MR enterography (CTE, MRE) are used to objectively measure small bowel Crohn's disease inflammation. Quantitative severity scores have been developed for MRE (i.e., MaRIA score), but no CT severity scoring system exists.

METHOD AND MATERIALS

Patients with biopsy-proven Crohn's disease with CTE and MRE within 30 days were identified. A GI radiologist examined CTE images for ulceration, mural edema, comb sign, perienteric stranding and fistulae involving the distal 10 cm of terminal ileum (TI), and measured wall thickness and attenuation. The CT EMBARK score (a visual score from 1 to 3, for enhancement, wall thickness, and ulceration) was assigned. MaRIA scores for the TI were separately calculated by an abdominal imaging fellow for each MRE. Total lengths of inflamed ileal segments were measured by both radiologists. Statistical modeling (i.e., linear models, regularized linear models, and Random Forests) was conducted to predict the MaRIA scores based on CT findings. Performance of fitted models was assessed by R-square (R2).

RESULTS

43 patients (18 M, 25 F) had CTE and MRE within a mean of 4 days (range 0-28). By MRE, 27 (63%) patients had evidence of active TI inflammation (mean MaRIA score 17±12; mean inflamed length 13±11 cm). By CTE, 30 (70%) had active TI inflammation (mean inflamed length 13±11 cm), with 8 (19%) showing ulceration, 19 (44%) mural edema, 9 (21%) comb sign, 6 (14%) perienteric stranding and 1 (2%) fistula. Association of the CTE severity scores with MaRIA score ranged from R2 = 0.60 for the

visual EMBARK score to R2=0.93 for the Random Forest model with all CT features considered. A parsimonious linear model, with variables informed through variable selection in a cross-validated regularized (elasticnet) regression model, was as follows: Predicted MaRIA = 2.90 + 2.78 * CT Wall Thickness + 5.72 (if Perienteric Stranding is present) + 6.72 (if Ulceration is present). This model performed well (R2 = 0.64). ICC for length measurements was 0.82 (95% CI: 0.70 to 0.90).

CONCLUSION

We determined CT features and weightings to calculate a CT severity score similar to MaRIA. Further work will be required to finalize and validate the scoring system.

CLINICAL RELEVANCE/APPLICATION

Because CT imaging is used to guide management in symptomatic Crohn's disease, a CT severity score similar to MaRIA has been developed to measure inflammatory severity and quantify therapeutic response.

SSC05-04 MR T2* Mapping Helps to Characterize Intestinal Fibrosis in Patients with Crohn's Disease

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

Awards
Student Travel Stipend Award

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PURPOSE

The assessment and quantification of fibrosis in Crohn's disease (CD) patients has important therapeutic implications. T2* mapping has the potential to reflect small changes in the biochemical components of the counterpart tissue without contrast medium injection. We first aimed to determine the utility of T2* mapping for grading diverse degrees of intestinal fibrosis using surgical pathology as reference standard.

METHOD AND MATERIALS

This was an observational study of 20 CD patients who underwent an MR T2*WI scan within 15 days before elective enterectomy. The T2* values of the bowel wall to be resected were measured for each region. Resected bowel tissues with pathological fibrosis and type I collagen were classified into four severity grades (from 0 to 3).

RESULTS

Eighty-six surgical specimens from twenty patients were analyzed, including non-fibrotic (n=1) and mild (n=14), moderate (n=48) and severe (n=23) fibrosis specimens. The T2* value differences of the fibrotic segments among non-fibrotic or mild, moderate and severe CD patients were significant (all P<.001). The T2* values were moderately associated with the histologic fibrosis (r=-0.687, P<.001) and type 1 collagen scores (r=-0.588, P<.001). T2*mapping could discriminate no or mild fibrosis (grade 0-1) from moderate-severe (grade 2-3) fibrosis deposition with an area under the receiver operating characteristic (ROC) curve of 0.939, which included a sensitivity of 84.6% and a specificity of 93.2%. A threshold T2* value of 21.84 was recommended for differentiating no or mild fibrosis from moderate-severe fibrosis.

CONCLUSION

T2*mapping is capable of detecting and distinguishing between certain degrees of bowel fibrosis in CD lesions. T2* mapping might be a potentially novel imaging tool for the evaluation of fibrotic stricture in CD patients.

CLINICAL RELEVANCE/APPLICATION

The T2* value is sensitive to small changes in biochemical composition, which suggests that lesion properties, particularly the transformation of water mobility within the macromolecular network, reflect the varying phase and status of CD. The T2* values were highly accurate for differentiating non- or mildly fibrotic and moderate-severe fibrotic bowel walls in CD patients. This may be important in further stratifying CD patients regarding the disease severity or suitability for modifying disease therapy.

SSC05-05 DECT in Bowel Inflammation Assessment on Low KeV Images

Monday, Nov. 27 11:10AM - 11:20AM Room: E451A

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PURPOSE

Low mono-energetic image derived by Dual Energy CT (DECT) can enable greater attenuation of contrast and improve conspicuity

Low mono-energetic image derived by Dual Energy CT (DECT) can enable greater attenuation of contrast and improve conspicuity. We hypothesized the low mono-energetic image will improve the reliability in the assessment of bowel inflammation. We aimed to compare conventional abdominal contrast-enhanced CT images with the low mono-energetic and virtual-non-contrast (VNC) DECT images to assess the contrast enhancement, contour and related findings in acute bowel inflammation.

METHOD AND MATERIALS

Forty patients who underwent abdominal contrast enhanced DECT (IQon, Philips Healthcare, Eindhoven, Nederland) between January and April 2017, with radiological findings correlating to bowel inflammation were retrospectively reviewed. Contrast enhanced series were performed using conventional single-energy mode at 120 kV. VNC and mono-energetic (ME) images at 50 keV were reconstructed from the conventional study. Qualitative assessments of the inflamed bowel wall, mural or intra luminal findings, adjacent fat stranding and fluid were performed on the conventional, VNC and ME images and rated on a scale of 1-5 (5 being the highest). Paired t-test was used to assess the significance of the differences between the conventional, VNC and ME images.

RESULTS

Bowel inflammation was cause by acute appendicitis (15%, 6/40), bowel obstruction (35%, 14/40), tumor (20%, 8/40) and colitis (30%, 6/40). The score of the qualitative assessment on the ME images at 50 keV (4.7) was significantly higher ($p<0.001$) compared to the score on the conventional image (3.9) The qualitative assessment had a lower score on the VNC image compared to the conventional image, with no significant difference.

CONCLUSION

Virtual low mono-energetic DECT images have the ability to significantly improve the conspicuity of bowel inflammation assessment. Non-conclusive radiological findings may thus be turned into definite and clinically relevant studies.

CLINICAL RELEVANCE/APPLICATION

The diagnostic yield of bowel inflammation can be increased with the use of mono-energetic images at low keV and therefore avoid non-conclusive radiological reports. This may assist in the clinical therapeutic decision making.

Honored Educators

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SSC05-06 Natural History of Endoscopic Skipping of the Terminal Ileum (ESTI): Incidence of Isolated Radiographic Intramural Inflammation

Monday, Nov. 27 11:20AM - 11:30AM Room: E451A

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PURPOSE

ESTI refers to a normal appearance of the terminal ileum (TI) at ileocolonoscopy (ICO) despite active small bowel (SB) Crohn's disease as evidenced by SB inflammation proximal to ICO, isolated radiographic findings of intramural inflammation (IMI) in the TI, or positive biopsy (microscopic inflammation). Our purpose is to evaluate the natural history of ESTI and the incidence of IMI in Crohn's patients.

METHOD AND MATERIALS

Patients were included who had normal ICO and CT/ MR enterography (CT/MRE) performed within 30 days showing active TI inflammation, as well as follow-up CTE/MRE. Severity of TI inflammation was assessed using a 4 point scale: 0: None; 1: hyperenhancement w/o thickening; 2: w/ >=5 mm thickness; 3: ulcers or > 10 mm in thickness. The length of TI involvement was recorded. Endoscopy and pathology reports were reviewed for length of TI intubation, endoscopic impression, and biopsy results. Patients were evaluated for new or worsening SB inflammation or stricture formation on subsequent CTE/MRE. Development of TI ulcers or inflammation detected on subsequent endoscopy or surgery was recorded. Patients with ESTI were then classified as: confirmed inflammation (subsequent worsening TI severity/length, new ulceration, or need of surgery); probable inflammation (decreased inflammation with medical therapy); inflammation unlikely.

RESULTS

113 patients had ESTI, 72 (64%) - IMI; 11 (10%) - proximal SB inflammation; 30 (27%) - microscopic and radiographic inflammation. 68 patients (60%) had confirmed inflammation, 14 (12%) - probable inflammation, and 31 (28%) - inflammation unlikely. Confirmed Inflammation was verified by subsequent surgery (n=40), positive ICO (n=41), worsened SB inflammation/stricture (n=39), and most had (IMI) (n=43/68; 63%). Median severity score and length were highest for confirmed inflammation (2, 10 cm) versus probable inflammation (1.5, 6 cm) and inflammation unlikely (1, 2 cm).

CONCLUSION

Patients with ESTI identified by CTE/MRE and who have more than 2 cm of inflammation with wall thickening >= 5mm will have

Patients with ESTI identified by CTE/MRE and who have more than 2 cm of inflammation with wall thickening >= 3mm will have inflammatory Crohn's, which worsens over time, or which will respond to medical therapy. About two-thirds of patients with ESTI have IMI, which behaves similarly.

CLINICAL RELEVANCE/APPLICATION

SB Crohn's disease should be monitored by endoscopy and enterography, as endoscopic skipping of the TI and isolated radiographic intramural inflammation will progress unless it is treated medically.

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/ Michael L. Wells, MD - 2017 Honored Educator

SSC05-07 Quantitative Inflammation Assessment for Crohn's Disease Using Ultrasound Microvessel Imaging: A Pilot Study

Monday, Nov. 27 11:30AM - 11:40AM Room: E451A

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PURPOSE

To evaluate Crohn's Disease (CD) bowel wall inflammation using the quantitative flow measurements derived from ultrasound microvessel imaging (UMI).

METHOD AND MATERIALS

Forty-four bowel wall segments (28 terminal ileum, 5 neoterminal ileum, 5 small bowel, 4 colon, 2 ileum) from 33 patients with CD symptoms undergoing CT or MR-enterography were imaged with UMI. UMI was performed with an ultrafast plane wave imaging system (Vantage, Verasonics Inc.) and a 5MHz linear array transducer (frame rate = 500 Hz, ensemble length = 250). A block-wise adaptive singular value decomposition (SVD)-based clutter filter was used extract the microvessel signal (Fig. (a)). UMI has significantly higher Doppler sensitivity than conventional Doppler (Fig. (a)). The dynamic range of the UMI images was carefully adjusted to reject background noise. Bowel wall microvessel density (MVD) was then calculated by measuring the number of microvessel pixels in the bowel wall and then normalizing to the bowel wall length. Bowel wall microvessel flow speed index (MVFS) was measured by calculating the local microvessel blood speckle decorrelation coefficient (faster flow speed leads to higher decorrelation), integrating the coefficient throughout the entire bowel wall, and normalizing to the bowel wall length. The CTE and MRE results were used as the reference standard for inflammation assessment.

RESULTS

Figures (c) and (d) show the MVD and MVFS measurements for normal, mild inflammation and active inflammation bowels. Active inflammation has significantly higher (p<0.05, one-tailed t-test) MVD and MVFS than normal and mildly inflamed bowels. MVD was significantly higher in mild than in normal bowel, while MVFS difference was not significant (p=0.07). A ROC analysis of using MVD to differentiate normal from inflamed (mild and active) bowel gave a sensitivity of 0.90, specificity of 0.85, and AUC of 0.96; differentiate active from normal and mild bowel gave a sensitivity of 0.96, specificity of 0.83, and AUC of 0.94.

CONCLUSION

The high Doppler sensitivity of UMI reveals bowel wall microvessels that are invisible to conventional Doppler. The quantitative microvessel measurements show promise of staging CD bowel wall inflammation.

CLINICAL RELEVANCE/APPLICATION

Reliable inflammation assessment for CD is essential to evaluate therapy efficacy and potential need for treatment modification. UMI offers a safe and cost effective tool for long term follow-up of CD.

SSC05-08 Consecutive Case Series of Pathologically Proven Small Bowel Neuroendocrine Neoplasms: Impact of Imaging Technologies

Monday, Nov. 27 11:40AM - 11:50AM Room: E451A

Awards
Student Travel Stipend Award

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PURPOSE

Neuroendocrine neoplasms are now the most common small bowel neoplasm. We conducted a retrospective review of small bowel neuroendocrine neoplasms (SBNEN) to determine: (1) frequency and diagnosis by various imaging modalities, (2) the impact of CT enterography (CTE) on diagnosis, and (3) rates of disease-free survival.

METHOD AND MATERIALS

Histopathologically confirmed SBNEN from 01/1996 - 02/2016 were identified, including those first diagnosed with SBNEN at our institution (FD-SBNEN). Clinical presentation, radiology, endoscopy, surgery, and pathology reports were reviewed and compared at 5-year periods.

RESULTS

294 SBNEN were included (178 FD-SBNEN). Diagnosis of SBNEN increased significantly (15 in 1996-2000, 168 in 2011-2016). GI bleeding increased as clinical presentation for FD-SBNEN (0% in 1996-2000, 25.4% in 2011-2016, p = 0.023). FD-SBNEN diagnosed by radiology increased 2-fold (n=3, 33.3% in 1996-2000; n=75, 65.8% in 2011-2016). The other primary diagnostic modality was EGD (n=3, 33.3% in 1996-2000; n=27, 23.7% in 2011-2016). For FD-SBNEN, CTE identified SBNEN 95% (52/55), with 91% (50/55) of original clinical reports diagnosing SBNEN. Routine abdominal CT detected 45% (37/85) and diagnosed 35% (29/85) of SBNEN. Of the 39 FD-SBNEN discovered by endoscopy, the recurrence rate correlated to initial lesion size; e.g., only 18% of SBNEN measuring 0.6± 0.3 cm recurred, but 75% measuring 3.7±1.0 cm recurred. Rates of disease-free survival during following resection for FD-SBNENs (n=96) was better when tumors were first identified by CTE rather than alternative radiologic methods (85% n=35 vs. 57% n=31, p=0.0034). Rates of local metastases (4.9% n=2 vs. 18.5% n=10, p=0.0475) and liver metastases (2.4% n=1, 24.1% n=13, p=0.0032) were also lower when CTE discovered SBNEN.

CONCLUSION

In the last two decades, there has been a dramatic increase (over 10-fold at our institution) in SBNEN's detected by CTE and endoscopy, and in patients with small bowel bleeding. SBNEN detection and characterization is better with CTE than routine abdominal CT. Small SBNEN's detected at endoscopy and CTE have longer disease-free survival.

CLINICAL RELEVANCE/APPLICATION

There has been a dramatic increase in SBNEN's detected by CTE and endoscopy, especially in patients with small bowel bleeding. Those with small tumors detected at endoscopy and CTE have longer disease-free survival after surgical resection.

SSC05-09 A New Semi-Automatic Technique for Crohn's Disease Diagnosis Using Supervised Machine Learning Algorithm: Kernel Support Vector Machine

Monday, Nov. 27 11:50AM - 12:00PM Room: E451A

Awards
Student Travel Stipend Award

Participants
Maria Chiara Terranova, Palermo, Italy (*Presenter*) Nothing to Disclose
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PURPOSE

We propose a new semi-automatic technique for Crohn's disease (CD) diagnosis, using Kernel Support Vector Machine (KSVM). KSVM is a supervised machine learning algorithm, which, instructed by a set of "labeled training example", outputs a function used to classify brand new data.

METHOD AND MATERIALS

Three radiologists extracted a dataset composed of 300 MR Enterography of 300 different patients used for KSVM training and validation. Each patient - classified in positive and negative according to histological specimen results - was "labeled" by 22 determined qualitative features, which are associated to CD or may help in CD diagnosis, according to worldwide literature: Terminal ileum thickening, length of the affected segment/s, single/skip lesions, fat wrapping, pseudo-polyps, ascites, stenosis/sub-stenosis, previous ileo-colonic surgery, sinus, fistulas, disease pattern and activity, complications, intestinal obstruction, lymph nodes, artifacts, enhancement pattern, parietal signal intensity on T2 SPAIR, signal intensity on DWI, bowel loops cleansing and distention. 300 MR enterography were divided as follows: 4/5 (240 patients) were used for KSVM training, and 1/5 (60 patients) were used for KSVM validation. This technique adopts a Stratified K(5)-Fold Cross-Validation strategy to enhance KSVM classifier reliability:

dataset is divided into k equal subsets, and the holdout method is repeated k times. Each time, one of the k subsets is used as validation set and the other K-1 subsets are put together to form the training set. So, the average error and/or any patient selection pitfall across all K experiments are computed and reduced.

RESULTS

The KSVM results were compared with the histological specimen results: Sensitivity: 94,80%; Specificity: 100,00%; Negative Predictive Value: 95,06%; Precision: 100,00%; Accuracy: 97,40%; Error: 2,60%.

CONCLUSION

The achieved results show that the proposed technique results are better than the manual reference methods reported in literature (Sensitivity: 93,00%; Specificity: 90,00%) with a greater usability and degree of acceptance.

CLINICAL RELEVANCE/APPLICATION

Crohn's Disease (CD) diagnosis using MRI requires great radiological expertise in gastrointestinal field. We propose a new semi-automatic technique for CD diagnosis, using machine learning algorithm.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

SSC11

Neuroradiology (Functional MRI)

Monday, Nov. 27 10:30AM - 12:00PM Room: N229

MR NR

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

FDA Discussions may include off-label uses.

Participants
Joshua S. Shimony, MD, PhD, Saint Louis, MO (*Moderator*) Nothing to Disclose
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Sub-Events

SSC11-01 Impact of Glycemic Control and Cardiovascular Disease Measures on Hippocampal Functional Connectivity in African Americans with Type 2 Diabetes: A Resting State fMRI Study

Monday, Nov. 27 10:30AM - 10:40AM Room: N229

Participants
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Albert Montillo, PhD, Dallas, TX (*Presenter*) Nothing to Disclose

PURPOSE

This study tests the hypothesis that inadequate Type 2 diabetes (T2D) management, including fine gradations of glycemic control, increasing measures of cardiovascular disease (CVD) and renal disease, leads to decreased hippocampal connectivity in African Americans (AA).

METHOD AND MATERIALS

The study includes 155 AA with T2D, 57% female with mean age of 59.2 years for whom diabetes management was quantified. Subjects had a mean diabetes duration of 14.5 years, hemoglobin A1c (HbA1c) of 7.97%, estimated glomerular filtration rate (eGFR) of 86.6 mL/min/1.73m2, and coronary artery calcium (CAC) score of 475.4mg. An 8min resting state fMRI was acquired and structural and functional MRI were co-registered, normalized to MNI space, and mean fMRI time courses per region were computed, and then pairwise region connectivity using Pearson's correlation was computed. The regions and connections form a graph of nodes and edges. Correlation was thresholded to retain the top 10% edges. The degree of each region which represents the overall connectivity of the region to the rest of the brain was computed to form a brain health measure. A linear support vector regression model was fit to predict the brain health measure using 10-fold cross-validation, while permutation testing was used to compute model reliability. The predictor set consists of diabetes measures: HbA1c, renal disease measures: eGFR, c-reactive protein (CRP), and urine albumin-to-creatinine ratio (ACR), and CVD measure: CAC. Our model is fully adjusted for education, age, sex and BMI.

RESULTS

The functional connectivity of the hippocampus was found to be significantly impacted by HbA1c and CAC with R2=1.9%, p=0.00047. Lower functional connectivity of right hippocampus (hippocampal degree) was associated with poor glycemic control (higher HbA1c) and greater calcified plaque (higher CAC). The results complement previous research demonstrating an inverse association between CAC and Montreal Cognitive Assessment test scores.

CONCLUSION

This work provides new evidence that elevated HbA1c and CAC are associated with decreasing functional connectivity of the right hippocampus in AAs with T2D.

CLINICAL RELEVANCE/APPLICATION

The results suggest that maintaining fine degree of glycemic control and cardiovascular health may support optimal hippocampal function, a structure critical for successful memory retrieval.

SSC11-02 Functional MRI Neuroimaging Study of Earnings Management Decision by Business Managers

Monday, Nov. 27 10:40AM - 10:50AM Room: N229

Awards
Student Travel Stipend Award

Participants
Eslam Y. Youssef, MD, Toledo, OH (*Presenter*) Nothing to Disclose
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Amal Said, Toledo, OH (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Although functional MRI (fMRI) techniques have been increasingly used to study human cognitive functions, there has been a lack of research on the applications of fMRI on brain activation of business managers. Specifically, there is research gap in using fMRI to examine managers' earning management decisions. Therefore, the current study to report on a newly developed paradigm for neuroimaging study of neuro-accounting research, and the new findings related to brain activation associated with earnings management as a mechanism to avoid violating debt covenants.

METHOD AND MATERIALS

The participants were 52 local business owners and managers, males and females, age 18 to 60 years old. All participants had some educational background in accounting, business or finance and significant employment in managerial capacity. To probe the related neurocircuits, we designed different scenarios in which firms are either close (CLOSE) or far (FAR) from violating debt covenants. The subject is assigned a role of a manager to choose whether or not to manage earnings in order to avoid debt covenant violations and the subject's managing style is evaluated in every scenario. The influences of subject's perception of his/her supervisor managing style are also evaluated in every scenario.

RESULTS

We found that there was greater pre-frontal cortex (PFC) activation in CLOSE than in FAR scenarios. These results suggest that earning management decisions under high levels of financial stress requires more PFC cognitive functions. We also found that there was greater activation in the bilateral nucleus accumbens (NA) and the left amygdala (Amy) in CLOSE than FAR scenarios.

CONCLUSION

The final findings reveal different activation in emotion response and cognitive processing when the company is close vs. far from violating debt covenants which influences the manager's managing style and performance evaluation approach on manager's earning management decision and related brain activation. The final findings also suggest influences of manager's perception of his/her supervisor's managing style on manager's emotion responses during earning management decision making.

CLINICAL RELEVANCE/APPLICATION

FMRI can demonstrate brain activation associated with earnings management behavior to avoid violating debt covenants by business managers.

SSC11-03 Application of fMRI in the Assessment of Neuronal Activity in Patients with Fragile X Syndrome

Monday, Nov. 27 10:50AM - 11:00AM Room: N229

Participants
Andrey Tulupov, MD,PhD, Novosibirsk, Russia (*Presenter*) Nothing to Disclose
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PURPOSE

Fragile X syndrome (FXS) is the most common inheritable mental disease in children. The main cause of the disorder is CGG•GCC repeat expansion in 5' promoter region of the FMR1 gene. Commonly during the routine MRI study, the changes in brain structures in patients with fragile X syndrome are not observed. Thus the application of fMRI technique that provides information on the structure of neural networks in brain, is of a primary interest for diagnostics of the fragile X syndrome, as well as it is used for patients during examination in neurology and psychiatry. The aim of the study was to assess the neural activity of different brain regions in patients and the control group by resting state fMRI.

METHOD AND MATERIALS

The fMRI was performed on «Achieva» (Philips) scanner with a magnetic field strength of 1.5 T. Study involved two groups of patients: 5 children with confirmed fragile X syndrome and 8 healthy volunteers. Independent Component Analysis and seed-based correlation analysis were used. Statistical analysis was performed using FSL (fMRI Brain Software Library).

RESULTS

The fMRI study revealed a default mode network of brain function in patients with the fragile X syndrome, as well as in the control group. Furthermore, it was found that a default mode network of the brain in patients with fragile X syndrome and control groups do not have statistical significance ($p>0.05$), which may indicate that the basal activity of neurons in patients with fragile X syndrome it is not reduced. Also we have found a significant ($p<0.05$) reduction the functional connectivity within the prefrontal cortex of the frontal-parietal hemispheric network in the resting state in patients with fragile X syndrome.

CONCLUSION

New data of functional status of the brain in patients with fragile X syndrome were received. The significant reduction the functional connectivity within the prefrontal cortex of the frontal-parietal hemispheric network in the resting state in patients with fragile X syndrome was found.

CLINICAL RELEVANCE/APPLICATION

Neurology, psychiatry, genetics

SSC11-04 fMRI Markers of Decision-Making under Uncertain Conditions

Monday, Nov. 27 11:00AM - 11:10AM Room: N229

Awards
Student Travel Stipend Award

Participants
Danielle C. Farrar, MA, Boston, MA (*Presenter*) Nothing to Disclose
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Ronald Killiany, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To describe imaging markers of decision-making under certain and uncertain conditions in normal individuals, in order to provide baseline activity in which to compare impaired decision-making in such pathological states as schizophrenia, ADHD, and obsessive-compulsive disorder.

METHOD AND MATERIALS

Nineteen healthy subjects ages 18-35 completed a novel decision-making card-matching task using a Phillips T3 Scanner. Functional data were collected in six functional runs of a single shot echo-planar imaging sequence (TR = 2 s, TE = 35 ms, 30 slices, 3 mm slice thickness, inplane resolution 3 mm × 3 mm) and a T1-weighted structural image (1 mm3 voxel size). In one condition of the card-matching task, the participant was certain of the rule to apply to match the cards; in the other condition, the participant was uncertain. We performed cluster-based comparison of the two conditions using FSL FEAT.

RESULTS

The uncertain > certain comparison yielded 3 large clusters through general linear model (GLM) analysis using FSL FEAT - a midline cluster that extended through midbrain, the thalamus, bilateral prefrontal cortex, the striatum, and bilateral clusters that extended through the parietal cortex and occipital cortex. The certain > uncertain comparison yielded bilateral clusters in the insula that extend into the boundary of the parietal and temporal lobe, as well as a medial frontal cluster.

CONCLUSION

The involvement of the insula, parietal cortex, temporal cortex, ventromedial cortex, and orbitofrontal cortex that showed increased activation in the certain condition are generally associated with rule certainty and reward, which reinforces the notion that certainty is inherently rewarding. For the uncertain condition, we expected to see involvement of the prefrontal cortex, parietal cortex in resolving uncertainty, as well as involvement of the striatum, thalamus, amygdala and hippocampal were expected in rule updating; however, the unexpected involvement of occipital cortical involvement and midbrain involvement may be attributed to increased visual attention and increased motor control.

CLINICAL RELEVANCE/APPLICATION

We have established a network of functional brain regions involved in certain and uncertain decision-making conditions using fMRI and a novel paradigm on which to explore pathological disease states.

SSC11-05 Impaired Executive Control Function in Unilateral Temporal Lobe Epilepsy Revealed by Extrinsic Brain Network Connectivity: A Resting-state Functional fMRI Study

Monday, Nov. 27 11:10AM - 11:20AM Room: N229

Participants
Chao Zhang, Beijing, China (*Presenter*) Nothing to Disclose
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PURPOSE

To investigate functional connectivity (FC) between resting-state networks (RSNs) in unilateral intractable temporal lobe epilepsy (TLE) patients with abnormal executive control function (ECF).

METHOD AND MATERIALS

Forty left TLE patients and twenty-three volunteers were recruited for resting-state fMRI scanning. The patient groups were

divided into two subgroups according to ECF performance: ECN decreased group as subgroup 1 (G1) and ECN normal group as subgroup 2 (G2). The healthy control group (HC) included all 23 volunteers. All the subjects were received neuropsychological tests, including Wisconsin Card Sorting Test (WCST) and Montreal Cognitive Assessment (MoCA). Group-information-guided independent component analysis (GIG-ICA) was employed to estimate RSNs of all subjects. A general linear model with age, sex and education as covariates was used to analyze which pairs of internetwork FC reached significant differences ($p<0.05$) among G1, G2 and HC. Pearson correlation between FC, clinical features and neuropsychological performances were also observed though partial correlation analysis with age, sex and edu as covariates ($p<0.05$).

RESULTS

Eleven meaningful RSNs were identified though empirical analysis. G2 exhibited decreased FC between ECN and DMN network when compared with G1 ($p=0.000$, bonferroni corrected) and HC ($p=0.000$, bonferroni corrected). However, G1 showed no significant difference with control group. Furthermore, FC of patients had significantly negative correlation with WCST performance and duration of disease ($p=0.000$), but have no correlation with MoCA. Besides, significantly positive correlation were also found between FC with age-onset ($p=0.000$). However, there was no significant correlation between FC and neuropsychological tests of HC.

CONCLUSION

Our study suggested that FC abnormal between ECN and DMN may potentially act as an imaging biomarker candidate, which can not only differentiate ECF normal and ECF impairment, but also can reflect ECF impairment degree of TLE patients. Furthermore, such FC pattern may also provide us new insight into understanding ECF pathophysiological mechanisms of unilateral intractable TLE.

CLINICAL RELEVANCE/APPLICATION

Neuropsychological performance was closely related to functional connectivity between large-scale networks which can be well depicted by fMRI.

SSC11-06 Accuracy of Resting-State fMRI Language Networks in Brain Tumor Patients: Comparison Between Blind Seed-Based Analysis versus Independent Component Analysis

Monday, Nov. 27 11:20AM - 11:30AM Room: N229

Participants
Ammar A. Chaudhry, MD, Corona, CA (*Presenter*) Nothing to Disclose

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PURPOSE

Compare concordance of language networks derived fromSeed Based Analysis (SBA) resting-state fMRI in patients with brain tumors with Independent Component Analysis (ICA)

METHOD AND MATERIALS

Resting state fMRI was performed and language networks identified for patients presenting for presurgical task-fMRI mapping between 1/1/2009 and 7/1/2015. 79 patients were analyzed of which 49 met the inclusion criteria (presence of brain tumors without history of prior brain surgery, adequate task-fMRI performance). Language networks were obtained from rs-fMRI using ICA with 50 components and SBA using blind seed in the IFG from the rs-fMRI maps. Seeds generated from maximal task-fMRI activation in the IFG were used as control. Rs-vs-task-fMRI concordance for each resultant map was measured using Dice coefficients across varying fMRI thresholds. Multi-threshold Dice coefficient volume under the surface (DiceVUS) and maximum Dice coefficient (MaxDice) were calculated. ANOVA was performed to determine significant differences in DiceVUS and MaxDice between the methods of analysis.

RESULTS

Paired T-test showed there is no statistical difference between blinded-SBA and ICA-50 ($P<0.4694$). Also, there is statistical difference between task-SBA and blinded-SBA ($P<0.001$) and task-SBA and ICA-50 ($P<0.0178$).Group mean DiceVUS and MaxDice were highest for the task-based SBA than both blind-SBA and ICA. Paired T-test demonstrate no significant diffference between the blind-SBA and ICA. ANOVA with Tukey HSD demonstrated statistically significant differences for both DiceVUS and MaxDice between blind-SBA and ICA. The violin plot (figure 6) demonstrates the data distribution relative to the mean for ICA, SBA, RBA (AMPLE) and blind-SBA (left, right, optimal; respectively). ICA and SBA demonstrate similar degree of variability of values across subjects relative to the mean and kernel density estimation (KDE).

CONCLUSION

We demonstrate that blind rs-FMRI and ICA have similar accuracy in identifying language networks on rs-fMRI. Both the group mean MaxDice and DiceVUS were greater for task-SBA than ICA and blind-SBA.

CLINICAL RELEVANCE/APPLICATION

Blind-SBA analysis can be utilized to reliably identify neuronal language networks on pre-operative studies, especially in patient who are unable to perform all the tasks required in conventional task-fMRI.

SSC11-07 Self-Regulation of the Primary Auditory Cortex Activity via Directed Attention Mediated By Real-Time fMRI Neurofeedback

Monday, Nov. 27 11:30AM - 11:40AM Room: N229

Participants
Matthew S. Sherwood, PhD, Dayton, OH (*Presenter*) Nothing to Disclose
Emily E. Diller, MS, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose
Subhashini Ganapathy, PhD, Dayton, OH (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine the potential efficacy of treating auditory cortex hyperactivity by self-regulation of the primary auditory cortex (A1) based on real-time functional magnetic resonance imaging neurofeedback training (fMRI-NFT).

METHOD AND MATERIALS

10 healthy volunteers with normal hearing (no more than 1 frequency >40 dB on a standard audiogram) underwent 5 fMRI-NFT sessions. Each session was composed of a simple auditory fMRI followed by 2 runs of A1 fMRI-NFT. FMRI data was acquired using 2D, single-shot echo planar imaging during all 3 runs using a 3T. The auditory fMRI was comprised of 6 blocks, each containing a 20s period of no auditory stimulation followed by a 20s period of white noise stimulation at 90 dB. A1 activity, defined from a region using the activity during the preceding auditory run, was continuously updated during fMRI-NFT using a simple bar plot, and was accompanied by white noise (90 dB) stimulation for the duration of the scan. Each fMRI-NFT run contained 8 blocks, each separated into a 30s relax period followed by a 30s lower period. Subjects were instructed to watch the bar during the relax condition and actively lower the bar by decreasing A1 activity during the lower condition. The average A1 activity was measured from the simple auditory task from each session. Average A1 deactivation was extracted from each fMRI-NFT run, representative of A1 self-regulation performance.

RESULTS

A one-way ANOVA evaluated the effect of session on A1 activity during the simple auditory task. The main effect of session was not significant ($p = 0.41$, sphericity assumed, two-tailed). A 5x2 (session by run) ANOVA was carried out on A1 deactivation during fMRI-NFT. There was a significant effect of session ($p = 0.0275$, sphericity assumed, one-tailed) and a significant interaction effect ($p = 0.0395$, sphericity assumed, one-tailed). The most successful subjects reportedly adopted mindfulness tasks associated with directed attention.

CONCLUSION

For the first time, fMRI-NFT has been applied to teach A1 self-regulation using more than 1 session. This is important to therapeutic development as it is unlikely a single fMRI-NFT session will reverse the effects of tinnitus.

CLINICAL RELEVANCE/APPLICATION

Chronic tinnitus has implications of impaired auditory and attentional networks. Our study indicates that fMRI-NFT may provide an innovative approach to alter of these systems simultaneously.

SSC11-08 Characterization of Obsessive-Compulsive Disorder Using a Multiparametric Classification Approach Based on Resting-State fMRI

Monday, Nov. 27 11:40AM - 11:50AM Room: N229

Participants
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PURPOSE

Obsessive-compulsive disorder(OCD)is a common,heritable and disabling neuropsychiatric disorder.Recent advances in resting-state functional magnetic resonance imaging(rs-fMRI)have facilitated the abnormality of a specific network of cortico-striato-limbic regions.However,the vast majority of these studies published so far have been based on average differences between groups.Whether functional neuroimaging could be used to inform the clinical assessment of individual OCD patients remains unclear.The machine learning approach is a promising technique which allows the classification of individual observations into distinct groups and bears the advantage of individualized judgement.Thus,in current study,we aimed to apply one of the machine learning approach known as Support Vector Machine(SVM)to distinguishing drug-naive OCD patients from healthy control subjects(HCS)based on various rs-fMRI parameters.

METHOD AND MATERIALS

A total of 54 drug-naive OCD patients and 54 age,sex,handedness and years of education well matched HCS were recruited in current study.The rs-fMRI were obtained via a 3.0 T GE MRI system.Four different rs-fMRI parameter maps including amplitude of low-frequency fluctuation (ALFF),fractional amplitude of low frequency fluctuation (fALFF),regional homogeneity (ReHo) and functional connectivity strength (FCS) were separately calculated using REST software.Subsequently,all these rs-fMRI parametric maps were used to discriminate OCD patients from HCS based on leave one-out cross-validation approach with SVM implemented in the PROBID software package.We also drew a receiver operating characteristic(ROC)curve to help evaluate the performance of each parameter.

RESULTS

The classification accuracy,sensitivity and specificity for SVM classifier of each rs-fMRI parameter are presented in the Figure.Overall,the SVM classification accuracies for the four rs-fMRI parameters were all above 74%.The highest classification accuracy(95.37%,$p<0.001$)was achieved when ALFF maps were employed.

CONCLUSION

Our findings suggest that the four rs-fMRI parameters would exhibited significant differences in predicting diagnosis of OCD,and ALFF showed the highest accuracy,which is fit to be an assistant measure in clinical practice to help identify OCD at the individual level.

CLINICAL RELEVANCE/APPLICATION

Application of SVM to ALFF maps could be used to aid the identification of OCD in clinical practice.

SSC11-09 Identification of the Sensorimotor Network in Brain Tumor Patients Using Resting-State Functional MRI

Monday, Nov. 27 11:50AM - 12:00PM Room: N229

Participants
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Chih-Chun Wu, MD, New York, NY (*Presenter*) Nothing to Disclose
Mariana Lazar, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Rajan Jain, MD, Hartsdale, NY (*Abstract Co-Author*) Consultant, Cancer Panels; Royalties, Thieme Medical Publishers, Inc

PURPOSE

Evaluate the ability of resting-state fMRI in localizing the sensorimotor network (SMN) and its individual components in patients with brain tumors, using independent component analysis (ICA) and seed-based analysis.

METHOD AND MATERIALS

This is a retrospective analysis of 29 patients with brain tumors presenting for fMRI mapping. ICA with a predetermine output of 20 components was performed for each patient. Eight seed-based analyses were performed, with seeds allocated in the medial, knob-like area and lateral precentral gyrus and in the posterior superior frontal gyrus of each hemisphere. The ability of identifying a complete SMN or any of its parts, composed by bilateral primary sensorimotor cortex (PSMC) and bilateral supplementary motor area (SMA) with ICA and seed-based analysis was subjectively assessed. For each of the precentral gyrus seed-based analysis, the capacity of localizing the correspondent region of the seed in the contralateral hemisphere was also assessed.

RESULTS

ICA identified a complete SMN in 13 patients (44%), the left PSMC in 18 patients (62%), the right PSMC in 18 patients (62%), the left SMA in 18 patients (62%) and the right SMA in 18 patients (62%). Combined analysis of the correlation maps generated by all seeds identified a complete SMN in 15 patients (51%), the left PSMC in 17 patients (58%), the right PSMC in 18 patients (62%), the left SMA in 28 patients (96%) and the right SMA in 27 patients (93%). Combined ICA and seed-based analysis identified a complete SMN in 20 patients (68%), the left PSMC in 22 patients (75%), the right PSMC in 22 patients (75%), the left SMA in 28 patients (96%) and the right SMA in 27 patients (93%). Seed-based analysis of the precentral gyrus identified the correspondent area in the contralateral hemisphere in 154 of 174 analyses (88%).

CONCLUSION

Combining ICA and seed-based analysis increases the ability of resting-state fMRI in identifying the SMN and its components. Seed-based analysis consistently identifies the correspondent area of the seed in the contralateral hemisphere.

CLINICAL RELEVANCE/APPLICATION

Resting-state fMRI can be used to identify the sensorimotor network, this being especially valuable when brain lesions generates morphological distortion and patients are unable to perform the tasks required by conventional task-fMRI.

SSC12

Neuroradiology (White Matter Diseases: Do They Matter?)

Monday, Nov. 27 10:30AM - 12:00PM Room: N226

MR NR

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

FDA Discussions may include off-label uses.

Participants
Peter B. Barker, DPhil, Baltimore, MD (*Moderator*) Nothing to Disclose
Ronald L. Wolf, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSC12-01 Clinical Use of Brain MRI Biomarkers for Multiple Sclerosis: A Health Economical Study in the United States

Monday, Nov. 27 10:30AM - 10:40AM Room: N226

Participants
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Anke Maertens, MSc , Leuven, Belgium (*Abstract Co-Author*) Employee, icoMetrix NV
Eline van Vlierberghe, Leuven, Belgium (*Abstract Co-Author*) Employee, IcoMetrix NV
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CONCLUSION

The accurate and reproducible assessment of MRI lesions and brain atrophy in MS is not only clinically important, but also has major health economic benefits thanks to the reduction of medication costs. [1] Sa et al. 2015 [2] Gauthier et al., Journal Neurological Sciences 2009 [3] Giovannoni et al. Brain Health 2015 [4] Hartung et al., Neurology. 2015 26 [5] Rio et al., EJN 2012 [6] Rojas et al., Neurological Research 2014

Background

Since Multiple Sclerosis (MS) is an incurable chronic disease, the focus of therapy is to slow down the relapses and disability progression. Currently, over 10 disease modifying treatments are clinically approved for relapsing remitting MS. However, providing the best treatment for each patient remains a major challenge as over 25-30% of treatments have a suboptimal effect [1,2]. It is shown that personalized and accurate monitoring of MRI lesions and brain atrophy allows the prediction of disability progression, relapses and treatment effect [3]. This work assesses the health economic benefit.

Evaluation

A two scenario decision-tree model is used comparing the situation with and without accurate monitoring of MRI lesions (T2/Gd enhancing and evolution) and brain atrophy. We estimate that yearly 10000 therapy initiations or switches take place in the US, with an average medication cost of $60k [4]. Considering that 26% of these treatments are suboptimal [1] for 3.9 years [5], current costs of failing treatments are about $600M. With an accurate monitoring of MRI lesions and atrophy, the probability to detect treatment failure is 3.1 times higher [6], reducing the average time on suboptimal treatment to 1.3 years. This results in a cost saving of about $400M (67%).

Discussion

In order to realize such a significant cost saving, efforts are required to introduce accurate and reproducible assessments of MRI lesions and atrophy into the radiological reporting [3]. Today, counting lesions and identifying new (and enlarging) lesions is time consuming and prone to variability (intra-rater and inter-rater), and accurately assessing brain atrophy is not even possible by human eye. Automated quantification by software imposes itself as a solution.

SSC12-02 Longitudinal Persistence of Meningeal Enhancement on Post-Contrast 7 Tesla FLAIR MRI in Multiple Sclerosis

Monday, Nov. 27 10:40AM - 10:50AM Room: N226

Awards
Student Travel Stipend Award

Participants
Samuel N. Jonas, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Izlem Izbudak, MD, Baltimore, MD (*Abstract Co-Author*) Institutional Grant support, Biogen Idec Inc; Consultant, Alexion Pharmaceuticals, Inc; Institutional Grant support, Siemens AG;

Daniel Harrison, MD, Baltimore, MD (*Abstract Co-Author*) Consultant, Genentech; Research grant, EMD Serono

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PURPOSE

Multiple sclerosis (MS) is a chronic demyelinating disorder associated with increased magnetic resonance signal on T2-weighted sequences within characteristic white matter regions of the brain and spinal cord. Recently, post-contrast FLAIR has emerged as a technique for evaluating meningeal inflammation, an under-recognized facet of MS pathophysiology. We have recently reported the incidence of this finding on 7 Tesla (7T) MRI. In this study, we aimed to determine if the presence of meningeal enhancement on 7T MRI in MS is a transient or persistent phenomenon.

METHOD AND MATERIALS

11 patients with MS were prospectively scanned at two time points, approximately 1 year apart, on a Philips 7T Achieva magnet between September 2014 and May 2016. Magnetization-prepared FLAIR (MPFLAIR) images were acquired at 0.7mm3 resolution before and after administration of 0.1mmol/kg of gadoteridol. Co-registered pre- and post-contrast scans were reviewed by two independent judges: one board certified neurologist and one PGY-3 radiology resident. Foci of meningeal enhancement were annotated using Medical Image Processing, Analysis & Visualization (MIPAV) v. 7.3.0. Discordant lesions that were marked by one but not both judges were reviewed by a third judge: a board certified neuroradiologist. Finalized annotations were classified into 4 subtypes: pachymeningeal nodules (PN), leptomeningeal nodules (LN), subarachnoid amorphous (SA), and dural venous rim (DVR). Follow-up images were then reviewed to determine if they changed between time points.

RESULTS

The median number of enhancing meningeal foci detected per subject on the initial scan was 9 (range 1-15). 86% percent of foci identified on the initial scan were again identified on the follow-up scan; 14% resolved. In 7 of 11 subjects, follow-up scans revealed foci not present on the initial scan. When stratified by morphologic subtype, persistence was observed in 92% PN, 67% LN, 68% SA, and 95% DVR.

CONCLUSION

The majority of enhancing meningeal foci on 7T MPFLAIR are longitudinally persistent in MS. The likelihood of persistence appears dependent on the morphologic features and location of enhancement.

CLINICAL RELEVANCE/APPLICATION

It is critical to determine to what extent meningeal enhancement persists on MRI over time in MS patients, as it will inform future study of the clinical relevance of this phenomenon.

SSC12-03 Edge Density Mapping of Cerebral White Matter in Persons with Cerebral Microbleeds in the Rotterdam Study

Monday, Nov. 27 10:50AM - 11:00AM Room: N226

Participants
Cyrus Raji, MD, PhD, San Francisco, CA (*Presenter*) Consultant, Brainreader ApS
Maxwell B. Wang, BS, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
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Pratik Mukherjee, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company Medical Adivisory Board, General Electric Company
Meike W. Vernooij, MD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Cerebral microbleeds reflect presence of small vessel disease and as such are known to be related to white matter disease (hyperintensities and atrophy). Yet, little is known on the overall influence they may have on specific white matter tracts. We studied edge density mapping of white matter in persons with and without microbleeds.

METHOD AND MATERIALS

This study is based on subjects from the population-based Rotterdam Study. Non-demented, stroke-free subjects previously assessed with lobar microbleeds (n = 17) and controls without microbleeds (n = 14) were selected from the larger study population. In all subjects, diffusion tensor imaging (DTI) with 64 directions was available for edge density mapping from a 3T MR Scanner. Edge density images (EDI) were computed from edges involved in a previously defined consensus connectome with each voxel's edge density defined as the number of consensus edges passing through the voxel of interest. To enable comparison between EDI maps of different subjects, EDI maps were registered to MNI152 space. Principal components analysis was done to extract specific EDI maps that separate the microbleed group from control with machine learning using support vector machine learning with leave one out cross validation.

RESULTS

Average age was 64.1 (S.D. 4.5; range 55-73), 45% women. There were no statistically significant differences in age or gender between the microbleed and control group. The microbleed group had an average of 2.43 lobar microbleeds. EDI imaging identified principle components in the posterior corona radiata, splenium of the corpus callosum, and superior longitudinal fasiculus ($p = 10 \times 10\text{-}4$). Figure 1 highlights these three areas in light blue. The area under the curve for these three areas identifying white matter abnormalities on microbleed scans was 87.8%. The sensitivity was 95% and specificity was 70%.

CONCLUSION

Edge density imaging identifies abnormalities in white matter in persons with lobar microbleeds with high accuracy and sensitivity. This suggests the importance of future studies to better elucidate applications of connectome image to vascular brain aging.

CLINICAL RELEVANCE/APPLICATION

Edge density imaging is a new type of connectome mapping that identifies tract-specific white matter abnormalities in persons with cerebral microbleeds. These results suggest this method can identify white matter abnormalities in relation to other brain imaging biomarkers of disease.

SSC12-04 Axial, Radial and Mean Diffusivity in FLAIR-Positive Lesions and Normal-Appearing White Matter in Young Adult Multiple Sclerosis Patients

Monday, Nov. 27 11:00AM - 11:10AM Room: N226

Participants
Tao Wang, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
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Kenneth T. Wengler, MS, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Jie Ding, MS, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
David Ouellette, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Carlos Carcamo, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
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Lauren Krupp, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
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Christine DeLorenzo, PhD, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Patricia Coyle, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Tim Duong, PhD, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Andrew LaBella, BEng, Stony Brook, NY (*Presenter*) Nothing to Disclose

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PURPOSE

This study investigated axial, radial and mean diffusivity in FLAIR-positive lesions and normal-appearing white matter (NAWM) in young adult MS patients.

METHOD AND MATERIALS

FLAIR and DTI were acquired on 12 relapse-remitting MS patients (18-33yo, 1.5-10 year disease duration, 0-4 EDSS scores) and 12 age- and sex-matched healthy controls at 3T. DTI parameters (axial, radial and mean diffusivity: AD, RD, MD) were calculated. DTI parameters were tabulated for ROIs of the FLAIR positive lesions, NAWM in MS, and corresponding regions in controls. Comparisons were also made with EDSS, disease duration, lesion volume and counts.

RESULTS

In FLAIR positive ("established") lesions, axial, radial and mean diffusivity in MS were significantly higher than controls (AD:1.54±0.22 versus 1.19±0.24, P=0.0002; RD:1.00±0.22 versus 0.73±0.24, P=0.004; MD:1.18±0.22 versus 0.88±0.24, P=0.0008), suggesting edema or cell loss. Covariances of diffusivity data amongst pixels within the ROIs in MS were lower than controls (AD:0.24±0.07 versus 0.40±0.14, P=0.002; RD:0.35±0.06 versus 0.56±0.29, P=0.001; MD:0.28±0.07 versus 0.49±0.21, P=0.004), suggesting reduced tissue heterogeneity. In NAWM, radial and mean diffusivity in MS were significantly smaller than controls (RD:0.58±0.04 versus 0.72±0.04, P=0.001; MD:0.75±0.03 versus 0.83±0.04, P=0.001), but axial diffusivity was not (AD:1.09±0.02 versus 1.08±0.13, P=0.05+). Changes in radial and mean diffusivity suggest early and widespread cytotoxic injury. Covariances of diffusivity data of NAWM in MS were lower than controls (AD:0.31±0.02 versus 0.49±0.13; RD:0.22±0.02 versus 0.44±0.11; MD:0.21±0.02 versus 0.45±0.06, P=0.001 for all), suggesting reduced tissue heterogeneity. DTI parameters were not significantly (P=0.05+) correlated with EDSS, disease duration, lesion volume, and lesion counts.

CONCLUSION

Diffusivity data revealed cell loss in established lesions and cytotoxic injury in NAWM in young adult MS patients. Covariances of diffusivity data corroborated reduced tissue heterogeneity in established MS lesions and NAWM.

CLINICAL RELEVANCE/APPLICATION

DTI diffusivity data provide insights in the pathophysiology of MS in young adults. Diffusivity data may serve as imaging biomarkers of early disease pathophysiology in MS.

SSC12-05 The Relationship Between Brain White Matter Hyperintensity Burden Assessed Ante-mortem and Post-mortem

Monday, Nov. 27 11:10AM - 11:20AM Room: N226

Participants
Arman Kulkarni, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Arnold M. Evia JR, BS, Chicago, IL (*Presenter*) Nothing to Disclose
Julie A. Schneider, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Many studies have used ex vivo MRI to investigate the association of white matter hyperintensity (WMH) burden with age-related

Many studies have used ex-vivo MRI to investigate the association of white matter hyperintensity (WMH) burden with age--related neuropathologies while eliminating the interval between imaging and death (ante-mortem interval, AMI). All such investigations assume that WMH burden assessed ex-vivo is identical to that observed in-vivo, but that has not yet been established. Thus, the purpose of this work was twofold: 1) to investigate the relationship between WMH burden assessed in-vivo and ex-vivo on the same older adults, and 2) to test the hypothesis that WMH burden assessed ex-vivo is higher than that assessed in-vivo for longer AMI.

METHOD AND MATERIALS

83 older adults (90±7 years of age) recruited from two longitudinal, cohort studies of aging, underwent both in-vivo and ex-vivo brain MRI. The average AMI was 2.2±1.5 years. The average post-mortem interval (PMI; from death to immersion in fixative) was 8.1±4.7 hours. The average PMI to imaging was 30 days. A rater trained by an expert assessed WMH severity based on the original Fazekas scale. WMH burden was defined as the maximum of the periventricular and deep white matter WMH ratings. Intra-class reliability and agreement with the expert were assessed. In-vivo and ex-vivo ratings were compared for all participants. Two groups of participants were defined based on whether the WMH burden rating increased from in-vivo to ex-vivo MRI or not (excluding participants that already had the maximum rating in-vivo), and logistic regression of two groups was used to test the hypothesis that increased WMH burden ex-vivo is associated with longer AMI.

RESULTS

Intra-rater reliability (ICC=0.76) and agreement with the expert (ICC=0.80) were both strong. WMH burden generally stayed constant or increased from in-vivo to ex-vivo MRI. Logistic regression showed that for every one year increase in AMI, the odds of greater WMH burden ex-vivo increase by 59% (p=0.04).

CONCLUSION

This study demonstrated no drastic differences between in-vivo and ex-vivo WMH burden, providing strong evidence that WMH burden assessed ex-vivo is of the same nature as WMH burden assessed in-vivo. Any differences observed were probably due to additional pathology developing during the AMI.

CLINICAL RELEVANCE/APPLICATION

This study indicated no drastic differences between in--vivo and ex--vivo WMH, suggesting that WMH ex-vivo may be linked to in-vivo WMH, and thus may be used to assess neuropathological WMH correlates.

SSC12-06 Occupational Hazards of High Flight: A Proposed Mechanism of Neuronal Injury in Pilots and Aircrew Personnel with Hypobaric Exposure

Monday, Nov. 27 11:20AM - 11:30AM Room: N226

Participants
Jeremy M. Bernot, MD, Joint Base San Antonio Lackland, TX (*Presenter*) Nothing to Disclose
Mariya Gusman, BS, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Stephen McGuire, MD, Lackland Air Force Base, TX (*Abstract Co-Author*) Nothing to Disclose
Paul M. Sherman, MD, Lackland Air Force Base, TX (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Discover cellular mechanisms that lead to cerebral white matter hyperintensities in human pilots following non-hypoxic hypobaric exposure utilizing magnetic resonance spectroscopy (MRS) and arterial spin labeling (ASL). Human exposure to non-hypoxic hypobaria is associated with increased white matter hyperintensities, degradation of axonal integrity, and decrements in neurocognitive processing. The pathophysiologic mechanism underlying this is unknown. We hypothesized that using MRS and ASL could offer insight into cellular changes occurring after acute hypobaric exposure in hypobaric naïve trainees.

METHOD AND MATERIALS

85 U.S. Air Force (USAF) aircrew trainees were evaluated while undergoing their initial occupational hypobaric exposure. Standard USAF procedure is approximately a 30-minute exposure to 25,000 feet. Three high-resolution MR imaging scans were obtained - T-24 hours, T+24 hours, and T+72 hours. Quantitative analysis of ASL and frontal white matter MRS was performed. Fifty-five healthy USAF control subjects meeting the same physical and physiological criteria minus hypobaric exposure served as controls. Paired two-tailed t-tests were used for comparison.

RESULTS

ASL showed an upregulation of both white and gray matter cerebral blood flow at both T+24 and T+72 hours in the exposed subjects (white matter p=0.003/0.020; gray matter p=0.053/0.041) with no significant change in the control's white matter cerebral blood flow. Exposed subjects had a decrease at T+24 in N-acetylaspartate (p=0.065) and myo-inositol (0.027) with no significant change in controls.

CONCLUSION

Significant declines in markers of neuronal integrity suggest that oxidative stress is evident within 24 hours of hypobaric exposure. The increase in cerebral blood flow measured by ASL in subjects exposed to hypobaric conditions is a response to oxidative damage and is evidence of increased metabolic demand. This study provides evidence that white matter hyperintensity formation may occur because of repeated oxidative stress without adequate time for healing. Cerebral white matter hyperintensities in this population are likely a function of both cumulative effects as well as frequency of hypobaric exposure.

CLINICAL RELEVANCE/APPLICATION

Understand the neuropathophysiologic mechanism of hypobaric induced white matter injury in oder to mitigate or prevent its effects upon high altitude pilots and special operations personnnel

SSC12-07 When Pigs Fly: A Swine Model for Study of Hypobaric Non-Hypoxic Exposure Effects on the Brain

Monday, Nov. 27 11:30AM - 11:40AM Room: N226

Participants
Mariya Gusman, BS, MD, San Antonio, TX (*Presenter*) Nothing to Disclose
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Stephen McGuire, MD, Lackland Air Force Base, TX (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Non-hypoxic hypobaric exposure in Air Force U-2 pilots and hypobaric chamber personnel is associated with subcortical increased white matter hyperintensities, degradation of axonal integrity, and neurocognitive processing decrements. The mechanism for this is unknown. We developed a swine model to demonstrate and quantify axonal cerebral injury following non-hypoxic hypobaric exposure utilizing advanced magnetic resonance (MR) diffusion tensor imaging, Q-space, and advanced diffusion kurtosis imaging.

METHOD AND MATERIALS

Female miniature pigs (Sus scrofa domestica) were repetitively exposed to non-hypoxic hypobaria at 30,000 feet while controls remained at 5,000 feet altitude. All subjects underwent advanced MRI imaging three times. MR imaging was obtained at baseline, immediately post-exposure, and 4 weeks post-exposure. Advanced diffusion quantification was used to include kurtosis anisotropy, multi-b-value diffusion (Q-space), and fractional anisotropy (FA). Two-tailed t-tests were used for individual and group comparisons.

RESULTS

Perfusion-diffusion index and mean kurtosis anisotropy revealed an increase in unrestricted water immediately after repetitive high-altitude exposures. Repeated imaging at 4 weeks post exposure showed normalization to pre-exposure values. Age-adjusted mean fractional anisotropy (FA) at 4 weeks post-exposure was significantly decreased in the high-altitude group when compared to controls ($p < 0.0001/0.547$).

CONCLUSION

Our study demonstrates increase in unrestricted free water immediately after repetitive high-altitude exposure that is consistent with axonal injury, not seen in the control group. The significant decrease in FA at 4 weeks suggests degradation of axonal integrity. This replicates similar MR imaging findings in humans. This study provides evidence that repetitive hypobaric exposure incites axonal damage. Moreover, it supports the utility of advanced diffusion imaging techniques such as kurtosis anisotropy. To our knowledge, this is the first study to provide evidence that repetitive non-hypoxic hypobaric exposure incites axonal damage, as well as demonstrates our swine model as a feasible vector to study hypobaric neuronal injury and, possibly, other axonal injury processes like TBI.

CLINICAL RELEVANCE/APPLICATION

Understand the neuropathophysiology of hypobaric induced white matter injury in order to mitigate or prevent effects upon aircrew and special operations personnel

SSC12-08 Histologic Validation of MRI-Detected Myelin

Monday, Nov. 27 11:40AM - 11:50AM Room: N226

Participants
Marcel Warntjes, Linkoping, Sweden (*Presenter*) Employee, SyntheticMR AB
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Johan Berge, MD, Linkoping, Sweden (*Abstract Co-Author*) Nothing to Disclose
Wolf-Dieter Zech, MD, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Myelin detection and monitoring is of great value for diseases such as multiple sclerosis and dementia as well as for follow-up in paediatric patients. However, most MRI methods to measure myelin are challenging to perform in clinical routine. Recently, a model was published, where myelin partial volume in the brain is measured using a rapid quantitative MRI sequence. The purpose of this work was to validate the model with post-mortem histology.

METHOD AND MATERIALS

The brains of 12 fresh, intact cadavers were scanned with a quantification sequence to determine the R1 and R2 relaxation rates and proton density PD, as input for the myelin model. Subsequently, the brains were excised at autopsy and brain slices were stained with Luxol Fast Blue to verify the presence of myelin. The stained brain slices were photographed, converted to optical density and registered with the MRI images. A correlation analysis was performed between the MRI-detected and LFB-stained myelin values.

RESULTS

A correlation was found between the two methods with a mean Spearman's rho for all subjects of 0.74±0.11. Linear regression showed a mean intercept of 1.50±2.84% and a mean slope of 4.37±1.73 %/%. A lower correlation was found for the separate R1 and PD (rho = 0.63±0.12 and -0.73±0.09, respectively). For R2, the rho was very low (0.11±0.28).

CONCLUSION

The observed correlation with post-mortem histology supports the validity of the myelin measurement model using rapid MRI

The observed correlation with post-mortem histology supports the validity of the myelin measurement model using rapid MRI quantification.

CLINICAL RELEVANCE/APPLICATION

The study validated histologically that a single MRI sequence of less than 6 minutes scan time can provide myelin content estimation in the brain.

SSC12-09 Axonal Water Fraction (AWF)-Based Parcellation of the Corpus Callosum: A White Matter Tract Integrity (WMTI) Study

Monday, Nov. 27 11:50AM - 12:00PM Room: N226

Participants
Sohae Chung, PhD, New York, NY (*Presenter*) Nothing to Disclose
Els Fieremans, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Xiuyuan Wang, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Dmitry S. Novikov, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Yvonne W. Lui, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Despite the corpus callosum (CC) being composed of many different anatomic white matter (WM) tracts, structurally informed intra-callosal parcellation remains a challenge as clear boundaries between WM bundles are difficult to separate. Most previous work relies on gross callosal geometry or operator-dependent manual placement of regions-of-interest. Here we present a method of intra-callosal parcellation based on white matter tract integrity (WMTI) metrics derived from two-compartment modeling of multi-shell diffusion imaging, specifically axonal water fraction (AWF) to attempt to separate CC regions based on axon density.

METHOD AND MATERIALS

21 healthy individuals(34±9 y.o) were scanned using a 3T MR scanner (Skyra, Siemens) under IRB approval. Multi-shell diffusion imaging was performed using 5 b-values (upto 2.5ms/μm2, 60 directions). The CC skeleton was acquired in a fractional anisotropy(FA) template space and was dilated to avoid volume averaging through CSF(Fig.1(top,red)). Subject AWF maps were registered to a template space. AWF values within ROIs were averaged in each coronal slice along the CC. Subdivisions were placed at local maxima of the first derivative(Fig.1(bottom)), demarcating the CC into distinct segments based on greatest degree of change in AWF. We looked at this also: extra-axonal radial diffusivity(De,perp) to see patterns across segmented regions in De,perp reflective of myelination(Fig.2).

RESULTS

Fig.1 shows the plot of AWF along the CC. Its fist derivative plot was used to partition the CC into 5 regions(Fig.1(bottom)). Our results support the work of Hofer and Franhm (Neuroimage,2006) based on tractography from manual ROI placement.

CONCLUSION

WMTI has been proposed to disentangle intra- and extra-axonal environments. This can be leveraged to partition the CC based on AWF, reflective of biophysical factors of the underlying WM microstructure. Specifically, we found relatively lower AWF and higher De,perp in region 4, the posterior callosal body, known to contain a greater number of large diameter axons with thicker myelin. This technique would be easily translatable to individual subjects, even without morphing to a template space and future work is underway in this direction.

CLINICAL RELEVANCE/APPLICATION

Compartment specific *white matter tract integrity* metrics are sensitive to the underlying white matter microstructure and specifically *axonal water fraction* is able to partition the corpus callosum.

LL20

Lunch and Learn: Where Two Worlds Meet: How Real-time MRI May Transform Radiation Oncology: Presented by Elekta (invite-only)

Monday, Nov. 27 12:30PM - 1:30PM Room: S404AB

PARTICIPANTS

William Hall, MD, Milwaukee, WI

PROGRAM INFORMATION

A new class of radiation devices is emerging, and it has the potential to transform how cancer is treated through more precise tumor targeting. Elekta's high field (1.5T) MR-linac technology integrates the power of state-of-the-art MR imaging with precision radiation technology. It can deliver precisely-targeted radiation doses while simultaneously capturing highest-quality MR images, which will allow clinicians to visualize tumors and surrounding healthy tissue at any time during radiation delivery and adapt the treatment accordingly. Still in its early phase of clinical introduction, novel high field MR-linac technology offers many avenues for exploring improvements in radiotherapy, such as shorter treatment regimens or expansion of clinical indications. Also, by integrating the two technologies, MRI capabilities such as functional imaging can be optimally explored and bring personalized cancer care to radiation therapy. Speakers will share their experience on the rapidly-emerging area of high field MR-guided radiation therapy.

RSVP

https://www.elekta.com/rsna-lunch-symposium

LL22

Lunch and Learn: MR Elastography in Clinical Practice: Presented by Resoundant (invite-only)

Monday, Nov. 27 12:30PM - 1:30PM Room: S403B

PARTICIPANTS

Claude Sirlin M.D., Professor of Radiology, UCSD San Diego, CA; Sudhakar Venkatesh M.D., Professor of Radiology Mayo Clinic-Rochester, MN

PROGRAM INFORMATION

Join your colleagues at RSNA 2017 for a Lunch & Learn educational program to explore the application for MRE in clinical practice. Internationally-known experts will share their knowledge and experience with MRE in this session. Topics include Indications and clinical rationale for MRE - Overview of basic principles of MRE - Clinical evidence - Practical tips for interpreting an MRE exam - MRE image analysis - Troubleshooting - New clinical MRE applications on the horizon

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MSAS23

Emerging Imaging Trends in MRI Fusion Techniques (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Monday, Nov. 27 1:30PM - 3:00PM Room: S105AB

MR NM

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

FDA Discussions may include off-label uses.

Participants
Kendra Huber, RT, BS, Castle Rock, CO (*Moderator*) Nothing to Disclose
Kristen Welch, RT, New Berlin, WI (*Moderator*) Nothing to Disclose

Sub-Events

MSAS23A PET/MRI Applications and Challenges

Participants
Behrang Amini, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the technical challenges of PET/MRI. 2) Understand the similarities and differences between applications of PET/CT and PET/MR. 3) Be in a position to apply the knowledge to the creation of clinically useful images.

Active Handout:Behrang Amini

http://abstract.rsna.org/uploads/2017/17000221/Active MSAS23A.pdf

MSAS23B MR Image-Guided Adaptive Radiation Therapy

Participants
Geoffrey S. Ibbott, PhD, Houston, TX (*Presenter*) Investigator, Elekta AB; Travel support, Elekta AB

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LEARNING OBJECTIVES

1) Learn about new research into MR-guided radiation therapy and the potential applications for clinical practice. 2) Understand the technological developments necessary to combine a linear accelerator with a 1.5T magnetic field. 3) Assess the benefits of MR-guidance during adaptive treatment of tumors in specific clinical sites. 4) View examples of MR images taken during radiation delivery and dose distributions delivered in the presence of a strong magnetic field. 5) Understand the issues associated with commissioning, dosimetry, and quality assurance of MR-guided treatment machines, and techniques for addressing those issues.

ABSTRACT

The introduction of image guidance in radiation therapy has revolutionized the delivery of treatments. Modern imaging systems can supplement or even replace the historical practice of relying on external landmarks and laser alignment systems. While common kilovoltage imaging modalities provide excellent bony anatomy image quality, magnetic resonance imaging (MRI) surpasses them in soft tissue image contrast for better visualization and tracking of soft tissue tumors with no additional radiation dose to the patient. However, the introduction of MRI into a radiotherapy facility carries with it a number of complications including the influence of the magnetic field on the dose deposition, as well as the affects it can have on dosimetry systems. The development and introduction of MR-guided radiotherapy equipment will be reviewed and the benefits and disadvantages of representative technologies will be described. Clinical examples of the capabilities of MR image guidance will be discussed. The workflow of daily MR-guided adaptive treatment will be described, as well as potential benefits to patient care. Representative treatment plans will be shown, demonstrating ways in which the effects of the magnetic field can be ameliorated. The characteristics of quality assurance and dosimetry equipment that can enhance or minimize the effects of the magnetic field will be explained.

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SSE02

Breast Imaging (MRI Response to Neoadjuvant Treatment)

Monday, Nov. 27 3:00PM - 4:00PM Room: E450A

BR MR

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

Participants
Elizabeth A. Morris, MD, New York, NY (*Moderator*) Nothing to Disclose
Constance D. Lehman, MD, PhD, Boston, MA (*Moderator*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company

Sub-Events

SSE02-01 Phenotypic Biomarkers of Intra-Tumor Heterogeneity in Breast DCE-MRI Can Augment Tumor Volume Measures in Predicting Survival after Neoadjuvant Chemotherapy for Locally Advanced Breast Cancer: Results from the ACRIN 6657/I-SPY-1 Trial

Monday, Nov. 27 3:00PM - 3:10PM Room: E450A

Participants
Despina Kontos, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Elizabeth S. McDonald, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Breast cancer is biologically heterogeneous. Image-based assessment may alleviate pathologic sampling limitations to allow for more comprehensive assessment of tumor heterogeneity. We investigate tumor heterogeneity metrics derived from DCE-MRI as biomarkers to augment early prediction of long-term survival after neoadjuvant chemotherapy for locally advanced breast cancer.

METHOD AND MATERIALS

The ACRIN 6657/ISPY-1 trial cohort was accessed from NCI's Cancer Imaging Archive and DCE-MRI images were retrospectively analyzed for 106 women who had complete clinical and imaging data with tumor segmentations. Age, race, hormone receptor status (ER/PR/Her2), and functional tumor volume (FTV) were available. Four kinetic features (signal enhancement ratio, peak enhancement, wash-in/wash-out slope) were computed voxel-wise from DCE-MRIs acquired at the first post-treatment visit. Spatio-temporal heterogeneity was quantified for each feature using multi-resolution wavelets and principal component analysis was applied on the wavelet decomposition feature vectors to reduce dimensionality. Time-to-event analysis was performed using the Cox proportional hazards model and prediction of recurrence-free survival (33 events) was estimated with the c-statistic. A baseline model with FTV, age, race, and receptor status was compared using the likelihood-ratio test (LRT) to a model where tumor heterogeneity measures were added based on their univariate performance and low (<0.25) correlation to FTV.

RESULTS

The baseline model with age, race, receptors, and FTV had a c-statistic=0.70 (p=0.005), where FTV was the only significant predictor (p<0.001). A parsimonious model including FTV plus the top four univariate performing tumor heterogeneity features with low correlation to FTV had a c-statistic=0.77 (pLRT<0.001), where 3 out of 4 included features had independent contribution (p<=0.05). A model including the four heterogeneity features, but without FTV, had a c-statistic=0.71 (p=0.007), indicating similar performance to FTV.

CONCLUSION

Our preliminary data suggests that early prediction of survival after breast neoadjuvant chemotherapy can be improved when DCE-MRI measures of tumor heterogeneity are added to tumor volume measures.

CLINICAL RELEVANCE/APPLICATION

Tumor heterogeneity analysis via imaging may improve prediction of therapeutic efficacy, allowing for early treatment modification to avoid futile therapy while achieving precision cancer treatment.

SSE02-02 Patterns, Predictive Factors of Locoregional Recurrence in Breast Cancer Patients Undergone Breast-Conserving Surgery After Tumor Down-staging by Neoadjuvant Chemotherapy

Monday, Nov. 27 3:10PM - 3:20PM Room: E450A

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PURPOSE

We evaluated patterns and predictive factors of locoregional recurrence (LRR) in patients undergone BCS after tumor down-staging through NAC by comparison with those of pre-planned BCS group.

METHOD AND MATERIALS

Between October 2003 and September 2015, 688 consecutive breast cancer patients who had undergone BCS after NAC were identified. Patients with incomplete clinicopathologic information (n=27), bilateral breast cancer (n=6), or unavailable preoperative breast MRI (n=3) were excluded. Finally, 652 women (mean age, 45.4 years; range, 22-78 years) composed of 551 down-staged BCS and 101 pre-planned BCS patients were included. Rate and site of LRR were compared between the two groups using Fisher's exact test. MR imaging features (non-mass enhancement, rim enhancement, and peritumoral edema) and clinicopathologic features (age, stage, histologic grade, lymphovascular invasion, margin status, tumor subtype, radiotherapy, endocrine therapy) were analyzed to identify independent predictors associated with LRR by using multivariable regression analysis. Median follow-up was 64.1 months.

RESULTS

LRRs were diagnosed in 50 patients (9.8% [72.0% local and 28.0% regional]). No difference was found in the rate of LRR between the down-staged and pre-planned BCS groups (9.8% [54/552] vs. 9.9% [10/101], P=.975). LRR was more frequently found at the original tumor bed in down-staged BCS group than in pre-planned BCS group (50.9% [27/53] vs. 10% [1/10]; P=.016). In multivariable regression analysis, younger age <= 40 years (OR = 2.180, 95% CI = 1.157 to 4.108, P=.016), pathologic stage of 3 (OR = 6.297, 95% CI =2.614 to 15.170, P=<.001), and absence of radiotherapy (OR = 5.222, 95% CI =1.832 to 14.880, P=.002) remained an independent predictor of LRR. In addition, there was a tendency that patients with non-mass enhancement on preoperative MRI experience LRR (OR = 2.119, 95% CI = 0.976 to 4.597, P=.058).

CONCLUSION

Non-mass enhancement on preoperative MRI tends to be associated with LRR which frequently occurs in the original tumor bed in breast cancer patients undergone BCS after down-staging by NAC.

CLINICAL RELEVANCE/APPLICATION

Although BCS after tumor down-staging by NAC is oncologically safe, careful postoperative surveillance is needed for the original tumor bed, when non-mass enhancement was present on initial MRI.

SSE02-03 Comparison of Pathologic Response Evaluation Systems after Neoadjuvant Chemotherapy in Breast Cancers: Correlation with Breast MRI Computer-Aided Detection

Monday, Nov. 27 3:20PM - 3:30PM Room: E450A

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PURPOSE

Several pathologic methods are used to assess the tumor response of breast cancer after neoadjuvant chemotherapy (NAC) to predict clinical outcome. The purpose of the study was to investigate the tumor response after NAC using dynamic contrast-enhanced (DCE) magnetic resonance (MR) imaging parameters assessed with a commercially available computer-aided system and analyzed their correlation with pathologic response assessment systems.

METHOD AND MATERIALS

Our institutional review board approved this retrospective study. Between January and December 2015, 223 consecutive patients who had DCE MR imaging before and after completion of NAC prior to definitive surgery were included. The reduction rate of maximum diameter, volume, peak enhancement, and persistent, plateau, and washout-enhancing components were measured with a computer-aided system on DCE MR images and correlated with the Miller-Payne grading system, residual breast cancer burden (RCB) classes and RCB index.

RESULTS

The reduction rate was 65.5 ± 34.5 for maximum diameter, 84.4 ± 46.6 for volume, 56.8 ± 48.1 for peak enhancement, -31.0 ± 426.1 for persistent component, -7.8 ± 756.9 for plateau component, and 42.8 ± 225.9 for washout component. All six MR imaging parameters showed the best correlation with the Miller-Payne grading system (r = 0.472 to 0.722, P < 0.001), followed by RCB class (r = -0.580 to -0.412, P < 0.001) and RCB index (r = -0565 to -0.413, P < 0.001). Comparing with Miller-Payne grading system, the reduction rate of volume (r = 0.722, P < 0.001) showed the strongest correlation followed by maximum diameter (r = 0.687, P < 0.001), peak enhancement (r = 0.638, P < 0.001), plateau component (r = 0.562, P < 0.001), washout component (r =

0.548, P < 0.001), and persistent component (r = 0.472, P < 0.001).

CONCLUSION

Miller-Payne grading system showed the best correlation with the changes of DCE MR imaging parameters measured automatically by a commercially available computer-aided system, and the reduction rate of tumor volume measured on MR imaging showed the strongest correlation with the pathologic tumor response.

CLINICAL RELEVANCE/APPLICATION

The reduction rate of tumor volume measured on MR imaging showed the strongest correlation with the Miller-Payne grading system and could be applied to predict pathologic response.

SSE02-04 DCE-MRI Texture Features of Locally Advanced Breast Cancer: Correlation with Tumor Biomarkers, Post-Treatment Imaging and Pathologic Complete Response

Monday, Nov. 27 3:30PM - 3:40PM Room: E450A

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PURPOSE

Computer-extracted texture analysis of locally advanced breast cancers (LABC) on pre-treatment dynamic contrast MR imaging (DCE-MRI) may predict radiomic classification of tumors and pathologic response. The purpose of this study was to evaluate tumor and peritumoral texture features associated with tumor type, pathologic complete response (pCR), and post-treatment imaging volume.

METHOD AND MATERIALS

In this institutional review board-approved study, 44 women with LABC underwent breast DCE-MRI on a 3.0T magnet prior to and after neoadjuvant chemotherapy. In-house segmentation software was used to draw whole lesion 3D regions of interest on pre- and post-treatment imaging and automatically select a peritumoral enhancement ring. Computer-generated texture features for whole lesion and peritumoral enhancement were extracted from fat-suppressed first post-contrast T1-weighted (T1W) and corresponding subtraction (sub) pre-treatment images using three spatial scales (SS) at ~1 mm/4 mm/8 mm resolution. Texture features were correlated with tumor biomarkers, post-treatment imaging % volume change, and pCR, using Kruskal-Wallis, Mann-Whitney and Spearman rank tests.

RESULTS

Cancers were 29.5% (13/44) estrogen receptor/progesterone receptor positive, (ER/PR+), 15.9% (7/44) triple negative breast cancer (TBNC) and 54.5% (24/44) human epidermal growth factor receptor 2-overexpressed (HER2+). 43% (19/44) achieved pCR. For all lesions, lesion entropy on SS-8 mm sub images correlated with pCR (p=0.039). Peritumoral enhancement mean on T1W images correlated with ki-67 (R=0.391, p=0.024); peritumoral enhancement entropy (R=0.433, p=0.006) and skew (R=0.0372, p=0.02) correlated with volume change after chemotherapy. Peritumoral enhancement entropy on T1W (p=0.018) and sub images (p=0.042) correlated with tumor markers, as did whole lesion sub mean (p=0.004), skew (p=0.003), kurtosis (p= 0.003) and entropy (p=0.049). For HER2+ cancers, peritumoral and whole lesion features did not predict pathologic or imaging response, but correlated to ki-67 (R=0.662, p=0.003; R=0.604, p=0.008).

CONCLUSION

Whole lesion and peritumoral texture features on pre-treatment DCE-MRI may predict tumor biomarkers and response to neoadjuvant chemotherapy in LABC.

CLINICAL RELEVANCE/APPLICATION

Pre-treatment DCE-MRI texture features may predict tumor aggressiveness and response to neoadjuvant chemotherapy in locally advanced breast cancer, allowing for targeted treatment.

SSE02-05 Texture Entropy Features at 1 Centimeter Outside HER2+ Breast Cancer Lesions Predict Response-Associated Molecular Subtypes on DCE-MRI

Monday, Nov. 27 3:40PM - 3:50PM Room: E450A

Awards
Trainee Research Prize - Medical Student

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PURPOSE

Radiomics (computerized imaging feature extraction) has been successful in the prediction of breast cancer biology and outcomes, but has thus far focused within the lesion or bulk parenchyma. In this work, we evaluate whether radiomic features relating to heterogeneity patterns extracted from outside the tumor are predictive of the molecular sub-subtypes (enriched and non-enriched) of HER2+ breast cancers identified by PAM50 profiling. We hypothesize that the HER2-Enriched (HER2E) subtype, associated with high treatment response, may be distinguishable by radiomic analysis of the peritumoral region on DCE-MRI.

METHOD AND MATERIALS

42 1.5 or 3 T pre-treatment DCE-MRI scans of HER2+ patients with PAM50-identified molecular subtype (19 HER2E, 23 non-HER2E) were retrospectively analyzed. Radiomic features (Co-occurrence of Local Anisotropic Gradient Orientations (CoLIAGe), Laws, Haralick, and Gabor) were computed intratumorally and within 3 mm annular peritumoral rings out to a 15 mm radius . The top 5 HER2E-associated features within each region were identified by Wilcoxon feature selection and used to train a diagonal linear discriminant analysis classifier in a 3-fold cross-validation setting. The feature most commonly selected across all bins was identified and used to predict HER2E alone in each region.

RESULTS

The set of top intratumoral features, consisting of Gabor, Haralick, and Laws features, predicted HER2E with an area under the receiver operating characteristic curve (AUC) of .77 +/- .03. Within the 6-9 mm and 9-12 mm bins, top feature sets consisted solely of CoLIAGe features and predicted HER2E with AUCs of .82 +/- .03 and .83 +/- .02, respectively. Statistics of the single most commonly selected feature only (CoLIAGe Difference Average) predicted HER2E most effectively within the 9-12 mm bin (AUC = .77 +/- .02), but performed poorly intratumorally (AUC = .51 +/- .07).

CONCLUSION

Texture features extracted 6-12 mm beyond the lesion were found to distinguish HER2+ sub-subtypes more strongly than features within the tumor. Elevated disorder of intensity gradient orientations detected by CoLIAGe features in the peritumoral region better identified HER2E compared to texture features from within the tumor.

CLINICAL RELEVANCE/APPLICATION

Imaging features from the peritumoral region may help enable non-invasive sub-subtyping of breast cancer patients and provide new insights into tumor biology that are as yet poorly understood.

SSE02-06 Performance of Late Enhancement and Apparent Diffusion Coefficient Ratio Detected on Magnetic Resonance Imaging to Predict Pathologic Response after Neoadjuvant Systemic Therapy in Various Breast Cancer Subtypes

Monday, Nov. 27 3:50PM - 4:00PM Room: E450A

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PURPOSE

To assess the performance of MR late enhancement (LE) and apparent diffusion coefficient (ADC) ratio to predict pathologic response (PR) after neoadjuvant systemic therapy (NST) in breast cancer subtypes.

METHOD AND MATERIALS

This was a prospective study with waiver of informed consent. From January 2015 to December 2016, 83 women (mean age, 58) with breast cancer undergoing NST were enrolled. Eight lesions (10%) were immunohistochemically HER2+, 12(14%) triple negative, 10(12%) luminal A-like, 43(52%) luminal B-like and 10(12%) luminal B-like/HER2+. Breast MRI was performed before and after NST. On MRI, absence or presence of LE in the posttreatment exam and ADC ratio (ADC postreatment/ADC pretreatment) of the lesion were assessed. Pathologic complete response (pCR) was defined as no residual ductal carcinoma in situ or invasive disease in the breast. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and global accuracy of LE were calculated. Receiver operating characteristic (ROC) curves evaluated the predictive performance of univariate and multivariate models for PR.

RESULTS

PCR was reported in 16% (13/83) of cases. Absence of LE was observed in 19% (16/83). Overall, assessment of LE after NST had a 87% sensitivity, 54% specificity, 91% PPV, 44% NPV and 82% accuracy to predict PR. The breakdown by subtypes showed no pCR in luminal A-like or luminal B-like/HER2+. Luminal B-like subgroup achieved pCR in 9% (4/43). Triple-negative cancers showed pCR in 33% (4/12) and LE predicted PR with 100% sensitivity, 20% specificity, 73% PPV, 100% NPV and 75% accuracy. Finally, the HER2+

subgroup responded the most, achieving pCR in 63% (5/8) with LE predicting PR with 67% sensitivity, 80% specificity, 67% PPV, 80% NPV and 75% accuracy. Mean ADC ratio in the pCR subgroup was significantly higher than that in the non-pCR subgroup (p= 0.003). A multivariate model including LE and ADC ratio predicted PR with an 85% accuracy (95% CI: 72%-97%).

CONCLUSION

Late enhancement and ADC ratio are independent predicting factors for pathologic response after NST in breast cancer.

CLINICAL RELEVANCE/APPLICATION

These results pose the possibility of omitting locorregional surgery in highly-selected groups of patients with HER2+ breast cancer who achieve pCR after NST demonstrated by absence of LE and high ADC ratio on MR imaging. Vacuum-assisted biopsy would be needed previously to confirm the predicted pCR.

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SSE03

Cardiac (Myocardial Ischemia and Viability: MRI)

Monday, Nov. 27 3:00PM - 4:00PM Room: S502AB

CA MR

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

SSE03-01 First Human Application of a Prototype Non-Binary Myocardial Infarct Quantification Technique Accounting for Partial Volume Averaging: Technical Feasibility and Inter-Reader Assessment

Monday, Nov. 27 3:00PM - 3:10PM Room: S502AB

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PURPOSE

Binary threshold-based myocardial infarct (MI) quantification techniques ignore partial volume averaging, yielding substantial mischaracterization of MI. This study aimed to assess the technical feasibility of MI quantification using a prototype non-binary algorithm - percent infarct mapping (PIM) - in patients with suspected MI.

METHOD AND MATERIALS

Patients (n=171, 64±14y) referred for 1.5T cardiac MR were prospectively enrolled in this IRB-approved study. MRI protocol included late gadolinium enhancement (LGE) acquisition (in-plane 1.2×1.2mm2, echo/repetition time [TE/TR] 3.9/8.4ms; flip 25°), and post-contrast T1 mapping (MOLLI scheme 4(1)3(1)2; in-plane 1.56×1.56mm2; TE/TR 2.6/1.1ms; flip 35°). MI percentage (MI%) was quantified by two readers based on LGE images using manual delineation and binary approaches (2-5 standard deviations [SD] and full-width at half-maximum [FWHM] thresholds), as well as based on T1 and LGE images applying the previously described PIM algorithm (PIMT1 and PIMLGE, respectively) using an in-house developed application integrated into the Research Mass Software. Mann-Whitney and Bland-Altman (BA) tests were used for data analysis.

RESULTS

MI was observed in 89 (52%) patients and in 185 short-axis slices. MI% with binary 2, 3, 4, 5 SDs and FWHM techniques was 15.7±6.6, 13.4±6.8, 11.6±5.9, 10.9±5.5, and 10.1±5.9%, respectively. The 5SD and FWHM techniques showed the best agreement with manual MI delineation (9.9±6.1%, BA bias 1.3% and 1.2%, respectively). 2SD and 3SD algorithms, however, significantly overestimated manual MI% (P=0.0054 and P=0.0197, respectively). PIMLGE measured significantly lower MI% (7.9±4.8%) compared to manual measurements (P=0.0011). PIMLGE, however, showed the best agreement with the PIMT1 reference (7.6±4.9%, P=0.1084, BA bias 0.4%). Inter-reader agreement was high using all the algorithms (BA bias range 0.1-1.3%).

CONCLUSION

The human application of PIMLGE technique for MI quantification is feasible. As expected, PIMLGE provides significantly smaller MI% than any thresholding technique due to its ability to account for voxel-wise MI content. Additionally, it has excellent agreement with the T1-based, validated reference.

CLINICAL RELEVANCE/APPLICATION

PIMLGE is able to visualize and quantify the heterogeneity of MI providing further advantages in multiple clinical scenarios such as localizing post-MI arrhythmia foci and assessing potential myocardial salvage.

SSE03-02 Rest and Stress T1-Mapping and T1 Reactivity in Patients with and Without Coronary Artery Disease

Monday, Nov. 27 3:10PM - 3:20PM Room: S502AB

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PURPOSE

To demonstrate the possibilities of T1 mapping in rest and stress as a novel gadolinium-free method for tissue characterization discriminating normal and diseased myocardium in a patient group with or without coronary artery disease (CAD).

METHOD AND MATERIALS

We prospectively included patients who underwent stress perfusion as part of clinical work up due to suspicion of CAD. Conventional stress perfusion imaging and late gadolinium enhancement (LGE) were performed to identify perfusion defects and to discriminate ischemic and infarcted myocardium. The patients were divided into three groups, an ischemic group, an infarct group and a control group without perfusion defects. A Modified Look-Locker Inversion Recovery (MOLLI) based T1-mapping sequence was performed at both rest and in stress using a 1.5T MR system. A pixel-wise T1 map of the myocardium was acquired in short-axis view with inline motion correction. A single-shot steady-state free-precession readout was used to generate the images. The T1 maps were analyzed on commercial software. Short-axis T1 maps were manually contoured using conservative septal sampling , and specific sampling in ischemic or infarcted regions of interest (ROI) based on perfusion images and LGE images.

RESULTS

We included a total of 64 patients, 10 patients with ischemic myocardium, 15 patients with infarcted myocardium and 39 control patients. Heart rate increased in all three groups with the use of adenosine, but in the infarcted group the heart increased significantly less during stress compared to the control group. Pre-contrast native T1-values were significantly higher in infarcted myocardium in rest and stress (median 1044(IQR 985-1076) and 1053(IQR 989-1088)) compared to ischemic myocardium (median 961(IQR 939-988) and 958(IQR 945-988)). T1 reactivity was significantly lower in ischemic and infarcted myocardium (median 0.00 (IQR -0.18-0.16) and 0.41(IQR 0.09-0.86))compared to normal remote myocardium (median 3.54(IQR 1.48-5.78) and 3.21(IQR 1.95-4.79)).

CONCLUSION

In conclusion T1-mapping in rest and stress is able to distinguish between normal, normal remote, ischemic and infarcted myocardium using native T1 and T1 reactivity.

CLINICAL RELEVANCE/APPLICATION

Native T1 and T1 reactivity holds potential as a biomarker for tissue characterization in MR without the use of gadolinium.

SSE03-03 T1 Map-based Quantitative Inversion Time Prescription for Late Gadolinium Enhancement Outperforms Look-Locker-based Subjective Inversion Time Estimation

Monday, Nov. 27 3:20PM - 3:30PM Room: S502AB

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PURPOSE

Look-Locker (LL)-based subjective estimation of the inversion time (TI) ("TI-scout") for late gadolinium enhancement (LGE) imaging has multiple limitations. Our aim was to develop and test a T1 map-based synthetic inversion recovery (SyIR) technique allowing for the quantitative calculation of the optimal TI (TI0).

METHOD AND MATERIALS

Patients (n=78; 61±17y) referred for 1.5T cardiac MR were prospectively enrolled in this IRB approved study. LL TI-scout (in-plane 2.08×2.08mm2; echo/repetition time [TE/TR] 1.1/2.5ms; flip 50°; TI range 90-600ms) and T1-map (MOLLI scheme 4(1)3(1)2; in-plane 1.56×1.56mm2; TE/TR 1.1/2.6ms; flip 35°) were acquired at 12-min post-contrast in a random order. SyIR images were calculated from T1 maps in a TI range of 200-400ms. Two groups (Gr) were defined: GrLL (n=40; T1 map followed by LL, LL used for TI0 prescription for LGE) and GrT1 (n=38; LL followed by T1 map, T1-based SyIR used for TI0 prescription). Image quality

(quality of nulling, ability to differentiate enhanced myocardium from blood, and enhanced from normal) was rated (3-point Likert scale) and objectively measured. Groups were compared using the Kruskal-Wallis and Mann-Whitney tests.

RESULTS

LGE was observed in 45 (56.9%) subjects. TI0 was significantly shorter based on LL compared to T1-based SyIR (GrLL: 242±47ms vs. 286±56ms, P=0.0198; GrT1: 244±29ms vs. 285±32ms, P<0.0001). A significant difference was observed between LL-based TI0 and the actual TI applied for the LGE scan (242±47ms vs. 279±54ms, P=0.0009) due to the need to account for LL correction ("fudge factor"). This difference was not shown between SyIR TI0 and the actual TI used. LGE images based on SyIR TI0 had better image quality ratings compared to LL TI0-based LGE images for the quality of nulling (2.3 [2.0-2.6] vs. 1.8 [1.4-2.2], P=0.0027). There was no difference in the other subjective measures. Myocardial/background signal ratio was lower in GrT1 compared to the GrLL (1.2±0.4 vs. 2.4±1.1, P=0.0079).

CONCLUSION

T1-based SyIR imaging provides objective, quantitative, and real-time prescription of TI0 for LGE imaging; eliminating the need for LL correction and the substantial operator dependence of the acquisition ("fudge factor").

CLINICAL RELEVANCE/APPLICATION

The T1-based SyIR technique provides improved quality of myocardial signal nulling for LGE, retrospective TI0 selection, higher TI resolution, no need for LL correction or TI0 adjustment, and less operator dependence.

SSE03-04 Stress Perfusion CMR: Improved Correlation with Invasive Fractional Flow Reserve after Correction for Perfusion Changes in Remote Myocardium

Monday, Nov. 27 3:30PM - 3:40PM Room: S502AB

Participants
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PURPOSE

This study was undertaken, considering fractional flow reserve (FFR) as the reference: (i) to evaluate a predictive model of flow reserve using adenosine cardiac magnetic resonance (CMR) time-signal intensity measurements collected in the area distal to a focal coronary artery stenosis (CAS) and (ii) to assess the incremental value of correcting this model by including similar measurements in remote areas.

METHOD AND MATERIALS

This retrospective study was approved by the hospital ethics committee. Forty-six patients (mean age 61±9 years; 33 males) who underwent both adenosine first-pass CMR and FFR in the work-up for a focal CAS (n=49) were included after written informed consent. Areas-at-risk (RISK) and remote adenosine/rest time-signal intensity parameters were evaluated. Boosting models were elaborated to predict the FFR value from (i)the whole (extended) and (ii)RISK-only parameters. The relationship between the predictions and FFR value was described with Bland-Altman and summarized with intra-class correlation(ICC). Diagnostic accuracies of the models predicting FFR<=0.80 were calculated.

RESULTS

The average FFR value was 0.84±0.09 (0.60-0.98 range), 15(31%) were <=0.80. Decreasing FFR was associated with opposite effects on myocardial time-signal intensity responses downstream of the CAS or remotely. Compared to the RISK-only models, the extended models exhibited higher correlations with the FFR value (0.73;95%CI,0.57-0.84 versus 0.25;95%CI,0.03-0.50) and diagnostic accuracy to predict FFR<=0.80 CAS [44/49 (90%; 95%CI,78-98) vs 36/49 (73%;95%CI,55-88)].

CONCLUSION

When evaluating the functional significance of a CAS using adenosine first-pass CMR, considering time-signal intensity measurements in remote areas allows a better correlation with invasive FFR and improved diagnostic accuracy for FFR<=0.80.

CLINICAL RELEVANCE/APPLICATION

To improve the clinical relevance of evaluating coronary stenoses by using adenosine first-pass CMR, each perfusion-related parameter should be corrected by its value in remote segments.

SSE03-05 Assessment of Left-Ventricular-Wall Motion Disorders after Myocardial Infarction Using Compressed Sensing Real-Time Cine Imaging

Monday, Nov. 27 3:40PM - 3:50PM Room: S502AB

Participants
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PURPOSE

To evaluate the reliability of a compressed sensing (CS) real-time prototype cine sequence (Sparse 2D cine, Siemens Healthineers) for the detection of left ventricle (LV) wall motion disorders after myocardial infarction (MI) in clinical practice.

METHOD AND MATERIALS

Thirty consecutive adult patients (20 males, 10 females; mean age = 64.5 ± 13.4 years) referred for either initial work-up or follow-up by cardiac magnetic resonance (CMR) in the clinical context of MI were prospectively included. Each patient underwent the same CMR protocol: (a) the reference segmented multi-breath-hold steady-state free precession cine sequence including short-axis stack, one four-chamber slice, one two-chamber slice (Group 1) and (b) a CS real-time single-breath-hold sequence (Group 2) providing the same slice number, position and thickness. In both groups, wall motion disorders were independently and blindly assessed by two radiologists, based on the American Heart Association LV segmentation. Paired Wilcoxon signed-rank test was used to analyze the statistical difference. ROC study was performed to assess the differential diagnosis performance.

RESULTS

All patients presented at least one segmental wall motion abnormalities in Group 1 and in Group 2. In Group 1, among 510 segments analyzed, 278 (54.5%) had motion disorder described as hypokinesia (n= 147; 28.6%), akinesia (n= 124; 24.3%) or dyskinesia (n= 7; 1.4%). There was no significant difference regarding wall motion disorder description in Group 2 compared to Group 1 (p = 1.0) with a 98.92% sensitivity (95%CI [96.9-99.8]) and a 99.14% specificity (95%CI [96.9-99.9]). Area under the curve was 0.992 (95%CI [0.980-0.998]; p < 0.0001).

CONCLUSION

The single-breath-hold Compressed Sensing real-time cine imaging technique is a reliable sequence to assess wall motion abnormalities by CMR in the context of myocardial infarction.

CLINICAL RELEVANCE/APPLICATION

As patients suffering from MI may present shortness of breath, use of CS cine imaging can significantly reduce acquisition time without compromising detection accuracy of LV-wall motion disorders.

SSE03-06 Development of Cardiac Remodeling in Patients with Acute Myocardial Infarction Studied by Cardiac MRI (CMR)

Monday, Nov. 27 3:50PM - 4:00PM Room: S502AB

Participants
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PURPOSE

Left ventricular (LV) remodeling after acute myocardial infarction (AMI) is defined as an increase of left ventricular end-diastolic volume index (LVEDVi) >=15% within the first months after AMI. The purpose of this study was to analyze the exact course of LVEDVi and its relation to infarct size and LV ejection fraction.

METHOD AND MATERIALS

We performed CMR in 84 consecutive patients (mean age 56 years) with reperfused first AMIs to assess LV volumes, myocardial mass and function. Infarct size was obtained by late gadolinium enhancement (LGE) CMR. Patients underwent the baseline CMR 7 ±4 days after AMI. Follow-up scans were performed after 6.5 ±1.5 weeks, 3.5 ±0.6 months and 6.7 ±1.4 months. An increased LVEDVi was defined as >97 mL/m2 in males and >90 mL/m2 in females.

RESULTS

Two distinct different types of LV remodeling were observed. Twenty-one of 84 patients (25%) showed a classic remodeling with normal LVEDVi at baseline (76 ±13 mL/m2), which significantly increased to 89 ±19 mL/m2 at 7 week (P<0.05) and than remained stable. Thirteen patients (16%) showed early remodeling with an increased LVEDVi of 112 ±14 mL/m2 at baseline and no further change of LVEDVi during follow-up. Infarct size of patients with early remodeling (22 ±7 %LV) and classic remodeling (19 ± 9 %LV) were larger compared to patients without remodeling 12 ±9 %LV, (P<0.01). At baseline, patients with early remodeling had a significantly lower ejection fraction (EF) with 42 ±9 % compared to patients with classic (55 ±13%, P<0.01) and to patients with no remodeling (57 ±10 %, P<0.01). Patients with early remodeling had no recovery of EF during follow-up (45 ±5 %, P=ns).

CONCLUSION

Besides classic remodeling, 16% of our patients showed early remodeling, which is characterized by immediate LV dilatation after AMI and initially severely reduced EF with no recovery during follow-up.

CLINICAL RELEVANCE/APPLICATION

Patients with early remodeling may represent a subgroup of patients at higher risk for heart failure and sudden cardiac death, requiring more intensive treatment to prevent these events.

SSE04

Cardiac (Coronary Artery Disease: General I)

Monday, Nov. 27 3:00PM - 4:00PM Room: S504AB

CA CT MR

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

FDA Discussions may include off-label uses.

Participants
Karin E. Dill, MD, Evanston, IL (*Moderator*) Nothing to Disclose
Pal Maurovich-Horvat, MD, PhD, Pecs, Hungary (*Moderator*) Nothing to Disclose

Sub-Events

SSE04-01 Improving the Degree and Uniformity of Enhancement in Coronary CT Angiography with a New Bolus Tracking Method Enabled by Free Breathing

Monday, Nov. 27 3:00PM - 3:10PM Room: S504AB

Participants
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PURPOSE

To demonstrate the improved degree and uniformity of enhancement in coronary CT angiography (CCTA) on a 16cm wide-coverage CT with a new bolus tracking method enabled by free breathing, in comparison with the conventional method with breath holding.

RESULTS

The mean enhancement in vessels in Group A (412.7±55.3HU) was higher than in Group B (337.6±72.7HU) ($P<0.05$). The fluctuation rate for the enhancement was lower in the free breathing group in AS (13.4%), RCA (16.4%), LAD (19.5%) and LCX (16.7%) than in the breath holding group (21.5%, 20.8%, 21.5% and 26.2%, respectively) (all $P<0.05$). There was no significant difference in image quality score, SD, SNR, CNR between the two groups.

CONCLUSION

A new bolus tracking method enabled by free-breathing in CCTA on 16cm wide-coverage CT system increases the enhancement degree and uniformity in coronary arteries, compared with the conventional triggering method.

CLINICAL RELEVANCE/APPLICATION

Free-breathing CCTA can increase the enhanement effect of coronary artery, provide us a consistency enhancement effect image, and improved the overall image quality.

SSE04-02 The Effect of the Motion Correction Algorithm on the Image Quality of Coronary CT Angiography with Fast kVp Switching Single Source Dual-Energy CT at the Reconstructed Various Cardiac Phases

Monday, Nov. 27 3:10PM - 3:20PM Room: S504AB

Participants
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PURPOSE

To investigate the effect of the motion correction algorithm (SnapShot Freeze: SSF; GE Healthcare) on the image quality at various cardiac phases in coronary CT angiography (CCTA) with fast kVp switching single source dual-energy CT (ssDECT).

METHOD AND MATERIALS

Twenty five patients with heart rate below 65 bpm (42 - 65 bpm) who underwent CCTA using ECG-gated axial step-and-shoot with dual-energy scan mode on a 64-row ssDECT (Revolution GSI; GE Healthcare) were included. For the CCTA scan, we used the scan parameter as follows; tube voltage: 80/140 kVp fast switching, rotation time: 0.35 s/rot, and tube current was determined 375 mA or 600 mA or 640 mA based on patient BMI (CTDIvol was 36.7 ± 8.3 mGy). Cardiac axial images were reconstructed with and without SSF at the cardiac phases of 60% to 90% with 5% interval. Two readers graded the image quality of the 4 major coronary arteries (right coronary artery: RCA, left main trunk: LMT, left arterial descending artery: LAD, and left circumflex: LCX) reconstructed with and without SSF by using 5-point scores (5, no motion artifacts; 4, minor artifacts; 3, moderate artifacts; 2, severe artifacts; 1, image not evaluated and vessel structures not differentiable) with consensus and score above 3 was defined as diagnostic acceptable vessel. Average scores of the per-vessel and the per-segment in each cardiac phase were compared between reconstruction with and without SSF by using Wilcoxon signed rank test.

RESULTS

In all cardiac phase, average scores of SSF were higher than that of without SSF in the all vessels and the all segments (with SSF: 3.6±0.9, without SSF: 3.2±0.9, P<0.01). Without SSF, cardiac phases that coronary vessel was diagnostic acceptable were from 65% to 80% in RCA, 60% to 85% in LMT, 60% to 85% in LAD, 65% to 80% in LCX. With SSF, those cardiac phases were 60% to 80% in RCA, 60% to 90% in LMT, 60% to 85% in LAD, 60% to 85% in LCX. Diagnostic acceptable cardiac phase for all vessels was 65% to 80% without SSF, and 60% to 85% with SSF.

CONCLUSION

SSF controlled the motion artifact and improved image quality of CCTA with fast kVp switching ssDECT. In addition, SSF extended the diagnosable range of reconstructed cardiac phases.

CLINICAL RELEVANCE/APPLICATION

Motion correction algorithm (SSF) in coronary CT angiography with fast kVp switching dual-energy CT was useful to reduce the motion artifacts and extend diagnostic acceptable cardiac phase.

SSE04-03 Single-Phase Coronary Artery CT Angiography Extracted From Stress Dynamic Myocardial CT Perfusion on a Third-Generation Dual-Source CT: Validation by Coronary Angiography

Monday, Nov. 27 3:20PM - 3:30PM Room: S504AB

Participants
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PURPOSE

To investigate the image quality (IQ) and diagnostic performance of single-phase coronary CT angiography (SP-CCTA) images extracted from stress dynamic myocardial CT perfusion (CTP) scans using third-generation dual-source CT (DSCT).

METHOD AND MATERIALS

The institutional review board approved the study and written informed consent was obtained from all patients. Consecutive symptomatic patients who met appropriateness criteria for cardiac CT were prospectively recruited and scanned with adenosine triphosphate-stress dynamic myocardial CTP and routine CCTA protocol using third-generation DSCT. Images from the phase of the CTP scan with the best enhancement of the coronary arteries were selected as the SP-CCTA. Baseline characteristics and IQ results were assessed. Coronary angiography (CAG) was used as a reference standard, the diagnostic accuracy for stenosis >=50% detection was compared with SP-CCTA and routine CCTA.

RESULTS

51 patients successfully underwent the combined ATP-stress dynamic myocardial CTP and CCTA examination, among which 34 patients underwent CAG. The mean heart rate during stress CTP was much higher than that during CCTA (85.0±12.7 and 67.9±10.0 bpm, p<0.001). The qualitative IQ scores of SP-CCTA were similar to that of routine CCTA (p>0.05). On a per-vessel basis, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the curve results of SP-CCTA and routine CCTA for diagnosis of stenosis >=50% exhibit no significant difference (SP-CCTA: 95.0%, 86.0%, 84.4%, 95.6%, 0.841; routine CCTA: 92.1%, 88.5%, 85.4%, 93.9%, 0.829; all P>0.05). The mean effective radiation dose (ED) of CTP and routine CCTA plus CTP were 3.92±1.72mSv and 5.98±2.01mSv (P<0.05), respectively.

CONCLUSION

With third-generation DSCT, the IQ and diagnostic value of SP-CCTA was equivalent to routine CCTA. It is potentially feasible to replace a separate routine CCTA acquisition with SP-CCTA images extracted from stress dynamic myocardial CTP.

CLINICAL RELEVANCE/APPLICATION

The single-phase CCTA derived from CTP with the third-generation dual-source CT is able to replace the routine CCTA scan and create highest possibilities for "one-stop" cardiac CT examination, which allowing patients in need of myocardial blood flow assessment to benefit from it.

SSE04-04 Participants

3D Fusion of Coronary CT Angiography and CT Myocardial Perfusion Imaging: One-Stop-Shop Assessment of Morphology and Function

Monday, Nov. 27 3:30PM - 3:40PM Room: S504AB

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PURPOSE

To develop a software tool for 3D fusion imaging of CT coronary angiography (CTCA) and CT myocardial perfusion imaging (CTPerf), intuitively visualizing relevant coronary artery stenoses and corresponding myocardial perfusion deficits for diagnostics of coronary artery disease (CAD).

METHOD AND MATERIALS

12 patients underwent CTCA and CTPerf after heart transplant in this prospective study (mean age 56±12 years, range 32-76 years, all males, scan date 08/2015-03/2016). CT image quality was rated. Coronary diameter stenoses >50% were documented for CTCA. Adenosine stress-induced perfusion deficits were noted for CTPerf. A software tool was implemented to allow for 3D fusion imaging of both datasets. Coronary arteries and heart contours were segmented in a fully automatic fashion using centerline or model-based region growing algorithms, respectively. To overcome registration mismatch due to different heart phases of CTCA/CTPerf image acquisition, myocardial perfusion values were mathematically projected on the CTCA left ventricle. 3 resulting datasets (i.e., coronary tree, heart contour, and perfusion values) were fused for 3D multiparametric volume rendering. Either endocardial, transmural, or epicardial average perfusion values could be visualized. 3D fusion was compared to CTCA/CTPerf side-by-side analysis and results from catheter CA.

RESULTS

CT image quality was rated as good-excellent (mean score 3.6±0.5, scale 1-4). In 5/12 patients (41%), manual heart phase adjustment used for automatic segmentation was required. Subsequent 3D fusion imaging was successfully feasible in all cases (12/12, 100%). 2/12 patients (17%) showed stress-induced perfusion deficits. Ischemic regions could be intuitively correlated to culprit coronary lesions in both cases (2/2, 100%). Results from 3D multiparametric volume rendering approved coronary assignment of side-by-side analysis and were in full correspondence with findings from catheter CA.

CONCLUSION

A software framework for 3D CTCA/CTPerf fusion imaging was developed, advancing a CT one-stop-shop multiparametric CAD diagnostic procedure for patients being not able to undergo CMR perfusion imaging due to MRI contraindications.

CLINICAL RELEVANCE/APPLICATION

For diagnostics of CAD, assessment of coronary artery stenosis and myocardial ischemia are equally important. 3D fusion of CTCA and CTPerf eases the assignment of anatomical to functional information.

SSE04-05 Single Breath-Hold Whole-Heart Unenhanced Coronary MRA Using Multi-Shot Gradient Echo EPI with 3T MRI: Comparison with Free-Breathing TFE Coronary MRA in Healthy Volunteers

Monday, Nov. 27 3:40PM - 3:50PM Room: S504AB

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PURPOSE

The single breath-hold technique for coronary magnetic resonance angiography (MRA) can shorten the total scan time and reduce the influence of respiratory motion. However, unenhanced whole heart coronary MRA at 3T MRI is still challenging because of increased B0 inhomogeneity compared with 1.5T MRI. Here we investigated the feasibility of single breath-hold unenhanced coronary MRA using multi-shot gradient echo planar imaging (MSG-EPI) with a 3T-scanner.

METHOD AND MATERIALS

14 volunteers underwent single breath-hold coronary MRA with MSG-EPI and free-breathing turbo field echo (TFE) coronary MRA at 3T. The acquisition time, signal to noise ratio (SNR), and the contrast of the sequences were compared using paired t-tests. Readers evaluated the image contrast, noise, sharpness, artifacts, and overall image quality.

RESULTS

The acquisition time was 88.1% shorter for MSG-EPI than TFE (24.7 ± 2.5 vs 206.4 ± 23.1 sec, $p < 0.01$). The SNR was significantly higher on MSG-EPI than TFE scans ($p < 0.01$). There was no significant difference in contrast between MSG-EPI and

TFE scans (1.8 ± 0.3 vs 1.9 ± 0.3, p = 0.24). There was no significant difference in image contrast, image sharpness, and overall image quality between the two scanning techniques. The scores for image noise and artifacts were significantly higher on MSG-EPI than TFE scans ($p < 0.05$).

CONCLUSION

The single breath-hold MSG-EPI sequence is a promising technique for shortening the scan time and preserving the image quality of unenhanced whole-heart coronary MRA with 3T MRI.

CLINICAL RELEVANCE/APPLICATION

The MSG-EPI sequence with a 3T MRI scan provides adequate quality for single breath-hold unenhanced coronary MRA, compared with the conventional TFE sequence.

SSE04-06 Effects of Coronary Stents on Phase Contrast Flow Measurements in Cardiovascular MRI: Phantom Study

Monday, Nov. 27 3:50PM - 4:00PM Room: S504AB

Participants
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PURPOSE

The evaluation of restenosis after coronary stent implantation is important for management after treatment. Assessing coronary flow reserve using phase contrast MRI has potential for the noninvasive detection of coronary artery stenosis, including in-stent restenosis. However, in patients with stents, metallic compounds often evoke image artifacts, such as phase alterations and image distortions of the magnetic field. The purpose of this study was to evaluate influences according to various types of stents (different material and cell design) on phase contrast measurements in a phantom study.

METHOD AND MATERIALS

Three stents (MULTI-LINK VISION, Nobori, and Ultimaster) from varying material and cell designs were placed in a flow phantom. Phase contrast measurements were acquired with a 1.5 T MR scanner using conventional gradient-echo sequences proximal and distal to the stent at a predefined distance (every 3mm from the stent's distal edge). Scan parameters were as follows: temporal resolution 47ms, TE 4.2ms, TR 7.0 ms, slice thickness 5mm, flip angle 30 degrees, and in-plane resolution 1.7x3.0mm. In each stent, results (peak velocity and average flow per second) were compared to measurements with a reference flow at the proximal level without any stents.

RESULTS

Flow results distal to the stent differed significantly from the reference flow (25.8cm/sec and 7.02ml/sec) acquired at the proximal level of the stent according to the stent type. The maximum flow miscalculation of peak velocity and average flow per second was -10.95cm/sec and +3.52ml/sec for MULTI-LINK VISION, -23.84cm/sec and -5.86ml/sec for Nobiri, and+2.00cm/sec and -0.35ml/sec for Ultimaster. For MULTI-LINK VISION and Ultimaster, flow values measured approximately 3mm distal to the level of the stent agreed with the reference flow. For Nobiri, flow values measured approximately 12mm were effective.

CONCLUSION

Tested coronary stents led to a significant deviation of measured flow rates compared to a reference. A distance effective to avoid this influence should be adjusted according to the stent type.

CLINICAL RELEVANCE/APPLICATION

For flow measurements of the coronary artery after stent implantation, a distance effective to avoid the deviation of measured flow due to a stent should be adjusted according to the stent type.

SSE07

Gastrointestinal (Image Biomarkers)

Monday, Nov. 27 3:00PM - 4:00PM Room: E350

BQ 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

SSE07-01 Baseline Tumor Enhancement and Apparent Diffusion Coefficient in Predicting Short-Term Response to TACE in Breast Metastases to the Liver: A Volumetric Technique

Monday, Nov. 27 3:00PM - 3:10PM Room: E350

Participants
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PURPOSE

To investigate whether magnetic resonance (MR) obtained volumetric pretreatment enhancement and apparent diffusion coefficient (ADC) and their change after treatment may predict short-term response in patients with liver breast cancer metastases

METHOD AND MATERIALS

In this retrospective, HIPAA compliant study liver MR images of 91 patients with breast liver metastases (2004-2015) who had received hepatic trans-arterial chemoembolization (TACE) were reviewed. Baseline and 2-4 months post-TACE volumetric lesion enhancement in the portal venous phase (PVP) and ADC (b value >500) were calculated using a prototype Siemens Healthcare-developed software (MR Onco-Treat). Percent change in the largest transverse diameter at 2-4 month post-treatment was defined according to Response Evaluation Criteria in Solid Tumors (RECIST), and decrease in size by 30% was considered partial response to therapy. SPSS software (ver. 21) and Mann-Whitney U test were used for statistical analysis.

RESULTS

The median pretreatment ADC value was significantly lower in the group with partial response to treatment as compared to that with stable disease (1240.4 x 10-6 mm2/s vs. 1433.9 x 10-6 mm2/s, p=0.03). Post-TACE percent increase in ADC value and percent decrease in PVP enhancement were significantly more in patients with partial response to treatment compared to those with stable disease (28.5% vs. 0.9%, p<=0.04 and -25.5% vs. -5.0%, p<0.01, respectively). The two groups were comparable as to the baseline enhancement during the PVP (64.5% in those with partial response vs. 85.3% in those with stable disease, p=0.19).

CONCLUSION

Volumetric baseline ADC, as well as post-TACE enhancement and ADC changes were associated with response to treatment in patients with breast cancer metastases to the liver. Accordingly, a lower baseline ADC, more decrease in post-TACE enhancement during the PVP and more increase in post-TACE ADC were indicators of a better response to treatment.

CLINICAL RELEVANCE/APPLICATION

Baseline volumetric ADC could be used to predict prognosis in patients with breast cancer metastasis to the liver.

Honored Educators

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SSE07-02 Volumetric Functional MRI as New Prognostic Marker to Predict Survival in Unresectable Intrahepatic

Cholangiocarcinoma Undergoing Systemic Chemotherapy: Long Term Single Institution Outcomes

Monday, Nov. 27 3:10PM - 3:20PM Room: E350

Awards
Student Travel Stipend Award

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PURPOSE

Value of multi-parametric assessment of volumetric functional MRI in predicting overall survival (OS) of patients with unresectable intrahepatic cholangiocarcinoma (iCCA) treated with systemic chemotherapy.

METHOD AND MATERIALS

72 patients (mean age 65±13 years, 29 males) with unresectable iCCA were included in this retrospective HIPAA compliant, IRB approved study with waived patient consent. All patients received systemic chemotherapy as the only treatment after undergoing baseline CE-MRI with DWI/ADC map. Single largest lesion was assessed using semi-automatic software for RECIST and volume, and volumetric functional parameters including viable tumor volume, percent viable tumor volume (100* viable tumor volume/whole tumor volume), percent viable tumor burden (100* viable tumor volume/whole liver volume), and ADC. These parameters were compared between low (<=10 months) and high (>10 months) OS groups. ROC, Cox regression and Kaplan Meier survival analysis was performed. P<0.05 was considered significant.

RESULTS

RECIST (58.9±40.4 vs 43.9±26.0 mm; P=0.06), tumor volume (142.2±232.4 vs 77.8±93.2 cm3, P=0.18), viable tumor volume (58.3±89.3 vs 55.1±67.2 cm3; P=0.887) and percent viable tumor burden (2.8±4% vs 2.8±3.0%; P=0.975) were not different between low and high OS groups. Baseline ADC was lower (1228.9±207.2 vs 1621.6±412.7 x 10-6 mm2/s; P<0.0001) and percent viable tumor volume was higher (58.5±37.7 vs 81.7±21.3%; P=0.009) in OS >10 months. Baseline ADC cut off 1325 x 10-6 mm2/s could differentiate low from high OS with a sensitivity, specificity and accuracy of 76.9%, 81.8% and 81.4%, respectively, with better OS for ADC <= 1325 x 10-6 mm2/s (log-rank test, P<0.001). Univariate Cox regression analysis revealed association of baseline ADC (HR, 1.003; P<0.0001) and percent viable tumor volume (HR, 0.981; P<0.01) with OS.

CONCLUSION

There is 0.3% increase and 1.9% decrease in the expected mortality risk relative to a unit increase in baseline ADC and percent viable tumor volume, respectively, in iCCA patients receiving systemic chemotherapy. ADC cut off of 1325 x 10-6 mm2/s at baseline showed OS differences with an accuracy of 81% in identifying patients with OS more than 10 months.

CLINICAL RELEVANCE/APPLICATION

Baseline functional MR parameters like volumetric ADC and percent viable tumor can be used to assess mortality risk and predict OS in patients with unresectable iCCA receiving systemic chemotherapy.

Honored Educators

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SSE07-03 Pre-Surgical Texture Analysis of Rectal Cancer to Distinguish Residual Tumor from Complete Response

Monday, Nov. 27 3:20PM - 3:30PM Room: E350

Participants
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PURPOSE

Non-operative management in patients with complete response is a new trend, but hinge on accurate imaging and clinical assessment. To investigate ability of texture features to differentiate residual tumor from complete response on rectal MRI.

METHOD AND MATERIALS

IRB approved retrospective study of 30 patients, with preoperative rectal MRI. Uniform pre-operative treatment included induction chemotherapy and neoadjuvant chemoradiation, followed by surgery. 3D volume of interest (VOI) was manually delineated from oblique axial T2 images using ITK-SNAP software. Haralick texture features (energy, entropy, correlation, contrast, homogeneity), and Gabor edge images at angles 0, 45, and 90 were computed from within delineated VOIs using in-house developed software. The features were tested for significance by comparing patients with complete vs. partial response on surgical pathology. Additionally, elastic net regression using Least absolute shrinkage and selection operator (LASSO) regression was performed to extract the most relevant features with alpha=0.1. Leave-one-out cross- validation (LOOCV) was performed to extract the best model.

RESULTS

21/30 cases were analyzed (6 excluded due to insufficient 3D coverage, and 3 due to mucin). Preliminary results showed that three texture features (entropy p=0.044, Gabor(0°) p=0.027, and Gabor(45°) p=0.04) showed statistically significant differences between partial and complete tumor response. Elastic net regression identified correlation, entropy, Gabor(0°) and Gabor(45°) to be relevant for distinguishing between complete and partial response. The feature weights were: correlation=0.0017, entropy=0.0027, Gabor(0°) = 0.007, and Gabor(45°) = 0.0037. The mean square error of the regression analysis was (RMSE=0.48). Figure shows post-treatment MRIs of 2 patients, the first with complete response and the second with partial. Table shows the application of texture analysis to MR images in these patients.

CONCLUSION

Combining texture features may predict partial from complete tumor response. Further studies with larger number of cases are important to confirm preliminary results.

CLINICAL RELEVANCE/APPLICATION

Preliminary results indicate that it is potentially feasible to use texture features to assess response. Our results suggest that lesions depicting lower heterogeneity in terms of edges and those depicting higher entropy are associated with complete response.

SSE07-04 Magnetic Resonance Tumor Regression Grade (mrTRG) To Assess Response after Neoadjuvant Chemoradiation Therapy for Locally Advanced Rectal Cancer: Pathologic Characteristics of the Response Assessment System

Monday, Nov. 27 3:30PM - 3:40PM Room: E350

Awards
Trainee Research Prize - Fellow

Participants
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PURPOSE

Chemoradiation therapy (CRT) before surgery has become the standard for locally advanced rectal cancer. Imaging methods to assess CRT response have been proposed, of which magnetic resonance tumor regression grade (mrTRG) is most prominent although its pathologic characteristics are not well known yet. This study is to determine the pathologic nature of mrTRG and suggest how to use mrTRG for patient management.

METHOD AND MATERIALS

472 consecutive patients (M:F, 308:164; 62.2±11.8 years) who had newly diagnosed rectal cancer of T3 or N+ stage as assessed with MRI, no distant metastasis or any lesions that were not cleared of metastasis as evaluated with both CT and PET/CT, and no previous (during past 5 years) or concomitant cancers, underwent long-course CRT. We finally analyzed 439 patients after excluding dropouts during CRT (n=19), no post-CRT MRI (n=4), no surgical resection (n=9), and loss of pathology data (n=1). Post-CRT MRI was obtained 4-6 weeks after the finish of CRT. Three experienced abdominal radiologists evaluated CRT response using mrTRG (1 to 5). Pathologic tumor regression was graded using surgical specimen according to complete (1), near complete (2), moderate (3), minimal (4), and no regression (5). We performed a correlative analysis between mrTRG and pathologic TRG and pT stage.

RESULTS

The study cohort consisted of pathologic TRG1 (n=88), 2 (n=113), 3 (n=175), 4 (n=62), and 5 (n=1). mrTRG grades distributed similarly, showing 15% mrTRG1 (n=66), 25.5% mrTRG2 (n=112), 37.1% mrTRG3 (n=163), 21.4% mrTRG4 (n=94), and 0.9% mrTRG5 (n=4). mrTRG1 showed complete and near complete regression in 60.6% and 27.3%, respectively. These were 22.3% and 52.7%, respectively, for mrTRG2. mrTRG3 and 4 had only 26.4% and 14.9%, respectively, rates of combined complete and near complete regression. Pathologic T stages of mrTRG1 were pT0 (ie, complete regression) in 60.6%, pT2 or lower in 89.4%, and pT3/4 without achieving near complete regression in only 3%. When mrTRG1 and 2 are combined, these values were 36.5%, 77.5%, and 7.9%.

CONCLUSION

mrTRG1, possibly combined mrTRG 1 and 2, seems to be reasonable criteria to recommend a local excision instead of a radical surgery while it seems unclear if mrTRG could be a robust tool to find candidates for nonsurgical observation.

CLINICAL RELEVANCE/APPLICATION

mrTRG could be used to guide local excision of rectal cancer after CRT, which should be further proved with oncologic outcome trials.

SSE07-05 Texture Analysis Can Be a Potential Tool to Differentiate Gastrointestinal Stromal Tumors with KIT Exon 11 Mutations, which is an Important Genotype for Imatinib Therapy, on Enhanced CT Images

Monday, Nov. 27 3:40PM - 3:50PM Room: E350

Participants
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PURPOSE

To determine the accuracy of texture analysis to differentiate gastrointestinal stromal tumors (GISTs) with KIT exon 11 mutations on enhanced CT images.

METHOD AND MATERIALS

Ethical approval was obtained for this retrospective analysis, and the requirement for informed consent was waived. This study consisted 69 patients with GISTs, of which 46 patients with KIT exon 11 mutations (yes-exon11-GISTs), and 23 patients without KIT exon 11 mutations (no-exon11-GISTs). Clinical information of the patients were collected and their correlation with GISTs genotypes were analyzed. Enhanced CT images including two sets of single-section were contoured manually by three independent radiologists. Two-dimensional texture analysis were performed for each lesion and the repeatability was assessed. Texture features including histogram parameters, Gray-Level Co-occurrence Matrix Parameters, and Gray-Level Run Length Matrix Parameters, were evaluated. Logistic regression models were built using clinical features and CT texture parameters. Enhanced CT images for each patient were independently reviewed by two radiologists who subjectively graded lesion heterogeneity on a five-point scale, and the correlation between the subjective heterogeneity rating and GISTs genotypes were evaluated.

RESULTS

There were lower lesion heterogeneity in yes-exon11-GISTs. The repeatability of the texture features were very good within and between readers. The texture parameters stdDeviation was included in the logistic regression model in each ROI session. The AUCs of stdDeviation ranged from 0.727±0.063 to 0.750±0.063. The visual subjective heterogeneity rating evaluated by the two radiologists had no significant difference between yes-exon11-GISTs and no-exon11-GISTs.

CONCLUSION

CT texture analysis can be used to differentiate GISTs with exon 11 mutations in KIT gene from those GISTs without KIT exon 11 mutations on enhanced CT images.

CLINICAL RELEVANCE/APPLICATION

The specific mutation in GISTs correlates with clinical response to molecular therapies. The importance of matching the GISTs genotypes with specific therapies, which makes precision medicine for GISTs feasible, have been noticed. Patients with exon 11 mutations of KIT gene are more likely to respond to imatinib than those with other mutations or those who are wild type for KIT and PDGFRA mutations. Our study suggest that CT texture analysis can be used to differentiate yes-exon11-GISTS from no-exon11-GISTs.

SSE07-06 Using Texture Analysis on Perfusion-Weighted Magnetic Resonance Imaging in Assessing Microvascular Invasion of Hepatocellular Carcinoma

Monday, Nov. 27 3:50PM - 4:00PM Room: E350

Participants
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PURPOSE

To prospectively test whether the texture analysis on perfusion-weighted magnetic resonance imaging (PW-MRI) can offer reliable indexes capable of predicting and grading microvascular invasion (MVI) of hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

Perfusion-weighted magnetic resonance imaging was performed on 31 HCC patients on a 3.0 Tesla MR scanner. The perfusion data was acquired using a prototype radial stack-of-stars three-dimensional spoiled gradient echo pulse sequence with golden-angle radial sampling schemes over the course of 6.25 minutes. Post-processing of PW-MRI data was performed on an in-housed software O.K.(Omini-Kinetics) to calculate Ktrans, Kep, Ve and the semi-quantitative parameter of area under the curve (AUC) using the Extended Tofts linear model, followed by texture analysis on those parametric maps using the same software. A total of 75 texture features were calculated for each perfusion results. The presence of MVI was histopathologically determined and classified into three groups: A-negative (without MVI), B-mild (had one to five invaded vessels), and C-severe (had more than five invaded vessels). Spearman correlation coefficients were determined between texture parameters and the degree of MVI. Receiver operation characteristic (ROC) analysis of predicting the presence of MVI was performed for identified texture parameters.

RESULTS

The MinLocation of Ktrans (r=0.377, P=0.037), RelativeDeviation of Ve (r=0.371, P=0.04) as well as the MinIntensity (r=-0.366, P=0.043), MinLocation (r=0.377, P=0.037), skewness (r=0.542, P=0.002) and kurtosis (r=0.467, P=0.008) of AUC mapping showed week to moderate correlations with the degree of MVI. The MinLocation, skewness and kurtosis of AUC were significantly different between the groups with and without MVI (P<0.05), with area under the ROC curve of 0.707, 0.859 and 0.734, respectively, in predicting the presence of MVI.

CONCLUSION

A combination of perfusion-weighted magnetic resonance imaging and texture analysis can help predicting and grading microvascular invasion (MVI) of hepatocellular carcinoma (HCC))

CLINICAL RELEVANCE/APPLICATION

Texture analysis on PW-MRI provides additional information regarding distribution and heterogeneity of intratumoral microvasculature, and therefore helps non-invasive evaluation of tumor MVI.

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SSE08

Gastrointestinal (Elastography)

Monday, Nov. 27 3:00PM - 4:00PM Room: E352

GI MR US

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

Participants
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Sudhakar K. Venkatesh, MD, FRCR, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

SSE08-01 Hepatic MR Elastography at 3T: Agreement Across Pulse Sequences and Effect of Hepatic Iron

Monday, Nov. 27 3:00PM - 3:10PM Room: E352

Participants
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PURPOSE

To compare 3 prototype hepatic magnetic resonance elastography (MRE) sequences at 3T with the standard clinical implementation gradient echo (GRE) sequence and to determine the effect of hepatic R2* on measurable area of liver stiffness (LS).

METHOD AND MATERIALS

52 patients (28 men, 24 women; mean age 56 years) underwent liver MRE at 3T (MAGNETOM Prisma, Siemens Healthcare) in this IRB-approved, HIPAA-compliant study. Sequences included: GRE (TR/TE 50/22 msec; slice thickness/gap 5/1 mm; matrix 77 x128; phase partial Fourier; flip angle, 250; breath hold, 18 sec), rapid GRE (TR/TE 25/22 msec; slice thickness/gap 5/1 mm; matrix, 84 x 128; flip angle, 150, breath hold, 9 sec), rapid fractional GRE (TR/TE 25/15 msec; slice thickness/gap 5/1 mm; matrix, 84 x 128; flip angle, 150, breath hold, 9 sec), and spin-echo echoplanar imaging (SE-EPI) (TR/TE 1600/49; slice thickness/gap 5/1 mm; matrix, 128 x 128; echo train length, 47; flip angle, 900; breath hold 18 sec). Hepatic R2* values were calculated using a multi-echo Dixon technique (LiverLab, Siemens). Mean LS and measurable area of stiffness (> 95% confidence threshold) were compared. Hepatic R2* was correlated with measurable area of LS and technical success rate.

RESULTS

In 6/52 patients, $\geq$ 1 sequence (5 GRE, 1 GRE and SE-EPI) failed (< 100 mm2 measurable area of LS). Mean LS was not significantly different across the 4 sequences (GRE 2.55 kPa, Rapid GRE 2.66 kPa, Rapid Fractional GRE 2.51 kPa, SE-EPI 2.52 kPa; P = 0.10). There was a significant difference in measurable area of LS (GRE 12389 mm2, Rapid GRE 14053 mm2, Rapid Fractional GRE 17039 mm2, SE-EPI 11212 mm2, P < 0.0001). Hepatic R2* was inversely correlated with measurable LS area for all 4 sequences (P < 0.0004). Mean hepatic R2* was higher among patients in whom $\geq$ 1 pulse sequence failed (mean R2* 100 sec-1 vs 50 sec-1, P = 0.0065).

CONCLUSION

Measured LS was equivalent across 4 hepatic MRE sequences, but there was a significant difference in measurable area of LS, with the largest area achieved with the rapid fractional GRE sequence. Hepatic R2* was significantly correlated with measurable area of LS and was significantly higher among patients with one or more failed sequences.

CLINICAL RELEVANCE/APPLICATION

Modified GRE (reduced TR/TE) or SE-EPI sequences may be useful alternatives for hepatic MRE, especially at 3T, because of less susceptibility to T2* effects associated with liver iron and shorter breath-holds.

SSE08-02 Evaluation of Hepatic Fibrosis by Using Monoexponential, Biexponential, and Stretched Exponential Diffusion-Weighted MR Imaging

Monday, Nov. 27 3:10PM - 3:20PM Room: E352

Participants
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PURPOSE

To compare the ability of diffusion parameters acquired from monoexponential, biexponential, and stretched exponential diffusion-weighted imaging (DWI) models for the diagnosis of hepatic fibrosis (HF)

METHOD AND MATERIALS

Ninety five patients who underwent DWI using 9 b-values at 3T and had a pathologic reference standard of HF were included in this study. Liver apparent diffusion coefficient (ADC) obtained from a monoexponential model; true diffusion coefficient (Dt), pseudo-diffusion coefficient (Dp), and perfusion fraction (f) calculated from a biexponential model; distributed diffusion coefficient (DDC) and diffusion heterogeneity index (a) obtained from a stretched exponential model were compared with the pathologic HF stage (F). For the stretched exponential model, parameters were also obtained using a 6 b-value dataset with omitted lower b values (DDC#, a#). Spearman correlation analysis was performed to assess the relationship between HF and DWI parameters. The accuracy of DWI in the determination of HF stage was evaluated with Obuchowski measures. Diagnostic performance in diagnosing significant HF (>= F2) was compared using generalized estimating equation.

RESULTS

All parameters except Dt showed a significant negative correlation with the HF stage ($P < 0.05$). Among these, DDC# showed the strongest negative correlation with the HF stage ($\rho = -0.61$). The diagnostic accuracy for HF staging was highest for DDC# (Obuchowski measures, 0.770 ± 0.03) followed by a# (0.768 ± 0.04), DDC (0.748 ± 0.03), and Dp (0.728 ± 0.04). The accuracy of DDC# (78.9%) for determining significant HF (>= F2) was significantly higher than that of ADC, Dt, and f ($P < 0.05$). Dp showed similar accuracy (74.7%) with DDC# for determining >= F2 ($P > 0.999$), but revealed significantly lower specificity than DDC# (61.4% vs. 93.2%, $P < 0.001$). The diagnostic performance of DDC and a obtained with all b-values were not significantly different from those with 6 b-values (DDC#, a#) ($P > 0.05$).

CONCLUSION

Stretched exponential DWI is a promising method in the staging of HF. DDC showed comparable or better diagnostic performance with Dp even at fewer b-value acquisition.

CLINICAL RELEVANCE/APPLICATION

Stretched exponential DWI is a promising noninvasive method for classifying the severity of hepatic fibrosis, and it has the advantage of reducing scanning time with fewer b-value acquisitions.

SSE08-03 Evaluation of 2-D Ultrasound Shear Wave Elastography, Magnetic Resonance Elastography and Transient Elastography for the Non-Invasive Diagnosis of Advanced Fibrosis in Patients with Nonalcoholic Fatty Liver Disease: Preliminary Results

Monday, Nov. 27 3:20PM - 3:30PM Room: E352

Participants
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PURPOSE

To evaluate the performance of 2D ultrasound shear wave elastrography (2D-SWE), magnetic resonance elastography (MRE) and transient elastography (TE) for the diagnosis of advanced fibrosis in patients with biopsy-proven nonalcoholic fatty liver disease (NAFLD).

METHOD AND MATERIALS

In this IRB-approved, cross-sectional study 35 (21F, 14M) adult subjects (mean age, 50 years) with biopsy-proven NAFLD were prospectively recruited. The patients underwent 2D-SWE, MRE and TE the same day and with a median interval time of 72 days from liver biopsy. 2D-SWE was performed on a GE LOGIQ E9 scanner. MRE was conducted on a 1.5T scanner using a 2D-GRE sequence (GE Healthcare). TE was performed on Fibroscan (Echosens) using the XL probe. The median of measurements in the right hepatic lobe was considered for statistical analysis. Histologic evaluation included the fibrosis stage (F0-4) and the NAFLD activity score (NAS). Receiver operating characteristic (ROC) analysis was used to evaluate the performances of 2D-SWE, MRE and TE in diagnosing advanced fibrosis (F3-F4). Logistic regression analysis was used to assess the effect of BMI and NAS score on the diagnostic performance.

RESULTS

The distribution of fibrosis stage was as follow: F1, n=10; F2, n=13; F3, n=6; F4, n=4. 2D-SWE, MRE and TE detected advanced fibrosis with an area under the ROC (AUROC) respectively of 0.85 (95% confidence interval [CI], 0.72-0.97; P=0.001), 0.95 (95%

CI, 0.88-1.0; P<0.001) and 0.94 (95% CI, 0.86-1.0; P<0.001). The mean ± SD BMI was 34.5 ± 7.3 kg/m2 and the mean ± SD NAS was 4.7±1.4. NAS was significantly associated with changes in AUROC (Odds ratio=3.1; P=0.012).

CONCLUSION

2D-SWE, MRE and TE are highly accurate methods for the non-invasive diagnosis of advanced fibrosis in patients with NAFLD.

CLINICAL RELEVANCE/APPLICATION

Ultrasound and MR-based elastography methods are highly accurate for the detection of advanced fibrosis in patients with NAFLD.

SSE08-04 Correlation of Liver Stiffness Values Measured by Transient Elastography with Histopathologic Grading of Hepatic Fibrosis by Quantitative Morphometric Measurement and Semi-Quantitative Analysis

Monday, Nov. 27 3:30PM - 3:40PM Room: E352

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PURPOSE

To correlate liver stiffness values measured by transient elastography with two different histopathologic fibrosis grading systems, i.e. quantitative morphometric measurement of the fibrosis area and semi-quantitative analyses using the METAVIR score

METHOD AND MATERIALS

This prospective study was approved by the institutional review board and informed consent was obtained. We finally enrolled 74 subjects who were examined by transient elastography and underwent liver resection for focal hepatic lesions (60 subjects) or donor lobectomy (14 subjects) from March 2015 to January 2016. The time interval between transient elastography and liver resection was less than one month. Histopathologic hepatic fibrosis was graded quantitatively by using morphometry of the fibrosis area and semi-quantitatively by using the METAVIR score. The Spearman correlation coefficient (ρ) was used to examine the correlation between liver stiffness values measured by transient elastography and the two histopathologic fibrosis grading systems. The correlation between the two histopathologic fibrosis grading systems was also analyzed.

RESULTS

Liver stiffness values measured by transient elastography were poorly correlated with quantitiative morphologic analysis of the fibrosis area ($\rho = 0.305$, $P = 0.008$), while they were much better correlated with the METAVIR score ($\rho = 0.729$, $P < 0.001$). The correlation between the two histopathologic fibrosis grading systems was also poor and not significant ($r = 0.265$, $P = 0.265$).

CONCLUSION

Liver stiffness values measured by transient elastography were correlated better with semi-quantitative histopathologic grading than with qualitative morphometric analyses.

CLINICAL RELEVANCE/APPLICATION

This study enhances our understanding of physical properties measured by US elastography on the basis of histopathologic backgrounds.

SSE08-05 Two-Center Experience with Ultrasound Elastography in Cirrhosis: Factors Affecting the Application of SRU Consensus Guidelines

Monday, Nov. 27 3:40PM - 3:50PM Room: E352

Participants
Amol Shah, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
David T. Fetzer, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Stefan J. Friemel, MD, Irving, TX (*Abstract Co-Author*) Nothing to Disclose
Chandra Sehgal, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Anil Chauhan, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

1) To evaluate if patients with known hepatic cirrhosis have shear wave velocities of >2.2 m/s, the cutoff for advanced fibrosis established by recent SRU guidelines.2) To identify potential patient or technique-related factors that can lower the otherwise expected high stiffness measurements in patients with cirrhosis.

METHOD AND MATERIALS

In this IRB-approved study, we identified 131 patients with known cirrhosis from two large academic centers. Thirty of these patients did not qualify due to lack of sufficient criteria for cirrhosis, 17 were excluded due to high interquartile range/median value

(>0.3), and 2 were considered invalid due to unexpectedly high numbers (>5 m/s). All of the remaining 82 patients underwent Acoustic Radiation Forced Impulse (ARFI) Shear Wave Elastography (SWE) using a Philips EPIQ ultrasound machine. Ten shear wave velocity (SWV) measurements were obtained and the median was considered the final SWV.

RESULTS

Patient age ranged from 28-79 years (mean 58). SWV ranged from 1.17-2.66 m/s. Only 9 (11%) patients met the SRU cutoff of SWV > 2.2 m/s for advanced fibrosis, and 9 (11%) patients demonstrated normal SWV (<1.34 m/s). There was weak correlation (0.3-0.5) between SWV and elevated liver function tests (LFTs) as well as lower platelet counts. However, there was no correlation between SWV and HCV titers, serum fibrosis/inflammation tests, body-mass-index, age, and presence of portal hypertension. All patients with sustained viral response (SVR) and/or Harvoni treatment had SWV <1.8 m/s, but there was no significant difference in SWV between patients with and without SVR.

CONCLUSION

The vast majority (89%) of patients with cirrhosis demonstrate SWV less than the SRU cutoff of 2.2 m/s. Only weak correlation was noted between SWV and LFTs as well as low platelet counts. No other factors demonstrated a significant effect on SWV alone, indicating a multifactorial approach may be more appropriate. Our study suggests that revision of the current SRU cutoff may be necessary in the near future.

CLINICAL RELEVANCE/APPLICATION

The current SRU cutoff of SWV > 2.2 m/s would miss the majority of patients with advanced fibrosis (including cirrhosis) and thus revision of these guidelines may be necessary in the near future.

SSE08-06 Hepatic Sinusoidal Obstruction Syndrome: Diagnostic Value of Ultrasound Shear-Wave Elastography - An Experimental Study in a Rat Model

Monday, Nov. 27 3:50PM - 4:00PM Room: E352

Participants
Eun Kyoung Hong, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ijin Joo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyoung-Bun Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyo-Cheol Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Hyoung In Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jae Young Lee, MD,PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic value of ultrasound shear-wave elastography (SWE) in the assessment of hepatic sinusoidal obstruction syndrome (SOS) in a monocrotaline (MCT)-induced rat SOS model.

METHOD AND MATERIALS

The institutional animal care and use committee approved this study. Twenty rats were randomly divided into four groups with five animals each. Each group of animals were administered phosphate-buffered saline vehicle, or different doses of MCT (90, 160, and 200 mg/kg) by gavage. All rats underwent liver stiffness measurement (LSM) by 2D ultrasound SWE and immediately sacrificed to obtain liver tissue. LSMs were correlated with histologic grades of SOS using Spearman's rank correlation test, and receiver operating characteristic (ROC) curve analysis was performed to determine the accuracy and cutoff values for SOS severity.

RESULTS

According to histologic analysis, 10, 4, and 6 rats were categorized as having none, mild, and moderate/severe SOS, respectively. LSM by ultrasound SWE showed significant correlation with SOS severity (rho = 0.91, P <0.001) with means of 6.2, 10.5, and 12.3 kPa, in none, mild, and moderate/severe SOS, respectively. The area under the ROC curves were 0.98 (none vs. mild or moderate/severe) and 0.93 (none or mild vs. moderate/severe) with optimal cutoffs of LSM of 7.9 and 8.5 kPa, respectively.

CONCLUSION

LSM by ultrasound SWE may be helpful in the diagnosis and severity classification of hepatic SOS.

CLINICAL RELEVANCE/APPLICATION

Hepatic sinusoidal obstruction syndrome (SOS), a drug-induced liver injury, is associated with increased morbidity after major hepatectomy. Therefore, there has been a great need of a noninvasive quantitative test for diagnosis and monitoring of hepatic SOS. This animal study suggests that ultrasound shear wave elastography can be useful in the noninvasive assessment of hepatic SOS while further validation is needed in human subjects.

SSE11

Genitourinary (GU Intervention: Non-prostate)

Monday, Nov. 27 3:00PM - 4:00PM Room: E351

GU IR MR

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

FDA Discussions may include off-label uses.

Participants
Meghan G. Lubner, MD, Madison, WI (*Moderator*) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson;
K. Pallav Kolli, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSE11-01 Clinical Outcome of Uterine Fibroids Treatment: MR Guided High Intensity Focused Ultrasound Compared to Current Therapeutic Strategies

Monday, Nov. 27 3:00PM - 3:10PM Room: E351

Participants
Fabrizio Andrani, MD , Roma, Italy (*Presenter*) Nothing to Disclose
Alessandro Napoli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Hans Peter Erasmus, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Federica Fanto, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To prospectively evaluate clinical outcome of Magnetic Resonance Focused Ultrasound (MRgFUS), Uterine Artery Embolization (UAE) and Surgery in the treatment of Symptomatic Uterine Fibroid.

METHOD AND MATERIALS

585 symptomatic uterine fibroids underwent to pre-treatment MR evaluation in order to assess myoma characteristics and MRgFUS eligibility. 187 (32%) were considered eligible to MRgFUS and treated in our department using ExAblate-InSightec, while 398 resulted ineligible and were directed toward other therapeutic strategies. Of these, 137 underwent to UAE, 143 to myomectomy and 61 to hysterectomy. Clinical outcome for each treatment was evaluated comparing pre-treatment Symptoms Severity Score (SSS) with post-treatment SSS at 3-month and 12-month follow-up. Data concerning number and type of complications, days of hospitalization and days of convalescence were also collected and compared.

RESULTS

SSS mean reduction at 3 and 12-months was of 27,4% and 56,3%, respectively, for MRgFUS group; 48,7% and 56,9% for UAE group; 69,8% and 67,1% for myomectomy group; 96,6% and 94,5% for hysterectomy group. MRgFUS group demonstrated fewer complications (4 patients, 2,3 %), while the major adverse events rate was reported in UAE group (33 patients, 25,4 %). All MRgFUS patients were treated in outpatient setting, while mean days for hospitalisation and convalescence for other groups were respectively 3,4±2 and 11,7±9 days for UAE group; 4,1±2 and 16,9±12 days for myomectomy group; 4,5±1 and 24,6±14 days for hysterectomy group.

CONCLUSION

Clinical efficacy of MRgFUS for uterine fibroids treatment is comparable to UAE but slightly lower than myomectomy. However, MRgFUS is feasible in an outpatient setting and adverse events rate is significantly lower than other therapeutic strategies.

CLINICAL RELEVANCE/APPLICATION

MRgFUS is a new therapeutic strategy for symptomatic uterine fibroids, representing a non-invasive, safe and effective choice for selected patients.

SSE11-02 Percutaneous Ablation Therapy of Small Renal Tumors in Healthy Patients: A First Line Treatment

Monday, Nov. 27 3:10PM - 3:20PM Room: E351

Awards
Student Travel Stipend Award

Participants
Renato N. Zangiacomo, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose
Marcos R. Menezes, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose

Guilherme L. Martins, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Publio C. Viana, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of our study is to evaluate the oncologic outcomes of ablative percutaneous therapies, such as radiofrequency (RFA) and cryoablation (Cry), used as first-line therapy for small renal masses (SRM) (T1a) in healthy / surgical patients.

METHOD AND MATERIALS

This study consisted of an institutional review board approved retrospective review at a multicentric center. Between November 2010 and July 2016, 85 healthy patients (those with an American Society of Anesthesiologists [ASA] physical status classification score of 1 or 2) with 95 SRM who underwent RFA (n=19) or cryoablation (n=76) were identified with a median largest tumor diameter of 2,4 cm (range 0,7 - 4,0 cm). Inclusion criteria were: American Society of Anesthesiologists [ASA] physical status classification score of 1 or 2; a diagnostic biopsy prior to the treatment; a malignant T1a renal tumor; and more than 6 months follow-up. Patients with an identified genetic disease predisposing them to RCC were excluded from the analysis. Patients who had undergone a previous intervention in the ipsilateral kidney were not excluded, based on ASA criteria. The minimally invasive approach, such as ablation therapies, was achieved either by the patient's choice or after multidisciplinary discussion. Patients were followed up with contrast-enhanced CT or MRI at 3, 6, 9 and 12 months and every 6 months thereafter sequentially. Oncological outcomes were calculated from the time of the ablation therapy.

RESULTS

Technique effectiveness was almost 98% (93 of 95). Median follow-up was 19 months (range 6-77). LTP were found in two patients (2%) with a median follow-up tume 11 months. All LTP were retreated successfully with ablation percutaneous therapy. Median LTPFS could not be calculated due to the fact that most of the patients in the study were still alive at the conclusion of the study period. No patient developed metastatic renal cell carcinoma (RCC) and none died from RCC.

CONCLUSION

Percutaneous ablations therapies seem to be a reasonable option to treat SRM as the first line due to the similarly oncological outcomes to the surgery in healthy patients.

CLINICAL RELEVANCE/APPLICATION

Percutaneous ablations therapies may be a reasonable treatment choice for the SRM in healthy patient.

SSE11-03 Percutaneous Microwave Ablation of Renal Cell Carcinoma

Monday, Nov. 27 3:20PM - 3:30PM Room: E351

Participants
Sepideh Shakeri, Los Angeles, CA (*Presenter*) Nothing to Disclose
Allan Pantuck, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Anthony Sisk, DO, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
David S. Lu, MD, Los Angeles, CA (*Abstract Co-Author*) Consultant, Medtronic plc; Speaker, Medtronic plc; Consultant, Johnson & Johnson; Research Grant, Johnson & Johnson; Consultant, Bayer AG; Research Grant, Bayer AG ; Speaker, Bayer AG
Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess the safety and efficacy of image guided Microwave ablation (MWA) in biopsy - proven renal tumors within a minimum of 1- year postablation follow-up.

METHOD AND MATERIALS

In this retrospective study, 95 biopsy - proven renal tumors in 73 patients who underwent the renal MWA procedure from 2013 to 2016 at our institution were evaluated. This was an institutional review board-approved study. Data collected included demographic data, tumor characteristic data, procedural protocols and clinical follow-up visits within a 1 year. Primary outcomes were assessed by technical success, local recurrence-free (LRFS), and complications. Technical success was evaluated with Imaging immediately after MWA. Presence LRFS was examined with Imaging at 3-month target intervals for the first 2 years. Complications were categorized using the Clavien-Dindo classification system.

RESULTS

73 patients with 95 biopsy-proven renal lesions within 1 year postablation follow up were included. The mean patient age was 64(27-93) years and 63% were male. The mean tumor size was 2.7cm (0.8-7.4). 19% were benign while 81 % were RCC with clear cell 61 %(58/95), papillary13 %(12/95), chromophobe1.2%(1/95),oncocytoma 15% (14/95) and the rest were metastatic, unclassified lesions and benign cyst. Tumors were located 56% in the left kidney and most 39%(37/95) in lower pole.89/95 lesions were treated in a single encounter with 94% technical success but 6%(6/95) required a second ablation which most was 83%(5/6) CC with mean size of 4.1cm.The primary and secondary technical and overall technical success rate was 94%,100% and 100% respectively.The local recurrence rate was10.5% (10/95) with mean tumor size of 3.3cm and most 50%(3/6) had Interpolar location.The highest recurrence rate was in 70%(7/10) CC,10% Papillary (1/10) and the rest were unclassified and metastatic tumors. The complication rate was 7%(6/95) with minor complication (hematoma and severe pain) and no major one.The mean cancer-free survival was 11.9 months. All patients (99.4%) are alive only one patient died with unrelated cause (Melanoma,metastasis RCC) to the MW ablation.

CONCLUSION

Image-guided MWA appears to be a reliable and effective treatment option with low recurrence and complication rates in early

Image-guided MWA appears to be a reliable and effective treatment option with low recurrence and complication rates in early (1year) postablaton follow up.

CLINICAL RELEVANCE/APPLICATION

Percutaneous Microwave Ablation has achieved mature development in renal cancer therapy Since It shows the great safety and efficacy.

SSE11-04 The Increasing Utilization of Percutaneous Radiofrequency- and Cryo-ablation of Kidney Tumors in Recent Years

Monday, Nov. 27 3:30PM - 3:40PM Room: E351

Participants
Ali B. Syed, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
David C. Levin, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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 radiofrequency ablation (PRFA) and percutaneous cryoablation (PCRYO) have been billable since 2006 (PRFA) and 2008 (PCRYO). They are alternatives to surgical treatment. Our purpose was to study trends in their use compared with similar surgical approaches, and to determine the degree to which radiologists participate.

METHOD AND MATERIALS

The data source was the Medicare Part B Physician/Supplier Procedure Summary Master Files for 2003-2015. Procedure codes for PRFA, PCRYO, laparoscopic ablation, and open ablation were selected. Volumes for each of these ablative approaches were tracked. Medicare specialty codes were used to identify the specialty of the provider of each service. The code for partial nephrectomy was also studied for comparison.

RESULTS

Medicare volume of percutaneous ablation (both PRFA and PCRYO combined) was 927 in 2006. It then increased steadily, reaching 3378 in 2015 (+526%). Radiologists have always done the vast majority of these interventions; their share in 2015 was 89.9% while urologists' share was 9.0%. Of the percutaneous procedures that year, 33% were PRFA and 67% were PCRYO. Laparoscopic ablation volume was 452 in 2003, peaked at 1691 in 2007, but then declined sharply over the ensuing years to 470 in 2015. Virtually all of these were done by urologists. Open ablation volume was 241 in 2006 (the first year a code was available), increased to 260 in 2007, but then declined sharply to 84 in 2015. Almost all were done by urologists. Partial nephrectomy volume hovered in the 3400-3700 range but then began to drop in 2013, 2014, and 2015. Volume in 2015 was 2540.

CONCLUSION

Use of percutaneous ablation of renal lesions (both PRFA and PCRYO) has grown rapidly in recent years. By comparison, laparoscopic ablation and open ablation volumes have dropped sharply. The percutaneous approach is now used with considerably greater frequency than even partial nephrectomy. Radiologists strongly predominate in the percutaneous procedures. PCRYO is used twice as often as PRFA.

CLINICAL RELEVANCE/APPLICATION

Percutaneous techniques now appear to be the preferred approach in many patients with renal tumors, outstripping all 3 surgical approaches.

SSE11-05 Submucosal vs Intramural Uterine Fibroids (UFs): Follow-Up in Patients Treated by MRgFUS (Magnetic Resonance-Guided Focused Ultrasound Surgery)

Monday, Nov. 27 3:40PM - 3:50PM Room: E351

Participants
Sonia Iafrate, L'Aquila, Italy (*Presenter*) Nothing to Disclose
Ilaria Capretti, LAquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Ester Cannizzaro, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Margherita Di Luzio, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
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Aldo Victor Giordano, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Sara Mascaretti, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Giulio Mascaretti, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To assess the volume reduction and, symptom improvement rate following MRgFUS in patients affected by submucosal and intramural fibroids 2 years after treatment of MRgFUS.

METHOD AND MATERIALS

A total of 35 women, aged between 38 and 52, with only one symptomatic uterine fibroid underwent MRgFUS between February 2014 and February 2015.They were studied with preliminary MRI and UFs were classified with the FIGO staging system. Thirteen/35

patients were affected by submucosal fibroids (GROUP A, 3 of type 0, 4 of type 1 and 6 of type 2). They mainly were affected by reproductive problems but also by dismenoerrea. Twenty-two/35 patients were affected by intramural fibroid (GROUP B, 7 of type 3, 8 of type 4 and 7 of type 5) and were symptomatic for abnormal uterine bleeding, pelvic pressure and menorrhagia.The following parameters were evaluated: the non-perfused-volume (NPV) that represent the treated area immediately after treatment; the reduction of UFs and, the clinical symptomatology (evaluated by Symptoms severity score questionnaire (UFS-QOL).

RESULTS

All treated patients showed a very good procedural outcome with a mean initial extension of the NPV about 80-90 %. After 2 years from the MRgFUS, in the GROUP A, 8/13 showed progressive reduction of the UFs with a restoration of uterine wall morphology. Four/13 showed a complete disappearance of the UFs and in one patient, the fibroid of type 0 were partially expelled from the uterine cavity, without necessity of hysteroscopy. Also in the GROUP B we recorded a reduction in UFs volume , (18/22 about 70%, and 4/22 about 90%). In addition, all the women experienced an improvement of UFS-QOL around 90%, when compared with the pre-MRgFUS and no severe adverse events were identified in these patients during and post the procedure.

CONCLUSION

A sustained symptomatic improvement may be observed in patients affected by both submucosal and intramural uterine fibroids that underwent to MRgFUS, along the 2 year-follow-up.

CLINICAL RELEVANCE/APPLICATION

To improve the management of the patients affected by symptomatic submucosal and intramural uterine fibroids with mini-invasive treatment.

SSE11-06 Comparison of General Anesthesia and Conscious Sedation during Percutaneous Radiofrequency Ablation of T1a Renal Cell Carcinoma

Monday, Nov. 27 3:50PM - 4:00PM Room: E351

Participants
Byung Kwan Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

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PURPOSE

Percutaneous radiofrequency ablation (RFA) is so painful that this treatment requires pain control such as conscious sedation (CS) or general anesthesia (GA). It is still unclear which type of anesthesia is better for treatment outcomes of renal cell carcinoma (RCC). This study aimed to compare GA and CS in treating patients with RCC with RFA.

METHOD AND MATERIALS

Between 2010 and 2015, 51 patients with biopsy-proven 51 RCCs (<4 cm) were treated with CT-guided RFA. GA was performed in 41 and CS in 10 patients. Tumor size, local tumor progression, metastasis, major complication, effective dose, glomerular filtration rate (GFR) difference, and recurrence-free survival rate were compared between these groups.

RESULTS

The mean tumor size was 2.1 cm in both groups (p=0.673). Local tumor progression occurred in 0% (0/41) of GA group, but in 20% (2/10) of CS group (p=0.035). Metastases in these groups occurred in 2.4% (1/41) of GA group and 10% (1/10) of CS group (p=0.357). No major complications developed in either group after the first RFA session. The mean effective doses in these groups were 21.7 mSv and 21.2 mSv, respectively (p=0.868). The mean GFR differences in GA and CS groups were -13.5 mL/min/1.73m2 and -19.1 mL/min/1.73m2, respectively (p=0.575). Two-year recurrence-free survival rates in these groups were 97.5% and 78.8%, respectively (p=0.043).

CONCLUSION

GA may provide lower local tumor progression and better intermediate outcomes than CS in treating small RCCs with percutaneous RFA.

CLINICAL RELEVANCE/APPLICATION

GA instead of CS is recommended for pain control in treating a small RCC with image-guided RFA.

SSE14

Science Session with Keynote: Musculoskeletal (Upper Extremity)

Monday, Nov. 27 3:00PM - 4:00PM Room: E450B

CT MK MR

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

FDA Discussions may include off-label uses.

Participants
Jenny T. Bencardino, MD, Lake Success, NY (*Moderator*) Nothing to Disclose
Adam C. Zoga, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSE14-01 Musculoskeletal Keynote Speaker: Update on Upper Extremity Imaging

Monday, Nov. 27 3:00PM - 3:10PM Room: E450B

Participants
Lynne S. Steinbach, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

SSE14-02 4D MSK MRI: Feasibility in the TMJ and GHJ and Comparison with 2D Dynamic Evaluation

Monday, Nov. 27 3:10PM - 3:20PM Room: E450B

Participants
Won C. Bae, PhD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose
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Dawn Berkeley, BS, Tustin, CA (*Abstract Co-Author*) Employee, Toshiba Medical Systems Corporation
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Karen C. Chen, MD, Providence, RI (*Presenter*) Nothing to Disclose
Sheronda Statum, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
Christine B. Chung, MD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

There are limited reports of 2D dynamic MR evaluation in the MSK system. These are appealing for evaluating dynamic stabilization in joints. 2D dynamic imaging has limited slice profile with out-of-plane movement of imaging targets. Our objective was to develop a 4D (3D volume + 1D time) technique with application in the temporomandibular (TMJ) and glenohumeral (GHJ) joints and compare to its 2D counterpart.

METHOD AND MATERIALS

4D MR technique was developed for in vivo imaging at 3-T (Toshiba), and compared with 2D dynamic technique. In a volunteer, TMJ during a mouth opening-closing was imaged with: 1) 2D FASE (single shot spin echo; TR=400 ms, TE=10 ms, ETS=5 ms, FA=90/160 deg, FOV=20 cm, matrix=160x160, slice=6 mm (single slice), and 3.3 frames per sec, fps); and 2) 3D FASE (similar to 2D except: FOV=25 cm, matrix=256x256, slice=2 mm (6 slices), 1.1 fps). GHJ was imaged during a medial rotation of a forearm with: 3) 2D FASE at 2.5 fps and 4) 3D FASE at 0.4 fps with 8 slices.

RESULTS

Dynamic 2D and 4D techniques both yielded images of the TMJ (Fig.1) and GHJ (Fig.2) that depicted major structures with good quality and contrast. For example, in the GHJ, SNR of humeral head was 9.0 and 12.6, and CNR was 8.0 and 11.6, for 2D and 4D respectively. In the TMJ, the movement of mandibular condyle (Fig.1, circle) can be seen against stationary temporal bone (Fig.1, star). In the GHJ, changing orientation of humeral head (Fig.2, star) and glenoid (Fig.2, circle) during forearm rotational motion is seen. 4D technique, however, offered a crucial advantage of volume acquisition. For both TMJ and GHJ, evaluation of the soft tissues (TMJ disc, biceps tendon in groove) through range of motion is important for diagnosis and treatment. With 2D imaging, target structure can move out of the imaging slice. The 4D acquisition remedies this, albeit at a slower frame rate.

CONCLUSION

This feasibility study suggests that 2D dynamic and 4D MR techniques are available for evaluation of MSK structures in real-time motion, and that 4D has added advantage in case where complex, out-of-slice motions are involved.

CLINICAL RELEVANCE/APPLICATION

The 4D MR technique has utility for evaluation of joint instability.

SSE14-03 Rapid High-Resolution MRI of Elbow Injuries: Comparison of a Novel 10-min 3D TSE Technique

Against a 20-min 2D TSE Standard of Reference

Monday, Nov. 27 3:20PM - 3:30PM Room: E450B

Participants
Filippo Del Grande, MD, MBA, Baltimore, MD (*Presenter*) Speaker, Siemens AG; Speaker, Bayer AG; Institutional research collaboration, Siemens AG;
Dharmdev H. Joshi, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Gaurav K. Thawait, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Steven E. Stern, Brisbane, Australia (*Abstract Co-Author*) Nothing to Disclose
Jan Fritz, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG; Scientific Advisor, Siemens AG; Scientific Advisor, Alexion Pharmaceuticals, Inc; Speaker, Siemens AG

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PURPOSE

To test the hypothesis that a 4-fold accelerated 10-min 3D CAIPIRINHA SPACE prototype protocol is equivalent to a 2-fold accelerated 2D TSE standard for the MRI diagnosis of internal derangement of the elbow.

METHOD AND MATERIALS

Our study was approved by our internal review board. Following informed consent, 40 patients underwent 3T MRI of their symptomatic elbow consisting of six axial, sagittal and coronal IW and T2FS 2D TSE (20 min) and two sagittal isotropic IW and T2FS 3D TSE (10 min) pulse sequences. The novel 4-fold acceleration of the 3D SPACE TSE sequences was facilitated by bi-directional parallel imaging and CAIPIRINHA sampling pattern. Corresponding 2D and 3D TSE data sets were separated, anonymized and randomized into 80 studies and independently evaluated by two musculoskeletal radiologists. Outcome variables in each study included the integrity and diagnostic confidence of the 3 joints, 4 ligaments, 4 tendons, and 3 bones of the elbow. Descriptive statistics, inter-rater reliability, inter-modality concordance, and diagnostic confidence test were applied. A p-value of <0.05 was considered significant.

RESULTS

There was a high degree of inter-rater reliability with exact agreements of 78% for 2D and 89% for 3D studies ($p<0.05$). The degree of diagnostic concordance between 2D and 3D TSE was high with a Kendall's coefficient W for cartilage of 0.842, ligaments of 0.769, tendons of 0.890, and bone of 0.894. Raters diagnosed a total of 6 cartilage defects on 2D and 8 on 3D images, 14 ligament tears on 2D and 12 on 3D, 31 tendon tears on 2D and 33 on 3D, and 26 bone abnormalities on 2D and 28 on 3D. The disagreements between 2D and 3D diagnoses for cartilage, ligaments, tendons, and bone were 17.8%, 5.6%, 5.0%, and 3.8%, respectively. The readers' diagnostic confidence was significantly higher for 3D TSE ($p<0.05$).

CONCLUSION

For the diagnosis of internal derangement of the elbow, the presented 10-min 3D CAIPIRINHA SPACE MRI protocol is equivalent to a 20-min 2D TSE standard of reference. Radiologists' concordance and confidence were significantly higher for 3D studies, indicating a higher diagnostic definitiveness and possibly increased accuracy.

CLINICAL RELEVANCE/APPLICATION

Rapid 3D CAIPIRINHA SPACE TSE MRI is at least equivalent to a 2D TSE MRI reference standard for diagnosing elbow abnormalities and holds promise to substantially improve the efficiency of elbow MRI exams.

SSE14-04 Four-Dimensional Computed Tomography (4DCT) Evaluation of the Modified Radio-Ulnar Line in Correlation with Imaging Features of the Distal Radio-Ulnar Joint Osteoarthritis

Monday, Nov. 27 3:30PM - 3:40PM Room: E450B

Participants
Nima Hafezi Nejad, MD, MPH, Baltimore, MD (*Presenter*) Nothing to Disclose
Robert M. Kwee, Heerlen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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Shadpour Demehri, MD, Baltimore, MD (*Abstract Co-Author*) Research support, General Electric Company; Research Grant, Carestream Health, Inc; Consultant, Toshiba Corporation;

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PURPOSE

Modified Radio-Ulnar line (mRU) is a previously validated and reliability tested index of the Distal RadioUlnar Joint (DRUJ) and ulnar head alignment. The purpose of our study was to investigate the association between mRU measurements derived from Four-Dimensional Computed Tomography (4DCT) examination with clinical symptoms and imaging features of DRUJ osteoarthritis (OA).

METHOD AND MATERIALS

This is an IRB approved HIPAA compliant retrospective evaluation of 18 wrists (10 patients with unilateral wrist pain and instability) that were prospectively recruited in our 4DCT cohort study. Imaging of the contralateral asymptomatic side was performed to aid the diagnosis in the symptomatic side. The 4DCT was obtained using a 320-row detector scanner (Aquilion One, Toshiba Medical Systems) in active pronation-supination. Our previous study confirmed the reliability of mRU measurements using 4DCT examination. The mRU measurements were obtained in pronation, midpoint and supination by a fellowship trained MSK radiologist. Presence of symptoms (yes vs. no) and the Kellgren-Lawrence grade of OA (0-4) were assessed in correlation with mRU measurements in active motion.

RESULTS

The mRU values indicated a significantly greater volar motion of the ulnar head in asymptomatic wrists (mRU mean values (standard error): -0.10 (0.03) vs. 0.10 (0.03); P<0.001) in supination. Changes in the mRU measurements from pronation to midpoint (mean change: 0.11 (0.03), P:0.002) and to supination (0.19 (0.03), P<0.001) were significant only in the asymptomatic wrists. Unlike wrists with KL grade >=2, wrists with KL grade <2 had significant changes in the mRU values while moving from pronation to midpoint (mean change: 0.09 (0.02), P:0.004) and from pronation to supination (0.14 (0.06), P:0.059). The mRU values in pronation were not associated with the presence of symptoms or DRUJ OA. However, mRU values in supination were significantly correlated with both the presence of symptoms (correlation coefficient: 0.796, P<0.001) and KL grade of DRUJ OA (correlation coefficient: 0.647, P:0.005).

CONCLUSION

Presence of clinical symptoms and imaging features of DRUJ OA severity are associated with restricted volar motion of the ulnar head (assessed by the mRU line) while moving from pronation to supination.

CLINICAL RELEVANCE/APPLICATION

4DCT can feasibly detect dynamic changes in DRUJ alignment that are associated with clinical symptoms and imaging features of DRUJ OA.

SSE14-05 ECU Pseudolesion: A Spectrum of Change with Radiologic-Pathologic Correlation

Monday, Nov. 27 3:40PM - 3:50PM Room: E450B

Participants
Leah C. Davis, DO, Charleston, SC (*Presenter*) Nothing to Disclose
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PURPOSE

Axial MRI of the distal extensor carpi ulnaris (ECU) tendon commonly demonstrates increased central signal often attributed to tendinosis but recently described as 'ECU pseudolesion' from central tissue degeneration. On ultrasound (US), the ECU often appears heterogeneous, sometimes with a discrete cleft, even in asymptomatic patients which likely correlates with signal changes on MRI. The purpose of our study is to evaluate the distal ECU tendon by US, gross dissection and histologic evaluation to identify the ECU subsheath and elucidate the underlying cause of central signal abnormality.

METHOD AND MATERIALS

Distal ECU tendons in 28 cadaveric wrists were evaluated with static and dynamic US; images were reviewed in blinded fashion by two MSK radiologists for the presence of ECU subsheath (visible, not visible) and echogenicity of distal ECU tendon (homogeneous, heterogeneous, discrete cleft). 20 wrists were dissected by a plastic surgeon for gross evaluation of the ECU subsheath and distal ECU tendon to assess for split tear. Seven dissected ECU tendons were cross-sectioned and stained by one MSK pathologist for histologic evaluation.

RESULTS

The ECU subsheath was visible in 92.3% and 100% cases, with interreader reliability of 92%. No ECU subluxation was visualized in any wrist, with less than 40% volar displacement of the tendon during wrist rotation. In regards to echogenicity, interreader reliability was 54%, with a cleft noted in six cases by reader 1 but only one by reader 2. Of the 20 specimens dissected, all of them demonstrated an intact ECU subsheath and none of them demonstrated a tear. Of the 7 pathology specimens, all of them demonstrated internal bands of connective tissue between tendon bundles but within the tendon sheath and none of them demonstrated a tear.

CONCLUSION

The ECU subsheath is well visualized by US. Hypointensity in the distal ECU tendon on US represents bands of connective tissue, not tendinosis or longitudinal tear, and in some cases is contiguous with the external ECU tendon sheath on histologic evaluation.

CLINICAL RELEVANCE/APPLICATION

Distal ECU tendon often appears heterogeneous on US, sometimes with a discrete hypoechoic cleft, which is attributable to bands of connective tissue between tendon bundles and does not represent tendinosis or a longitudinal split tear. US is a reliable method to visualize the ECU subsheath, which can be assesed during dynamic maneuvers to diagnose ECU subluxation.

SSE14-06 Cost Effectiveness of MRI versus Ultrasound for the Detection of Symptomatic Full-Thickness Supraspinatus Tendon Tears

Monday, Nov. 27 3:50PM - 4:00PM Room: E450B

Participants
Soterios Gyftopoulos, MD,MSc, New York, NY (*Presenter*) Nothing to Disclose
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PURPOSE

To determine the value of MRI and ultrasound-based imaging strategies in the evaluation of a hypothetical population with a symptomatic full thickness supraspinatus tendon (FTST) tear using cost effectiveness.

METHOD AND MATERIALS

Decision analytic model from the health care system perspective for 60-year-old patients with symptoms secondary to a suspected FTST tear was used to evaluate the incremental cost effectiveness of three imaging strategies over a two-year time-horizon: MRI, ultrasound, and ultrasound followed by MRI (US/MRI). Comprehensive literature search and expert opinion provided input data on cost, probability and utility estimates. The primary effectiveness outcome was quality-adjusted life years (QALYs) through 2-year follow up. Costs were estimated in 2016 U.S. dollars. Costs and health benefits were discounted at 3%.

RESULTS

Ultrasound was the least costly imaging strategy ($1385). MRI was the most effective (1.332 QALYs). Ultrasound was the most cost-effective imaging strategy, but was not dominant. Incremental cost-effectiveness ratio for MRI was $22,756/QALY gained, below the $100,000 willingness-to-pay threshold. Two-way sensitivity analysis demonstrated that MRI was favored over the other imaging strategies over a wide range of reasonable costs. In probabilistic sensitivity analysis, MRI was the preferred imaging strategy in 78% of the simulations.

CONCLUSION

MRI and ultrasound represent cost-effective imaging options to evaluate the patient suspected of a symptomatic FTST tear.

CLINICAL RELEVANCE/APPLICATION

Based on our results, MRI is the preferred strategy from the standpoint of cost effectiveness although the decision between MRI and US for a radiology department or group is likely dependent on additional factors, such as available resources and workflow.

RSNA 2017 Explore. Invent. Transform.
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SSE15

Science Session with Keynote: Musculoskeletal (Arthritis)

Monday, Nov. 27 3:00PM - 4:00PM Room: E451B

CT MR MK NM

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

Participants
Andrew J. Grainger, MRCP, FRCR, Leeds, United Kingdom (*Moderator*) Nothing to Disclose
Arvin Kheterpal, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Sub-Events

SSE15-01 Musculoskeletal Keynote Speaker: Update on Arthritis Imaging

Monday, Nov. 27 3:00PM - 3:10PM Room: E451B

Participants
Andrew J. Grainger, MRCP, FRCR, Leeds, United Kingdom (*Presenter*) Nothing to Disclose

SSE15-02 Integrated 18F PET/MRI for Assessment of Association of Inflammatory Activity in Psoriatic Arthritis and Vascular Calcification Metabolism

Monday, Nov. 27 3:10PM - 3:20PM Room: E451B

Participants
Nika Guberina, MD, Essen, Germany (*Presenter*) Nothing to Disclose
Michael Forsting, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Andreas Bockisch, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The study aimed to scrutinize the association between vascular calcification metabolism and musculoskeletal manifestations in patients with active psoriatic arthritis.

METHOD AND MATERIALS

In a prospective clinical trial 21 patients with psoriatic arthritis were included in the study. The participants were examined according to a standardized whole-body protocol on the PET/MRI-scanner Magnetom Biograph mMR (Siemens Healthcare, Germany) within a single session. Joint inflammation based on 18F-NaF PET/MRI images was assessed with respect to 8 different variables (SUVmax, tenosynovitis, bone and soft tissue oedema, bone erosions, joint-space narrowing, joint-subluxation, and interphalangeal ankylosis). Vascular calcification metabolism was evaluated based on 18F-NaF-PET/MRI images in terms of 18F-NaF-uptake in large (aorta ascendens, aortic arch, thoracal and abdominal aorta descendens) and medium vessels (supra-aortic arteries, arteria mesenterica superior, iliac arteries, arteria femoralis superficialis). SUVmax was normalized for the mediastinal blood pool. Furthermore, association with laboratory parameters (CRP, CCP, leukocytes, rheumatoid factor, triglycerides and cholesterol) was investigated.

RESULTS

A total of 21 subjects (71.4% men, 28.6% women, age range 23?-?97 years) were evaluated. Vascular calcification metabolism of large and medium vessels showed a significant positive correlation with changes observed in advanced stage of psoriatic joint manifestation ($p < 0.05$). Moreover, arthritic changes were not associated and showed no correlation with laboratory markers of inflammation ($p > 0.05$).

CONCLUSION

The severity of psoriatic joint manifestations in advanced stage of psoriatic arthritis does significantly correlate with vascular calcification metabolism. Patients with psoriatic arthritis showing mild clinical symptoms may present severe atherosclerotic changes. Both, psoriatic changes and vascular inflammation may precede the actual onset of clinical symptoms.

CLINICAL RELEVANCE/APPLICATION

Both, psoriatic joint changes and vascular inflammation may precede the actual onset of clinical symptoms. Integrated 18F-NaF-PET/MRI allows the detection and severity monitoring of vascular calcification metabolism in patients with psoriatic arthritis.

SSE15-03 Diffusion Weighted Imaging of the Sacroiliac Joints: Does It Improve Diagnosis of Inflammatory Sacroiliitis?

Monday, Nov. 27 3:20PM - 3:30PM Room: E451B

Participants
Luis S. Beltran, MD, New York, NY (*Presenter*) Nothing to Disclose
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Catherine N. Petchprapa, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Mohammad M. Samim, MD, MRCS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Determine if diffusion weighted imaging (DWI) improves diagnostic performance of conventional MRI in detection of sacroiliitis

METHOD AND MATERIALS

63 adult MRI studies of the sacroiliac joints (SIJ) including conventional MRI (STIR, T2FS, T1) and DWI were retrospectively collected into two versions: 1) MRI without DWI, and 2) MRI with DWI. Three musculoskeletal fellowship trained radiologists independently reviewed each version for bone marrow edema (BME) lesions around the SIJ as the test marker of sacroiliitis. DWI measurements were obtained using normalized ADCmean in BME lesions and normal appearing bone marrow around SIJ. Patient medical charts were reviewed using Assessment of SpondyloArthritis (ASAS) International Society criteria as the reference standard diagnosis of sacroiliitis. Diagnostic performance (accuracy, sensitivity, and specificity) of each version was compared based on combined data from all readers using generalized estimating equations. Kappa coefficient and McNemar test were used to compare inter-reader concordance rates. Mann-Whitney test was used to compare nADCmean values between patients with and without sacroiliitis based on reference standard ASAS criteria. ROC analysis was used to assess utility of nADCmean as a predictor of sacroiliitis.

RESULTS

29 patients with sacroilliitis and 34 patients without sacroiliitis were evaluated using ASAS criteria. Accuracy, sensitivity, and specificity of MRI without DWI was 65.1% (95% CI: 56.6-72.7), 65.5% (52.6-76.5), and 64.7% (53.3-74.7), and for MRI with DWI was 67.2% (57.7-75.5), 60.9% (45.8-74.2), and 72.5% (60.7-81.9), with no significant difference for all parameters (p>0.1). Kappa coefficient for MRI without DWI was 0.28 and for MRI with DWI was 0.46 (p=0.041). The mean nADCmean in patients without sacroiliitis was 2.01 (SD=4.05) and in patients with sacroiliitis was 2.91 (SD=3.14) (p=0.012). The nADCmean AUC was 0.697 (0.60-0.79). The nADCmean did not significantly improve ability to detect sacroiliitis relative to accuracy achieved using MRI without DWI alone (p=0.977).

CONCLUSION

Addition of DWI to conventional MRI does not significantly improve diagnostic performance in detection of inflammatory sacroiliitis.

CLINICAL RELEVANCE/APPLICATION

The potential utility of DWI for improving detection of sacroiliitis is currently of great interest. However, based on our data, we cannot recommend adding DWI to routine MRI of the sacroiliac joints.

SSE15-04 Postpartum Changes in the Sacroiliac Joints May Mimic Sacroiliitis of Axial Spondyloarthritis on MR Imaging

Monday, Nov. 27 3:30PM - 3:40PM Room: E451B

Participants
Christoph A. Agten, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
Veronika Zubler, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
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Christoph A. Binkert, MD, Winterthur, Switzerland (*Abstract Co-Author*) Research Grant, Merit Medical Systems, Inc; Research Grant, Cook Group Incorporated; Speakers Bureau, Merit Medical Systems, Inc; Consultant, BIOTRONIK GmbH & Co KG
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PURPOSE

To compare bone marrow edema (BME) on MRI in the sacroiliac joints of women in the early postpartum period with women suffering from axial spondyloarthritis.

METHOD AND MATERIALS

This multicenter study was IRB-approved and informed consent was obtained from all participants. We prospectively acquired MR images of the sacroiliac joints of healthy postpartum women within three days after giving birth. We retrospectively acquired an age- and gender-matched control group of patients with known axial spondyloarthritis (based on diagnostic codes in our university hospital database) and used the initial MR scan of these patients in our PACS (i.e. before consecutive treatment). All MR scans comprised a coronal oblique STIR sequence of the sacroiliac joints. We assessed all MR images according to the Assessment of SpondyloArthritis international Society (ASAS) criteria for the presence of BME, and compared between the postpartum and spondyloarthritis group (Chi-square test). In a subgroup analysis, we compared BME between vaginal deliveries and cesarean sections (Chi-square test).

RESULTS

Thirty women were imaged postpartum (mean (±standard deviation) age 33±5 years, 17 vaginal deliveries, 13 cesarean sections, after 39±1 weeks of gestation, baby weight 3270±503g), and 30 women with axial spondyloarthritis (36±5 years). MRI was positive (based on ASAS-criteria) for axial spondyloarthritis in 19/30 (63.3%) of postpartum women and in 22/30 (73.3%) of women with

axial spondyloarthritis without a statistically significant difference (P=.579). Lumbar back pain at the time of MRI was present in 10/30 (33%) of postpartum women. Of those, 6/10 (60%) showed positive MRI for axial spondyloarthritis. In postpartum women without lumbar back pain, 13/20 (68.4%) showed positive MRI for axial spondyloarthritis. BME was present in 8/17 (47.1%) women with vaginal deliveries and in 8/13 (61.5%) of women with cesarean sections (P=.676).

CONCLUSION

Postpartum women may show similar bone marrow changes in the sacroiliac joints on MR imaging as patients with axial spondyloarthritis.

CLINICAL RELEVANCE/APPLICATION

Pregnancy induced BME in the sacroiliac joints may mimic sacroiliitis of axial spondyloarthritis on MRI. Caution is warranted not to overcall all BME as sacroiliitis of axial spondyloarthritis.

SSE15-05 The Significance of Subchondral Sclerosis at the Sacroiliac Joints in the Diagnosis of Inflammatory Sacroiliitis

Monday, Nov. 27 3:40PM - 3:50PM Room: E451B

Participants
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Robert G. Lambert, MBBCh, Edmonton, AB (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To determine whether subchondral bone sclerosis is a specific finding for the CT diagnosis of sacroiliitis.

METHOD AND MATERIALS

CT scans of 215 patients with low back pain were retrospectively reviewed, comprising 107 with clinically proven spondyloarthritis (SpA) and a control group of 108 age and gender matched subjects. Three blinded musculoskeletal radiologists received formal training and scored the CT scans for diagnosis and the features of sacroiliitis. Sclerosis was specifically defined and scored if located along the cartilaginous compartment, measuring more than 5mm in all 3 planes and present more than 5mm from the joint perimeter. Discrepant scores were arbitrated by majority and reader correlation calculated using ICC statistics. Sclerosis was compared with clinical diagnosis and using statistical logistic regression, the relationship was determined by calculating sensitivity and specificity for each variable using 95% confidence intervals (CI).

RESULTS

The cohort comprised 140 males and 75 females, with a mean age of 45. For any single articular surface, the specificity range of subchondral sclerosis for sacroiliitis was between 84% (CI 79-89%) and 94% (CI 91-97%), and for any two articular surfaces 94 (CI 91-97) to 97% (CI 95-100). If all four articular surfaces were affected, specificity was 99% (CI 98-100%). Sensitivity ranged from 14% for all four articular surfaces, to 55% for either ilium. The inter-observer correlation for the three readers was substantial and, calculated individually for each articular surface, ranged between 0.65-0.76. Subchondral erosion had comparable specificity range 90-100% (CI 85-100% depending on number of surfaces affected), and ICC range 0.71-0.78.

CONCLUSION

When subchondral bone sclerosis measures more than 5mm in three planes and is located more than 5mm from a joint perimeter, it has high specificity for sacroiliitis, regardless of how many articular surfaces are involved, with comparable specificity and reader correlation to erosion.

CLINICAL RELEVANCE/APPLICATION

When subchondral bone sclerosis satisfies location and minimum size criterion, it is specific for inflammatory sacroiliitis. Understanding the application of these location and size criteria is important to Reporting Radiologists analyzing radiological imaging for sacroiliitis.

SSE15-06 Evaluation of Bone Erosions in Rheumatoid Arthritis Patients using CBCT and MRI

Monday, Nov. 27 3:50PM - 4:00PM Room: E451B

Participants
Gaurav K. Thawait, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
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PURPOSE

This study assessed the utility of a novel cone beam CT (CBCT) extremity scanner for evaluation of radiological signs of rheumatoid

This study, assessed the utility of a novel cone beam CT (CBCT) extremity scanner for evaluation of radiological signs of rheumatoid arthritis (RA), such as bone erosions in wrist and metacarpophalangeal (MCP) joints. For this purpose, we compared the bone erosion scores for CBCT and MRI in RA patients along with test-retest reproducibility of the CBCT data.

METHOD AND MATERIALS

In this IRB approved study, informed consent was obtained from 10 patients (5 males, 5 females; mean age 58 years, age range 34 - 81 years) who had clinically confirmed diagnosis of RA. All patients underwent 1 MRI scan and 1 CBCT scan of the wrist and hand followed by a second CBCT scan one week later. The field of view for all scans extended from the distal radioulnar joint to the phalanges. The MRI was done on a 3T clinical MR scanner with dedicated hand coil, while the CBCT was done using a prototype CBCT extremity scanner. A radiologist with 7 years of musculoskeletal imaging evaluated all images for bone erosions in MCPs, carpal bones and distal radius and ulna, using RAMRIS like scoring between 1 to 10 (1 is 0-10% erosion, 2 is 11-20% erosion etc). Repeatability and agreement of both methods were evaluated with Intraclass Correlation Coefficients (ICC) and Bland-Altman plots.

RESULTS

Bland-Altman analysis showed agreement of 0.007±3.5, 3.5 to -3.5 (bias ± repeatability coefficient, 95% limits of agreement interval) with ICC score of 0.65 showing moderate correlation between MRI and CBCT bone erosion scores. Correlation was higher for bone erosion scores of MCPs than for wrist joints. Test-retest reproducibility for the CBCT scans showed agreement of 0.03±1.13, 1.17 to -1.10 with an excellent ICC score of 0.95.

CONCLUSION

Moderate correlation for bone erosion scores between MRI and CBCT can be attributed to higher spatial resolution of CBCT, while the prototype extremity CBCT images showed high test-retest reproducibility. Further analysis of image data for bone edema and synovitis will provide additional validation of utility for CBCT extremity systems.

CLINICAL RELEVANCE/APPLICATION

The prototype CBCT extremity scanner may, after further validation in longitudinal studies, become a useful tool for detection of RA diagnostic evaluation.

SSE16

Nuclear Medicine (Neurodegenerative Disease Imaging)

Monday, Nov. 27 3:00PM - 4:00PM Room: S505AB

BQ CT MR NR 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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Amir H. Khandani, MD, Chapel Hill, NC (*Moderator*) Consultant, Progenics Pharmaceuticals, Inc; Consultant, WorldCare International, Inc; Consultant, F. Hoffmann-La Roche Ltd;

Sub-Events

SSE16-01 Parallel Artificial Intelligence (AI) to Simulate Human Consensus Reading of Amyloid PET in Alzheimer's Disease (AD)

Monday, Nov. 27 3:00PM - 3:10PM Room: S505AB

Participants
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PURPOSE

This study is to develop and evaluate a parallel AI system to simulate human consensus reading of amyloid PET scans and to improve AI interpretation of imaging data in dementia.

METHOD AND MATERIALS

Parallel AI architecture was realized using 'U Health Vivian' AI Framework (University of Utah) in which 3 multi-layer perceptron (MLP) AI cores were adjudicated by a concurrent MLP AI to simulate human consensus reading. 3D-SSP extracted regional values from [F-18]florbetapir PET data (165 normals, age 75±6.9 yrs, 78 female and 148 AD patients, age 75±8.2 yrs, 62 female, normalized to the cerebellum) were used for testing. Each AI core was trained independently via randomization and bootstrap with 1) a different number of scans (50% and 100% of total cases) and 2) an unequal case mix of positive and negative scans (one-third positives vs negatives) to simulate heterogeneity in the human observer experience. The discriminatory accuracy by the Parallel AI was compared to that by the conventional SUVr analysis.

RESULTS

Each AI core achieved the average discriminatory accuracy of 84% by training with an unequal case mix; 88% with a smaller number of balanced cases; and 90% with a larger number of balanced cases. Smaller numbers of the training data sets and an unbalanced case mix resulted in larger variances and lower accuracy (79%-88%, $p<0.05$ compared to the larger balanced cases). The parallel AI with a concurrent AI consistently improved the accuracy of individual AI cores from 84% to 89% for the unbalanced case mix and 88% to 89% for a smaller number of balanced cases while the accuracy with a larger number of balanced cases remained same at 90%. The Parallel AI performed equal to or better than the discrimination using the conventional SUVr (88% accuracy at SUVr threshold of 1.35).

CONCLUSION

This study demonstrates that a Parallel AI might be a novel approach to improve AI-based interpretation of amyloid PET scans, similar to the improvement typically seen by human consensus reading, especially when the training data set is limited and heterogeneous. Further investigation is warranted to test various configurations of the parallel AI system.

CLINICAL RELEVANCE/APPLICATION

AI is potentially a powerful way to support radiologist's work and improve consistency and accuracy of image interpretation. Unique AI technologies and applications will need to be explored further.

SSE16-02 PET Image Classification in Dementia: Comparison of a Deep Learning Algorithm to Standard Clinical Methods and Patient Follow-Up

Monday, Nov. 27 3:10PM - 3:20PM Room: S505AB

Participants
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PURPOSE

Deep learning has the potential to improve accuracy of diagnosis among patients presenting with symptoms of dementia, which could influence treatment decisions affecting this population. We describe the training and validation of a deep learning model to classification of FDG PET images from the Alzheimer's Disease Neuroimaging Initiative ADNI dataset, and the generalization of the model to a clinical dataset.

METHOD AND MATERIALS

~3500 FDG PET exams were downloaded from (ADNI) and ~50 FDG Neuro PET exams were obtained from PACS. Metadata was used to assign a diagnosis (Dx) of Normal (NL), Mild Cognitive Impairment (MCI), or Alzheimer's disease (AD) to each exam. UCSF images were labeled using Radiology reports to assign a Dx at the time of imaging, and chart review to assign a final Dx. All images were resampled to 2 mm isotropic voxels and cropped to a 20 x 20 x 18 cm3 region centered on the brain. A set of axial slices spanning the mid-cerebellar region to just inferior to the skull apex was determined, and slices were arranged into a 4 x 4 grid. Each grid was converted to PNG format and RGB channels were used to spatially encode the slices such that homologous slices were assigned the same color. ADNI subjects were divided into a training and validation set. An off-the-shelf deep learning model with ImageNet trained weights was implemented in Python using the Keras library and fine-tuned using the ADNI training set. The model was applied to the ADNI validation set and to the UCSF data. ROCs and AUCs were computed.

RESULTS

AUCs predicted by the model for the AD category were 0.89, 0.97, and 0.99 for the ADNI validation, UCSF Folow-up labeled and UCSF Rad-report labeled sets, respectively AUCs predicted by the model for the MCI category were 0.69, 0.64, and 0.51. AUCs predicted by the model for the NL category were 0.81, 0.78, and 0.82.

CONCLUSION

Deep learning may be an effective tool in AD diagnosis, however training and validation with larger data sets is required.

CLINICAL RELEVANCE/APPLICATION

Although qualitative interpretation by an expert is the most accurate method, other interpretive aids have been shown to be helpful to those who are less experienced with 18F-FDG PET. Deep learning models could support management of patients presenting with symptoms of dementia.

SSE16-03 Regional Brain Uptake Variations in Alzheimer's disease, Mild Cognitive Impairment and Normal Controls: 18F-FDG vs 18F-Florbetapir (Amyvid)

Monday, Nov. 27 3:20PM - 3:30PM Room: S505AB

Participants
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PURPOSE

Brain discrepant distribution patterns of amyloid radiotracers compared with that of FDG in subjects with different levels of dementia has long been a source of debate. This study aims to measure the uptake of two tracers in various brain regions and to compare how 18F-florbetapir (Amyvid) and 18F-FDG regional uptake values vary from Normal Controls (NC) to Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD).

METHOD AND MATERIALS

19 patients with a clinical diagnosis of AD, 23 with MCI and 21 elderly controls underwent PET/CT imaging with Amyvid and FDG. Regional brain uptakes were measured by manual delineation of ROIs on PET/CT fused image slices around Frontal (F), Temporal (T), and Prieto-Occipital (PO) regions, and cerebellum based on predefined anatomical Criteria. Average global glucose metabolism and average global amyloid burden were calculated by generating mean standardized uptake values (GSUVmean). Values were then normalized to cerebellum by developing GSUVmean ratios.

RESULTS

The highest SUVmean ratio for FDG was noted in the F region followed by PO and T regions. In NC group, the PO region had the highest uptake ratio followed by F and T regions. However, in MCI and AD groups, decreased PO ratios were observed and were followed by those of T region, while F region had the highest ratio. In NC and MCI groups, T region ratio was significantly lower than those of F and PO ($P<0.001$), but in the AD group, this difference was not statistically significant. In either MCI or AD groups, F, PO and T ratios were significantly decreased compared to the NC group.($P<0.001$) Amyloid imaging showed the highest SUVmean ratios in the F region followed by those of PO and T regions. This pattern was the same in NC, MCI and AD Group independently. As a whole, F ratios were the highest among the values measured. In spite of increased ratios in regions examined in MCI and AD, the differences were not statistically significant.

CONCLUSION

FDG images indicated major hypo-metabolism in the PO region as the disease converts from MCI to AD. While Amyvid shows the highest amyloid burden and the highest uptake rise in the F region which is not supported by histopathological findings and suggests a substantial contribution of non-specific binding.

CLINICAL RELEVANCE/APPLICATION

FDG accurately differentiates between NC and MCI and AD and appears to be more applicable and reliable method for assessing patients with Alzheimer's disease.

SSE16-04 Plasma Glucose Effect upon Regional Brain FDG Uptake: Implications for Semi-Quantitative Image Analysis and Dementia Classification

Monday, Nov. 27 3:30PM - 3:40PM Room: S505AB

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PURPOSE

We recently demonstrated that plasma glucose level can affect FDG uptake in the brain and basal ganglia. Additionally, prior studies have also suggested that plasma glucose, above or below 125 mg/dl could change the regional cerebral pattern of FDG uptake and thus may affect clinical interpretation. This current study attempted to look at the plasma glucose effect as a continuum on regional cerebral FDG uptake.

METHOD AND MATERIALS

We used our prior dataset of 436 scans from 229 patients was used to act as a comparison population. 100 consecutive patients scanned for tumor evaluation were obtained. Patient were excluded if they had history of dementia, CVA, prior treatment (chemotherapy or XRT), known structural brain lesion, or high tumor burden. This latter has been shown to affect brain FDG uptake (see separate abstract). Brain PET images were reformatted and analyzed by Scenium (Siemens Biograph T6; Siemens Medical Solutions, Hoffman Estates, IL, USA). The mean SUV from the different cortical brain regions were compared to the basal ganglia measurements using four different methods: absolute difference, normalized (to blood pool) absolute difference, population average absolute difference and normalized (to blood pool) population absolute difference. Additionally, Z-scores for these different regions were also looked at, using the internal Scenium database. These 4 "differences" and the Z-score were then plotted as a function of plasma glucose level; residual analysis and/or subsequent linear regression were performed. A region was deemed significantly different if the slope of this linear regression was significant ($p<0.05$).

RESULTS

We were able to confirm our previous finding that diffuse brain uptake decreases with increasing plasma glucose. However, we noted also regional cerebral differences, in particular the mesiotemporal lobes and cerebelli.

CONCLUSION

Variation in plasma glucose affects FDG uptake in brain regions differentially, in particular the mesiotemporal lobes and cerebelli.

CLINICAL RELEVANCE/APPLICATION

These findings may impact imaged based dementia classification, choice of normalization technique when analyzing brain PETs, and/or suggest a need in developing a normalized database that corrects for plasma glucose

SSE16-05 The Impact of Total Counts on Iodine-123 Ioflupane SPECT Quantification

Monday, Nov. 27 3:40PM - 3:50PM Room: S505AB

Participants
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PURPOSE

I-123 Ioflupane SPECT can be used to quantify the concentration of regional cerebral dopamine transporters (DAT) in patients with movement disorders to differentiate normal and abnormal states. The objective of this RSNA Quantitative Imaging Biomarker Alliance sponsored study is to determine the total counts needed for accurate and precise estimation of the striatal specific binding ratio

(SBR).

METHOD AND MATERIALS

An I-123 striatal phantom with SBRs of 4:1 and 2:1, which represent realistic uptake patterns of normal and abnormal distribution, was imaged on SPECT/CT with clinical acquisition parameters and 12 million total counts. Poisson resampling was implemented on Matlab to simulate 5 noise realizations corresponding to each of 4 reduced count levels of 3, 2, 1 and 0,5 million counts. Each data set was reconstructed with FBP, OSEM, and OSEM with resolution recovery and correction for attenuation and scatter. OSEM parameters included 12 iterations, 8 subsets and a Gaussian filter. Striatal compartments and background were defined on CT and applied to SPECT to determine mean counts. A generalized linear model was used to test the null hypothesis that the bias and precision of SBR measurements do not change when count levels of 0.5, 1, 2 million are compared to 3 million.

RESULTS

As expected, due to partial volume effects, the SBR was substantially underestimated in all cases. However, compared to the 3 million count level the 2 and 1 million levels resulted in similar bias and variance and only the 0.5 million level resulted in a statistically significant increase in bias and variance. This was consistent across brain regions and reconstruction methods, except for the left caudate where an increase in variance was not detected. For the 3, 2, 1, and 0.5 million levels the mean bias in measured SBR was 2.26, 2.29, 2.27 and 2.52, respectively, while the mean variance was 0.0069, 0.0056, 0.0057 and 0.0147, respectively.

CONCLUSION

The data suggests that apart from the 0.5 million level the bias and precision of measured SBR are similar for evaluated count levels, hence a count level down to 1 million can be used to quantify DAT with reduced acquisition time or radiation exposure.

CLINICAL RELEVANCE/APPLICATION

Guideline in USA and Europe recommend > 1.5 and > 3 million counts for I-123 Ioflupane SPECT. Low count acquisitions without compromising imaging objectives allows reducing patient discomfort and/or radiation exposure.

SSE16-06 Evaluation of the PET Performance of Hybrid PET/MRI Compared to PET/CT in Non-Lesional Epilepsy

Monday, Nov. 27 3:50PM - 4:00PM Room: S505AB

Participants
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PURPOSE

PET/MRI can provide greater rates of lesion localization in patients with medically refractory epilepsy (MRE). However, the use of PET/MRI can be limited by MRI based attenuation correction (MRAC), where inaccurate estimation of AC may lead to erroneous estimation of PET activity. Recent advances in MR image processing have improved the performance of MRAC for PET/MR neuroimaging. This paper compares a novel MRAC approach to CT based attenuation correction (CTAC) - the current clinical standard, in patients with MRE.

METHOD AND MATERIALS

PET/MRI was acquired simultaneously in 15 patients with MRE on a hybrid system (Siemens Healthcare, Erlangen, Germany) immediately after a clinical PET/CT scan. PET/MRI data were corrected for attenuation using CT (PET-MRI-CTAC) and RESOLUTE MRAC method (PET-MRI-MRAC). PET images were compared through visual rating of metabolic activity in the frontal, temporal, parietal, occipital lobes and cerebellum and augmented by quantitative comparison of each patient's PET scan to controls (MI Neurology, Siemens Medical Solutions, USA). The mean relative difference (RD) between the two PET images was calculated for whole brain and in selected brain regions. PET/MRI performance was further evaluated using Pearson correlation to compare regional mean SUV and z-scores between PET AC methods.

RESULTS

The global RD between PET-MRAC and PET-CTAC activity was (mean ± SD%) -4.66 ± 1.93%, while regional RD ranged from -4.71 to -3.65%. A strong correlation between PET AC methods was seen across brain regions (range $r2 = 0.79$ to 0.98, $p<0.0001$) and in particular the mesial temporal lobe ($r2 = 0.98$, $p<0.0001$), an area commonly associated with MRE. Visual assessments between PET/MRI and clinical PET/CT were matched in all but 3 patients, where PET/MRI revealed mild abnormalities not reported on PET/CT.

CONCLUSION

Similar PET performance was observed between AC methods highlighting the feasibility of PET/MRI imaging in epilepsy. Further clinical evaluation using multiple raters is ongoing as well as evaluation of PET/MRI diagnostic accuracy compared to reference standards (histology and seizure-free outcomes).

CLINICAL RELEVANCE/APPLICATION

PET/MRI is emerging as a powerful tool for detecting abnormalities in epilepsy. Wider clinical adoption would occur if diagnostic equivalence to current clinical standard (PET/CT) is demonstrated.

SSE18

Neuroradiology (Spine Imaging: Backbone of Neuroradiology?)

Monday, Nov. 27 3:00PM - 4:00PM Room: N229

MR NR

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

Participants
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John L. Go, MD, Los Angeles, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSE18-01 Biochemical Intervertebral Disc Alterations in Patients with Low Back Pain and Radiculopathy

Monday, Nov. 27 3:00PM - 3:10PM Room: N229

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PURPOSE

To assess the glycosaminoglycan (GAG) content of lumbar intervertebral discs (IVD) in patients with low back pain (LBP) and radiculopathy using glycosaminoglycan chemical exchange saturation transfer imaging (gagCEST).

METHOD AND MATERIALS

258 lumbar IVDs of 53 participants, 21 healthy volunteers, 19 patients with LBP and 13 patients with radiculopathy (28 female; 25 male; mean age: 45.5 ± 16.7 years; range: 23 - 83 years), were examined with a 3T MRI scanner. Biochemical gagCEST imaging was used to determine the GAG content of each nucleus pulposus (NP) and annulus fibrosus (AF).

RESULTS

Significantly reduced gagCEST values of NP were found in patients with LBP and/or radiculopathy ($p < 0.0001$) compared to healthy control group. NP gagCEST values were significantly lower in patients with LBP ($p < 0.0001$) and radiculopathy ($p = 0.0005$) compared to healthy volunteers, respectively. We saw an association between pain and GAG loss with significantly lower gagCEST values in participants with dorsal pain at examination day ($p = 0.0004$) and higher pain scores ($p < 0.0001$) compared to participants without LBP. Participants with body mass index >= 25 revealed lower gagCEST values compared to participants with BMI < 25 ($p = 0.02$).

CONCLUSION

GagCEST analysis indicated significantly lower GAG values of NP in patients with LBP or radiculopathy, in participants with elevated BMI, current pain at examination day and elevated pain scores.

CLINICAL RELEVANCE/APPLICATION

1. Biochemical lumbar disc alterations are associated with clinical symptoms like low back pain, radiculopathy, current pain or elevated pain scores. Additionally, participants with elevated BMI showed GAG loss of the lumbar IVDs. 2. Biochemical imaging with gagCEST may provide an early biomarker for IVD and spine degeneration. 3. GagCEST imaging may be helpful in monitoring therapy effects. 4. Molecular imaging with gagCEST is a non-ivasive tool that allows to dicriminate between healthy participants and patients with low back pain..

SSE18-02 Assessment of Imaging Appropriateness Based on the ACR Appropriateness Criteria in MRI Evaluation of Back Pain

Monday, Nov. 27 3:10PM - 3:20PM Room: N229

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PURPOSE

The purpose is to evaluate the appropriateness of MR imaging in the lumbar spine for back pain using ACR Appropriateness Criteria and to assess whether information provided by the requesting clinician at the time of order entry is adequate in allowing assessment of imaging appropriateness.

METHOD AND MATERIALS

This is a retrospective study of 111 outpatient MRI examinations of the lumbar spine performed for back pain. Cases were identified via an informatics query for MR exams associated with an ICD10 code of M54.5 (low back pain). Exclusion criteria included absence of a clinical note in the medical record. Using the history obtained, the study was placed into one of six Variants as outlined in the ACR Appropriateness Criteria document for Low Back Pain. Imaging appropriateness was assessed using only text provided by the clinician in the 'Reason for Exam' or 'Ordering Comments' fields, and appropriateness scores were assigned for the Variant that was deemed most likely based on the limited information provided. Following review of the medical record, each MRI exam was re-categorized into one of six Variants based on history components or potential 'red flags' as outlined in the ACR Appropriateness Criteria document. Based on the Variant assigned, the study was then given a rating of 1-9 based on the ACR Appropriateness Criteria, with 1-3 considered 'usually not appropriate' and 7-9 considered 'usually appropriate'.

RESULTS

Of the 111 MRI examinations reviewed, 15 were excluded due to aforementioned criteria. After review of the medical record for the included 96 studies, 77 (80%; 95% CI: 72-88%) ultimately received a rating of at least 7, the range considered 'usually appropriate'. Based solely on the clinician-provided 'Reason for Exam' or 'Ordering Comments' fields, 25 exams (26%; 95% CI: 17-35%) were considered 'usually appropriate'.

CONCLUSION

Most lumbar spine MRI examinations for low back pain are appropriate based on ACR Appropriateness Criteria, but a large portion of appropriate examinations could be falsely deemed inappropriate if only information provided by the clinician at order entry is evaluated.

CLINICAL RELEVANCE/APPLICATION

Communication of relevant clinical information from referring providers improves assessment of imaging appropriateness at the time of protocolling, performing, or interpreting a lumbar spine MRI study.

SSE18-03 Immunotherapy Associated Pseudoprogression of Spinal Leptomeningeal Disease

Monday, Nov. 27 3:20PM - 3:30PM Room: N229

Participants
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PURPOSE

Metastatic melanoma (MM) with leptomeningeal disease (LMD) has a poor prognosis. Immunotherapy has recently demonstrated improved outcomes, but very little is known about changes on imaging studies in the central nervous system during treatment. The purpose of this study was to characterize the imaging features of spinal leptomeningeal enhancement in metastatic melanoma patients during intrathecal (IT) interleukin-2 (IL-2) immunotherapy for LMD.

METHOD AND MATERIALS

The clinical and imaging data of 43 MM patients with LMD undergoing treatment with IT IL-2 were retrospectively reviewed. IL-2 was administered via an Omaya reservoir daily for 5 days during the 1st week, and 2-3 times per week for an additional 3 weeks, guided by patients' tolerance to treatment.

RESULTS

In 8 cases increased spinal leptomeningeal enhancement was identified after the initial IT administration of IL-2. The median time interval between administration of IL-2 and increase in the leptomeningeal enhancement in the first follow-up scan was 24 days. In all 8 cases there was a decrease in leptomeningeal enhancement on the subsequent scan acquired at a median of 38.5 days after the first follow-up MRI study.

CONCLUSION

Intrathecal IL-2 immunotherapy can result in a transient increase in spinal leptomeningeal enhancement. This is likely reflective of pseudoprogression secondary to IL-2 induced inflammatory reaction.

CLINICAL RELEVANCE/APPLICATION

Radiologists interpreting MRI spine studies in MM patients with LMD receiving intrathecal IL-2 should be cognizant of this transient increase in leptomeningeal enhancement so as to not mistake it for disease progression.

SSE18-04 High Field Magnetic Resonance Imaging of Microstructural Changes in Post-Mortem ALS Spinal Cord

Monday, Nov. 27 3:30PM - 3:40PM Room: N229

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PURPOSE

Amyotrophic lateral sclerosis (ALS) is characterized by progressive loss of upper (UMN) and lower motor neurons. UMN loss leads to degeneration of lateral and ventral corticospinal tracts (LCST and VCST). In this work we imaged post-mortem ALS spinal cord with diffusion tensor imaging (DTI) and echo-planar spectroscopic imaging (EPSI) and correlated results with histology. Both methods are sensitive to microstructural tissue changes and may serve as biomarkers of disease.

METHOD AND MATERIALS

Cord sections were imaged at 9.4T. DTI data were acquired using a Stejkal-Tanner sequence over 60 directions (b=3000s/mm^2, 0.1x0.1x0.4mm voxels) and radial diffusivity (rADC) was computed. EPSI data were acquired using a multi-gradient echo pulse sequence (128 echoes, 1.85ms echo spacing, 0.07mm^3 voxels) from which voxel-wise water proton spectra were produced. The asymmetry (ASYM) of each spectrum was computed as the integral of the spectral half below the peak subtracted from that above the peak (normalized by the total peak area). Regions of interest (ROIs) were defined in myelin stained (LFB) histology and registered with MRI data.

RESULTS

Increased rADC values in left and right LCSTs and VCSTs reflect ALS dependent neuronal loss compared with unaffected dorsal column (DC) white matter (2.07, 2.08, 2.1, 2.13, and 1.79 x10^-4 mm^2/s, respectively). ASYM values computed across the same ROIs also suggest sensitivity of the water spectrum shape to disease. The spectrum shape is sensitive to microstructural magnetic field perturbations, such as demyelination. ASYM values in CST ROIs are smaller than the more heavily myelinated DC and larger than the myelin free grey matter.

CONCLUSION

rADC and ASYM values are sensitive to ALS pathology in post-mortem spinal cord and could potentially serve as a biomarker to stratify UMN burden in ALS. Both rADC and ASYM results suggest sensitivity to underlying microstructural tissue changes. Of particular interest, similar myelin concentrations between VCSTs and LCSTs produce opposite changes in the water spectrum; positive asymmetry suggests increased spectral density at frequencies above the peak, while negative asymmetry suggests the same, but below it.

CLINICAL RELEVANCE/APPLICATION

These results obtained from post-mortem tissue suggest methods that could be used in vivo for non-invasive assessment of ALS as well as serve as an intermediary between histopathology and in vivo MRI.

SSE18-05 Comparative Analysis of Conventional T2 MRI versus Volumetric T2 MRI in the Evaluation of Spinal Vascular Malformations

Monday, Nov. 27 3:40PM - 3:50PM Room: N229

Awards
Student Travel Stipend Award

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PURPOSE

Importance of volumetric T2 in spinal vascular malformations is less studied. Our objective was to determine the sensitivity and specificity of conventional T2 as well as volumetric T2 imaging findings in the detection of spinal vascular malformations.

METHOD AND MATERIALS

We conducted a retrospective case control study of subjects, who had spinal DSA for suspected vascular malformations, during a 11-year period from Jan 2006 to Dec 2016. Subjects with angiographically proven vascular malformations were taken as cases and remaining as controls. Anonymized images of conventional T2 and volumetric T2 MR sequences were analysed at an interval of 2 weeks. MRI was evaluated for the presence of flow voids, cord hyper-intensity, cord expansion, presence of nidus, based on which the spinal vascular malformations was identified. The sensitivity and specificity of these MRI observations in both conventional T2 and Volumetric T2 was analysed.

RESULTS

Totally 89 subjects were included in the final analysis. There were 70 angiographically proven vascular malformations {38 cases were spinal cord arterio-venous malformations (SCAVM) which includes spinal arteriovenous malformations and peri-medullary AV

fistulas, 32 cases were spinal dural AV fistulas(SDAVF)} and remaining 19 were normal. The sensitivity and specificity of flow voids in the identification of spinal vascular malformations were 98.1% and 90% for volumetric T2 sequences, compared to 83% and 89.4% of conventional MRI. For detecting flow voids in SDAVF, Volumetric T2 had 100% sensitivity while conventional T2 had only 71.8% sensitivity. For SCAVM sensitivity of volumetric T2 (96.4%) was slightly better compared to conventional T2 (92%). There was no significant difference in nidus detection rate between conventional (77%) and volumetric T2 (78.9%).

CONCLUSION

Volumetric imaging is superior to conventional T2 MR sequences in detecting vascular malformations, especially SDAVF. This sequence should be routinely included in the evaluation of suspected spinal vascular malformations.

CLINICAL RELEVANCE/APPLICATION

1. Spinal vascular malformations are a rare entity and failure to detect and treat early can lead to devastating complications. 2. Conventional T2 has significantly very low sensitivity compared to volumetric T2, in detecting spinal vascular malformations, especially for SDAVF. 3. Volumetric T2 MRI should routinely be done in all suspected spinal vascular malformations.

SSE18-06 MRI Features of Aquaporin-4 Immunoglobulin G Antibody Positive Longitudinally Extensive Transverse Myelitis (LETM) in Asians: Suggestive of Neuromyelitis Optica Spectrum Disorders

Monday, Nov. 27 3:50PM - 4:00PM Room: N229

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PURPOSE

To evaluate imaging features of spinal cord MRI for aquaporin-4 immunoglobulin G antibody (AQP4-IgG) positive longitudinally extensive transverse myelitis (LETM), which is highly associated with neuromyelitis optica spectrum disorders (NMOSD).

METHOD AND MATERIALS

This study was approved by the institutional review board. Forty-one patients with LETM from 2004 to 2014 who underwent aquaporin-4 antibody test were included in our study. Cervicomedullary junction extension, cord expansion ratio, bright spotty lesion, number of involved segments, presence of skipped lesion, enhancement pattern, axial distribution pattern was evaluated in spine MRI. Univariate logistic regression analysis was performed to identify factors associated with the presence of AQP4-IgG positive results. Statistically significant factors which was associated with AQP4-IgG positive results were used to build a scoring system. Interrater reliability for the measurement of cord expansion was evaluated using the intraclass correlation coefficient derived from a 2-way mixed effects model. Interrater agreement for the judging the presence of bright spotty lesion was evaluated with kappa values.

RESULTS

Fifteen patients (15/41, 38.9%) were aquaporin-4 antibody positive LETM. The regression analysis showed that gender, cervicomedullary junction extension, cord expansion ratio > 1.4, and bright spotty lesion was significantly associated with positive AQP4-IgG result.The sensitivity of the scoring system was 73.3% and specificity was 96.2%. Interclass correlation value of the cord expansion ratio was 0.78 and Kappa value of bright spotty lesion was 0.61.

CONCLUSION

Cervicomedullary junction extension, higher cord expansion ratio, bright spotty lesion, and female highly suggests AQP4-IgG positive in LETM, which is highly suggestive of NMOSD.

CLINICAL RELEVANCE/APPLICATION

The result of AQP4-IgG which orientates the treatment in LETM, could be predicted with specific spinal MRI findings(cervicomedullary junction extension, higher cord expansion ratio, bright spotty lesion) and gender.

RSNA 2017 Explore. Invent. Transform.
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MSMI24

Molecular Imaging Symposium: Cardiovascular MI Applications

Monday, Nov. 27 3:30PM - 5:00PM Room: S405AB

CA MR MI NM

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

FDA Discussions may include off-label uses.

Participants
Markus Schwaiger, MD, Munich, Germany (*Moderator*) Research Grant, Siemens AG; Speaker, Siemens AG
Robert J. Gropler, MD, Saint Louis, MO (*Moderator*) Grants, Bayer AG; Consultant, Biomedical Systems; Scientific Adivsor, Amgen Inc; Scientific Advisor, sanofi-aventis Group

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Sub-Events

MSMI24A PET/MR Perfect Imaging Tool for MI?

Participants
Markus Schwaiger, MD, Munich, Germany (*Presenter*) Research Grant, Siemens AG; Speaker, Siemens AG

LEARNING OBJECTIVES

1) Get an overview of recent publications and set this into perspective based on a seven year long experience. 2) Identify potential clinical targets with a reasonable cost benefit ratio based on a weakness/strength analysis of the individual modalities. 3) Understand technical opportunities and limitations for hybrid PET/MRI cardiac imaging.

ABSTRACT

Since their introduction around 15 years ago, PET/CT and SPECT/CT hybrid imaging devices saw high clinical utilization, which was driven clearly by oncology. Fortunately, the basic availability in a clinical setting enabled the investigation of the cardiac imaging perspective and facilitated numerous research activities. Given the fact that cardiac MRI is a very attractive research field with an increasing clinical utilization, PET/MR raised the expectation of potential imaging scenarios with synergistic applications. Integrating molecular imaging with a multitude of PET agents and the high temporal and spatial resolution of MRI are ideally suited for novel applications having especially a reduced burden of ionizing radiation and lack of contrast media in mind. This presentation aims to provide insights into current and future applications but also the logistical issues one should consider when implementing a cardiac PET/MRI program.

MSMI24B Metabolic Characterization of Heart Disease

Participants
Robert J. Gropler, MD, Saint Louis, MO (*Presenter*) Grants, Bayer AG; Consultant, Biomedical Systems; Scientific Adivsor, Amgen Inc; Scientific Advisor, sanofi-aventis Group

LEARNING OBJECTIVES

1) To become more familar with the central role of myocardial metabolism in CV health and disease; 2) Understand how prolonged abnormalities can lead to impaired LV function; 3) Become more familar with how metabolic imaging can advance CV invesitgation and ehnace clinical care of cardiac patient.

ABSTRACT

The metabolism of exogenous and endogenous substrates, under baseline conditions and in response to metabolic and physiological stimuli, is necessary to maintain cardiac myocyte health. The increasing evidence demonstrating the primacy of perturbations in intermediary metabolism in the pathogenesis of common cardiovascular diseases such as ischemic heart disease, heart failure, and diabetic cardiomyopathy, further supports this contention. Of note, it is becoming increasingly apparent that chronic adaptations in cellular metabolism initiates a host of pleiotropic actions detrimental to cellular health such as impaired energetics, increases in inflammation, oxidative stress, and apoptosis.Moreover, our understanding of metabolic pathways continues to evolve with the acquisition of vast quantities of information from metabolomics, proteomics, and transcriptomics that are integrated from "big-data" sets such as the Kyoto Encyclopedia of Genes and Genomes. Indeed, the importance of myocardial metabolism was highlighted in a recent Scientific Statement from the American Heart Association. Finally, interest in modifying myocardial metabolism underlying human cardiovascular disease is exemplified by the robust drug discovery and development efforts to identify new metabolic modulators. Positron emission tomography (PET) is the most widely used methods to perform in vivo assessments of myocardial metabolism in pre-clinical model of disease and humans. Its high sensitivity, resulting in the administration of nano- to pico-molar concentrations of various radiotracers, and inherent quantitative capability permits the measurement of fluxes in absolute rates through key metabolic processes without perturbing the biochemical system. Moreover, PET benefits from the availability of an extensive portfolio of metabolic radiotracers. More recently, carbon-13 hyperolarized MR has been emplyed to provide detailed assessments of various metabolic pathways, albeit primarily in pre-clinical disease models. In this talk the fundamentals of these technologies in measuring myocardial metabolism will be disccused and their contribution to cardiovascular research highlighted and potential new clinical applications are reviewed.

MSMI24C PET Imaging of Infective Endocarditis and Cardiac Device Infection

Participants
Daniel Juneau, MD, Montreal, QC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

daniel.juneau@umontreal.ca

LEARNING OBJECTIVES

1) Review the available literature and discuss the accuracy of PET imaging for the diagnosis of infective endocarditis and cardiac device infection. 2) Review the advantages and limitations of PET versus other molecular imaging modalities and tests for these indications. 3) Discuss proper patient preparation and imaging protocols for these indications. 4) Discuss the role and appropriateness of PET for these indications, and how it should be integrated into current medical practice.

ABSTRACT

The indications for and use of cardiac implantable electronic device (CIED) and valve replacement have increased over the last decades. This increase in use has been accompanied by an increase in infectious complications. Despite efforts towards prevention, incidence of CIED infection and infective endocarditis (IE) have not declined. Both conditions are serious and life-threatening and are associated with a significant cost and burden on health systems. Their diagnosis relies on a mix of clinical, microbiological and echocardiographic findings, but due to the highly variable and nonspecific presentation of these processes, it remains challenging. Early and accurate diagnosis helps to lower morbidity and mortality. This situation has led to an increased interest in using advanced cardiac imaging, including PET/CT, to help complement the current investigative approach. This presentation will explore the value of molecular imaging in the diagnosis of CIED infection and IE, and explore how it can be properly integrated in the current diagnostic approach.

MSMI24D Myocardial Inflammation and Heart Failure

Participants
Marcelo F. Di Carli, MD, Boston, MA (*Presenter*) Research Grant, Spectrum Dynamics Medical, Inc; Research Consultant, General Electric Company; Research Consultant, sanofi-aventis Group; ;

MSMI24E Molecular Imaging of Atherosclerotic Plaques

Participants
Zahi A. Fayad, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Define Nanomedicine and its opportunity in cardiovascular disease detection and treatment. 2) Demonstrate the methods of plaque molecular imaging with MR Imaging, PET, CT. 3) Discuss the advantages and limitations of plaque molecular imaging using MR Imaging, PET, CT. 4) Discuss the preclinical and clinical relevance of plaque molecular imaging by MR Imaging, PET, CT. 5) Discuss novel methods for atherosclerotic plaque treatment using nanomedicine.

ABSTRACT

Atherosclerosis is a chronic progressive disease, affecting the medium and large arteries, in which lipid-triggered inflammation plays a pivotal role. The major clinical manifestations of atherosclerosis are coronary artery disease (CAD), leading to acute myocardial infarction (MI) and sudden cardiac death; cerebrovascular disease, leading to stroke; and peripheral arterial disease, leading to ischemic limbs and viscera. These complications of atherosclerosis are leading causes of death worldwide. Despite progress in medical and revascularization therapies for atherothrombotic disease, the incidence of MI and stroke remain high under the current standard of care, and the past decade has generated few new medical therapies to prevent atherosclerosis-induced events. Similarly, current diagnostic approaches to atherosclerosis do not accurately identify those individuals who will suffer an ischemic complication. The field of atherosclerosis is therefore ripe for reengineering in both the therapeutic and diagnostic arenas. Research into the process of atheroma lesion development and maturation has implicated many immune cells including lymphocytes, dendritic cells, and neutrophils. The most numerous cells in atherosclerotic plaque are macrophages, which are leukocytes that are central to the innate immunity. Because they play a major role in instigating plaque development and complication—both of which are inflammation-related disease processes—leukocytes are promising targets for more effective atherosclerosis treatments. However, the complexity of the immune system and its role as a defensive force against infection require novel tools to very precisely identify and treat the inflammatory cells that promote atherosclerosis. Biomedical engineering offers unique possibilities for diagnosing and treating atherosclerotic plaque inflammation. Thus, interfacing engineering with immunology will be essential to meaningful advances in disease management. This talk will discuss how recent discoveries in atherosclerosis immunology can provide opportunities for diagnostic imaging of atherosclerotic plaques and cardiovascular complications of atherosclerosis, including translatable molecular imaging techniques. Integrated diagnostic modalities have uncovered new pathways that can serve as potential diagnostic and therapeutic targets, and show hat these pathways can be specifically modulated by nanomedicine based interventions.

SPSH30

Hot Topic Session: Abbreviated Abdomen MRI Protocols

Tuesday, Nov. 28 7:15AM - 8:15AM Room: E450B

GI GU MR

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

FDA Discussions may include off-label uses.

Participants
Zhen J. Wang, MD, Hillsborough, CA (*Moderator*) Stockholder, Nextrast, Inc

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Understand the workflow and finance issues related to implementing abbreviated MRI protocols in the clinics. 2) Describe the use of abbreviated MRI protocols for the evaluation of hepatocellular carcinoma, cystic pancreatic lesions, prostate cancer, and uterine cancer.

Sub-Events

SPSH30A Economic Rationale for Shorter MR Examinations

Participants
Sanjay Saini, MD, Boston, MA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To understand long-term reimbursement trends for diagnostic imaging in general and MRI in particular. 2) To provide the clinical and economic rationale for shorter MR protocols made possible through recent technologic advances.

SPSH30B Abbreviated MRI for HCC Screening and Surveillance

Participants
Bachir Taouli, MD, New York, NY (*Presenter*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA

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LEARNING OBJECTIVES

1) Review the current evidence on HCC screening and surveillance. 2) Introduce the concept of abbreviated MRI using gadoxetic acid for HCC screening. 3) Review early results of AMRI for HCC screening.

ABSTRACT

HCC is the fastest growing cause of cancer death in the United States. Practice guidelines recommend semi-annual HCC surveillance using ultrasound for high-risk patients to permit detection of HCC at an early stage, enabling effective treatment, and potentially improving survival. Due to known limitations of ultrasound, there is recent interest in developing fast MRI methods for HCC screening. In this presentation, we will discuss a novel abbreviated MRI (AMRI) exam designed to detect early-stage HCC in cirrhotic patients. AMRI is performed after gadoxetate disodium injection without the use of dynamic acquisitions, and combines only 3 sequences: T1 during the hepatobiliary phase, diffusion-weighted imaging and T2 SS FSE. The total exam time is <=15 min, thus potentially decreasing costs. We will discuss pros and cons of AMRI, future directions and other alternatives.

SPSH30C A 10-min MRI Protocol for Follow Up Incidental Cystic Pancreatic Lesions

Participants
Ivan Pedrosa, MD, Dallas, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To recognize the role of MRI in the follow up of incidental cystic pancreatic lesions. 2) To understand the potential advantages and disadvantages of a short MRCP protocol for the follow up of incidental cystic pancreatic lesions.

ABSTRACT

The diagnosis of incidental cystic pancreatic lesions has increased dramatically in the last decades due to widespread use of cross-sectional imaging and improvements in image quality. While the vast majority of these lesions exhibit a benign behavior a minority of them can evolve into invasive malignancies. This has led to the development and implementation of practice guidelines for the follow up of these lesions by several major medical organizations, all of which recognize serial imaging as the pillar of such strategies. Magnetic resonance cholangiopancreatography (MRCP) offers several advantages for the follow up of incidental pancreatic cystic lesions including excellent soft-tissue contrast and sensitivity to detect fluid and delineate ductal structures of the pancreaticobiliary system, and the lack ionizing radiation. However, several qualities may challenge its broad implementation including long acquisition times, cost, and concerns about the repeated administration of gadolinium-based contrast agents during serial examinations. In this talk we will review the potential advantages and disadvantages of a short MRCP protocol for the follow up of incidental cystic pancreatic lesions.

Active Handout:Ivan Pedrosa

http://abstract.rsna.org/uploads/2017/17001338/Active SPSH30C.pdf

SPSH30D Abbreviated MRI of the Uterus and Cervix: When and How

Participants
Evis Sala, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss patient preparation and specific MRI protocols for imaging of various uterine conditions. 2) Emphasize the role and indications for abbreviated MRI of the uterus and cervix. 3) Review specific MRI reporting tips for uterine and cervical pathologies.

ABSTRACT

URL

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/ Evis Sala, MD, PhD - 2013 Honored EducatorEvis Sala, MD, PhD - 2017 Honored Educator

SPSH30E Abbreviated Prostate MRI Protocols: Tips and Caution

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

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Review the motivations for shortening standard protocols for prostate MRI. 2) Review various strategies for shortening prostate MRI protocols. 3) Consider pitfalls and published data relevant to shortened prostate MRI protocols.

RSNA 2017 Explore. Invent. Transform.
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McCormick Place, Chicago
Explore Invent Transform

RCB31

Prostate MRI (Hands-on) Course will be repeated Monday, Tuesday, Wednesday and Thursday from 8am-10am

Tuesday, Nov. 28 8:00AM - 10:00AM Room: S401CD

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
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Siemens AG
Roel D. Mus, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Geert M. Villeirs, MD, PhD, Ghent, Belgium (*Presenter*) Nothing to Disclose
Marloes van der Leest, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Renske L. van Delft, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Rianne R. Engels, Cuijk, Netherlands (*Presenter*) Nothing to Disclose
Leonardo K. Bittencourt, MD, PhD, Rio De Janeiro, Brazil (*Presenter*) Investor, Healfies LLC
Joseph J. Busch, MD, Chattanooga, TN (*Presenter*) Nothing to Disclose
Daniel J. Margolis, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Antonio C. Westphalen, MD, Mill Valley, CA (*Presenter*) Scientific Advisory Board, 3DBiopsy LLC ; Research Grant, Verily Life Sciences LLC
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LEARNING OBJECTIVES

1) Understand the Pi-RADS v2 Category assessment to detect and localize signifant 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 30 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. PLEASE NOTICE: Based on last year's experience we expect this course to be very popular. We only have 50 computers, and two spots per computer.Only the first 100 people will be accepted in the room. The front rows are reserved for beginners. Do you have experience with prostate MR? Please take a seat at the computers in the back of the room. We will not have space for any additional listeners this year. The coursebook can be found as handout to this course, please download and take your tablet to view the coursebook during the course.

Active Handout:Renske Lian van Delft

http://abstract.rsna.org/uploads/2017/16002001/Active RCB.pdf

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RC303

Cardiac Series: Emerging Cardiovascular MR and CT Imaging Techniques

Tuesday, Nov. 28 8:30AM - 12:00PM Room: S502AB

CA BQ CT MR

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

FDA Discussions may include off-label uses.

Participants
Suhny Abbara, MD, Dallas, TX (*Moderator*) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Bernd J. Wintersperger, MD, Toronto, ON (*Moderator*) Speakers Bureau, Siemens AG; Research support, Siemens AG; Speaker, Bayer AG

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Sub-Events

RC303-01 Spectral Detector CT

Tuesday, Nov. 28 8:30AM - 8:55AM Room: S502AB

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

Honored Educators

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

RC303-02 Accuracy of Calcium Scoring (CACS) Calculated From Contrast Enhanced Coronary Computed Tomography Angiography (CCTA) Using Single Source Dual Layer Spectral Imaging CT

Tuesday, Nov. 28 8:55AM - 9:05AM Room: S502AB

Participants
Jonathan Nadjiri, MD, Munich, Germany (*Presenter*) Nothing to Disclose
Michael Rasper, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Georgios Kaissis, MD, PhD, Munchen, Germany (*Abstract Co-Author*) Nothing to Disclose
Felix Meurer, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Alexandra S. Straeter, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Ernst J. Rummeny, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Armin M. Huber, MD, Munchen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Standard evaluation of Coronary Artery Disease(CAD) requires non-contrast imaging for determination of(CASC) and contrast-enhanced imaging for evaluation of vascular stenosis. Several methods of calculating(CASC) from contrast-enhanced images have been proposed with good results. The principle for that has been spectral imaging to generate virtual non-contrast images allowing a specific subtraction of iodine from the image. However, the so far proposed techniques have some limitations: Dual Source imaging can lead to increased radiation exposure and switching the voltage of the tube (KV-switching) results in slower rotation speed of the gantry and is prone to motion artefacts which is especially critical in cardiac imaging. Spectral imaging with a dual layer detector might overcome these difficulties. Through absorption in the first layer, the second layer detects a harder spectrum of the emitted radiation from the same tube resulting in detection of two different radiation spectra. Our objective was to evaluate the accuracy of CACS from the virtual non-contrast imaging computed from spectral data in comparison to standard non-contrast imaging.

METHOD AND MATERIALS

We consecutively investigated 17 patients referred to CCTA with suspicion of CAD. The used scanner was a Philips IQon Spectral CT. CACS was calculated from both, real- and virtual non-contrast image by certified software for medical use.

RESULTS

Mean age was 59±12 years. 9 patients(53%) were male. Inter-quartile-range of clinical CACS was 0-461. Correlation of measured CACS from real- and virtual non-contrast images was very high (0.99); $p < 0.0001$. The slope was 2.1 indicating that values from virtual non-contrast are approximately half of the results from real-non contrast image. Visual analysis of Bland-Altman-Plot of

CACS shows good accordance of both methods when results from virtual non-contrast data are multiplied by the slope of the logistic regression model (2.1). The acquired power of the results is 0.99.

CONCLUSION

Determination of Calcium Score from contrast enhanced CCTA using spectral imaging with a dual layer detector is possible and shows good agreement with the standard technique when multiplied with a correction factor.

CLINICAL RELEVANCE/APPLICATION

In the future radiation exposure can be reduced through omitting native scans for patients referred to CCTA by using dual layer spectral imaging without the usual limitations of dual energy analysis.

RC303-03 Optimized Energy of Spectral Coronary CT Angiography for Coronary Plaque Detection and Quantification

Tuesday, Nov. 28 9:05AM - 9:15AM Room: S502AB

Participants
Rolf Symons, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Younhee Choi, BS, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Mark A. Ahlman, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Marissa Mallek, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Amir Pourmorteza, PhD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Jan G. Bogaert, MD, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
David A. Bluemke, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Research agreement, Siemens AG; Research support, Siemens AG; Research agreement, Carestream Health, Inc; Research support, Carestream Health, Inc
Veit Sandfort, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Optimal reconstruction methods for dual energy (DE) reconstruction of coronary plaque are unknown. The purpose of this study was to evaluate conventional mixed, conventional virtual monoenergetic (VM), and frequency spectrum noise-optimized virtual monoenergetic (VMO) reconstructions of coronary plaque with the goal of reducing image noise and improving signal- and contrast-to-noise ratio for coronary CT angiography (CCTA).

METHOD AND MATERIALS

DE CCTA was performed in 50 prospectively enrolled subjects eligible for high-intensity statin therapy using a dual-source CT scanner (90/Sn150 kVp, IRB approved: NCT02740699). Images were reconstructed with linear mixed blending, VM, and VMO with photon energies of 40-150 keV at 10-keV intervals. Image noise, iodine signal-to-noise-ratio (SNR), and contrast-to-noise ratio (CNR) for calcified (CP) and non-calcified plaque (NCP) were measured. Semi-automated software (QAngioCT, Medis) was used to quantify coronary plaque volumes using mixed and VMO images with photon energies of 40, 70, 100, and 130 keV. Linear mixed-models that account for within-subject correlation of plaques were used to compare the results.

CONCLUSION

Spectral DE CCTA with low energy (40-70 keV) virtual optimized post-processing can improve the CNR of coronary plaque detection by 25-28%. However, the lowest energy (40 keV) images may be prone to errors in plaque quantification likely due to lack of software optimization.

CLINICAL RELEVANCE/APPLICATION

Dual energy spectral CT using highly optimized, low keV images can substantially improve image quality for evaluation of coronary artery plaque compared to conventional CT images.

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

Tuesday, Nov. 28 9:15AM - 9:40AM Room: S502AB

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

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Active Handout:Bernd J. Wintersperger

http://abstract.rsna.org/uploads/2017/16001381/Active RC303-04.pdf

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 is required to provide normal ventricular output. While the evaluation of global cardiac function and volumes aims at assessment of the gross ventricular status, measures of regional myocardial function provide a more detailed analysis of the myocardial function and its individual components.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.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.

RC303-05 MR-based Assessment of Myocardial 2D Strain using Feature Tracking: Association to Cardiovascular Risk Factors in a Population based Cohort free of Cardiovascular Disease

Tuesday, Nov. 28 9:40AM - 9:50AM Room: S502AB

Participants
Tanja Zitzelsberger, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose
Astrid Scholz, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Holger Hetterich, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Roberto Lorbeer, Greifswald, Germany (*Abstract Co-Author*) Nothing to Disclose
Fabian Bamberg, MD, MPH, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG; Research Grant, Siemens AG;
Sigrid Auweter, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
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Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Maximilian F. Reiser, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Annette Peters, Neuherberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Christopher L. Schlett, MD, MPH, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Myocardial strain analysis is a promising tool for the detection of subtle but relevant alterations of left ventricular function, also in asymptomatic subjects. Thus, we determined the feasibility of cardiac MR-based 2D global strain analysis using feature tracking and its association with cardiovascular risk factors in a sample from the general population.

METHOD AND MATERIALS

Subjects without history of cardiocerebrovascular disease were enrolled in a sub-study of the population-based KORA (Cooperative Health Research in the Region of Augsburg) cohort. In all participants with absence of late gadolinium enhancement, longitudinal and circumferential global strain were measured on Cine SSFP imaging (TR: 29.97ms, TE: 1.46ms, ST: 8mm), using a semiautomatic segmentation algorithm (CVI42, Circle, Canada). Differences in strain values according to age, gender, BMI, hypertension, diabetes mellitus and hyperlipidemia were derived using linear regression analysis.

RESULTS

Among 360 subjects (mean age, 56.2±9.2 years, 57% male), average global systolic radial strain was 40.1±8.2%, circumferential 19.9±2.7% and longitudinal 19.8±3.2%. Male gender was associated with decreased global strain values, independent of the strain direction (all $p<0.001$). While many cardiovascular risk factors were correlated with strain in univariate analysis, mainly waist-to-hip ratio and HbA1c remained associated with decreased radial and circumferential strain in fully adjusted models. Similarly, higher radial and circumferential strain was observed in older subjects (ß=0.14, p=0.01 and ß=0.11, p=0.04, respectively).

CONCLUSION

Strain analysis using MR feature tracking is feasible in population-based cohort studies and shows differences with respect to age and gender as well as an independent association with markers of metabolic syndrome.

CLINICAL RELEVANCE/APPLICATION

MR-based strain analysis is a very useful tool for detection of early cardiac dysfunction, but several influencing factors need to be considered.

RC303-06 Sparse CINE SSFPs for Left Ventricular Functional Analysis in Cardiac MRI: Accuracy in Patients with Structural Myocardial Inhomogeneities

Tuesday, Nov. 28 9:50AM - 10:00AM Room: S502AB

Participants
Sonja Sudarski, MD, Mannheim, Germany (*Presenter*) Nothing to Disclose
Holger Haubenreisser, Mannheim, Germany (*Abstract Co-Author*) Speaker, Siemens AG Speaker, Bayer AG
Christina Doesch, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Johannes Budjan, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Henzler, MD, Mannheim, Germany (*Abstract Co-Author*) Research support, Siemens AG Speaker, Siemens AG
Theano Papavassiliu, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Stefan O. Schoenberg, MD, PhD, Mannheim , Germany (*Abstract Co-Author*) Institutional research agreement, Siemens AG

For information about this presentation, contact:

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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

51 patients (25 LGE+; 26 LGE-) who underwent LGE-imaging and LV analysis with the RS and the SSIR sequence were investigated. Linear regression analysis revealed with sBH-SSIR in comparison to RS excellent correlation coefficients r from 0.85-0.98 in LGE+ patients, from 0.92-0.99 in LGE- patients and with non-BH-SSIR r from 0.83-0.97 in LGE+ and 0.91-0.98 in LGE- patients, respectively (All p-values <0.0001). No significant bias was found in Bland-Altman-analysis when SSIR LV functional results in both LGE+ and LGE- patients were compared to RS results (all p-values > 0.05).

CONCLUSION

LV functional parameters can be accurately assessed using SSIR datasets acquired with a single breath-hold or during free breathing in patients with circumscribed cardiac structural inhomogeneities indicated by presence of LGE. Data acquisition is accelerated on average by factor 12.

CLINICAL RELEVANCE/APPLICATION

Accurate MR LV functional analysis can be accelerated by factor 12 using sparse sampling featuring iterative reconstruction (SSIR) imaging even in patients with structural myocardial inhomogeneities.

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

Tuesday, Nov. 28 10:20AM - 10:45AM Room: S502AB

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

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 Optimized Aortic 4D Flow MRI in Under 3 Minutes: Impact of Resolution and Respiratory Navigator Gating On the Quantification of 3D Wall Shear Stress

Tuesday, Nov. 28 10:45AM - 10:55AM Room: S502AB

Participants
Emilie Bollache, Chicago, IL (*Presenter*) Nothing to Disclose
Alex Barker, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Julia Geiger, MD, Freiburg, Germany (*Abstract Co-Author*) Nothing to Disclose
James C. Carr, MD, Chicago, IL (*Abstract Co-Author*) Research Grant, Astellas Group; Research support, Siemens AG; Speaker, Siemens AG; Advisory Board, Guerbet SA
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Ryan S. Dolan, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (*Abstract Co-Author*) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;

PURPOSE

Wall shear stress (WSS) plays an important role in the regulation of cellular function and remodeling. We evaluated the performance of aortic WSS estimates using a newly developed k-t accelerated non-navigator gated 4D flow MRI sequence, which was shown to provide consistent velocity and flow indices with total scan times under 3 minutes.

METHOD AND MATERIALS

k-t accelerated free breathing 4D flow MRI (PEAK GRAPPA acceleration factor R=5, spatial resolution SRes=3.4±0.1x2.3x2.8±0.2mm3, temporal resolution TRes=65.6-67.2ms, scan time=1:21-2:40min) combined with a custom k-space reordering was compared to conventional navigator-gated 4D flow MRI acquired according to consensus recommendations (GRAPPA R=2, SRes=3.2±0.1x2.2±0.1x2.7±0.3mm3, TRes=38.4-39.2ms, scan time=8:58-17:37min). Acquisitions were performed *in-vitro* using a patient-specific 3D-printed descending aortic (DA) coarctation model and a pulsatile pump, in 10 healthy volunteers (6 men, 61±16years) and in 10 patients with aortic disease (7 men, 60±10years). Data analysis included calculation of 3D systolic aortic WSS and quantification of maximal WSS (2% highest values) throughout the cardiac cycle in the ascending aorta (AA), aortic arch and DA.

RESULTS

3D aortic systolic WSS distributions and regional maximal WSS waveforms are illustrated in Figure A and B for conventional and the k-t accelerated 4D flow MRI. Figure C provides Bland-Altman diagrams combining all time frames and aortic regions. Absolute differences between k-t accelerated and conventional WSS were as follows for the AA, arch and DA, respectively: 6.9±5.6, 9.2±5.7 and 7.9±3.9% (*in-vitro*); 15±16, 19±23 and 19±20% (volunteers); 11±8.0, -11±11 and 14±15% (patients). While peak systolic WSS was similar between the 2 techniques in healthy subjects at all locations, it was significantly underestimated (by 19±22%, p=0.04) in the DA in patients when using k-t accelerated 4D flow.

CONCLUSION

Aortic WSS calculation is sensitive to respiration gating and/or reduced resolution in patients with complex flow due to stenosis or

aneurysm. Larger studies are warranted to define the best compromise between short 4D flow MRI scan time, resolution, respiratory motion and accuracy in calculating WSS.

CLINICAL RELEVANCE/APPLICATION

Highly accelerated 4D flow MRI will help enhancing the clinical usefulness of its 3D time-resolved wall shear stress quantification in cardiovascular disease.

RC303-09 First Results of CT-Derived Cardiac 4D Blood Flow: Comparison with 4D Flow MRI

Tuesday, Nov. 28 10:55AM - 11:05AM Room: S502AB

Participants
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PURPOSE

Current computed tomography (CT) technology can provide high-resolution time-resolved cardiac anatomy images, but unlike 4D Flow MRI or ultrasound, blood flow data cannot be assessed directly with CT. However, with modelling approaches, fractional flow reserve can now be estimated using CT. The aim of this study was to extend the use of clinical CT applications to assessment of intracardiac blood flow. This was done by utilizing our recently developed 4D Flow CT framework that can compute the resulting cardiac blood flow using conventional retrospectively gated coronary CT angiography (cCTA) images.

METHOD AND MATERIALS

cCTA and 4D Flow MRI measurements were acquired in a cohort of 9 patients who all had a cCTA referral. Our 4D Flow CT framework is based on computational fluid dynamics with wall motion extracted from CT data. Using this framework, intracardiac flow fields were obtained for all patients. Results could then be compared to 4D Flow MRI measurements.

RESULTS

Characteristic cardiac blood flow patterns, like vortices and jets, were seen in atriums and ventricles in both techniques. The 4D Flow CT derived flow field agreed visually very well with 4D Flow MRI. Linear regression showed that peak flow rate derived from 4D Flow CT had an excellent agreement with 4D Flow MRI measurements ($R^2=0.96$, Pearson correlation coeff. $p=0.98$) as well as for stroke volume ($R^2=0.80$, $p=0.89$).

CONCLUSION

We demonstrate the feasibility of a novel patient specific CT method to obtain intracardiac blood flow. Nine patients were evaluated with 4D Flow CT, and both qualitative and quantitative results agreed well with in vivo MRI measurements. This provides the ability to obtain new functional information without affecting the cCTA examination. Additionally, the method gives the potential to simulate "what if" scenarios. Larger prospective studies are required to further establish its diagnostic performance and incremental value compared with MRI or cCTAs.

CLINICAL RELEVANCE/APPLICATION

The method can add new functional information to cCTA and has great potential to increase the moderate positive predictive value of clinical cCTA while keeping the high negative predictive value.

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

Tuesday, Nov. 28 11:05AM - 11:30AM Room: S502AB

Participants
Kate Hanneman, MD, FRCPC, Toronto, ON (*Presenter*) Nothing to Disclose

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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 Educator

RC303-11 Quantitative Comparison of T1 Shortening by Three Different Macrocyclic Gadolinium-Based Contrast Agents in Cardiac MRI of the Myocardium and Left Ventricle

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S502AB

Participants
Takahito Nakajima, MD, Maebashi, Japan (*Presenter*) Nothing to Disclose
Ayako Shimazaki, Maebashi, Japan (*Abstract Co-Author*) Nothing to Disclose
Kouichi Ujita, Maebashi, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoshito Tsushima, MD, Maebashi, Japan (*Abstract Co-Author*) Institutional Research Grant, Bayer AG ; Institutional Research Grant, DAIICHI SANKYO Group; Institutional Research Grant, Eisai Co, Ltd; Institutional Research Grant, Nihon Medi-Physics Co, Ltd; Institutional Research Grant, FUJIFILM Holdings Corporation ; Institutional Research Grant, Fuji Pharma Co, Ltd; Institutional Research Grant, Siemens AG ; Institutional Research Grant, OncoTherapy Science, Inc; Institutional Research Grant, Becton, Dickinson and Company; Speaker, Bayer AG ; Speaker, DAIICHI SANKYO Group; Speaker, Eisai Co, Ltd; Speaker, Fuji Pharma Co, Ltd; Speaker, Guerbet SA; .;

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PURPOSE

The aim of this study is to investigate the effect of three different macrocyclic gadolinium-based contrast agents (mGBCA) on T1 shortening in the myocardium and left ventricle (LV).

METHOD AND MATERIALS

This retrospective study included 40 patients (20 women) who underwent CMR with T1 mapping before and after administration of the following mGBCAs:gadoterate meglumine (Magnescope®; Terumo Co. Ltd., Japan; n = 10); gadteridol (ProHance®; Eisai Co. Ltd., Japan; n = 13); and gadobutrol (Gadovist®; Bayer Co. Ltd., Japan; n = 17). Gadoterate meglumine and gadoteridol were administrated for patients from May 2015 to March 2016, and gadobutrol was administrated from April 2016 to September 2016. Gadoterate meglumine was used for patients weighing less than 55 kg, and gadoteridol was used for patients over 55 kg. Gadobutrol was used for patients of any body weight. MRI was performed using a 3T system (MAGNETOM Skyra, Siemens Healthcare, Germany). T1 mapping was conducted using modified look-locker inversion recovery (MOLLI) sequences to measure the T1 relaxation time values of the myocardium and LV. Regions of Interest were drawn on the short axis images of areas of the myocardium without lesion involvement, at the LV septal/inferior walls, and in the LV cavity. Statistical analyses were conducted using Kruskal-Wallis test with Bonferroni correction for multiple comparison of imaging parameters. $P < 0.05$ was considered statistically significant.

RESULTS

Native T1 relaxation times were not significantly different across the three groups for either the myocardium, ranging from 1220 ms ± 267 to 1265 ms ± 52, or the LV, ranging from 1740 ms ± 550 to 1957 ms ± 86. T1 relaxation times for the myocardium were significantly lower in the group administered gadobutrol (594 ms ± 53, $P < 0.0001$) compared to the groups administered gadoterate meglumine (691 ms ± 31) or gadoteridol (645 ms ± 53). T1 relaxation times for the LV were also significantly lower in the gadobutrol group (415 ms ± 51, $P < 0.0001$) compared with the groups administered gadoterate meglumine (555 ms ± 46) or gadoteridol (493 ms ± 55).

CONCLUSION

Gadobutrol showed the most effective shortening of T1 relaxation times in the myocardium and LV cavity.

CLINICAL RELEVANCE/APPLICATION

The T1-shortening abilities of gadobutrol would contribute to depict myocardial lesions even at the concentration of 0.1 mmol/kg.

RC303-12 Myocardial Edema Detecting By Cardiovascular Magnetic Resonance T2 Mapping in Patients with End Stage Renal Disease: Comparing with Conventional T2-Weighted Imaging

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S502AB

Participants
Wanlin Peng, MS, Chengdu, China (*Presenter*) Nothing to Disclose
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PURPOSE

To explore the effectiveness of T2 mapping and conventional T2-weighted imaging (T2WI) in the detection of myocardial edema in patients with end stage renal disease (ESRD), and further compare the reproducibility of these two technique.

METHOD AND MATERIALS

Forty-six ESRD patients and 12 age/gender matched healthy volunteers were recruited and underwent cardiac magnetic resonance (CMR) examination. The ERSD patients were divided into patient's with impaired left ventricular (LV) function (LV ejection fraction [EF] <50%, n=31) and those with preserved LV function (LVEF>50%, n=15). T2 values and T2 SI ratios for myocardial edema in basal, middle and apex segments were assessed from T2 mapping and T2WI images respectively by offline post-possessing software and statistically compared. By Intra-class correlation coefficient (ICC) analysis, inter-and intra- observer agreement representing the reproducibility of T2mapping and T2WI were obtained.

RESULTS

The global T2 values of ERSD patients with impaired LV function and with preserved LV function were high than normal controls (46.2 ± 4.58ms, 43.2 ± 4.65ms, 39.0 ± 3.33ms, respectively, all P<0.05). For the segmental heterogeneity, T2 values of basal, middle and apical segments in ERSD with impaired LV function were the highest comparing with those with preserved LV function and normal ones(all P<0.05). However, for the T2 SI ratios, ERSD with impaired LV function was highest among the three group, but no statistical difference were found (P=0.86). T2 values were negatively related with LVEF (r= -0.46 , p<0.001).By the analyzing of reproducibility, inter- and intra-observer agreement of T2 value were both improved and excellent high comparing with T2 SI ratio (Inter-observer: ICC=0.994 vs. 0.980; Intra-observer: ICC=0.988 vs. 0.960).

CONCLUSION

Quantitative T2 mapping is a higher reproducible tool replacing conventional T2WI imaging to evaluate the myocardial edema of ESRD patients. The myocardial edema was existed in ESRD patients and had a negative effect on cardiac dysfunction.

CLINICAL RELEVANCE/APPLICATION

(dealing with cardiovascular disease) 'Cardiac MR studies can demonstrate existing impaired myocardium in end stage renal disease patients and this exam will contribute to early detection of cardiac function impairment.

RC303-13 Diagnostic Value of Tissue Characteristic Parameters in Acute Myocarditis: A Double-Center Study

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S502AB

Participants
Mu Zeng, Changsha, China (*Presenter*) Nothing to Disclose
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Gang Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the diagnostic value of cardiac magnetic resonance imaging in patients with suspected acute myocarditis using multi-parameter cardiac magnetic resonance imaging with T1 mapping and T2 mapping as a tool for tissue characterization.

METHOD AND MATERIALS

A total of 50 patients with acute myocarditis and 100 controls from 2 centers were included in this study. Cardiac magnetic resonance imaging methods included black blood T2-weighted short tau inversion recovery, early gadolinium enhancement, delayed gadolinium enhancement, native T1 relaxation time, native T2 relaxation time and extracellular volume fraction. Diagnostic performance was compared using the receiver operating characteristic curve with clinical evidence of acute myocarditis as a reference standard.

RESULTS

The area under the curve of Lake Louise criteria was 0.865, with sensitivity of 92% and specificity of 81%. The area under the diagnostic curve of native T1 was 0.909, with sensitivity of 88% and specificity of 85% (cutoff, 1256 ms). The area under the diagnostic curve of native T2 was 0.679, with sensitivity of 78% and specificity of 65% (cutoff, 44.2 ms). The area under the diagnostic curve of ECV was 0.817, with sensitivity of 72% and specificity of 81% (cutoff, 28.1%).

CONCLUSION

Diagnostic performance of native T1 is superior to native T2 and ECV, and its specificity is also higher than the Lake Louise criteria. Native T1 relaxation time, as a supplement to existing cardiac magnetic resonance techniques, is of high value in the diagnosis of suspected acute myocarditis.

CLINICAL RELEVANCE/APPLICATION

(dealing with acute myocarditis)Native T1 relaxation time is of high value in the diagnosis of suspected acute myocarditis.

RC305

Neuroradiology Series: Stroke

Tuesday, Nov. 28 8:30AM - 12:00PM Room: N228

MR NR

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

FDA Discussions may include off-label uses.

Participants
Howard A. Rowley, MD, Madison, WI (*Moderator*) Research Consultant, Bracco Group; Research Consultant, Guerbet SA; Research Consultant, General Electric Company; Consultant, F. Hoffmann-La Roche Ltd; Consultant, W.L. Gore & Associates, Inc; ; ; ; ; ; ; Jeffrey L. Sunshine, MD, PhD, Pepper Pike, OH (*Moderator*) Research support, Siemens AG; Travel support, Siemens AG; Travel support, General Electric Company; Travel support, Sectra AB; Travel support, Allscripts Healthcare Solutions, Inc; Travel support, Imprivata, Inc; Travel support, KLAS Enterprises LLC

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LEARNING OBJECTIVES

1) To review latest developments and directions in stroke imaging and intervention relevant to practice.

Sub-Events

RC30501 Imaging for Stroke Triage: What I Look For and What I Wish I Had

Tuesday, Nov. 28 8:30AM - 9:00AM Room: N228

Participants
Gregory W. Albers, MD, Palo Alto, CA (*Presenter*) Stockholder, iSchemaView, Inc ; Consultant, iSchemaView, Inc; Consultant, Medtronic plc

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LEARNING OBJECTIVES

1) Understand the role of advanced imaging for patient selection in recent endovascular stroke trials. 2) Understand the rationale for obtaing data on both cerebral hemodynamics, collateral circuation and vascular anatomy with a single contrast injection. 3) Know the pros and cons of obtaining initial brain imaging data on stroke patients in the angiography suite.

RC305-02 Prediction of IV Thrombolysis Effect Using CT Perfusion-Post-Processed Detection of Vessel Occlusions

Tuesday, Nov. 28 9:00AM - 9:10AM Room: N228

Participants
Wolfgang G. Kunz, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
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Kolja M. Thierfelder, MD,MSc, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Wieland H. Sommer, MD, Munich, Germany (*Presenter*) Founder, Smart Reporting GmbH

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PURPOSE

To determine the predictive value of CTA-occult vessel occlusions detected using CT perfusion-post-processed wavelet-transformed angiography (waveletCTA) on the morphologic and functional outcome after IV thrombolysis (IVT) in acute ischemic stroke.

METHOD AND MATERIALS

Patients were selected from a cohort of 1,851 consecutive patients who had undergone multiparametric CT including whole-brain CT perfusion. Inclusion criteria were: (1) significant cerebral blood flow (CBF) deficit, (2) no evidence of occlusion on standard CTA, and (3) follow-up-confirmed infarction. waveletCTA defines angiographic signal by best fitting of time-attenuation curves to a generic contrast bolus curve in each voxel, and was analyzed by two blinded readers with respect to vessel occlusions. Morphologic outcome was defined as relative infarction growth using the ratio [final infarction volume] / [initial CBF deficit volume], of which

smaller values were considered favorable. Significant functional improvement was defined as a decrease in modified Rankin Scale score from admission to discharge (ΔmRS) of >=1 or a decrease of National Institutes of Health Stroke Scale score from admission to 24 hours (ΔNIHSS) of >=3. Linear and logistic regression analyses were performed to identify independent associations between predictors and outcomes.

RESULTS

Among all included patients (N=107) with unremarkable standard CTA, 58 (54%) showed an occlusion on waveletCTA. There was no significant difference between patients receiving IVT (n=57) vs. patients receiving only supportive care (SC, n=50) regarding age, sex, time from symptom onset, early infarction signs, perfusion mismatch, waveletCTA-detected occlusions or NIHSS on admission (all with p>0.05). In patients treated with IVT, regression analyses showed that the presence of a waveletCTA-detected occlusion was an independent predictor of a favorable morphologic (beta=-1.044, p=0.001) and functional outcome (ΔmRS: OR=7.868, p=0.041; ΔNIHSS: OR=9.810, p=0.013), while it failed to predict outcome in patients who received SC (all with p>0.05).

CONCLUSION

The presence of CTA-occult vessel occlusions detected using waveletCTA independently predicts a higher effectiveness of IVT in stroke.

CLINICAL RELEVANCE/APPLICATION

waveletCTA has the potential to contribute to decision making in acute ischemic stroke, as CTA-occult occlusions that are detected with this technique predict a better response to IVT.

RC305-03 Importance of CT-Perfusion in Diagnosis of Stroke Mimic Perfusion Patterns Related by Seizures in Daily Clinical Practice

Tuesday, Nov. 28 9:10AM - 9:20AM Room: N228

Participants
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Thomas Lindner, Kiel, Germany (*Abstract Co-Author*) Nothing to Disclose
Olav Jansen, MD, PhD, Kiel, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Stroke mimics (SM) constitute 5%-30% of clinically diagnosed strokes. CT perfusion (CTP) is the standard assessment in stroke diagnostics to rule out hemorrhage, a potential contraindication for thrombolysis, but fails to identify SM. Our aim was therefore to evaluate the diagnostic value and characteristics of seizure related perfusion alterations with CTP in the differential diagnosis of ictal or postictal state in acute neurological deterioration.

METHOD AND MATERIALS

We identified 37 patients over a 22-month period presented to our stroke center with acute stroke-like symptoms and a multimodal CT examination. Patients were included who underwent electroencephalography (EEG) within 5 days of symptom onset and had seizure as final diagnosis. Analysis of the perfusion maps was performed and was correlated with clinical symptoms and EEG.

RESULTS

The most common perfusion abnormality, seen in 22/37 (59.5%) patients, was regional hyperperfusion in a cortical ribbon pattern. 15 (40.5%) patients showed a hypoperfusion pattern with prolonged MTT/ Tmax with a regional or holo-hemispheric distribution and a decrease in CBF and CBV, contrary to the known increase of CBV in the ischemic penumbra by reactive collateral flow. Involvement of thalamus and hippocampus was associated with hyperperfusion and also with epileptiform EEG. Patients with hyperperfusion showed postictal MRI-changes (11/16). The two groups did not differ in clinical presentation, but hospital stay was longer in patients with hyperperfusion and they had a worse clinical outcome.

CONCLUSION

Our study results emphasize the benefit of an advanced CT stroke-protocol to identify SM, additional to the well-established mismatch-concept.

CLINICAL RELEVANCE/APPLICATION

CT perfusion appears attractive as diagnostic tool to identify stroke mimics and differentiate these from acute stroke and in further consequence lead to a more appropriate treatment.

RC305-04 Brain Computed Tomography Using Iterative Reconstruction to Diagnose Acute Ischemic Stroke: Usefulness in Combination with Optimized Window Setting and Thin-Slice Reconstruction

Tuesday, Nov. 28 9:20AM - 9:30AM Room: N228

Participants
Taihei Inoue, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose
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[redacted]

PURPOSE

The purpose of this study was to determine whether iterative model reconstruction (IMR) specialized for brain computed tomography (CT) with a combination of thin-slice images and narrow window settings would improve the detection of acute stroke.

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board; patient informed consent was waived. We retrospectively enrolled 27 patients with acute middle cerebral artery (MCA) stroke and 27 non-stroke patients matched for age and gender with individual stroke patients (control). Using images reconstructed using 1- and 5-mm-thick images with filtered back projection (FBP) and 1-mm-thick images with IMR, we compared the CT numbers in infarcted areas, image noise in the temporal pole, and contrast-to-noise ratios (CNRs) of infarcted and noninfarcted areas. To analyze the performance of acute MCA stroke detection, we used receiver-operating characteristic (ROC) curve techniques and compared 5 mm FBP with standard window settings, 1 mm FBP with narrow window settings, and 1 mm IMR with narrow window settings.

RESULTS

The image noise was significantly lower with 1 mm IMR [3.7 Hounsfield units (HU) ± 1.1] than with 5 mm (4.7 HU ± 0.6) and 1 mm (9.3 HU ± 1.5) FBP ($p < 0.001$), and CNR with 1 mm IMR (1.1 ± 1.0) was significantly higher than that with 5 mm (0.8 ± 0.7) and 1 mm (0.4 ± 0.4) FBP ($p < 0.001$). Furthermore, the average area under the ROC curve was significantly higher with 1 mm IMR with narrow window settings [0.90; 95% confidence interval (CI): 0.86,0.94] than with 5 mm FBP with standard window settings (0.78; 95% CI: 0.72,0.83).

CONCLUSION

The combination of thin-slice images and narrow window settings under IMR provides better diagnostic performance than the conventional reconstruction methods for acute MCA stroke detection.

CLINICAL RELEVANCE/APPLICATION

Combination of iterative model reconstruction and narrow window settings can improve the detectability of acute middle cerebral artery stroke.

RC305-05 Relationship between Collateral Circulation and Cerebral Hemodynamics in North American Moyamoya Patients

Tuesday, Nov. 28 9:30AM - 9:40AM Room: N228

Participants
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PURPOSE

Patients with Moyamoya disease typically have significantly abnormal cerebral hemodynamics and extensive collateral networks. We undertook this prospective study to understand the relationship between collaterals and MR perfusion imaging in a large cohort of North American Moyamoya disease patients.

METHOD AND MATERIALS

In 86 prospectively recruited, pre-operative North American Moyamoya disease patients (mean age 42±11 yrs, M/F 24/62), we performed 3T MR imaging (GE Healthcare) and digital subtraction angiography (DSA) (Axiom Artis dBA Twin; Siemens Medical Systems). Two neurointerventionalists scored the DSA for collaterals (0=none visible, 1=mild/moderate, 2=robust, 3=antegrade flow) in 20 pre-defined regions per patient (Kim et al., Stroke 2008). After placing all imaging into MNI-152 template space, cerebral hemodynamics (3D pseudocontinuous ASL with white paper parameters (Alsop et al., MRM 2015) (n=86) and bolus dynamic susceptibility contrast perfusion-weighted imaging (PWI) (n=82), which was processed using automated RAPID software (Straka et al., JMRI 2010) were measured in the same regions. We tested for trends using the Jonckheere-Terpstra Test for Ascending Ordered Alternatives.

RESULTS

There was a significant positive trend between increasing collateral score and increased ASL CBF ($p<0.0001$); regions with robust collateral flow and antegrade flow had the same CBF. No trend between collaterals and rCBF or rCBV was observed. Lower mean transit time (MTT) and time-to-maximum (Tmax) was seen with increasing collateral score (both $p<0.0001$). Increased ASL signal in serpentine vessels ("arterial transit artifact") was present in regions with higher collateral scores.

CONCLUSION

Increasing collateral scores on DSA predict increased CBF as measured by ASL, and decreased transit time metrics (MTT and Tmax) as measured by bolus DSC PWI. These relationships on MR perfusion imaging may be helpful to evaluate collateral flow in patients who do not receive DSA.

CLINICAL RELEVANCE/APPLICATION

Increasing collateral scores are associated with higher CBF (measured with ASL imaging) and lower MTT and Tmax (measured with bolus contrast PWI) in pre-operative North American Moyamoya disease patients.

RC30506 Imaging for Stroke Prevention: The Next Frontier

Tuesday, Nov. 28 9:40AM - 10:10AM Room: N228

Participants
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LEARNING OBJECTIVES

1) Identify imaging strategies that can be implemented into clincial practice to aid in primary stroke prevention efforts including imaging of high-risk plaque, silent ischemic brain disease, and impaired cerebral hemodynamics; and 2) Identify imaging strategies that can be implemented into clinical practice to aid in secondary stroke prevention efforts, including identification of potential culprit atherosclerotic lesions in patients with cryptogenic strokes.

RC30507 Intracranial Vessel Wall Imaging

Tuesday, Nov. 28 10:20AM - 10:50AM Room: N228

Participants
Mahmud Mossa-Basha, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand intracranial vessel wall MRI techniques and their advantages/disadvantages. 2) To understand why better diagnostic tools for intracranial vasculopathy assessment are necessary. 3) To understand the benefits of intracranial vessel wall MRI in disease differentiation. 4) To understand scenarios in which vessel wall MRI may be beneficial for diagnosis and management.

RC305-08 Lesion Evolution in Stroke and Ischemia on Neuroimaging (LESION) Study: The Probability of Ischemic Stroke Therapeutic Targets Across Time

Tuesday, Nov. 28 10:50AM - 11:00AM Room: N228

Participants
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PURPOSE

To quantify the relation of time from ischemic stroke onset to the probability of detection of therapeutic targets on imaging.

METHOD AND MATERIALS

A consecutive series of 7,007 patients were screened at two regional stroke centers over a ten-year period with 1,092 patients meeting criteria. Untreated patients with confirmed acute ischemic cerebrovascular syndrome with an evaluable MRI obtained within 24 hours from last known well and a NIHSS > 3 or in patients treated with an acute intervention with an MRI obtained prior to any intervention were included. Potential therapeutic targets were identified on MRI including vascular occlusion on MRA (ARTERY), ICA or M1 occlusion (ENDOVASCULAR), M1 or M2 occlusion (MCAO), hypoperfusion on perfusion MRI (PERFUSION), and perfusion-diffusion mismatch (MISMATCH). Logistic regression models defined the probability of each therapeutic target related to time from onset.

RESULTS

The probability of detection of therapeutic targets: ARTERY and ENDOVASCULAR ($p < 0.01$), MCAO, PERFUSION, MISMATCH ($p < 0.001$), decreased over time. Higher admit NIHSS increased the probability of target detection by approximately 5% per NIHSS point. At 24 hours from onset, 20% of patients still had a therapeutic target. At 24-hours, MISMATCH was observed in 76% of patients with MCA occlusion and ENDOVASCULAR in 77%. At least one therapeutic target was identified in 78.7% of patients prior to 4.5 hours, 79.2% up to 6 hours and 71.7% from 6 to 24 hours. In a multiple logistic regression model the probability of detection of MISMATCH was best fit by time from onset, NIHSS, MCAO, and the interaction of NIHSS MCAO.

CONCLUSION

Imaging therapeutic targets were found in a substantial proportion of patients (67%) beyond proven time windows for thrombolysis or endovascular therapy, and this proportion can be estimated by a logistic regression model based on time from onset and NIHSS thresholds. These results support the rationale for reperfusion trials beyond proven time windows.

CLINICAL RELEVANCE/APPLICATION

Treatment for acute stroke is limited to patients presenting within a specific time window. We found 38% of patients maintain a therapeutic target well past the times specified in current guidelines.

RC305-09 Patient Outcomes After Endovascular Vasospasm Treatment of Delayed Cerebral Ischemia Following Aneurysmal Subarachnoid Hemorrhage: A 10-Year Experience at a Neurovascular Referral Center

Tuesday, Nov. 28 11:00AM - 11:10AM Room: N228

Awards
Student Travel Stipend Award

Participants
Vivek P. Patel, MD,PhD, Stanford, CA (*Presenter*) Nothing to Disclose
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PURPOSE

Cerebral arterial vasospasm and delayed cerebral ischemia (DCI) following aneurysmal subarachnoid hemorrhage (aSAH) accounts for up to 50% of the morbidity and mortality in these patients. Endovascular vasospasm treatment in patients with DCI with intra-arterial (IA) vasodilator infusion or cerebral angioplasty is often performed to increase cerebral perfusion, although the effectiveness of these treatments has not been conclusively demonstrated. We determined patient outcomes and mortality following endovascular treatment of vasospasm and DCI over a 10-year period at our neurovascular referral center.

METHOD AND MATERIALS

We performed a retrospective cohort study of all patients who underwent endovascular vasospasm treatment following aSAH from 2006 to 2016. Primary outcome was good clinical outcome at 3-6 months (modified Rankin Scale [mRS] of <= 2). Secondary outcomes were mortality at discharge and at 3-6 months.

RESULTS

175 patients who developed DCI (121 female, 54 males; p=0.0001) with a mean age of 51 years, mean Hunt and Hess Scale score 3, and mean Fisher Grade 3 were included. The ruptured aneurysm was treated by endovascular coiling in 86 patients (49%) and surgical clipping in 89 patients (51%). Endovascular treatment for angiographic vasospasm in the context of DCI consisted of IA nicardipine infusion in 103 patients (59%) or a combination of IA nicardipine and balloon angioplasty in 72 patients (41%). 91 (58%) and 109 (69%) patients had follow-up at 3-6 months for the mRS and mortality data, respectively. 65 patients (71%) had a mRS <= 2 at 3-6 months. 18 patients (10%) died before discharge, and one additional patient (1%) died at 6 months.

CONCLUSION

Endovascular vasospasm treatment of DCI results in a good clinical outcome at 3-6 months and low mortality rates.

CLINICAL RELEVANCE/APPLICATION

Endovascular vasospasm treatment may reduce morbidity and mortality following aSAH. Additional studies are needed to define the most optimal endovascular management of DCI.

RC305-10 Virtual Non-Contrast Images Enable Better Delineation of Acute Infarction After Mechanical Thrombectomy Compared to Conventional Images Using a Dual-Layer Detector Spectral CT

Tuesday, Nov. 28 11:10AM - 11:20AM Room: N228

Participants
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PURPOSE

To evaluate the potential of the dual-layer detector spectral CT for the detection of acute ischemic lesions in the brain after mechanical thrombectomy by comparing virtual non-contrast with conventional images.

METHOD AND MATERIALS

Unenhanced head spectral-CT was performed in twenty-five patients 13 +/- 6 h after mechanical thrombectomy using a dual-layer detector spectral CT (IQon spectral CT, Philips Healthcare, USA). Virtual non-contrast (VNC) and conventional (CO) images were reconstructed using a dedicated software. As gold standard, Magnetic Resonance Imaging (MRI), acquired during the follow-up procedure (2 +/-2 d), was utilized. Region of interest (ROI) analysis was performed in the center of the acute infarction and the corresponding contralateral healty tissue and contrast-to-noise ratio (CNR) was calculated. The volume of the ischemic area was measured in VNC, CO and MRI in a random order.

RESULTS

Developing ischemic lesions appear more hypodense in VNC compared to CO (18.2 +/- 3.6 HU versus 26.5 +/- 4.4 HU). CNR is significantly higher in VNC compared to CO (3.1 +/- 1.5 versus 1.1 +/- 1.1, $p < 0.0005$). The mean ischemic lesion volume was higher in VNC compared to CO (27 +/- 51 cm^3 versus 21 +/- 49 cm^3, 72% versus 55% of the infarct colume measured in MRI; $p < 0.05$).

CONCLUSION

Developing ischemic lesions appear more hypodense in VNC compared to CO with significantly higher CNR and better delineation of infarct volume.

CLINICAL RELEVANCE/APPLICATION

Dual-layer detector spectral CT improves diagnostic image quality for the detection of developing ischemic lesions after mechanical thrombectomy compared to conventional CT.

RC305-11 Can Dual-Energy CT of the Brain Performed After Mechanical Thrombectomy for Acute Ischemic Stroke Predict Hemorrhagic Complications?

Tuesday, Nov. 28 11:20AM - 11:30AM Room: N228

Participants
Matteo Bonatti, MD, Bolzano, Italy (*Presenter*) Nothing to Disclose
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PURPOSE

To assess the capability of Dual-Energy CT (DECT) of the brain performed immediately after mechanical thrombectomy to predict immediate and belated hemorrhagic complications.

METHOD AND MATERIALS

IRB-approved retrospective study, need for informed consent was waived. We included 85 consecutive patients who underwent brain DECT immediately after mechanical thrombectomy for acute ischemic stroke between August 2013 and January 2017. Two radiologists independently evaluated DECT images for the presence of parenchymal hyperdensity, iodine extravasation and hemorrhage. Maximum iodine concentration was measured using commercially available software. Follow-up CT examinations performed until patients' discharge were reviewed for intracranial hemorrhage (ICH) presence. Correlation between DECT parameters and ICH development was analyzed by Mann-Whitney U test and Fisher exact test. ROC curves were generated for continuous variables.

RESULTS

Fourteen out of 85 patients (16.5%) developed ICH (7/14 within 24 hours and 7/14 during the following days). On post-operative DECT, parenchymal hyperdensities and iodine extravasation were present in 100% of the patients who developed ICH and in 56.3% of the patients who did not (P=0.002); signs of bleeding were present in 35.7% of the patients who later developed ICH and in 0% of the patients who did not (P<0.001). Median maximum iodine concentration was 2.6 mg/ml in the patients who developed ICH and 1.4mg/ml in the patients who did not (P<0.001). Maximum iodine concentration showed an AUC of 0.89 for identifying patients developing ICH.

CONCLUSION

Presence of parenchymal hyperdensity with maximum iodine concentration >1.35mg/ml identifies patients developing ICH with 100% sensitivity and 67.6% specificity.

CLINICAL RELEVANCE/APPLICATION

The identification of patients with high hemorrhagic risk after mechanical thrombectomy enables to better tailor their medical treatment in order to minimize bleedings and to improve their outcome.

RC30512 What's in Store for Stroke in the Next 10 Years?

Tuesday, Nov. 28 11:30AM - 12:00PM Room: N228

Participants
Colin P. Derdeyn, MD, Saint Louis, MO (*Presenter*) Stock options, Pulse Therapeutics, Inc; ;

LEARNING OBJECTIVES

1) Recognize the importance of multidisciplinary performance improvement efforts in driving key metrics for stroke care. 2) Identify the major emerging new stroke diagnosis and treatment tools and approaches. 3) Recognize the driving force for all these efforts is to acheive revascularization as fast as possible.

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RC307

Chronic Pelvic Pain: Added Value of MRI in Endometriosis, Fibroids, and Pelvic Floor Relaxation

Tuesday, Nov. 28 8:30AM - 10:00AM Room: E450B

GU MR

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

Participants

Susan M. Ascher, MD, Washington, DC (*Coordinator*) Nothing to Disclose
Susan M. Ascher, MD, Washington, DC (*Moderator*) Nothing to Disclose
Elizabeth A. Sadowski, MD, Madison, WI (*Presenter*) Nothing to Disclose
Yuliya Lakhman, MD, New York, NY (*Presenter*) Nothing to Disclose
Gaurav Khatri, MD, Dallas, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Improve knowledge of the economic and psychosocial impact of chronic pelvic pain. 2) Review the indications and MRI imaging protocols for endometriosis. 3) Recognize the MRI appearance of endometriosis. 4) Review the epidemiology and clinical presentations of leiomyomas. 5) Review current treatment options for symptomatic leiomyomas. 6) Recognize the MRI appearance of leiomyomas to include differentiating them from other myometrial masses. 7) Review common surgical interventions for stress urinary incontinence and pelvic organ prolapse. 8) Describe the MRI technique for imaging synthetic material in the pelvic floor. 9) Recognize normal and abnormal MRI appearances of synthetic materials used in pelvic floor dysfunction. *New in 2017: PLEASE NOTE* - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

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RC313

Pediatric Series: Chest/Cardiovascular Imaging

Tuesday, Nov. 28 8:30AM - 12:00PM Room: N226

CA CH MR PD VA

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

FDA Discussions may include off-label uses.

Participants
Robert J. Fleck JR, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose
Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Moderator*) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;
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Sub-Events

RC313-01 Imaging of Obstructive Sleep Apnea

Tuesday, Nov. 28 8:30AM - 8:50AM Room: N226

Participants
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Active Handout:Robert Joseph Fleck

http://abstract.rsna.org/uploads/2017/17000774/Active RC313-01.pdf

LEARNING OBJECTIVES

1) Describe the rational and usefulness that underlies cine MR imaging prior to surgery for obstructive sleep apnea. 2) Explain the anesthesia procedures for obtaining a safe, useful and accurate MRI during drug-induced sleep. 3) Construct an imaging protocol for your scanner. 4) Describe the typical findings of a study. 5) Synthesize the information from imaging into a report that will be helpful to the surgeon.

ABSTRACT

Obstructive sleep apnea (OSA) occurs in approximately 3% of the pediatric population and is usualy very treatable with tonsil and adenoidectomy. However, up to 25% of subjects may not be cured by this common, first line treatment. This is especially true in obese children and children with syndromes, especially Down syndrome. In patient with continued positive symptom review, polysomnography is indicated to confirm continued presence of OSA. Continuous positive airway pressure is the next step in treatment, but compliance is poor in some patient despite persistent attempts to help the patient adapt. Causes of continue airway obstruction during sleep include glossoptosis or hypopharygeal collapse from poor activation of the dilator muscles, recurrent adenoids, enlarged lingual tonsils and relative macroglossia. These can be addressed by removal of excess tonsil tissue, tongue reduction surgery, tongue suspension, or expansion pharyngoplasty. MR imaging can be critical to guide surgical planning.

RC313-02 Quantitative Characterization of Bronchopulmonary Dysplasia Severity Using Neonatal Pulmonary MRI and Correlation to Short-Term Outcomes

Tuesday, Nov. 28 8:50AM - 9:00AM Room: N226

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Bronchopulmonary dysplasia (BPD) is a serious pulmonary condition associated with premature birth, but the underlying parenchymal disease is poorly characterized, with unclear links between initial NICHD consensus severity diagnosis and clinical outcomes. This work relates MRI-based radiological scoring of structural parenchymal abnormalities in neonates to NICHD severity and short-term clinical outcomes, and demonstrates preliminary quantitative characterization of BPD severity via parenchymal intensity distributions.

METHOD AND MATERIALS

With IRB approval, 22 quiet-breathing neonates (11 severe BPD, 4 moderate, 4 mild, 3 non-BPD control; 27±3 wk birth PMA) underwent structural pulmonary MRI (ultrashort echo-time, UTE, TE~0.2ms; gradient echo, TE~2ms) in a NICU-sited, neonatal-sized 1.5T scanner, with no procedurally-ordered sedation. MRI-based BPD severity was scored by one radiologist with a modified Ochiai system (7 categories, range 0-14). Scores were compared to NICHD severity and short-term outcomes. Separately, whole-lung segmentations from UTE images for a cohort subset (5 severe; 2 moderate; 4 mild) and 1 additional term control yielded normalized lung intensity distributions, a measurement akin to volumetric density (range 0-1 g/cm3).

RESULTS

MRI scores correlate significantly with NICHD severity ($P<0.0001$, $R2=0.71$), respiratory support at discharge (room air, oxygen, ventilator, death; $P<0.0001$, $R2=0.84$), and length of hospital stay (slope=0.06[score]/day, $P<0.0001$, $R2=0.60$). Qualitatively, lung intensity distributions for controls demonstrated a homogenous peak at ~0.5 g/cm3 (expected in healthy newborns), with this peak broadening toward increased density with severity through moderate BPD (representative subjects shown in Figure); severe BPD subjects exhibited prominent low- and high-density regions, particularly for deceased subjects.

CONCLUSION

Pulmonary neonatal MRI can assess structural determinants of BPD without sedation or ionizing radiation, with predictive measurements for severity and short-term outcomes. Importantly, structural and regional quantification from MRI yields the ability to phenotype BPD, with the potential to personalize clinical care via serial evaluation.

CLINICAL RELEVANCE/APPLICATION

Pulmonary neonatal MRI can classify underlying features in infants with bronchopulmonary dysplasia and may provide image-based disease phenotyping with relationship to short-term outcomes.

RC313-03 Evaluation of Tracheobronchial Tree Using Three-dimensional Turbo Field Echo Magnetic Resonance Imaging Sequence

Tuesday, Nov. 28 9:00AM - 9:10AM Room: N226

Participants
Qiaoru Hou, MD, Shanghai, China (*Presenter*) Nothing to Disclose
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PURPOSE

Tracheobronchial anomalies including tracheobronchial stenosis, tracheal bronchus, cardiac bronchus, and bronchial isomerism are common in congenital heart disease(CHD). It is necessary to assess tracheobronchial tree and make a preoperative airway evaluation.Our study intend to evaluate tracheobronchial tree using Three-dimensional Turbo Field Echo(3D-TFE) Magnetic Resonance Imaging Sequence

METHOD AND MATERIALS

Institutional Review Board exemption was obtained. Sixty-two consecutive children (32 males; mean age: 30 months, age range: 2-141 months) were enrolled from September 2016 to December 2016, who were diagnosed congenital heart disease by echocardiography.MR was performed to provide preoperative information about anatomy or/and function evaluation. 3D-TFE and 3D-B-TFE as well as CE-MRA sequences were performed to evaluate tracheobronchial anatomy. Image quality was objectively evaluated including contrast-to-noise ratio (CNR), signal intensity and tracheal-bronchial sharpness measurements. Two independent observers subjectively evaluated image quality and image noise using a 5-point scale.

RESULTS

The CNR and signal intensity of 3D-TFE(26.62±5.72, 539.92±54.17)in trachea was higher than that of 3D-B-TFE(9.39±3.09, 131.81±22.73) and CE-MRA(6.11±2.58, 63.30±11.85) (both $P<0.005$). The image quality scores of 3D-TFE(4.65±0.19) in tracheal-bronchial tree were also higher than those on 3D-B-TFE(3.83±0.20) and CE-MRA(2.64±0.31) ($P<0.005$). Tracheal-bronchial sharpness delineation of 3D-TFE was better than that of 3D-B-TFE and CE-MRA , and had significant difference.

CONCLUSION

3D-TFE had significantly higher CNR, signal intensity and image quality scores than 3D-B-TFE and CE-MRA. 3D-TFE can supply helpful information for preoperative strategies and postoperative follow-up.

CLINICAL RELEVANCE/APPLICATION

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RC313-04 Differing Pulmonary Structural Abnormalities Detected on MRI in Cystic Fibrosis Patients with Varying Pancreatic Function

Tuesday, Nov. 28 9:10AM - 9:20AM Room: N226

Participants
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Michael Esser, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
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Juergen F. Schaefer, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Cystic fibrosis (CF) patients with sufficient pancreatic function (PS) are known to exhibit milder lung disease compared to CF patients known to have insufficient pancreatic function (PI). We aimed to evaluate and correlate differences in the severity, type and distribution of pulmonary manifestations in CF patients with differing pancreatic status using standardized pulmonary magnetic resonance imaging (MRI).

METHOD AND MATERIALS

Twenty patients of our CF database were selected, ten with PS (mean age 11.8 years; six male; BMI 17.04 kg/m2; FeV1 102%), that were matched by gender, age and similar lung function with ten PI patients. We evaluated changes in each individual lung lobe on MRI. Experienced observers semi-quantitatively assessed whether bronchiectasis, mucus plugging, centrilobular opacity, consolidation, sacculation, and air trapping were present using an established 'MRI-CF-Score'. The severity and distribution of pulmonary disease were compared using nonparametric Kruskal-Wallis tests.

RESULTS

Patients with CF-PS had overall significantly lower MRI-CF scores (with 7.5; p=0.024), and therefore milder lung disease, compared to CF-PI. The differences were most significant in scores for bronchiectasis (p=0.0047) and air trapping (p=0.0336). In general the upper lobes were more affected, however there was a significant difference in PS and PI patients for both upper and lower lobes (p=0.0273 and 0.0217) and no predominant area for lung manifestation in PS patients.

CONCLUSION

Pulmonary MRI can depict significant differences in pathologic lung manifestations in patients with CF-PS compared to CF-PI. In PI the severity was higher, especially with respect to bronchiectasis and air trapping.

CLINICAL RELEVANCE/APPLICATION

Pulmonary MRI can identify differences in pathologic lung manifestation in cystic fibrosis patients with varying pancreatic function.

RC313-05 What Can the Single Axial Rotation with 16cm Wide-Detector Bring in Imaging Infant Lungs? Comparison between 256-Raw CT and 64-Raw CT

Tuesday, Nov. 28 9:20AM - 9:30AM Room: N226

Participants
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Jianying Li, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company

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PURPOSE

To explore the clinical value of using a single axial rotation with 16cm wide-detector CT in imaging infant lungs.

METHOD AND MATERIALS

Prospectively enrolled 32 infants (Group 1) for non-enhanced chest CT without sedation using a single axial rotation of 0.35s on a 16cm wide-detector Revolution CT scanner. Patients were scanned with automatic tube current modulation (ATCM) and tube voltages of 80kVp for patients <5 kg and 100 kVp for patients >5 kg to achieve a noise index (NI) of 8.5 HU. The subjective image quality was evaluated by 2 radiologists using a 3 point scoring system with scores equal or greater than 2 being clinically acceptable. Patient preparation time, radiation dose and the quantitative and qualitative image quality were compared with those of 30 infants in Group 2 who underwent a conventional helical scan with sedation using a 64-row VCT with 60 mAs tube current and 120 kVp tube voltage.

RESULTS

There was no statistical difference in body weight and age between the two groups. There was no significant difference between Group 1 and Group 2 in the mean CT value (41.00±11.49HU vs. 39.60±9.95HU), noise (12.40±4.67HU vs. 11.55±2.98HU) and signal-

to-noise ratio (3.70±1.60 vs. 3.64±1.24) in the descending aorta and average subjective image quality score (2.80±0.35 vs. 2.81±0.24) (all p>0.05). While no sedation was used in Group 1, 14 of the 30 (46.7%) patients in Group 2 required sedation. Compared with the conventional group (Group 2), Group 1 significantly reduced the scan time by 82.6% (0.35s vs. 2.01±0.21s), preparation time by 57.4% (41.25±103.78min vs. 96.5±151.77min), and effective radiation dose by 53.7% (0.81±0.28mSv vs. 1.75±0.49mSv) (P<0.05).

CONCLUSION

The use of axial CT mode in a single rotation for imaging infant lung without sedation on a 16cm wide-detector CT scanner provides same image quality as the conventional helical CT with sedation while effectively reduces radiation dose, patient preparation time to optimize scanning procedures, avoids the complications as well as potential risks of sedation.

CLINICAL RELEVANCE/APPLICATION

The single rotation, axial CT with 16cm wide-detector can be used in imaging infant chest to avoid sedation, optimize scanning procedures and provide good image quality with reduced radiation dose.

RC313-06 Towards Endotracheal Tube Sizing By Measurement on Neonatal Radiographs

Tuesday, Nov. 28 9:30AM - 9:40AM Room: N226

Participants
William F. Sensakovic, PhD, Orlando, FL (*Presenter*) Speaker, Bayer AG; Grant, Mazor Robotics Ltd
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Laura J. Varich, MD, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose
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Gregory A. Logsdon, MD, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose
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William Oh, MD, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine if radiographic measurements are accurate and repeatable enough to be used for sizing endotracheal tubes (ETTs) in the neonatal population. Further, to determine if image processing can improve measurement.

METHOD AND MATERIALS

Database: Radiographs were acquired for two phantoms. Phantom 1: Gammex 610 neonatal chest (trachea diameter: 4.57mm). Phantom 2: Solid water block with 10 air-filled tubes ranging 1.57mm to 9.13mm diameter. Phantoms were scanned with our standard clinical chest protocol. Patient data consisted of 12 chest and/or neck radiographs of children (<3months) acquired with our standard clinical protocol. A second set of radiographs was created by applying local normalization image processing to the original unenhanced images. Three observers independently measured the trachea in all images using digital calipers. Measurement accuracy, precision, and linearity with trachea size were assessed using phantom images with known trachea size. Precision was further measured on clinical images. Observers made 3 measurements for each patient image, above the carina, mid-trachea, and upper shoulder/neck, to assess the impact of measurement position on trachea diameter. ETTs are sized in 0.5mm increments, thus radiographic sizing was considered acceptable if mean absolute differences (MADs) were less than 0.5mm and ideal if 95% CI <0.5mm.

RESULTS

Phantom Data: MAD between measurement and true diameter was 0.2mm (95%CI [0.15,0.25]) for both phantoms. Measurements were linear over the investigated range with regression between true and measured values of Y = 1.02X (r2=0.99). Local normalization did not produce significant measurement differences (p=0.4). Patient Data: MAD among observer measurements was 0.48mm (95%CI [0.40, 0.56]). Diameter significantly changed with position of measurement (p<0.05). Measurements near the carina were 0.5mm larger than neck/upper shoulder measurements. Mid-trachea measurements were 0.3mm smaller than neck/upper shoulder measurements.

CONCLUSION

Radiographic trachea measurement has acceptable accuracy and precision for clinical use. Measurement position must be standardized since position substantially alters measured diameter. Local normalization did not improve measurement, but future work should investigate other enhancement methods.

CLINICAL RELEVANCE/APPLICATION

Radiographic measurement is suitable for determining trachea diameter for ETT sizing in neonates.

RC313-07 Ferumoxytol for Pediatric Vascular Imaging

Tuesday, Nov. 28 9:40AM - 10:00AM Room: N226

Participants
Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Presenter*) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;

LEARNING OBJECTIVES

1) Know advantages of ferumoxytol for pediatric cardiovascular imaging. 2) Know risks of ferumoxytol. 3) Know method of ferumoxytol administration.

ABSTRACT

Ferumoxytol is an iron oxide nanoparticle approved by the FDA for iron replacement therapy in adults. This presentation will discuss

Ferumoxytol is an iron oxide nanoparticle approved by the FDA for iron-replacement therapy in adults. This presentation will discuss off-label use of ferumoxytol for pediatric cardiovascular MRI. The most significant advantages of feruomoxytol are high signal enhancement in the blood pool and long blood pool residence time. These advantages can enable very high resolution imaging with less anesthesia. However, ferumoxytol has risks of hypotension and anaphylaxis. Hence, a slow dilute administration under direct visualization of the patient in a setting optimized for resuscitation is recommended. Compelling applications include congenital heart disease, peripheral MRV including vascular malformations, and pre-surgical mapping.

RC313-08 Extracardiac Complications of Cavopulmonary Bypass

Tuesday, Nov. 28 10:20AM - 10:40AM Room: N226

Participants
Rajesh Krishnamurthy, MD, Columbus, OH (*Presenter*) Nothing to Disclose

Honored Educators

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RC313-09 Assessment of Daunorubicin-Induced Cardiotoxicity in Childhood Acute Leukemia by Cardiac Magnetic Resonance Tissue Tracking

Tuesday, Nov. 28 10:40AM - 10:50AM Room: N226

Participants
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PURPOSE

To evaluate the deformation and dysfunction in children with acute leukemia caused by daunorubicin-induced cardiotoxicity using cardiac magnetic resonance (CMR) imaging tissue tracking.

METHOD AND MATERIALS

Forty-three children with acute leukemia were prospectively enrolled in the study (19 males and 24 females; mean age, 6.5years; range, 1-12 years), the clinical dose of daunorubicin was 25mg/kg and cumulative dose were 175mg/kg. Prior to chemical therapy, the baseline characteristics of heart were collected, including the biochemistry index and the CMR data. At the end of first-stage daunorubicin-containing therapy (32th weeks), the above mentioned data were recollected and compared, respectively. The imaging data were analyzed including the left ventricular ejection fraction (LVEF), tissue-tracking parameters (radial, circumferential, longitudinal peak strain (PS) and peak displacement (PD)) using dedicated post-processing software (cmr42; version, 5.2.2; Circle Cardiovascular Imaging Inc.; Calgary; Canada).

RESULTS

The decreased LVEFs was found in the 32th weeks during therapy (66.89±4.03% vs. 49.74±3.27%, $P < 0.05$) when compared with the LV function before therapy. At 32 weeks after the first-stage therapy, there are 11 children (approximately 26%) with impaired LV function (EF <50%), and 32 patients (74%) with a preserved LV function (EF >=50%). The regional radial, circumferential, longitudinal PS and radial PD decreased significantly in the 32 patients before-therapy compared with the 32th weeks therapy ($p< 0.05$), and the results were similar to the 11 patients before-therapy and 32th weeks agents, and the strain were all lower in the impaired EF group than in the preserved group (all $p< 0.05$). Furthermore, the radial direction of PS was associated with the LVEF ($r = 0.349$); circumferential and longitudinal PS were positive correlates with troponin T ($r= -0.151$).

CONCLUSION

CMR can monitor the myocardial deformation and dysfunction for early detection myocardial daunorubicin-induced cardiotoxicity in children with acute leukemia. Further follow-up of our subjects in children patients is underway.

CLINICAL RELEVANCE/APPLICATION

CMR strain can monitor the myocardial biomechanics in children daunorubicin-induced cardiotoxicity and is recommended as part of a MR study prior to left ventricle function.

RC313-10 Automatic Quantification of Left Ventricular Noncompaction using Fractal Analysis and Perimetric Ratio in Pediatric Population

Tuesday, Nov. 28 10:50AM - 11:00AM Room: N226

Participants
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PURPOSE

Left ventricular noncompaction (LVNC) is being diagnosed more frequently due to robust imaging techniques such as cardiac MR.

The purpose of this study is to quantify left ventricular noncompaction (LVNC) by fractal analysis and perimetric ratio using a novel automated analysis tool in a pediatric population.

METHOD AND MATERIALS

Short-axis stack of end-diastolic balanced SSFP images from 22 (age 14±4.7, range 2-21yrs) LVNC positive and 20 (age 15±10.5, range 5-46yrs) LVNC negative patients were analyzed retrospectively using a novel automated tool; only user interaction required was to select the most basal and apical slices to be included in the analysis. Geometric constraint based automatically tracked and cropped LV images were thresholded using an Otsu algorithm to obtain edges delineating papillary and trabeculae muscles. Fractal dimensions (FD) were computed on the edge images using the box counting method for all slices. A piecewise closed Bézier curve of 2nd order geometric continuity was fitted through the salient points of the convex hull of edges to delineate the endocardial contours (Fig 1). The ratio of blood pool to endocardial contour perimeter (PR) is computed for each slice and also as a cumulative value for all slices (cPR). Mean (mFD,mPR) and mean+std.dev (msFD,msPR) of the FD and PR were used as LVNC indices along with cPR.

RESULTS

Total computation time per subject was 7+/2 sec. All three indices, were significantly lower ($p<0.001$) in LVNC+ (mFD: 1.40±0.02, mPR:1.34±0.06, cPR: 1.37±0.07) than in LVNC- (mFD:1.47±0.04 , mPR:1.90±0.30, cPR: 1.93±0.30) patients. One to one line plot and Box plots for msFD, msPR and cPR indices is depicted in Fig 2. Correlation coefficients between msFD and msPR/cPR for LVNC- (2.27/0.86) and LVNC+(6.87/6) indicate enhanced dynamic range of msPR & cPR. Distribution of mFD-mPR for LVNC-/+ over the long-axis was: basal(1.4/1.42-1.3/1.7), mid (1.4/1.5-1.5/2.2), apical(1.3/1.5-1.1/1.7).

CONCLUSION

In this study, we described a novel automatic tool as well as a novel index to quantify LV trabecular complexity and irregularity. Both fractal analysis and perimetric ratio indices distinguish LVNC patients from negative controls, while the perimetric ratio provides a six times higher dynamic range.

CLINICAL RELEVANCE/APPLICATION

This novel tool can be used in an automated fashion to provide two quantitative indices that successfully distinguish between LVNC patients and negative controls.

RC313-11 Diagnostic Accuracy of Non-Contrast, Self-Navigated, Free-Breathing Coronary MR Angiography in Children with Coronary Anomalies: Prospective Comparison with Coronary CT Angiography

Tuesday, Nov. 28 11:00AM - 11:10AM Room: N226

Participants
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PURPOSE

To evaluate the diagnostic accuracy of a non-contrast, free-breathing, self-navigated 3D (SN3D) coronary MR angiography (cMRA) technique for the evaluation of coronary artery (CA) anatomy in children with known or suspected coronary abnormalities, using coronary CT angiography (cCTA) as the reference standard.

METHOD AND MATERIALS

We prospectively enrolled 21 pediatric patients (15 male, 12.3±2.6 years) in this IRB-approved, HIPAA-compliant study. Patients underwent same-day unenhanced SN3D cMRA and contrast-enhanced cCTA. Two radiologists scored the depiction of CA segments and reader confidence using a 3-point scale: 1=insufficient, 2=moderate, and 3=excellent. Readers assessed CAs for anomalies, high CA origin, and both inter-arterial and intra-mural CA course. Sensitivity, specificity, positive and negative predictive values (PPV, NPV) were calculated to evaluate diagnostic accuracy. Inter-observer agreement was assessed using Intra-class Correlation Coefficients (ICC).

RESULTS

Fourteen children showed CA anomalies or pathologies on cCTA images. Depiction of CA segments was scored higher for cCTA compared to cMRA ($P<0.015$), except regarding the left main CA ($P=0.301$), with good (ICC=0.62) to excellent (ICC=0.94) inter-observer agreement. Diagnostic confidence was higher for cCTA evaluation ($P=0.046$). Sensitivity, specificity, PPV and NPV of cMRA were 92%, 92%, 96% and 87% for the detection of CA anomalies, 85%, 85%, 74% and 92% for high CA origin, 71%, 92%, 82% and 87% for inter-arterial course, and 41%, 96%, 87% and 80% for intra-mural course.

CONCLUSION

SN3D cMRA is highly accurate for the detection of CA anomalies and inter-arterial course in children without radiation exposure

SN3D cMRA is highly accurate for the detection of CA anomalies and inter-arterial course in children without radiation exposure, contrast administration, or need for breathing commands. Diagnostic confidence and CA visualization, however, are still inferior in comparison with cCTA.

CLINICAL RELEVANCE/APPLICATION

SN3D cMRA can be used instead of cCTA in pediatric patients with suspected CA anomalies in order to avoid both ionizing radiation and contrast media administration. This cMRA technique is feasible, allows for excellent diagnostic accuracy and is especially useful for the evaluation of the proximal CA course.

RC313-12 Global Strain Analysis Using Cardiovascular Magnetic Resonance Feature Tracking to Predict Deterioration of Ventricular Function in Patients with Repaired Fontan at Follow Up: A Feasibility Study

Tuesday, Nov. 28 11:10AM - 11:20AM Room: N226

Participants
Li Wei Hu, BEng, Shanghai, China (*Presenter*) Nothing to Disclose
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PURPOSE

Ventricular dysfunction is common complication in young survivors with the Fontan circulation and has been identified as a risk factor for mortality. We hypothesized that the global ventricular strain would predict deterioration of ventricular function in patients with repaired Fontan.

METHOD AND MATERIALS

27 patients who haven't had interventional surgical or catheter procedures in 6 months after Fontan procedures were enlisted. CMR imaging was conducted on a 1.5 Tesla scanner (Achiva, Philips, the Netherlands) using a 8-channel phased-array cardiac coil. Global longitudinal(GLS), global radial(GRS) and global circumferential(GCS) strains of the left or dominant ventricle were measured using a CMR-Feature Tracking(FT) software(Circle Cardiovascular Imaging, Calgary, Canada). To compare ejection fraction and follow-up duration using Pearson's correlation and Paired sampled test (two tailed) on GraphPad Prism. We constructed ROC curved analysis to assess the independent effect of CMR-FT on subsequent risks of ventricular dysfunction. Bland-Altman method using MedCalc (Mariakerke, Belgium) to identify possible bias and the limits of agreement of the global strain between two observers.

RESULTS

The mean age of 27 patients was 9.6 ± 2.92 years,60% maleThe mean follow-up duration between the time of surgery and previous CMR scanning was 5.1 ± 1.9 years. Of the 27 patients, clinical diagnosis of suspected patients was cardiac dysfunction in 14 cases (NT-proBNP>125pg/ml).The correlations between follow-up duration and LVEF measured using the conventional method were negative weak but still significant($r=-0.45$, $p<0.05$). GCS(AUC=0.82) and GLS(AUC=0.78) were the best predict subsequent risks of ventricular dysfunction in 27 cases($p<0.05$,respectively).Bland Altman analysis of global strain inter-observer reproducibility yielded a better agreement (bias -0.08 and 95% CI -0.25 to 0.07 for GLS,bias -0.15 and 95% CI -0.28 to 0.02 for GCS, bias 0.28 and 95% CI -0.19 to 0.75 for GRS).

CONCLUSION

Feature Tracking strain analysis is clinically feasible and accessible tool for ventricular chamber quantification. GCS and GLS provides strengthen prognostic Information compared to conventional EF for predicting deterioration of ventricular function.

CLINICAL RELEVANCE/APPLICATION

CMR global strain analysis has the potential to detect myocardial motion using cardiovascular magnetic resonance. It is a new tool in following up patients after Fontan operation.

RC313-13 Assessing the Precision and Reproducibility of Novel MRI Sequence in Pediatric Congenital Heart Disease with Cardiac Volumetry and Function

Tuesday, Nov. 28 11:20AM - 11:30AM Room: N226

Awards
Student Travel Stipend Award

Participants
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PURPOSE

We have developed a novel 4D, multiphase, steady state imaging with contrast enhancement (MUSIC) MR sequence for pediatric congenital head disease (CHD) imaging that captures both detailed anatomy and 3D cardiac function in a single scan. It is hypothesized that with its higher resolution and phase-resolved 3D data, 4D MUSIC will allow for highly precise and reproducible measurements of ventricular volumetry and function.

METHOD AND MATERIALS

50 children with CHD (ages 2 days to 18 years, 25 females) who underwent MRI at 3.0T with 4D MUSIC sequence between 2013-2017 were included in the study. DICOM data were analyzed for cardiac volume and function with a 2D image processing software (Medis QMass) after reformatting into short-axis images as well as with a 3D image processing software (Materialise Mimics). The trabeculae, papillary muscles, and right ventricular outflow tracts were purposely excluded from the blood pool. 10 randomly selected patients were repeated for intrarater reliability and measured by a second observer for interrater reliability. Five sets of measurements (2D versus 3D software, intrarater for 2D and 3D, interrater for 2D and 3D) were compared for statistical differences using Wilcoxon signed-rank test, intraclass correlation coefficients, and Bland-Altman plots.

RESULTS

There was a high degree of reliability between measurements made on the 2D and 3D softwares. The intraclass correlation coefficient (ICC) between the two methods was 0.997 for LV (left ventricular) EDV (end-diastolic volume), 0.997 for LV ESV (end-systolic volume), 0.961 for LV EF% (ejection fraction), 0.998 for RV (right ventricular) EDV, 0.999 for RV ESV, 0.941 for RV EF%, and 0.996 all variables. The intrarater reliability for the 2D and 3D softwares were 0.985 and 0.998, respectively; similarly, the interrater reliability were 0.997 and 0.998, respectively.

CONCLUSION

This study demonstrates the clinical utility of 4D MUSIC as a MR sequence with both high precision and reproducibility across different image processing softwares and different readers. Both intrarater and interrater reliability were higher with the 3D software than with the 2D. 4D MUSIC has the potential to become the new standard of care in pediatric CHD diagnosis and surveillance.

CLINICAL RELEVANCE/APPLICATION

Novel MR sequence enables precise and reproducible cardiac volumetry and function measurements and is recommended for imaging pediatric congenital heart disease.

RC313-14 Low-Dose Dual-Source Computed Tomography for Evaluating Right Ventricle and Pulmonary Artery in Infant Patients with Tetralogy Of Fallot: Correlation with Post-Operative Pulmonary Regurgitation

Tuesday, Nov. 28 11:30AM - 11:40AM Room: N226

Participants
Yue Gao, Chengdu, China (*Presenter*) Nothing to Disclose
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PURPOSE

The aim of this study was to assess the influence of pre-operative right ventricle (RV) and pulmonary artery (PA) imaging characteristics by low-dose dual-source computed tomography (DSCT) on post-operative pulmonary regurgitation (PR).

METHOD AND MATERIALS

Fifty-five patients after tetralogy of Fallot (TOF) repair were recruited. The RV and PA parameters evaluated by pre-operative DSCT were compared between the PR and non-PR groups. Spearman's rank correlation was used to determine the correlations between the pre-operative parameters and PR. Receiver operating characteristic (ROC) analysis was used to predict the possibility of PR using individual effective parameters.

RESULTS

There were 20 patients in the PR group and 35 patients in the non-PR group. The pre-operative left PA (LPA) diameter, McGoon ratio, and Nakata index showed significant differences between the two groups (20.40 ± 6.13 mm/m2 vs. 16.41 ± 4.69 mm/m2, $p = 0.0025$; 2.18 ± 0.53 vs. 1.76 ± 0.49, $p = 0.005$; 399.95 ± 150.38 mm2/m2 vs. 275.50 ± 81.93 mm2/m2, $p < 0.0001$). The results showed a significant correlation between PR and LPA diameter, McGoon ratio and Nakata index ($r = 0.350$, 0.338, and 0.426, respectively; all $p < 0.05$). ROC analysis revealed that sensitivity and specificity were obtained for predicting the occurrence of PR with LPA (70.0%,77.1%), McGoon ratio (75.0%,57.1%) and Nakata index (50.0%,91.4%).

CONCLUSION

For TOF patients, the pre-operative LPA diameter and PA development indexes by DSCT are associated with post-operative PR. These pre-operative imaging characteristics can be new predictive factors for the occurrence of PR.

CLINICAL RELEVANCE/APPLICATION

Pre-operative right ventricle (RV) and pulmonary artery (PA) imaging characteristics on DSCT can be new predictive factors for the occurrence of post-operatively PR.

RC313-15 Lymphatic System in Congenital Heart Disease

Tuesday, Nov. 28 11:40AM - 12:00PM Room: N226

Participants
David M. Biko, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Improve knowledge of MR techniques to image the lymphatic system in pediatric congenital heart disease. 2) Understand the relationship between the complictions of surgical pallation of congenital heart disease and the lymphatic system. 3) Expand knowledge of lymphatic disorders and how they relate to congenital heart disease.

RSNA 2017 Explore. Invent. Transform.
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RC315

Breast Series: MRI Emerging Technology

Tuesday, Nov. 28 8:30AM - 12:00PM Room: Arie Crown Theater

BR MR

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

FDA Discussions may include off-label uses.

Participants
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Sub-Events

RC315-01 Screening Breast MRI

Tuesday, Nov. 28 8:30AM - 8:50AM Room: Arie Crown Theater

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

LEARNING OBJECTIVES

1) To analyze the data supporting the use of MRI for supplemental breast cancer screening. 2) To understand which sub-groups of women supplemental screening with MRI is currently recommended. 3) To become familiar with the potential future role of MRI for breast cancer screening.

RC315-02 Differential Performance of Screening Breast MRI in Varying Populations with Elevated Breast Cancer Risk

Tuesday, Nov. 28 8:50AM - 9:00AM Room: Arie Crown Theater

Participants
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Constance D. Lehman, MD, PhD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company

PURPOSE

Evaluate screening breast MRI performance across populations with varying indications for elevated breast cancer risk.

METHOD AND MATERIALS

This IRB approved, HIPAA compliant study reviewed all screening breast MRI exams performed from 2011-2014 at our academic medical center. Exam indication was extracted from the report and a primary indication determined for each study: BRCA mutation carrier (BRCA), history of mediastinal radiation (RAD), family history of breast cancer (FH), personal history of breast cancer (PH), and personal history of high-risk lesion (HRL). The final cohort included 5,301 exams in 2,709 patients. Cancer detection rate (CDR) and positive predictive value for biopsies performed (PPV) were compared using a X2 test.

RESULTS

The most common indication was PH (n=2917, 55%), followed by FH (n=1366, 26%), BRCA mutation (n=582, 11%), HRL (n=395, 7%), and RAD (n=41, 1%). Performance measures were compared across three groups: (1) BRCA or RAD, (2) FH, and (3) PH or HRL. There was a significant difference in CDR across the three groups (p=0.027) by X2 test with CDR highest in the BRCA/RAD group (22/1000), lowest in the FH group (8/1000), and moderate in the PH/HRL group (12/1000). Using logistic regression to control for age, mammographic density, and available prior breast MRI, there was no significant difference in CDR between the PH/HRL and BRCA/RAD groups (p=0.80), but the CDR was significantly lower in the FH group compared to the BRCA/RAD group (p=0.024). Presence of a prior MRI was significant in the logistic regression (p= 0.020), suggesting the difference in CDR between the PH/HRL and BRCA/RAD groups may be related to availability of a prior breast MRI. The PPV was highest in the PH/HRL group at 40% (95% CI: 30%-50%), followed by the BRCA/RAD group at 33% (95% CI: 20%-50%), and lowest in the FH group at 14% (95% CI: 8%-25%).

CONCLUSION

Screening breast MRI may be considered for women with a personal history of breast cancer or high-risk lesion, as performance is

similar to that in BRCA patients. Better risk assessment strategies are needed for patients with a family history of breast cancer to identify those most likely to benefit from breast MRI screening.

CLINICAL RELEVANCE/APPLICATION

The American Cancer Society supports MRI to screen BRCA carriers, but not for women with a history of breast cancer or high risk lesion. We found screening MRI performs equivalently for these groups.

RC315-03 Population-Based Assessment of the Effect of MRI Background Parenchymal Enhancement on Future Primary Breast Cancer Risk

Tuesday, Nov. 28 9:00AM - 9:10AM Room: Arie Crown Theater

Awards
Student Travel Stipend Award

Participants
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Karla Kerlikowske, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the effect of background parenchymal enhancement (BPE) on future risk of breast cancer among women undergoing breast MRI.

METHOD AND MATERIALS

In this IRB-approved and HIPAA-compliant prospective cohort study, data from five Breast Cancer Surveillance Consortium (BCSC) registries were collected on women who underwent breast MRI with qualitative BPE assessment between 2005-2014. Women were included if BPE was measured more than 3 months prior to their first diagnosis of invasive breast cancer or ductal carcinoma in situ (DCIS), using the baseline BPE assessment level. Cancer outcomes were ascertained through linkages with state or regional cancer registries and pathology databases. Breast cancer risk associated with BPE was estimated using a Cox proportional hazards model stratified by BCSC registry and adjusted for age and MRI indication (screening vs. diagnostic).

RESULTS

A total of 3,223 women were included, of whom 100 women developed cancer (71 invasive, 29 DCIS) during an average of 2.5 years of follow-up. Cases had a higher proportion of pre-menopausal women (41% versus 33%) and first-degree family history (59% vs. 51%). When using four ordinal categories of BPE with minimal BPE as reference, increasing levels of BPE were associated with significant or near significantly increasing cancer risk: mild BPE hazard ratio (HR) 1.66 (95% confidence interval (CI) 0.93, 2.96), moderate BPE HR of 2.23 (95% CI 1.25, 3.96) and marked BPE HR of 3.35 (95% CI 1.82, 6.16). When dichotomizing BPE using minimal BPE as reference, women with mild, moderate, or marked BPE had a significantly increased risk of cancer (HR 2.17, 95% CI 1.33, 3.55). Subgroup analysis using dichotomized BPE showed similar effects among women stratified by mammographically fatty/scattered fibroglandular breasts (HR 2.19, 95% CI 0.84, 5.70) and heterogeneous/extremely dense breasts (HR 1.93, 95% CI 0.99, 3.77). Dichotomized BPE significantly increased risk of invasive cancer (HR 2.44, 95% CI 1.35, 4.39), but associations with DCIS were weaker and not statistically significant (HR 1.61, 95% CI 0.66, 3.91).

CONCLUSION

BPE is a predictor of future breast cancer risk independent of breast density with stronger associations with invasive cancer than DCIS.

CLINICAL RELEVANCE/APPLICATION

BPE should be considered for incorporation into risk prediction models for high-risk women undergoing MRI.

RC315-04 Is the Amount of Fibroglandular Breast Tissue and Background Parenchymal Enhancement Risk Predictors for Breast Cancer Development and False Positive Results in a Breast MRI Screening Program?

Tuesday, Nov. 28 9:10AM - 9:20AM Room: Arie Crown Theater

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Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Director and Shareholder, ScreenPoint Medical BV; Shareholder, Volpara Health Technologies Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc;
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Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research agreement, Siemens AG; Research agreement, Seno Medical Instruments, Inc; Research agreement, Identification Solutions Inc; Research agreement, Micrima Limited; Scientific Advisor, ScreenPoint Medical BV

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[redacted]

PURPOSE

Breast density in mammography is associated with breast cancer risk in the average risk population. Recent publications use Background Parenchymal Enhancement (BPE) as a predictive tool for breast cancer on breast MRI. The purpose of this study is to investigate whether the amount of fibroglandular tissue (FGT), and BPE measured on baseline breast MRI are related to risk on breast cancer and false positive recalls in subsequent screening examinations.

METHOD AND MATERIALS

Baseline MRI scans of 1568 women participating in an intermediate and high risk screening program between 01/01/2003 and 01/01/2014 were selected. Automated tools based on deep learning were used to obtain quantitative values for FGT and BPE, that were dichotomised in low and high groups. Logistic regression using a forward selection method was used to investigate the relationships, adjusting for age and BRCA status.

RESULTS

Sixty-one cancers were detected in 4788 follow-up scans. 267 false-positive recalls occured with in total 206 false positive biopsies. FGT and BPE were not associated with breast cancer risk. Only BRCA status was significantly associated with breast cancer risk (p=0.001). High BPE and FGT were, however, associated with an increase in false positive recalls (OR: 1.303, p=0.020 and OR: 1.338, p=0.026, respectively) and high BPE increased the risk of false positive biopsy (OR: 1.540, p=0.003).

CONCLUSION

FGT and BPE, as measured on MRI baseline, are not associated to the risk of developing breast cancer in the future in this cohort of women at increased risk. High FGT and BPE at baseline are, however, associated with higher rates of false positive recall and biopsy.

CLINICAL RELEVANCE/APPLICATION

FGT and BPE cannot be used as an independent risk factors in models predicting breast cancer occurrence in high risk screening. Patient counseling should however include the higher risk of false positive outcomes in women with high FGT and BPE.

RC315-05 MRI Surveillance for Women with a Personal History of Breast Cancer: Comparison between Abbreviated and Full Diagnostic Protocol

Tuesday, Nov. 28 9:20AM - 9:30AM Room: Arie Crown Theater

Participants
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PURPOSE

To compare the diagnostic performance of breast magnetic resonance imaging (MRI) with Abbreviated Protocol (ABP) and Full diagnostic protocol (FDP) in women with a personal history of breast cancer.

METHOD AND MATERIALS

From September 2015, we started to obtain screening breast MRI in patients with a personal history of breast cancer using ABP. ABP consists of T2-weighted scanning and dynamic contrast enhanced imaging including one pre-contrast and two post-contrast scanning of gradient echo sequence at 80 and 160 seconds after contrast injection. Among the total 2918 screening breast MRIs using ABP, we selected 381 cases that were confirmed by histological diagnosis or by negative follow up images after one year. As a control group, we selected postoperative screening breast MRIs using FDP of recent 7 years before September 2015. We matched patients' age, interval between the cancer surgery and MRI examination, and stage of the operated breast cancer. Finally 311 matched cases from ABP and FDP groups were included. We analyzed diagnostic performance for detecting recurrent breast cancer including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy, and area under the curve (AUC) and compared the results between ABP and FDP.

RESULTS

The sensitivity and NPV were 100% in both ABP and FDP. Specificity, PPV, accuracy, and AUC of ABP and FDP were 95.7% vs 96.1%, 40.9% vs 14.3%, 95.8% vs 96.1%, and 97.9% vs 98.1%, respectively. Specificity, accuracy and AUC were FDP were slightly higher than ABP, but statistically not significant. PPV was significantly higher in ABP than FDP suggesting decreased number of false positive cases.

CONCLUSION

ABP showed comparable performance to the FDP in detecting recurrent breast cancer and decreased false positive cases.

CLINICAL RELEVANCE/APPLICATION

ABP can provide a better choice that has similar diagnostic performance and shorter MRI acquisition time in MRI surveillance for women with a personal history of breast cancer.

RC315-06 Does a T2-Weighted Sequence Add Accuracy to the Abbreviated Breast MR Examination?

Tuesday, Nov. 28 9:30AM - 9:40AM Room: Arie Crown Theater

Participants
Susan Weinstein, MD, Philadelphia, PA (*Presenter*) Consultant, iCAD, Inc
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Elizabeth S. McDonald, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Alice Chong, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Studies have shown is that dense breast tissue decreases the sensitivity of mammography. Women with dense breasts may opt to have supplemental screening. One such screening option is an abbreviated form of the MRI examination (AB-MR). The goal of the AB-MR exam is to efficiently deliver a supplemental screening study with high sensitivity and specificity, however retrospective, reader studies evaluating the AB-MR protocols have included T2-weighted sequences in addition to the pre-and post contrast sequences, with the T2-weighted sequence taking the longest acquisition time. The added value of T2-weighted sequence should be weighed against the time needed to obtain the sequence. In this prospective study, we evaluate what, if any, additional information was gained from by a T2-weighted sequence in the interpretation of clinical, prospectively acquired, AB-MR examinations.

METHOD AND MATERIALS

An IRB approved and HIPAA compliant prospective study was performed of women with heterogeneous or extremely dense breast tissue and recent negative mammograms who underwent supplemental screening with AB-MR . The study was initially interpreted utilizing only the pre-and post contrast injection sequences. The examination was then re-interpreted after review of the T2-weighted sequence. Radiologists reported any change in final assessment and recommendation in the interpretation after the addition of the T2-weighted sequence.

RESULTS

86 women underwent supplemental screening with AB-MR from January 2016 - April 2017. The age ranged from 41 to 76, mean 56 years. In 84/86 cases (97.6%), the T2-weighted sequence had no impact on the final interpretation. The radiologists reported that T2-weighted sequence altered the final interpretation 2/86 (2.3%) and in both cases, the lesions were downgraded to BI-RADS 2 from BI-RADS 4.

CONCLUSION

In this prospective study evaluating the utility of the T2-weighted sequence in the interpretation of the AB-MR, the radiologists indicated that the T2-weighted sequence was only helpful 2.3 % of the time although it accounts for approximately 60% of the total active scan time. However, the T2-weighted sequence was helpful in averting biopsy in two patients.

CLINICAL RELEVANCE/APPLICATION

As the T2-weighted sequence appears to have limited utility in the final interpretation, the fast MRI examination may be further shortened by eliminating the T2-weighted sequence. More data is needed.

RC315-07 Diagnostic Breast MRI

Tuesday, Nov. 28 9:40AM - 10:00AM Room: Arie Crown Theater

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

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LEARNING OBJECTIVES

Review the current diagnostic roles of breast MRI Describe the role of breast MRI in evaluating tumor heterogenity Review the role of ultrafast dynamic contrast-enhanced MRI Describe the radiogenomic analysis of breast cancer with MR

ABSTRACT

Breast MRI is used to predict breast cancer risk, to define extent of disease, and to monitor response to neoadjuvant chemotherapy. MRI is at the forefront of technology providing prognostic biomarkers that play an important role in this era of precision medicine. Technological advances and improvements in spatial and temporal resolution allow breast MRI to evaluate tumor heterogeneity. Breast cancer is a heterogeneous disease with inter- and intra-tumor genetic variation impacting predictive and prognostic risk. Radiogenomics, with feature extraction from breast MRI, allows the correlation of genomic information with non-invasive imaging biomarkers.

LEARNING OBJECTIVES

1) Review the current diagnostic roles of breast MRI. 2) Describe the role of breast MRI in evaluating tumor heterogenity. 3) Review the role of ultrafast dynamic contrast-enhanced MRI. 4) Describe the radiogenomic analysis of breast cancer with MRI.

ABSTRACT

Breast MRI is used to predict breast cancer risk, to define extent of disease and to monitor response to neoadjuvant chemotherapy. MRI is at the forefront of technology providing prognostic biomarkers that play an important role in this era of precision medicine. Technological advances and improvements in spatial and temporal resolution allow breast MRI to evaluate tumor heterogeneity. Breast cancer is a heterogeneous disease with inter- and intra-tumor genetic variation impacting predictive and prognostic risk. Radiogenomics, with feature extraction from breast MRI, allows the correlation of genomic information with non-invasive imaging biomarkers.

RC315-08 Time to Enhancement at Ultrafast Breast DCE-MRI: Potential Imaging Biomarker of Tumor Aggressiveness

Tuesday, Nov. 28 10:00AM - 10:10AM Room: Arie Crown Theater

Participants
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Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare the time to enhancement (TTE) of breast cancer at ultrafast breast DCE-MRI according to the histopathological characteristics

METHOD AND MATERIALS

Between January and April 2017, 86 consecutive breast cancer patients (mean age, 51.3; range, 27-78 years) who underwent the ultrafast breast DCE-MR examinations and subsequent surgery were identified. A total of 88 breast cancers (75 IDC and 13 DCIS) were included for analysis. Ultrafast-MR images were obtained using time-resolved angiography with stochastic trajectories sequence with a 4.5 second resolution for 20 phases (TR/TE 4.1/1.3 ms, 1.1×1.1×1.0 mm3 voxel) before conventional high spatial resolution DCE-MR images. One radiologist aware of tumor location but no other clinical or histopathologic information reviewed the ultrafast-MR images and assessed the TTE of the tumor. TTE was calculated as the phase of initial enhancement of tumor relative to the descending aorta, multiplied by 4.5 sec. Phase of initial enhancement was defined as the timing when the signal intensity of a region of interest became more than twice than that of non-enhancement images. Independent sample t-test was performed to compare the mean TTE according to the histologic type (invasive cancer vs. DCIS), histologic grade (high vs. low grade), lesion type (mass vs. non-mass), tumor subtype (luminal vs. HER-2 enriched vs. triple negative subtype) and level of Ki-67 (>20% vs. <=20%).

RESULTS

Mean TTE of triple-negative subtype (TNBC) was shorter than that of non-TNBC (9.00±0.00 vs. 11.61±4.49, P<.001). Mean TTE of tumors with high Ki-67 (>20%) was shorter than that of tumors with low Ki-67(<=20%) (9.00±0.00 vs. 11.50±4.44, P<.001). No difference was found in the TTE between IDC and DCIS (11.22±4.40 vs. 12.46±4.17, P=.347), high-grade and low-grade IDC (10.13±2.47 vs. 11.62±4.88, P=.087), high-grade and low-grade DCIS (12.00±5.20 vs. 12.60±4.14, P=.838), or mass and non-mass type (11.10±4.14 vs. 11.40±4.83, P=.775).

CONCLUSION

TTE of aggressive breast tumors is shorter than that of less aggressive breast tumors at ultrafast breast DCE-MRI.

CLINICAL RELEVANCE/APPLICATION

Early kinetic information of breast tumors at Ultrafast-MR images has the potential to provide information of refined tumor characterization.

RC315-09 Ultrafast DCE-MRI: Correlation with Microvessel Density in Invasive Breast Carcinoma

Tuesday, Nov. 28 10:10AM - 10:20AM Room: Arie Crown Theater

Participants
Naoko Mori, MD, PhD, Sendai, Japan (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate whether parameters from model-based analysis of ultrafast dynamic contrast-enhanced (DCE) MRI correlate with histological microvessel density (MVD) in invasive breast cancer.

METHOD AND MATERIALS

38 consecutive patients with invasive breast cancers underwent an IRB-approved "ultrafast" DCE-MRI including a pre- and 18 post-contrast ultrafast scans followed by 4 standard scans (60 seconds) using a 3T system. Ultrafast 3D bilateral scans were acquired with temporal resolution of 3 seconds per image . ROIs were placed within each lesion where the highest signal increase was observed on ultrafast DCE-MRI, and enhancement rate was calculated as follows:ΔS=(SIpost-SIpre) / SIpre*100. Where 'ΔS' is the change in signal intensity after contrast injection, and 'SIpost' and 'SIpre' are signal intensities post- and pre-contrast injection. The kinetic curve obtained from ultrafast DCE-MRI was analyzed using an empirical mathematical model:ΔS(t)=A*(1-e-at). Where A is the upper limit of the signal intensity, a(min-1) is the rate of signal increase. The initial slope of the kinetic curve is given by 'A*a'. Initial area under curve (AUC30) was calculated by integrating the kinetic curve. From the standard DCE-MRI, the initial enhancement rate and the signal enhancement ratio (SER) were calculated as follows: the initial uptake =(SIearly-SIpre)/ SIpre, SER=(SIearly-SIpre)/ (SIdelayed-SIpre). The parameters from ultrafast and standard images were compared with MVD obtained from surgical specimens. MVD was calculated by dividing the CD31 positive hot-spot areas by the total area on a ×200 field.

RESULTS

With respect to parameters from ultrafast imaging: the initial slope of the kinetic curve or 'A*a', AUC30, and A correlated

With respect to parameters from ultrafast imaging: the initial slope of the kinetic curve or 'A*a', AUC90, and A correlated significantly with MVD; r= 0.61, 0.59, and 0.54, respectively with P <0.0001, P = 0.0001, and P=0.0004, respectively. a, initial uptake and SER from conventional MRI did not correlate with MVD.

CONCLUSION

The model-based parameters, especially the initial slope or 'A*a' , from ultrafast DCE-MRI correlated with histological MVD in invasive breast cancer, while parameters from conventional MRI did not.

CLINICAL RELEVANCE/APPLICATION

The model-based parameters, especially the initial slope or 'A*a' , from ultrafast DCE-MRI correlated with histological MVD in invasive breast cancer.

RC315-10 Preoperative Breast MR Imaging Kinetic Features Using Computer-Aided Diagnosis: Association with Survival Outcome in Invasive Breast Cancer Patients

Tuesday, Nov. 28 10:20AM - 10:30AM Room: Arie Crown Theater

Participants
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PURPOSE

To evaluate whether the preoperative breast dynamic contrast -enhanced (DCE) magnetic resonance (MR) imaging kinetic features assessed using computer-aided diagnosis (CAD) can predict the survival outcome in invasive breast cancer patients

METHOD AND MATERIALS

The Institutional Review Board approved this retrospecti ve study, and waived the need for informed consent. Between March 2011 and December 2011, 301 women who underwent preoperative DCE MR imaging for invasive breast cancer, with CAD data, were identified. The Cox proportional hazards model was used to determine the association between the kinetic features assessed by CAD and the recurrence-free survival (RFS).The peak signal intensity and kinetic enhancement profiles were compared with the clinical-pathological variables using the Student t test and analysis of variance (ANOVA) test.

RESULTS

There were 32 recurrences during a mean follow-up time of 55.2 months (range, 5-72 months). On multivariate analysis, a higher peak enhancement (RFS hazard ratio, 1.004 [95% confidence interval (CI): 1.001, 1.006]; P = .009) on DCE MR imaging and a triple-negative subtype (RFS hazard ratio, 17.660 [95% CI: 2.255, 138.369]; P = .006) were associated with a poorer RFS . Higher peak enhancement was significantly associated with a higher T stage, clinical stage, and histologic grade. A higher washout component was associated with a higher histologic grade, triple-negative subtype, and pathologic diagnosis of invasive ductal carcinoma.

CONCLUSION

Patients with breast cancer that showed a CAD-derived higher peak enhancement on breast MR imaging had worse RFS. Peak enhancement and volumetric analysis of the kinetic patterns was useful for predicting the tumor aggressiveness.

CLINICAL RELEVANCE/APPLICATION

There has been a few report to date, to our knowledge , that has evaluated the correlation of preoperative MR imaging kinetic parameters assessed using a commercially available CAD with the recurrence outcomes in patients with breast cancer.

RC315-11 Maximum Intensity Projections for Incorporation of 4-Dimentional DCE-MR Images into Breast Lesion Classification with Deep CNNs

Tuesday, Nov. 28 10:30AM - 10:40AM Room: Arie Crown Theater

Participants
Natalia O. Antropova, Chicago, IL (*Presenter*) Nothing to Disclose
Hiroyuki Abe, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Maryellen L. Giger, PhD, Chicago, IL (*Abstract Co-Author*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Shareholder, QView Medical, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Medical Systems Corporation

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PURPOSE

To integrate volumetric and temporal components of dynamic contrast-enhanced magnetic resonance images (DCE-MRIs) into breast lesion malignancy assessment with convolutional neural network (CNN) features.

METHOD AND MATERIALS

A comparison study was conducted to investigate the benefit of using maximum intensity projections (MIPs) to efficiently incorporate 4D image data in CNN-based lesion classification. The study was performed on a clinical DCE-MRI dataset of 690 cases

- 212 benign and 478 malignant. A region of interest (ROI) was delineated around each lesion, with its size corresponding to the size of the enclosed lesion. First, MIPs were generated over the ROI area on the subtraction MRIs, 2nd postcontrast (t2) - precontrast (t0). For comparison, ROIs were selected on central slices of the subtraction and t2 MRIs. CNN features were extracted from the MIPs, the subtraction and the t2 central-slice ROIs using a VGGNet model pre-trained on ImageNet, a natural image dataset. The features were separately L2-normalized and were utilized to train support vector machine (SVM) classifiers to characterize lesions as malignant or benign. Classifier performance was evaluated using ROC analysis with five-fold cross-validation, standardizing training folds to zero mean and unit variance and the test folds with the statistics of the corresponding training folds. Area under the ROC curve (AUC) served as the figure of merit.

RESULTS

The SVMs trained on features from MIPs [AUC = 0.88 (se = 0.01)] outperformed the SVMs trained on features from subtracted central-slice ROIs [AUC = 0.84 (se = 0.02)] and t2 central-slice ROIs [0.80 (se = 0.02)], at a statistically significant level.

CONCLUSION

Integration of volumetric and temporal components of DCE-MRI through MIPs improves lesion classification with CNN features. In the task of malignancy assessment, a significantly better performance was achieved with CNN features from MIPs than from subtracted or t2 central-slice ROIs.

CLINICAL RELEVANCE/APPLICATION

MIPs are clinically used to evaluate the whole bilateral breast MRIs, integrating DCE-MRI's temporal and volumetric components. Utilizing MIPs, CNN-based radiomics extracts information from 4 dimensions of DCE-MRI data, significantly increasing the accuracy of the computer-aided malignancy assessment.

RC315-12 Kinetic Volume Analysis on Dynamic Contrast-Enhanced MRI of Triple Negative Breast Cancer: Association with Survival Outcomes

Tuesday, Nov. 28 10:40AM - 10:50AM Room: Arie Crown Theater

Participants
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Mariko Kawamura, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Hisashi Kawai, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Shinji Naganawa, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the association between kinetic volume analysis on dynamic contrast-enhanced MRI (DCE-MRI) and survival (disease-specific survival [DSS] and disease-free survival [DFS]) in patients with triple negative breast cancer (TNBC).

METHOD AND MATERIALS

Forty patients with TNBC who underwent pretreatment MRI between March 2008 and March 2014 were enrolled. DCE-MRI examinations were analyzed using a dedicated computer-assisted diagnosis (CAD) system, which allows volume analysis by segmentation of continuous enhancing voxels. Volumes of interest (VOI) were placed enclosing the entire tumor. Percentage tumor volume was calculated automatically by summing voxels meeting thresholds for kinetic curves in the initial and delayed phases. We selected 100% and 200% as thresholds of initial enhancement rate (IE), and selected ±10% and ±30% as thresholds for classification of delayed enhancement curve types into persistent, plateau, and washout. Clinico-pathologic factors, MR images based on BI-RADS MRI lexicon (including mass shape, mass margin, and internal enhancement), visual assessments on T2-weighted images (presence of intratumoral high signal intensity and peritumoral edema), and CAD-generated kinetic volume parameters were correlated with survivals using Cox Regression Analysis.

RESULTS

There were 12 recurrences and 7 deaths at a median follow-up of 73.6 months (range, 3.7-105.9 months). Multivariate Cox analysis showed that a higher percentage volume of IE> 200% (hazard ratio [HR] = 1.119; 95% confidence interval [CI]: 1.023, 1.223; p = 0.014) and higher percentage volume of IE>100% followed by delayed persistent enhancement with >30% signal increase (HR = 1.328; 95% CI: 1.096, 1.609; p = 0.004) were associated with worse DSS. In multivariate analysis for DFS, irregular shape (HR = 28.245; 95% CI: 2.761, 288.895; p = 0.005) and higher percentage volume of IE>100% followed by delayed persistent enhancement with >30% signal increase (HR = 1.375; 95% CI: 1.160, 1.630; p < 0.001) were associated with worse DFS.

CONCLUSION

Kinetic volume analysis on DCE-MRI showed a correlation with survival of TNBC.

CLINICAL RELEVANCE/APPLICATION

Our results suggest that kinetic volume analysis on DCE-MRI could be predictive of aggressiveness of TNBC, and has the potential to play a clinical role in personalized therapy.

RC315-13 Multiparametric Breast MRI

Tuesday, Nov. 28 11:00AM - 11:20AM Room: Arie Crown Theater

Participants
Katja Pinker, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the principle of multiparametric breast MRI. 2) Identify the potential and challenges of multiparametric breast MRI using different quantitative functional parameters. 3) Recognize established and emerging emerging techniques in multiparametric breast MRI. 4) Use multiparametric breast MRI in clinical practice. 5) Realize the future potential of functional imaging of breast tumors with multiparametric PET/MRI.

ABSTRACT

Magnetic resonance imaging (MRI) is an essential tool in breast imaging, with multiple established indications. Dynamic contrast-enhanced MRI (DCE-MRI) is the backbone of any breast MRI protocol and has an excellent sensitivity and good specificity for breast cancer diagnosis. DCE-MRI provides high-resolution morphological information, as well as some functional information about neo-angiogenesis as a tumour-specific feature. To overcome limitations in specificity, several other functional MRI parameters have been investigated and the application of these combined parameters is defined as multiparametric MRI (mpMRI) of the breast. MpMRI of the breast can be performed at different field-strengths (1.5 -7T) and includes both established [diffusion-weighted imaging (DWI), MR spectroscopic imaging (MRSI)] and novel MRI parameters [sodium imaging (23Na-MRI), chemical exchange saturation transfer (CEST) imaging, blood oxygen level-dependent (BOLD) MRI], as well as hybrid imaging with positron emission tomography (PET)/ MRI and different radiotracers. Available data suggest that multiparametric imaging using different functional MRI and PET parameters can provide detailed information about the underlying oncogenic processes of cancer development and progression and thus may add additional specificity. MpMRI of the breast is a still-evolving field and more significant advances are expected, which will further aid the development of novel personalized approaches in the management of breast cancers. However, there are still some challenges to the ubiquitous implementation of mpMRI of the breast in the clinical routine. Further advances in hardware and software to address the challenges unique to the individual MRI parameters, as well as large-scale, standardized, multicenter studies, are necessary and have been instituted to confirm the encouraging single-institution results prior to widespread clinical application.This presentation aims to provide a comprehensive overview of the current applications, challenges and emerging techniques of mpMRI of the breast.

RC315-14 Multiparametric Deep Learning Tissue Signatures as an Imaging Biomarker for Breast Cancer: Preliminary Results

Tuesday, Nov. 28 11:20AM - 11:30AM Room: Arie Crown Theater

Participants
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Katarzyna J. Macura, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Author with royalties, Reed Elsevier; Research Grant, Profound Medical Inc
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PURPOSE

This study was conducted to evaluate the feasibility and role of a novel deep learning method using multiparametric breast Magnetic Resonance Imaging (MRI) and to define tissue signatures for improved automated detection and characterization of breast lesions.

METHOD AND MATERIALS

We developed a multiparametric deep learning(MPDL) network for breast MRI for segmentation and classification of breast tissue into different tissue types. The MPDL network was constructed from stacked sparse autoencoders with five hidden nodes with input into the network using MPDL tissue signatures from multiparametric MRI of the breast(T1 and T2-weighted imaging, diffusion, and dynamic contrast imaging) obtained from 130 patients. Patients were randomly divided into two groups such that the proportions of benign and malignant cases were balanced. In order to evaluate the trained deep networks, the multi-fold cross-validation, sensitivity and specificity were computed. Finally, Dice similarity between MPDL post contrast DCE-MRI segmented lesions were evaluated. Gold standard MISNT(digit set) testing data was done for fine tuning the network. Benign versus malignant diagnoses was determined by histopathological examination or more than 2 years of follow-up confirming lesion stability. Statistical significance was set at $p<=0.05$.

RESULTS

The multiparametric deep learning approach accurately defined and segmented both synthetic and clinical data. In the synthetic data, the performance of the MPDL on MISNT data resulted in 99.7% accuracy. The MPDL successful segmented glandular, fatty, and lesion tissue in the test cohort with a Dice similarity of 89%, Segmentation metrics of precision=0.94 and F1-score=0.88.

CONCLUSION

The integrated MPDL method resulted in accurate segmented and classified tissue from clinical breast MRI data. The constructed MPDL images allow for improved visualization of different tissue characteristics from multiple radiological parameters. Deep learning can be used to construct a personalized database of tissue signatures with accurate characterization of different tissue types.

CLINICAL RELEVANCE/APPLICATION

Integration of advanced machine learning and computational methods to assist radiologists in the interpretative tasks provides the foundation for modeling of clinical and radiological variables and thus facilitates development of radiological precision medicine.

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/ Katarzyna J. Macura, MD, PhD - 2012 Honored EducatorKatarzyna J. Macura, MD, PhD - 2014 Honored EducatorRiham H. El Khouli, MD, PhD - 2012 Honored EducatorIhab R. Kamel, MD, PhD - 2015 Honored Educator

RC315-15 Diffusion Tensor Magnetic Resonance Imaging of Breast Cancer: Correlation between Diffusion Metrics and Histologic Prognostic Factors

Tuesday, Nov. 28 11:30AM - 11:40AM Room: Arie Crown Theater

Participants
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PURPOSE

To investigate whether quantitative diffusion metrics derived from diffusion tensor imaging (DTI) are correlated with histological prognostic factors in patients with breast cancer.

METHOD AND MATERIALS

Institutional review board approval and written informed consent were obtained. Between June 2016 and January 2017, 248 women (mean age, 53.4 years; range, 25-93 years) with breast cancer (230 invasive and 18 in situ) who had undergone preoperative MR imaging with DTI using a 3.0 Tesla scanner were identified. Diffusion gradients were applied in 20 directions with b values of 0 and 1000 s/mm2. DTI metrics such as mean diffusivity (MD) and fractional anisotropy (FA) were measured for breast lesions by two radiologists and correlated with histologic prognostic factors (invasive size; histological grade; lymphovascular invasion; axillary node metastasis; estrogen receptor, progesterone receptor, human epidermal growth factor receptor-2, Ki-67, and p53 status) using a Mann-Whitney U test and linear regression analysis.

RESULTS

MD and FA values in invasive breast cancers were significantly lower than those in ductal carcinoma in situ lesions (1.009 ± 0.256 × 10-3mm2/s versus 1.310 ± 0.195 × 10-3mm2/s, P<0.001; 0.291 ± 0.099 versus 0.354 ± 0.101, P=0.016; respectively). In patients with invasive breast cancer, larger tumor size (>2cm), high histological grade (grade 3), lymphovascular invasion, and axillary node metastasis showed significant associations with low MD values (P<0.001, P=0.008, P<0.001, P<0.001, respectively). Larger tumor size, and high histological grade also showed significant associations with low FA values (P<0.001, P=0.008, respectively). By multivariate stepwise linear regression analysis, larger tumor size, high histological grade, and axillary node metastasis were independently associated with low MD values (P=0.007, P=0.045, P=0.009, respectively). Larger tumor size, and high histological grade were also independently associated with low FA values (P<0.001, P=0.025, respectively).

CONCLUSION

DTI-derived diffusion metrics such as MD and FA are associated with histologic prognostic factors in patients with breast cancer.

CLINICAL RELEVANCE/APPLICATION

Quantitative diffusion metrics derived from DTI facilitate evaluation of histologic prognostic factors before surgery and may serve as diffusion biomarkers for prediction of breast cancer prognosis.

RC315-16 ACRIN 6702 Trial: A Multi-Center Study Evaluating the Utility of Diffusion Weighted Imaging for Detection and Diagnosis of Breast Cancer

Tuesday, Nov. 28 11:40AM - 11:50AM Room: Arie Crown Theater

Participants
Savannah C. Partridge, PhD, Seattle, WA (*Presenter*) Research Grant, General Electric Company
Zheng Zhang, PhD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Habib Rahbar, MD, Seattle, WA (*Abstract Co-Author*) Research Grant, General Electric Company
Thomas L. Chenevert, PhD, Ann Arbor, MI (*Abstract Co-Author*) Consultant, Koninklijke Philips NV
Averi Kitsch, BS, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Lucy Hanna, MS, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Sara M. Harvey, MD, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Wendy B. Demartini, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Mitchell D. Schnall, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Constance D. Lehman, MD, PhD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company
Christopher E. Comstock, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

scp3@uw.edu

PURPOSE

Diffusion-weighted imaging (DWI) has shown promise in single center studies to improve the positive predictive value (PPV) of conventional dynamic contrast enhanced (DCE) breast MRI. Many DCE false-positives exhibit higher apparent diffusion coefficient (ADC) values than breast cancers, suggesting an ADC threshold could be used to decrease the need for biopsy. The goal of ACRIN 6702 was to assess the performance of quantitative DWI added to DCE for differentiation of benign and malignant MRI-detected breast lesions in a multisite, multiplatform trial.

METHOD AND MATERIALS

This IRB-approved trial was performed at ten institutions on Philips, GE and Siemens 1.5T and 3T MR systems. Subjects were consented from 3/2014 to 4/2015 prior to undergoing clinical breast MRI, and those with BI-RADS 3, 4 or 5 lesions detected only on MRI were enrolled in the study. Multi-b value (b=0, 100, 600, 800 s/mm2) DWI was performed prior to DCE in clinical breast MRI exams, and lesion ADC values were later calculated by core lab central analysis. Benign or malignant lesion outcomes were

determined from biopsy and/or 12-month follow-up. Diagnostic performance was assessed by area under the receiver operating characteristic curve (AUC), and an ADC threshold with 100% sensitivity was determined.

RESULTS

Of 142 MRI breast lesions in 103 enrolled women, 28 were excluded for incomplete outcomes and 34 for inadequate DWI quality, yielding 80 DWI evaluable lesions (14 BI-RADS 3, 62 BI-RADS 4, 4 BI-RADS 5) with definitive outcomes (28 cancer and 52 benign) in 66 women (mean age 48.9±12.3 years). Mean ADC was lower in cancers than benign lesions (1.21±0.21 vs. 1.47±0.29 x10-3 mm2/s; p<0.0001), with an AUC of 0.75 (95% CI 0.64-0.86) for predicting malignancy. In this cohort, an ADC threshold <=1.53x10-3 mm2/s with 100% sensitivity combined with DCE BI-RADS increased specificity from 27% to 52% and PPV from 42% to 53%, which would reduce the biopsy rate by 20% (95% CI 10.9%-31.3%).

CONCLUSION

This multicenter trial confirms single site data supporting the value of DWI to improve breast MRI specificity without compromising sensitivity, warranting further testing of an ADC threshold in a larger study.

CLINICAL RELEVANCE/APPLICATION

Although image quality remains a challenge, these promising findings suggest adding DWI to conventional breast MRI could substantially decrease unnecessary biopsies without reducing cancer detection.

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RC315-17 Proton MR Spectroscopy: Lipid Metabolite Concentrations as Valuable Quantitative Imaging Biomarkers for Breast Cancer Diagnosis

Tuesday, Nov. 28 11:50AM - 12:00PM Room: Arie Crown Theater

Participants
Sunitha Thakur, PhD, MS, New York, NY (*Presenter*) Nothing to Disclose
Sandra Brennan, MBBCh, MSc, West Harrison, NY (*Abstract Co-Author*) Nothing to Disclose
Michael Weber, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Ileana Hancu, PhD, Niskayuna, NV (*Abstract Co-Author*) Nothing to Disclose
Elizabeth Manderski, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Katja Pinker, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In breast imaging, the value of proton MR spectroscopy (MRS) for breast cancer diagnosis has been largely based on the detection of choline. MRS can also provide information on other detectable metabolites such as lipids, which might be used for breast cancer diagnosis. Therefore the aim of this study was to determine whether lipid metabolite concentrations can be used for breast cancer diagnosis.

METHOD AND MATERIALS

In this HIPPA-compliant, IRB-approved study, data of 176 women who underwent MRI with T2weighted, dynamic contrast-enhanced MRI and MRS at 1.5T for either a suspicious imaging finding or staging of a known cancer (BI-RADS 0,4/5/6) were retrospectively analyzed. In all patients single-voxel MRS data were collected using a PRESS MRS Sequence with TR/TE=2000/135ms. Quantitative analysis of all lipid resonances present in the MRS data was done using LCModel analysis. We classified all metabolites into 6 groups based methyl, methylene, and methine proton chemical shifts, such as A (0.9ppm), BC (1.3 and 1.59 ppm), DE (2.04 and 2.25 ppm), F (2.77 ppm), GH (4.1 and 4.25 ppm), IJ (5.22 and 5.31 ppm). Histopathology was used as the standard of reference. Appropriate statistical tests were used to determine associations of MRS imaging biomarkers with tumor characteristics (benign vs. malignant, tumor grade, nodal status, lymphovascular invasion (LVI)).

RESULTS

There were 176 lesions including 85 invasive ductal cancers, 10 invasive lobular cancers, 13 ductal carcinoma in situ, 6 other types of breast cancer, and 62 benign lesions. The mean and std dev of voxel size was 4.4 ± 4.6 cm. All MRS lipid resonances were successfully quantified. A, BC, DE, and IJ lipid metabolite concentrations were significantly lower in malignant compared to benign tumors (p=0.028, 0.033, 0.015, and 0.0001). There was no significant difference in lipid metabolite concentrations in malignant lesion based on histological grade, LIV and axillary lymph node metastases.

CONCLUSION

Lipid metabolite concentrations quantified with proton MRS can successfully detect breast cancer and provide a valuable imaging biomarker in addition to choline.

CLINICAL RELEVANCE/APPLICATION

Proton MRS of lipid metabolite concentrations provides a non-invasive imaging biomarker for breast cancer and has the potential to obviate the need for biopsy.

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RC317

Emerging Technologies: Prostate Cancer Imaging & Management

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S505AB

GU MI MR NM

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*) Researcher, Koninklijke Philips NV; Researcher, General Electric Company; Researcher, Siemens AG; Researcher, iCAD, Inc; Researcher, Aspyrian Therapeutics, Inc; Researcher, ImaginAb, Inc; Researcher, Aura Biosciences, Inc

For information about this presentation, contact:

pchoyke@nih.gov

LEARNING OBJECTIVES

1) Understand current issues in prostate cancer relevant to imaging. 2) Understand the role of emerging technologies in the imaging and management of prostate cancer.

ABSTRACT

Prostate cancer is a major health issue. Imaging has made great strides in the last decade including the use of multiparametric MRI, MR-ultrasound fusion biopsies and most recently PET scanning. This refresher course explores emerging technolgies in prostate cancer imaging and management.

Sub-Events

RC317A Introduction to Imaging in Prostate Cancer

Participants
Peter L. Choyke, MD, Rockville, MD (*Presenter*) Researcher, Koninklijke Philips NV; Researcher, General Electric Company; Researcher, Siemens AG; Researcher, iCAD, Inc; Researcher, Aspyrian Therapeutics, Inc; Researcher, ImaginAb, Inc; Researcher, Aura Biosciences, Inc

For information about this presentation, contact:

pchoyke@nih.gov

LEARNING OBJECTIVES

1) Understand the impact of new screening guidelines on imaging of prostate cancer. 2) Understand the issues facing clinicians treating prostate cancer.

ABSTRACT

This talk will review the current status of screening for prostate cancer and how stage migration is beginning to be seen. The problems of early detection, early recurrence and early metastases will be discussed. This talk will serve as a starting off point for the subsequent talks on new technologies.

RC317B Next Generation Prostate MRI

Participants
Baris Turkbey, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

turkbeyi@mail.nih.gov

LEARNING OBJECTIVES

1) Understand current status and uses of multi-parametric MRI. 2) Understand role of MRI in assessment of prostate cancer agressiveness and tumor heterogeneity. 3) Understand role of computer aided diagnosis systems in evalaution of prostate cancer agressiveness and tumor heterogenetiy.

RC317C Molecular Prostate Imaging: Chemistry to Clinic

Participants
Martin G. Pomper, MD, PhD, Baltimore, MD (*Presenter*) Researcher, Progenics Pharmaceuticals, Inc; License agreement, Progenics Pharmaceuticals, Inc; Researcher, Advanced Accelerator Applications SA; License agreement, Advanced Accelerator Applications SA; Co-founder, Cancer Targeting Systems, Inc; Board Member, Cancer Targeting Systems, Inc; Researcher, Juno Therapeutics, Inc; Licensiing agreement, Juno Therapeutics, Inc; Co-founder, Neurly; Board Member, Neurly; Co-founder, Theraly

Pharmaceuticals, Inc; Board Member, Theraly Pharmaceuticals, Inc; ;

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC317D PET/MRI: Is Prostate Cancer a Perfect Fit?

Participants
Peter L. Choyke, MD, Rockville, MD (*Presenter*) Researcher, Koninklijke Philips NV; Researcher, General Electric Company; Researcher, Siemens AG; Researcher, iCAD, Inc; Researcher, Aspyrian Therapeutics, Inc; Researcher, ImaginAb, Inc; Researcher, Aura Biosciences, Inc

For information about this presentation, contact:

pchoyke@nih.gov

LEARNING OBJECTIVES

1) Understand the potential value of PET/MRI in prostate cancer. 2) Review potential pitfalls in the use of PET/MRI compared to PET/CT.

ABSTRACT

PET/MRI offers the sensitivity and specificity of PET with the high contrast resolution of MRI. In the prostate this can be very useful in identifying prostate cancers and recurrent disease after treatment. This talk will review the various features of PET/MRI that make prostate cancer a 'perfect fit' for it.

RC317E Hyperpolarized C-13 MR Molecular Imaging of Prostate Cancer

Participants
Daniel B. Vigneron, PhD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company;

LEARNING OBJECTIVES

View learning objectives under the main course title.

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RC322

MRI: Imaging for Radiation Treatment Planning

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S104B

MR RO PH

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

Participants
Eric Paulson, PHD, Milwaukee, WI (*Moderator*) Nothing to Disclose

Sub-Events

RC322A MRI for Anatomical Definition

Participants
Eric Paulson, PHD, Milwaukee, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the advantages of MRI simulation for anatomical delineation in both external beam radiation therapy and brachytherapy. 2) Understand the differences between images obtained during MRI simulation versus diagnostic MRI. 3) Understand the current solutions to address technical challenges of using MRI for anatomical delineation in Radiation Oncology.

ABSTRACT

MRI is rapidly emerging as a primary imaging modality in Radiation Oncology, fueled by innovations in MRI-guided treatment delivery, MRI simulation systems, and the role of MRI in individualizing and adapting radiation therapy. This course will discuss the advantages and technical challenges of using MRI for anatomical definition in radiation treatment planning. Current solutions to tailor MRI to the unique demands of Radiation Oncology will be explored. Clinical examples illustrating the use of MRI for anatomical delineation in both external beam radiation therapy and brachytherapy will be presented.

RC322B MRI for Functional Definition

Participants
Uulke A. van der Heide, PhD, Amsterdam, Netherlands (*Presenter*) Research support, Elekta AB; Speaker, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Get an overview of the most relevant functional MRI modalities are available. 2) Understand how they can be used to improve target definition. 3) Understand their limitations and specific concerns for use in radiation oncology.

ABSTRACT

In addition to anatomical imaging, MRI affords a range of functional techniques. Diffusion-weighted MRI images the restriction of water mobility in tissue, thus probing microanatomy. This is used to identify tumors and monitor response to treatment. Dynamic contrast-enhanced MRI shows the tracer kinetics of contrast agents and reflects the characteristics of the microvasculature, such as flow and permeability. These and other techniques can be used to improve target definition, and to characterize tumor tissue for radiotherapy dose painting.

RC323

MR Safety

Tuesday, Nov. 28 8:30AM - 10:00AM Room: N229

MR PH SQ

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

Participants
Yunhong Shu, PhD, Rochester, MN (*Director*) Nothing to Disclose

LEARNING OBJECTIVES

1) List several MR Safety incidents and describe their root causes. 2) List a variety of commonly implanted Neurostimulators and MR Conditional Pacemakers. 3) Identify potential risks associated with scanning patients implanted with these devices using MRI in the clinical environment. 4) Describe special MR Safety hazards present in the MR interventional environment, and identify countermeasures to reduce the associated risks. 5) Describe MR Safety guidelines and recommendations to prevent accidents and injuries.

Sub-Events

RC323A Case Review of Real MR Safety Incidents

Participants
Armen Kocharian, PhD, Houston, TX (*Presenter*) Research collaboration, General Electric Company

For information about this presentation, contact:

akocharian@houstonmethodist.org

LEARNING OBJECTIVES

1) Identify main safety risk factors from incident reviews at MR Imaging sites. 2) Assess and address the MRI safety potential risks. 3) Implement preventive measures in clinical practice for improved standard of care.

Active Handout:Armen Kocharian

http://abstract.rsna.org/uploads/2017/16001094/Active RC323A.pdf

RC323B MRI Safety of Deep Brain and Other Simulators

Participants
Yunhong Shu, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List a variety of commonly implanted neurostimulators. 2) Understand the importance of MRI as a diagnostic imaging tool for patient with implanted neurostimulator. 3) Identify the potential risks associated with scanning patient with implanted neurostimulator using MRI. 4) Describe MR safety guidelines and recommendations to prevent accidents and injuries.

ABSTRACT

A neurostimulator is a surgically placed programmable device. It delivers mild electrical signals to the targeted area through thin wires. The purpose is usually for pain relief or improving patient's ability to perform daily activities. There are a variety of commonly used neurostimulators include deep brain stimulator, spinal cord stimulator, vagus nerve stimulator and sacral nerve stimulator. MRI is clinically important for post-implantation evaluation. It is very likely that a patient will require an MRI scan after the neurostimulator is implanted. The risks of performing MRI on patients with neurostimulators are related to static magnetic field, gradient magnetic field and the RF field. The talk will provide an imaging physics overview on the potential risks and make recommendations for MR imaging safety procedure.

RC323C MRI Conditional Pacemakers: What to Do?

Participants
Anshuman Panda, PhD, Scottsdale, AZ (*Presenter*) Nothing to Disclose

Active Handout:Anshuman Panda

http://abstract.rsna.org/uploads/2017/16001096/Handout Panda Pacer RSNA 2017.pdf

RC323D MRI Safety in the MR-Guided Interventional Environment

Participants
Krzysztof Gorny, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Presentation will include overview of interventional MRI practice within context of generally accepted principles of MRI safety. 2)

Description of the practice will be provided including example protocol for safety testing of previously unlabeled equipment considered for potential use inside Zone 4.

Active Handout:Krzysztof Gorny

http://abstract.rsna.org/uploads/2017/16001097/Active RC323D.pdf

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RC329

Quantitative MR Imaging and Clinical Applications (An Interactive Session)

Tuesday, Nov. 28 8:30AM - 10:00AM Room: S504AB

BQ 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 Magnetic Resonance Fingerprinting: Principles and Applications

Participants
Vikas Gulani, MD, PhD, Cleveland, OH (*Presenter*) Research support, Siemens AG;

LEARNING OBJECTIVES

1) Understand the motivation behind the development of Magnetic Resonance Fingerprinting (MRF). 2) Understand basic principles and rationale in the design of an MRF acquisition, and comprehend the meaning of the output maps. 3) Identify applications to which MRF has been applied clinically thus far, and the unique insights that this work has thus far provided. 4) Understand the implications of MRF for tissue characterization, prediction of response to treatment, quantitative image analysis, radiomics, and computerized decision support. 5) Use the knowledge gained about MRF to analyze how this technology could be used in other clinical settings.

ABSTRACT

Magnetic Resonance Fingerprinting (MRF) is a new technology that enables efficient simultaneous mapping of multiple interesting MR properties, making it clinically feasible to measure T1 and T2, and thus provide a quantitative underlay to MRI. This enables a move towards a fully quantitative MR exam. We will start by laying out the rationale behind the need for quantitative MR. The approach adopted in MRF will be discussed, and the basics of such an acquisition will be explained. The initial clinical applications that have thus far been published will be shared, followed by a discussion of the implications of the technology in the future.

RC329B Radiomics for the Detection of Prostate Cancer

Participants
Masoom A. Haider, MD, Toronto, ON (*Presenter*) Consultant, Bayer AG; Advisory Board, Siemens AG; ;

LEARNING OBJECTIVES

1) Recognize the unmet needs in prostate cancer detection and surveillance. 2) Recognize the potential applications of quantitative imaging and radiomics to prostate cancer detection and surveillance. 3) Recognize what is required to have a valid imaging biomarker that can be applied to risk stratification in prostate cancer.

RC329C Free Breathing 3D Quantitative Perfusion MR Imaging of the Abdomen

Participants
Nicole Seiberlich, PhD, Cleveland, OH (*Presenter*) Research Grant, Siemens AG

For information about this presentation, contact:

nes30@case.edu

LEARNING OBJECTIVES

1) Describe various challenges to the collecting high-resolution, time-resolved MR images needed to quantify perfusion in the abdomen. 2) Understand different data collection and reconstruction strategies that have been recently proposed to enable this application. 3) Compare and contrast the merits of various novel acceleration methods for abdominal perfusion imaging. 4) Implement rapid perfusion quantification methods at their institution, or have the ability to contact those that can offer support in this area.

RC329D Elastography Beyond the Liver

Participants
Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

LEARNING OBJECTIVES

1) Explain the basic physical principles of MR Elastography (MRE). 2) Understand the emerging applications of MRE for intracranial imaging. 3) Describe other potential applications of MRE that are being investigated, including assessing cardiac, lung, breast, renal, and pancreatic disease.

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SSG04

Gastrointestinal (Liver Tumor Imaging)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: E352

BQ GI MR OI

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

Participants
Alice W. Fung, MD, Portland, OR (*Moderator*) Speaker, Guerbet SA
Bachir Taouli, MD, New York, NY (*Moderator*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA
Debra A. Gervais, MD, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSG04-01 Correlation of Molecular Transporter Receptor Expression with Hepatobiliary Phase Signal Intensity in Hepatocellular Adenoma Subtypes on Gd-EOB-DTPA-Enhanced MR Imaging

Tuesday, Nov. 28 10:30AM - 10:40AM Room: E352

Awards
Student Travel Stipend Award

Participants
Justin Tse, MD, Stanford, CA (*Presenter*) Nothing to Disclose
Bita Naini, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
David S. Lu, MD, Los Angeles, CA (*Abstract Co-Author*) Consultant, Medtronic plc; Speaker, Medtronic plc; Consultant, Johnson & Johnson; Research Grant, Johnson & Johnson; Consultant, Bayer AG; Research Grant, Bayer AG ; Speaker, Bayer AG
Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

jrtse@stanford.edu

PURPOSE

To correlate hepatobiliary phase signal intensity (SI) of hepatocellular adenoma subtypes (HCAs) on Gd-EOB-DTPA-enhanced MR with molecular transporter expression.

METHOD AND MATERIALS

In this IRB and HIPAA compliant study, the study cohort comprised of 49 histologically-subtyped HCAs from 21 consecutive patients: 14 inflammatory, 20 hepatocyte nuclear factor-1A-mutated (HNF-1A), 1 B-catenin-activated (BCA), and 14 unclassified (UC). Quantitative MR imaging features, including the SI ratio of the HCA relative to liver on the pre-contrast, arterial, portal venous, equilibrium, and hepatobiliary phases up to 20 minutes were calculated and reviewed by 2 abdominal radiologists. The histologic expression of organic anion-transporting peptide (OATP1B1/3) and multidrug resistant protein (MRP3) of 17 HCAs were compared to the surrounding liver semi-quantitatively using ImageJ software. Continuous variables were assessed using ANOVA and Student's t-test with Bonferroni correction for multiple comparisons.

RESULTS

On hepatobiliary phase, all 49 HCA lesions were hypointense to liver parenchyma with a nadir and plateau SI ratio by 10 minutes. At 20 minutes, the lowest SI ratio was from HNF-1A lesions (0.47±0.09), followed by inflammatory (0.73±0.18, $p<0.001$), UC (0.73±0.06, $p<0.0001$), and then BCA (0.82). On corresponding histology, HNF-1A (n=7) and inflammatory (n=7) HCA subtypes showed reduced OATP1B1/3 staining, with an expression ratio of 0.09±0.03 and 0.40±0.09 respectively ($p<0.001$), while BCA (n=1) had an increased expression ratio (1.2). UC lesions (n=2) showed complete absent OATP1B1/3 staining. There were no specific staining patterns identified with MRP3. Hepatobiliary phase SI demonstrated a strong correlation with OATP1B1/3 expression ($r=0.83$), but had no correlation with MRP3 expression ($r=0.06$). Atoll sign was identified in 2 inflammatory HCAs and correlated with histology to represent a band of cellular overexpression of OATP1B1/3.

CONCLUSION

In our HCA cohort, there was a strong correlation between OATP1B1/3 expression and differential hepatobiliary phase SI, suggesting that Gd-EOB-DTPA uptake may be mediated by OATP1B1/3, but not MRP3.

CLINICAL RELEVANCE/APPLICATION

Because HCAs demonstrate a strong correlation with molecular transporter receptor expression, Gd-EOB-DTPA-enhanced MR may help non-invasively determine HCA genotypic subtype and guide management.

SSG04-02 The Role of Baseline Tumor Enhancement and Apparent Diffusion Coefficient in Predicting Short-Term Response to Treatment in Liver Colorectal Metastatic Lesions: A Volumetric Approach

Tuesday, Nov. 28 10:40AM - 10:50AM Room: E352

Awards
Student Travel Stipend Award

Participants
Daniel Fadaei Fouladi, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Manijeh Zarghampour, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Mounes Aliyari Ghasabeh, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ankur Pandey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Pegah Khoshpouri, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Farnaz Najmi Varzaneh, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Pallavi Pandey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Nanna Shao, MBBS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG

For information about this presentation, contact:

dfoulad1@jhmi.edu

PURPOSE

To examine usefulness of magnetic resonance (MR) defined volumetric pretreatment enhancement and apparent diffusion coefficient (ADC) to predict short-term response to treatment in patients with liver colorectal metastases

METHOD AND MATERIALS

Liver MR images of 489 patients with colorectal liver metastases (2004-2015) were reviewed retrospectively in this HIPAA compliant study. Fifty-seven patients (154 liver lesions) fulfilled inclusion criteria and were categorized on the basis of the intervention into conventional chemotherapy group (41 lesions), hepatic trans-arterial chemoembolization or TACE group (98 lesions) and Y-90 radioembolization group (15 lesions). Baseline volumetric lesion enhancement in the portal venous phase (PVP), ADC (b value >500) and tumor necrotic volume were calculated employing a prototype software developed by Siemens Healthcare (MR Onco-Treat). Percent change in the largest transverse diameter at 3 month post-treatment was defined according to Response Evaluation Criteria in Solid Tumors (RECIST), and decrease in size by 30% was considered partial response to therapy. SPSS software (ver. 21), student t test and receiver operator characteristic curve analysis were used.

RESULTS

In all three groups a lower pretreatment ADC value, but not enhancement in the PVP or tumor necrotic volume, was significantly predictive of partial response to treatment (conventional chemotherapy: 939.7 x 10-6 mm2/s vs. 1305.4 x 10-6 mm2/s; p=0.01; optimal threshold, 1125 %; sensitivity, 75%; specificity, 69%; TACE: 1100.7 x 10-6 mm2/s vs. 1400.4 x 10-6 mm2/s; p<0.01; optimal threshold, 1244 x 10-6 mm2/s; sensitivity, 70.4%; specificity, 80%; Y-90 radioembolization: 895.6 x 10-6 mm2/s vs. 1140.9 x 10-6 mm2/s; p=0.03; optimal threshold, indefinable).

CONCLUSION

Volumetric baseline ADC could be used as a predictor of response to treatment in patients with colorectal liver metastases. Accordingly, a higher baseline ADC portends a worse outcome.

CLINICAL RELEVANCE/APPLICATION

Baseline volumetric ADC could be used to predict prognosis and tailor treatment strategies individually in patients with metastatic hepatic colorectal lesions.

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SSG04-03 Gadoxetic Acid-Enhanced MRI Outperformed Multidetector CT in Diagnosing Small Hepatocellular Carcinoma Measuring Up to 2 cm: A Systematic Review and Meta-Analysis

Tuesday, Nov. 28 10:50AM - 11:00AM Room: E352

Participants
Hanyu Jiang, Chengdu, China (*Presenter*) Nothing to Disclose
Xi Jiao Liu, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Jie Chen, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Bin Song, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

hanyu_jiang@foxmail.com

PURPOSE

A systemic review and meta-analysis of the diagnostic performance of gadoxetic acid disodium-enhanced magnetic resonance imaging (Gd-EOB-DTPA-enhanced MRI) and multidetector computed tomography (MDCT) was performed in diagnosing small hepatocellular carcinoma (HCC) measuring up to 2 cm(<=2 cm).

METHOD AND MATERIALS

Two investigators searched multiple databases for studies in which the performances of either Gd-EOB-DTPA-enhanced MRI or MDCT were reported with sufficient data to construct 2 * 2 contingency tables for diagnosing HCCs up to 2 cm on a per-lesion or per-patient level. Diagnostic performances were quantitatively pooled by a bivariate random-effect model with further meta-regression and subgroup analyses.

RESULTS

Twenty-seven studies (fourteen on Gd-EOB-DTPA-enhanced MRI, nine on MDCT and four on both) were included, enrolling a total of 1735 patients on Gd-EOB-DTPA-enhanced MRI and 1781 patients on MDCT. Gd-EOB-DTPA-enhanced MRI demonstrated significantly higher overall sensitivity than did MDCT (0.92 vs 0.66, p<0.001), without substantial loss of specificity (0.89 vs 0.91, p=0.354). Area under the summary receiver operating characteristic curve was 0.9712 with Gd-EOB-DTPA-enhanced MRI and 0.8538 with MDCT. Regarding Gd-EOB-DTPA-enhanced MRI, sensitivity was significantly higher for studies originated from non-Asian countries than Asian countries (0.96 vs 0.93, p=0.01), for retrospective studies than prospective studies (0.95 vs 0.91, p<0.01), and for those with Gd-EOB-DTPA injection rate >=1.5ml/s than that of <1.5ml/s (0.97 vs 0.90, p<0.01).

CONCLUSION

Gd-EOB-DTPA-enhanced MRI demonstrated higher sensitivity and overall diagnostic accuracy than MDCT, and thus should be the preferred imaging modality for diagnosing small HCCs measuring up to 2 cm.

CLINICAL RELEVANCE/APPLICATION

Early detection of small HCCs up to 2 cm can improve long-term patient survival. However, limited diagnostic accuracy has been demonstrated by traditional non-invasive imaging modalities including ultrasonography, multiphasic CT and MRI with non-specific contrast agents for the diagnosis of small HCCs. Fortunately, the introduction of MDCT and Gd-EOB-DTPA, a liver-specific hepatobiliary contrast agent, has led to better detection and characterization of small HCCs.

SSG04-04 MRI of Hepatocellular Carcinoma in Non-Alcoholic Fatty Liver Disease: Signal Characteristics and Inter-Rater Agreement

Tuesday, Nov. 28 11:00AM - 11:10AM Room: E352

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PURPOSE

To determine the MRI features of hepatocellular carcinoma (HCC) in the setting of non-alcoholic fatty liver disease (NAFLD)

METHOD AND MATERIALS

In this IRB-approved retrospective review from 1/1/2001 to 12/31/2016, consecutive patients with NAFLD and pathology proven HCC, biopsy proven hepatic steatosis (<=6 months from MRI) and/or hepatic fat signal fraction >= 5% at MRI were selected. HCC and liver parenchyma signal characteristics were independently reviewed by three abdominal radiologists and final features determined by majority. Inter-rater agreement was determined by prevalence-adjusted kappa. Hepatic fat signal fraction (FS %) was independently calculated. FS% was compared by HCC and liver MRI signal characteristics.

RESULTS

49 patients (80% male; mean age 63.3±11.9 years) with mean (±SD) HCC tumor size at MRI of 4.6±3.2 cm were included. HCC features included arterial phase hyperenhancement (APHE) (96%), portal venous phase washout (PVWO) (67%), delayed phase washout (DPWO) (82%), capsule (73%), T2W hyperintensity (90%), T1W hypointensity (65%), diffusion hyperintensity (93%), hepatic steatosis (65%) and cirrhotic morphology (43%). Mean FS% was 8.8 ± 8.4 %. Mean FS% by none, mild, moderate and severe steatosis at imaging: 0.9%, 8.3%, 20.1% and 27.5%, respectively (p<0.001). Mean FS% by mild, moderate and severe steatosis at pathology: 6.6% 11.2% and 21.8%, respectively (p<0.001). Inter-rater agreement was 0.80-0.84 for APHE, 0.47-0.63 for PVWO, 0.63-0.79 for DPWO, 0.35-0.63 for capsule, -0.22-0.22 for hepatic steatosis and 0.43-0.55 for cirrhosis. Agreement between pathology and MRI was 0.59 for cirrhosis. Hepatic FS% by HCC features: 9.1% (APHE) v. 2.1% (No APHE; p<0.02), 6.9% (PVWO) v. 12.5% (No PVWO; p<0.05) and 9.6% (T2W hyperintense) vs. 1.4% (T2W iso/hypointense; p<0.001).

CONCLUSION

A high proportion of HCCs occur in NAFLD without imaging evidence of cirrhosis (~60%) and are therefore not eligible for LIRADs categorization. Up to 20% of HCCs in NAFLD do not demonstrate washout and higher FS% is associated with absent PVWO but not DPWO. Inter-rater agreement is fair to very good for major HCC features at MRI but poor to moderate for hepatic steatosis and cirrhotic liver morphology in patients with NAFLD.

CLINICAL RELEVANCE/APPLICATION

In patients with NAFLD, many HCCs occur in the absence of cirrhotic liver morphology and may not demonstrate portal venous washout, thereby impacting the noninvasive imaging diagnosis of HCC.

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/ Sudhakar K. Venkatesh, MD, FRCR - 2017 Honored Educator

SSG04-05 Microvascular Invasion of Hepatocellular Carcinoma Predicted By T1 Mapping at Gd-EOB-DTPA Enhanced Magnetic Resonance Imaging: The Role of Texture Analysis

Tuesday, Nov. 28 11:10AM - 11:20AM Room: E352

Participants
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PURPOSE

To explore the value of texture analysis on T1 mapping at Gd-EOB-DTPA enhanced MRI in predicting and grading microvascular invasion (MVI) of hepatocellular carcinoma (HCC).

CONCLUSION

Texture analysis for T1 mapping at Gd-EOB-DTPA enhanced MRI held promise for predicting and grading MVI of HCC.

CLINICAL RELEVANCE/APPLICATION

Texture parameters of T1 mapping at Gd-EOB-DTPA enhanced MRI is related to tumor heterogeneity and the cellular uptake of Gd-EOB-DTPA, and therefore, can be used for HCC aggressiveness evaluation.

SSG04-06 Extent of Portal Invasion in Patients with HCC: The More, the Worse?

Tuesday, Nov. 28 11:20AM - 11:30AM Room: E352

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PURPOSE

Portal vein invasion (PVI) is known to have a significant impact on the prognosis of patients with hepatocellular carcinoma (HCC). Nevertheless, the degree of invasion can vary from sub-/segmental invasion to complete occlusion of the main trunk of the portal vein (PV). The purpose of this study was to evaluate whether the degree of invasion correlates with an impaired prognosis.

METHOD AND MATERIALS

763 patients with HCC were extracted from the clinical registry of our tertiary referral center as an ongoing effort to reevaluate the extent of PVI in all patients treated between 01/2005 - 06/2016. PVI was diagnosed by contrast enhanced CT or MRI. The extent of PVI was documented by the Liver Cancer Study Group of Japan-classification ranging from Vp0-Vp4: Vp0 = no PVI; Vp1 = segmental; Vp2 = right anterior or right posterior PV; Vp3 = right or left PV; Vp4 = main trunk. Median overall survival (OS) was calculated for each Vp-group.

RESULTS

PVI was present in 259 patients, 504 patients showed no sign of PVI. The patients with PVI were classified Vp1 to Vp4 in 12, 35, 88, and 124 cases. The corresponding median OS yielded 5.2, 5.6, 3.9, and 4.6 months for Vp1-Vp4, respectively. There was no significant difference between these PVI-subgroups ($p>0.05$). Median OS without PVI was 37.7 months and was therefore significantly longer compared to the patients with any form of PVI ($p<0.001$).

CONCLUSION

PVI in patients with HCC is associated with a dismal prognosis. However, the extent of PVI itself has no significant impact.

CLINICAL RELEVANCE/APPLICATION

Even a minor PVI leads to a very poor prognosis which has to be taken into account for treatment planning.

SSG04-07 Role of Diffusion Weighted Imaging in Differentiation of Pyogenic Hepatic Abscess from Necrotic Hepatic Metastatic Neoplasm

Tuesday, Nov. 28 11:30AM - 11:40AM Room: E352

Participants
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PURPOSE

To analyze the efficacy of DWI in the differentiation of pyogenic hepatic abscess from necrotic hepatic metastatic neoplasm

RESULTS

ADC values in cavity of pyogenic hepatic abscess were significantly lower with than necrotic hepatic metastatic neoplasm(1.61±0.77 vs 2.55±0.52×10-3mm2/s, P =0),which ADC value under the ROC curve (0.869), with a sensitivity of 96.3%, and a specificity of 73.2%.ADC values in cyst wall of two group were not significant(1.44±0.52 vs1.47±0.29×10-3mm2/s,p=0.627).ADC values in normal hepatic parenchyma of two group were not significant(1.61±0.45 vs 1.62±0.5×10-3mm2/s,p=0.865)

CONCLUSION

ADC values in cavity proved to be helpful in differentiation of pyogenic hepatic abscess from necrotic hepatic metastatic neoplasm.

CLINICAL RELEVANCE/APPLICATION

When pyogenic hepatic abscess and hepatic metastatic neoplasm can not be identified for enhanced examination or some patients are unable to perform enhanced examinations due to renal insufficiency or contrast agent allergies,DWI examination proved to be helpful.

SSG04-08 Quantitative Liver Function Reserve Analysis for Hepatocellular Carcinoma with Preoperative Gd-EOB-DTPA enhanced MR Imaging: Validation with Indocyanine Green Tests and Functional Liver Volume

Tuesday, Nov. 28 11:40AM - 11:50AM Room: E352

Participants
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PURPOSE

To determine the feasibility of functional liver volume for quantitative liver function reserve analysis in patients with hepatocellular carcinoma by preoperative Gd-EOB-DTPA enhanced magnetic resonance imaging (MRI)

RESULTS

The functional liver volume parameters FV, FV/W and T1HPB /LV (mean value: 879.93, 14.24, 0.18, respectively) were significantly correlated with ICG-R15 (rho=-0.552,-0.486,-0.579; p=0.006,0.019,0.004). T1/LV had the highest correlation with ICG-R15 among all the MRI functional quantitative parameter. The mean valueof rLV, rFV, rFV/W, rT1/LV calculated using virtual resection protocol were 805.89 ml and 546.24, 9.13, 0.29, respectively. Based on Gd-EOB-DTPA liver function reserve analysis, all the patients received standard resection successfully. The Child scores one week after surgery were ranged from 5 to 8 (Child A: n=18,Child B: n=4), except 1 patient suffered serve hepatic insufficiency.

CONCLUSION

It is feasible to assess liver function reserve in patients with HCC before surgery by functional liver volume assessment in Gd-EOB-DTPA MRI combined with volumetric T1mapping.

CLINICAL RELEVANCE/APPLICATION

Instead of ICG test, we provide a new method to assess the liver function reserve using preoperative Gd-EOB-DTPA enhanced MRI.and may facilitate the determination of adopting optimize surgery approach.

SSG04-09 Characterization of Malignancy of Hepatocellular Carcinoma Using Deep Feature with Contrast-Enhanced MR

Tuesday, Nov. 28 11:50AM - 12:00PM Room: E352

Participants
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PURPOSE

This study proposes a systematic method to automatically extract deep feature from the arterial phase of Contrast-enhanced MR of hepatocellular carcinoma (HCC) using convolution neural network (CNN) in order to characterize its malignancy. Meanwhile, the performance of deep feature is objectively compared with that of texture features for malignancy characterization.

METHOD AND MATERIALS

Consecutive 46 patients with 46 histopathologically proved HCC were included in the study from September 2011 to October 2015

Consecutive 46 patients with 46 histopathologically proved HCC were included in the study, from September 2011 to October 2015 (43male, 3 female, aged 53.09±12.45 years ranged 27 to 76 years). Gd-DTPA enhanced MR imaging were conducted with a 3T MR scanner. Of the 46 HCCs, one was Edmonson I, twenty were Edmonson II, twenty-four were Edmonson III and one was Edmonson IV (Low grade: I and II; High grade: III and IV). Firstly, each 3D tumor in the arterial phase was multiply resampled in three orthogonal views (Axial, Coronal and Sagittal) independently to increase training sets. Then, each view was performed with CNN to generate corresponding deep feature. Furthermore, a multi-kernel feature learning (MKL) method was investigated to fuse deep features derived from the three orthogonal views in a kernel space. Finally, experiments were conducted to evaluate the performance of the proposed method for malignancy characterization, and also objectively compared with the texture feature-based method with respect to the Axial view. 4-fold cross-validation with 10 repetitions on the 46 HCCs was used to test the proposed framework, in which 33 were randomly selected for training and the remaining 13 for testing.

RESULTS

In Axial view, deep feature (Accuracy: 91.08%±6.83%, Sensitivity: 89.17%±7.22%, Specificity: 92.58%±8.47%) clearly outperformed texture feature (Accuracy: 82.50%±12.70%, Sensitivity:88.89%±11.15%, Specificity: 74.55%±22.01%) in terms of accuracy, sensitivity and specificity. Furthermore, the accuracy of fusion of deep feature from three othogonal views using the MKL framework (97.95%±5.12%) was much better than that of deep feature in single orthogonal views (axial:91.08%±6.83%, Coronal: 76.15%±10.54%, Sagittal: 85.38%±5.68%) for malignancy characterization.

CONCLUSION

Deep feature was verified to be more powerful than the texture feature for malignancy characterization of HCCs.

CLINICAL RELEVANCE/APPLICATION

Deep features outperform texture feature for malignancy characterization of HCC, which may be extensively used for lesion characterization in clinical practice.

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SSG05

Genitourinary (Multiparametric Prostate MRI)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: S102CD

BQ GU MR OI

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

Participants
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Matthew S. Davenport, MD, Cincinnati, OH (*Moderator*) Royalties, Wolters Kluwer nv; ;

Sub-Events

SSG05-01 Feasibility of Quantitative Dynamic Contrast Enhanced MRI Using Low Dose Gadolinium: Comparative Performance with Standard Dose in Prostate Cancer Diagnosis

Tuesday, Nov. 28 10:30AM - 10:40AM Room: S102CD

Participants
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PURPOSE

We investigated whether administration of low doses of Gd for dynamic contrast enhanced (DCE) MRI can be effective as a standard dose in distinguishing prostate cancer (PCa) from benign tissue.

METHOD AND MATERIALS

Patients (n=16) with histologically confirmed PCa underwent preoperative 3T MRI using endorectal and phased array surface coils. DCE-MR images were acquired using two mDixon sequences at 8.3s temporal resolution with a low dose 0.015 and standard dose 0.085 mmol/kg of gadobentate dimeglumine (Multihance, Bracco) bolus injections. Low dose images were acquired for 3.5 min, followed by a 5 min gap before acquiring high dose images for 8.3 min. The data was analyzed by fitting signal intensity with an empirical mathematical model to obtain maximum intensity projection (MIP) and signal enhancement rate (a). Correlations of these parameters between low and standard doses of Gd administered were calculated. Receiver operating characteristic (ROC) analysis was performed to evaluate whether these parameters could distinguish between PCa and benign tissue using whole mount prostatectomy specimens as reference standard.

RESULTS

A moderately significant Pearson correlation for DCE parameters: MIP (0.53) and a (0.58) was found between low and standard doses of Gd. PCa showed significantly increased a compared to benign tissue for low (10.0±5.8 vs 5.1±2.9 s-1), but not for standard dose (4.3±2.2 vs 3.4±1.5 s-1). The ratio of low dose a to high dose a was significantly greater for PCa (2.8±2.3) than for normal prostate (1.6±0.9), suggesting changes in water exchange and T2* effects associated with cancer. Area under the ROC curve for differentiating PCa from benign tissue using a was higher for low dose (0.77, p<0.05) compared to standard dose (0.63, p>0.05). However, there were no significant differences between MIP calculated for PCa and normal tissue at both low (33±12 vs 29±16%) and standard doses (110±49 vs 94±43%).

CONCLUSION

Quantitative DCE-MRI with low Gd dose better distinguishes PCa from benign prostate tissue than standard Gd dose, based on signal enhancement rate. This may be due to water exchange and T2* effects. Further study is needed to find the optimal dose for PCa diagnosis using DCE-MRI.

CLINICAL RELEVANCE/APPLICATION

Prostate cancer diagnosis may be feasible with quantitative DCE-MRI with low dose Gd contrast.

Honored Educators

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SSG05-02 Pharmacokinetics Analysis and Prognostic Implications of Hypovascular Prostate Adenocarcinoma on Multiparametric MRI

Tuesday, Nov. 28 10:40AM - 10:50AM Room: S102CD

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PURPOSE

To compare dynamic contrast-enhancement (DCE) parameters and pharmacokinetics analysis of hypo and hypervascular prostate cancer (PCa) as predictors of patient outcome.

METHOD AND MATERIALS

54 men who underwent 1.5T multiparametric (mp) endorectal prostate magnetic resonance imaging (MRI) from January/2012 to March/2014 were enrolled in this HIPPA-compliant, IRB-approved retrospective study. Lesions with signal intensity at least 10% lower than the normal peripheral zone on DCE analysis were called hypovascular (group-1); all others were consider iso or hypervascular (group-2). 2-compartment Tofts model was used for pharmacokinetics analysis. Patients' outcomes (biochemical failure - BF, metastasis, death) were recorded after a minimum 3-year follow-up. Only the index lesion was analyzed. Demographics, Gleason score, PSA, lesion size, mean ADC, Ktrans, Kep, slope and patients outcomes between the groups were compared using the t-test or the Mann-Whitney test. Logistic regressions were used to compare how DCE characteristics, i.e. group-1 or group-2 features, predicted outcomes.

RESULTS

Twelve lesions (22.2%) were hypovascular and 42 (77.8%) were iso/hypervascular. Age (0.40), follow-up time (0.24), mean ADC, and Gleason score (0.08) did not differ between groups. Group-1 had a higher PSA (87.6 vs 24.8; p=0.01) and larger lesions (33.1 vs 19.1 mm; p<=0.001). Pharmacokinetics parameters were lower for group 1, confirming their hypovascular nature (ktrans, 0.041 vs 0.083; p=0.03 and Kep, 0.067 vs 0.177; p=0.04). At multivariate analysis, the hypovascular pattern (group-1) was a predictor of poor outcome (BF or worse, OR=8.08, p=0.02 and metastases or death, OR=8.3, p=0.05).

CONCLUSION

Hypovascular tumors represent a small proportion of PCa, but the feature is an independent predictor of poor outcome.

CLINICAL RELEVANCE/APPLICATION

Hypovascular PCa have worse prognoses, indicating a major role for lesion characterization with dynamic contrast enhancement.

SSG05-03 3T Multiparametric MRI: Comparison of Performance With and Without Endorectal Coil for Prostate Cancer Detection, PI-RADS v2 Lesion Scoring and Staging with Whole Mount Histopathology Correlation in 429 Patients

Tuesday, Nov. 28 10:50AM - 11:00AM Room: S102CD

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PURPOSE

To investigate prostate cancer (PCa) detection & compare the radiological & pathological characteristics of the lesions on 3T multiparametric MRI (mpMRI) with & without endorectal coil (ERC) with whole mount histopathology (WMHP) correlation.

METHOD AND MATERIALS

In this HIPAA-compliant, IRB-approved case control study, we evaluated a cohort of 429 men with prostate cancer who underwent 3T mpMRI from 7/2009 to 12/2016, prior to robotic prostatectomy. The subcohorts with & without ERC were evaluated. Tumor

detection rate was calculated for total & index PCa lesions. The MRI characteristics of true positive PCa lesions, including PIRADSv2 scoring, prostate volume, tumor volume & ADC value & pathology findings including tumor location & staging were evaluated between two groups. Chi-square & Independent sample T tests assessed the significance of discrete & continuous variables using SPSS v24.

RESULTS

A total of 871 consecutive WMHP localized lesions (54.2% clinically significant) in 429 patients with a mean age of 65.4±7 were included in the study cohort. The ERC & non ERC subcohorts comprised 260 patients with 529 lesions & 169 patients with 342 lesions, respectively. Tumor detection rates for overall, ERC & non ERC subcohorts were 49.5% (431/871), 50.3% (266/529) & 48.2% (165/342), & 77.6% (333/429), 78.5% (204/260) & 76.3% (129/169) for overall & index lesions, respectively (p >0.05). The ERC & non-ERC subcohorts detected 35.9% (66/184) & 48.4% (76/157) of anterior lesions (p =0.019), 58% (200/345) & 48.1% (89/185) of posterior lesions (p=0.025), 37.3% (41/110) & 54.4% (62/114) of transition lesions (p=0.010) & 53.7% (225/419) & 45.2% (103/228) of peripheral lesions (p=0.033). The individual lesion ADC, PIRADSv2 score, pathological staging, tumor volume & prostate volume were similar between two groups (p>0.05).

CONCLUSION

3T mpMRI with & without ERC had similar performance for overall & index PCa detection, PI RADS v2 scoring & staging. However, the ERC subcohort had significantly higher detection rates of clinically significant posterior & peripheral PCa lesions & lower detection rates of anterior & transition PCa lesions compared to non ERC subcohort.

CLINICAL RELEVANCE/APPLICATION

Although performance of 3T mpMRI with & without ERC is similar, ERC enables improved detection of posterior & peripheral lesions.

SSG05-04 PIRADS 2 Lexicon Deep Dive: Association between Lexicon Terms and Predictive Values

Tuesday, Nov. 28 11:00AM - 11:10AM Room: S102CD

Participants
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PURPOSE

To determine the association between PIRADS v2 lexicon terms and histopathological outcomes in a blinded randomized setting to assess the discriminatory power of these terms.

METHOD AND MATERIALS

120 prostate MRI in patients with subsequent TRUS/MRI biopsy were evaluated in a blinded and randomized setting by two radiologists (>6 years of prostate MRI experience) using a dedicated review software. Lesions were marked and each lesion was characterized with respect to PI-RADS lexicon terms for shape and border. Lexicon terms describing diffusion weighted imaging were included for comparison. Positive and negative predictive values (PPV, NPV) were calculated for each of the terms and reported. A combination of high PPV/NPV was considered favorable for malignant features, a combination of low PPV/NPV for benign features.

RESULTS

A total of 134 lesions were identified of which 82 (61.2%) were positive for prostate cancer on histopathology. Separated by PI-RADS-Score, 5 PI-RADS 1, 37 PI-RADS 2, 14 PI-RADS 3, 29 PI-RADS 4 and 49 PI-RADS 5 lesions were marked and described. Terms denoting the lesions' shape performed as following (PPV/NPV): "round" 36.4%/54.3%, "oval" 40.2%/66.7%, "lenticular" 39.7%/75.0%, "lobulated" 40.3%/73.3%, "water dropshaped" 41.5%/90.9%, "wedge shaped" 35.3%/38.9%, "linear" (benign) 34.1%/9.1%, "irregular" 40.6%/66.7%. Terms describing the lesion s' borders as following: "circumscribed" 32.3%/55.1%, "non-circumscribed" 41.0%/83.3%, "indistinct" 39.4%/62.9%, "obscured" 48.4%/84.6%, "irregular" 40.9%/73.7%, "spiculated" 39.1%/100.0%, "encapsulated" 31.6%/11.8%, "organized chaos" 31.6%/11.8%, "erased charcoal" 41.7%/85.7%. DWI-associated terms: "restricted diffusion" 72.2%/83.8%, "DWI hyperintensity' 83.7%/87.1%, "ADC hyperintense' 37.9%/0.0%, "ADC isointense" 24.8%/10.3%, "ADC hypointense" 88.9%/79.6%.

CONCLUSION

Almost all DWI specific terms had a favorable PPV/NPV profile. In contrast PI-RADS lexicon terms describing lesions shape and border - with the exception of "encapsulated", "organized chaos" and "linear" to describe benign lesions - tended to have less favorable PPV/NPV mostly with a potential to describe but not exclude tumor (high PPV, low NPV). Values for the respective terms indicate areas of improvement, suggesting refinement of these terms.

CLINICAL RELEVANCE/APPLICATION

This study identifies PI-RADS lexicon strengths and weaknesses of PI-RADS terms to be addressed in further iterations of the lexicon with a potential to improve the reporting accuracy.

SSG05-05 Are Post-Contrast Images Really Helpful on Multiparametric MRI for Detection of Clinically Significant Prostate Cancer

Tuesday, Nov. 28 11:10AM - 11:20AM Room: S102CD

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PURPOSE

To evaluate the incremental value of contrast-enhanced images for clinically significant prostate cancer detection on multiparametric MRI (mpMRI) prior to biopsy.

METHOD AND MATERIALS

IRB approved, prospective study. In an 8 months period, all men who underwent prostatic mpMRI in our institution without a prior diagnosis of clinically significant prostate cancer were enrolled. Patients performed mpMRI on a 3-Tesla scanner with a phased array coil using a routine protocol: T2-weighted, diffusion-weighted and dynamic post-contrast enhancement sequences. Two radiologists read images independently, first without, and subsequently including the post-contrast series. The analysis was performed on a sextant basis, and graded on 5-points scale for cancer suspicion. Sensitivity, specificity, PPV, NPV and accuracy for both readers were calculated using biopsy with imaging fusion ultrasound/mpMRI as the gold standard. The level for statistical significance was set at $p < 0.05$.

RESULTS

Of 449 patients enrolled in our study, 102 were submitted to prostate biopsy with US/MRI imaging fusion. Median time between MRI and biopsy was 15 days. Positivity for different levels of suspicion on mpMRI, comparing images without and with contrast, showed no statistically significant difference for both readers (p-values > 0.05). Sensitivity ranged from 64.5 to 77.7%, specificity from 58.9 to 67.0%, PPV from 23.9 to 25.6%, NPV from 91.8 to 92.8% and accuracy from 60.6 to 65.5%, also with no statistically significant difference between both protocols.

CONCLUSION

Our study shows that detection of clinically significant prostate cancer on mpMRI protocols with and without contrast-enhanced sequences were similar.

CLINICAL RELEVANCE/APPLICATION

A prostate MRI performed without contrast is desirable due to its lower cost, faster scanning time and increased safety for a broader range of patients.

SSG05-06 Influence of the Location and Zone of Tumor in Prostate Cancer Detection and Localization on 3T Multiparametric MRI Based On PI-RADS V2 on 39 Sector Segmentation: Correlation with Whole Mount Histopathology (WMHP) in 415 Consecutive Cases

Tuesday, Nov. 28 11:20AM - 11:30AM Room: S102CD

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PURPOSE

To determine 3T mp-MRI for detection & localization of prostate cancer (PCa) using PI-RADS v2 scoring and segmentation stratified by location & zone correlated with whole mount histopathology (WMHP)

METHOD AND MATERIALS

With IRB & HIPAA compliance, we included 415 consecutive men with 3T mp-MRI within 90 days of robotic prostatectomy (RALP) & WMHP. A GU pathologist detected, graded & outlined each PCa lesion. Jointly a GU radiologist & pathologist classified each focus on mp-MRI with each PCa lesion on WMHP as true or false positive. Two other GU radiologists re-reviewed each mpMRI & assigned PI-RADS v2 scores to all previously detected mp-MRI foci and PI-RADS v2, 39 prostate sector model (for location and zone) in

consensus. Both a rigid (RS) & adjusted sector (AS) matching models were utilized to account for fixation related issues.

RESULTS

We analyzed 863 PCa foci & 16,185 prostate sectors. 3T Mp-MRI detected more PCa lesions in the midgland (54.9 % all & 83.1 % index lesions) than in base (42.1% all [p=0.04] & 64.0 % index lesions [p=0.02]) or apex (41.9% all lesions [p=0.001] and 71.4% index lesion [p 0.006]). There was no difference in detection between overall peripheral and transitional zone PCa (50.4 % vs 43.2 % (p=0.2)) or index PCa 79.1 % vs 73.1 % (p=0.2). The highest of PCa localization sensitivity was for midgland PCa vs. base or apical PCa. AS was higher than RS localization for overall (70.8% vs 36.0%) & index midgland PCa match (71.3% vs 43.7%). 3T Mp-MRI had greater sensitivity (p<0.05) of PZ PCa vs. TZ PCa localization for overall PCa (30.28% vs 24.53% by RS, 58.9% vs 51.2 % by AS match) and for index lesions (37.0% vs 29.2% by RS, and 58.4% vs 50.5% by AS match). 3T mp-MRI had similarly high specificity (93.8-98.3.%) for overall and index tumor localization when using both rigid adjusted sector match approaches.

CONCLUSION

Using 3T mp-MRI and the PI-RADS v2, achieved 83.1% sensitivity for detection of index PCa in the mid gland with 98.3.% specificity. Sectoral localization of PCa within the prostate was moderate and was best with an AS vs RS match.

CLINICAL RELEVANCE/APPLICATION

In this largest study to evaluate influence of the location and zone of tumor in PCa detection and localization on 3T mp-MRI with WMHP correlation. We have demonstrated excellent sensitivity and specificity for prostate cancer detection but moderate performance for intraprostatic sectoral localization, which may have implications for focal therapy.

SSG05-07 Comparison of Subjective and Quantitative Shape Analysis for Differentiation of Transition Zone Prostate Cancer (TZ PCA) From Benign Prostatic Hyperplasia (BPH)

Tuesday, Nov. 28 11:30AM - 11:40AM Room: S102CD

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PURPOSE

TZ PCa overlaps in appearance with BPH nodules on MRI. Shape features favoring TZ PCa in PI-RADS version 2 include: non-circumscribed/spiculated margin with absent hypointense rim and lenticular shape. Reproducibility of these findings may be limited and have not been compared to quantitative analysis. This study compares subjective and quantitative shape analysis for differentiation of TZ PCa from BPH.

METHOD AND MATERIALS

With IRB approval, 22 TZ PCa were compared to 30 consecutive BPH nodules (15 stromal/15 glandular) identified using MRI-radical prostatectomy (RP) mapping. Two blinded radiologists (provided with location of lesions) subjectively evaluated: shape (round/oval vs lenticular), margin (smooth/lobulated or spiculated/irregular) and presence of hypointense rim on T2W-MRI. Radiologists manually contoured lesions which were quantitatively assessed for: circularity (roundness), convexity (lens shape) and number of skeleton branches/junctions (spiculations). Comparisons were performed using logistic regression, accuracy assessed with ROC and inter-observer agreement calculated.

RESULTS

There was no difference in size comparing TZ PCa to BPH (17.8 ± 6.4 vs. 18.7 ± 7.7 mm), p=0.64. Lenticular shape, irregular/spiculated margin and lack of hypointense rim were associated with TZ PCa (p<0.001). Inter-observer agreement was weak to moderate (K=0.32-0.48). Area under ROC curve (AUC) and sensitivity/specificity of shape and margin to diagnose PCa were: 0.77; 32.2%/100.0% and 0.89; 81.8%/96.7%. Hypointense rim showed AUC=0.89 with sensitivity/specificity of 70.3%/93.3% for diagnosis of BPH. There were significant differences in circularity and convexity (p<0.001) with no difference in number of branches comparing PCa to BPH (p=0.36). There was excellent agreement between readers with low mean difference. Circularity and convexity were accurate for diagnosis of PCa with AUC and SENS/SPEC of: 0.98; 95%/90% and 0.85; 73%/97%.

CONCLUSION

Lenticular shape is specific but insensitive for diagnosing TZ PCa with weak inter-observer agreement. Comparatively, quantitative shape features (circularity and convexity) showed higher accuracy and inter-observer agreeement. Irregular/spiculated margin and lack of hypointense rim are accurate features of TZ PCa.

CLINICAL RELEVANCE/APPLICATION

Quantitative shape analysis improves accuracy and reproducibility for diagnosis of TZ PCa compared to subjective analysis.

SSG05-08 Validation of a Prospective Quantitative Evaluation of Gleason Score Prediction Using Prostate Diffusion Weighted Imaging: A Single Institution Experience in 293 Men with a Clinical Suspicion of Prostate Cancer

Tuesday, Nov. 28 11:40AM - 11:50AM Room: S102CD

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PURPOSE

To evaluate the potential of prostate diffusion weighted imaging (DWI) for Gleason score (GS) prediction in men with a clinical suspicion of prostate cancer.

METHOD AND MATERIALS

A total of 315 men with a suspected prostate cancer (PCa) based on elevated PSA (2.5 - 20.0 ng/ml) were enrolled in single institutional registered clinical trials between March 2013 and March 2017. Three tesla biparametric MRI (bpMRI) was performed using surface array coils and consisted of T2-weighted imaging (T2w) and three separate epi read-out based diffusion weighted imaging (DWI) acquisitions (5 b values 0-500 s/mm2, 2 b values 0-1500 s/mm2, 2 b values 0-2000 s/mm2). The probability of a suspicious lesion containing Gleason grade 4 was prospectively assigned based on the apparent diffusion coefficient (ADCm) maps calculated using a monoexponential fit and 5 b-values in the range of 0 to 500 s/mm2. This probability was expressed as a Gleason grade score (GGS): 1. unlikely- ADCm above or equal to 850 x 10-6 mm2/s, 2. probable: ADCm below 850 x 10-6 mm2/s 3. highly probable- ADC below 750 x 10-6 mm2/s. All bpMRI reports were reported and/or approved by one reader before biopsy.

RESULTS

Two hundred ninety three (293/315, 93%) men completed bpMRI and subsequent biopsy procedure. GGS could not be assigned in 7 men (2%, 7/293) due to susceptibility artefacts. GGS of 1, 2, and 3 were found in 53% (152/286), 17% (48/286), and 30% (86/286) of men, respectively. PCa with GS of 3+3, 3+4, >3+4 was present in 14% (41/286), 24% (69/286), and 30% (86/286) of men, respectively, while targeted and systematic biopsy cores were free of cancer in 97 men (34%, 97/293). In 58% (88/152) and 18% (28/152) of men with GGS 1 no PCa and GS 3+3 was found, respectively, in contrast to 2% (2/86) and 8% (7/86) of men with GGS 3 ($p<0.001$). The negative predictive values of GGS 1 for GS >3+4 was 88% while positive predictive value of GGS 3 was 60%. The corresponding values for GS equal to or higher than 3+4 were 76% and 90% for GGS 1 and GGS 3, respectively.

CONCLUSION

Our newly developed system for GS prediction demonstrated high negative and positive predictive values for clinically significant prostate cancer in men with a clinical suspicion of prostate cancer.

CLINICAL RELEVANCE/APPLICATION

Prostate diffusion weighted imaging (DWI) performed as a part of biparametric MRI, T2-weighted imaging and DWI acquired using "low" and "high" b values, has a potential to predict the Gleason score.

SSG05-09 Characteristics of PI-RADS 4 Lesions within the Prostatic Peripheral Zone: A Retrospective Diagnostic Accuracy Study Evaluating 170 Lesions

Tuesday, Nov. 28 11:50AM - 12:00PM Room: S102CD

Participants
Prasad R. Shankar, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
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PURPOSE

To assess whether lesion shape, margination within the peripheral zone, or PI-RADS v2 diagnostic criteria impact accuracy in the detection of clinically significant cancer within the peripheral zone.

METHOD AND MATERIALS

This was an IRB-approved, HIPAA-compliant, retrospective diagnostic accuracy study to evaluate a subset of peripheral zone (PZ) lesions identified on multiparametic prostate MRI (mpMRI) at our large academic medical center. Our prospectively maintained mpMRI database was queried for all PI-RADS 4 (PR4) lesions reported over a 16-month period. Following pre-determined exclusion criteria, 170 PR4 PZ lesions (149 mpMRIs) were reviewed by two faculty abdominal radiologists, blinded to inter-reader assessment and pathologic outcome. Readers classified each lesion based on shape, margination within the PZ, and basis for PR4 score. Lesions were classified as: PR4 by a DWI score of 4, PR4 by a DWI score of 3 + early enhancement, or not meeting PR4 criteria. Lesions not meeting PR4 criteria (n=22) were excluded from the analysis of the remaining variables. All lesions within the study met the reference standard of MR-Ultrasound fusion biopsy. The primary outcome measure was detection of Gleason >= 7 prostate cancer. Logistic regression analysis and chi^2 testing were used for statistical analysis.

RESULTS

Oval shaped lesions were most strongly associated with clinically significant prostate cancer with a PPV of 59.4% (19/32 [p=0.03]). PR4 lesions with a DWI score of 4 were more likely to represent clinically significant prostate cancer than those with a DWI score of 3 + early enhancement (p=0.04). Lesions that did not meet PR4 criteria were statistically less likely to represent Gleason >= 7 prostate cancer (p=0.02).

CONCLUSION

PR4 PZ lesions with an oval shape or DWI score of 4 are more likely to represent clinically significant prostate cancer than the population of all PR4 lesions. Additionally, strict adherence to PI-RADS v2 criteria in classifying PZ lesions leads to exclusion of

lesions that are statistically less likely to represent clinically significant cancer.

CLINICAL RELEVANCE/APPLICATION

This study highlights a subset of PR4 lesions within the PZ that are associated with a higher probability of clinically significant prostate cancer. These findings may help radiologists in determining the suspicion of a given prostatic lesion and may help urologists in management of discordant targeted biopsies.

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SSG09

Science Session with Keynote: Musculoskeletal (Machine Learning)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: E450B

CT MK MR IN

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

Participants
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Sub-Events

SSG09-01 Musculoskeletal Keynote Speaker: Machine Learning Basics: A Radiologist's Perspective

Tuesday, Nov. 28 10:30AM - 10:50AM Room: E450B

Participants
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SSG09-03 Accelerated Knee MRI with Machine Learning Based Reconstruction Compared to Standard Knee MRI Protocol: Analysis of Protocol Interchangeability and Image Quality

Tuesday, Nov. 28 10:50AM - 11:00AM Room: E450B

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PURPOSE

Assess protocol interchangeability and image quality of an accelerated knee MRI reconstructed with a machine learning based algorithm compared to standard MRI.

METHOD AND MATERIALS

A neural network trained to differentiate between acceleration related aliasing artifacts and true image content was developed, according to methods previously described. 25 patients referred for diagnostic knee MRI underwent examination at 3T with five 2D FSE sequences using both standard reconstruction (parallel imaging acceleration factor 2, acquisition time 12:57 minutes) and an accelerated knee protocol that utilized machine learning based reconstruction (acceleration factor 3, 9:10 minutes). Images were interpreted retrospectively by two MSK radiologists, blinded to acquisition and reconstruction parameters, for meniscus, ligament, bone marrow, and chondral pathology. Concordance of standard MRI interpretation was compared to concordance between machine-learning and standard MRI interpretation. Image quality was assessed using a 4-point ordinal scale.

RESULTS

Agreement between readers was similar when using the standard protocol compared to using different protocols (86%-98% for all structures). Different readers had a higher impact on concordance than different protocols, with higher inter-protocol concordance (same reader, different protocols; 93%-99.5%) than intra-protocol concordance (different readers, same protocol; 86%-98%). Interchangeability analysis demonstrated that switching from the standard protocol to machine learning would introduce less than 5% discordance (upper limit of a 95% confidence interval) for all structures. Overall image quality degradation ($p<0.001$) was observed with the machine learning based reconstruction.

CONCLUSION

Accelerated knee MRI utilizing a machine-learning-based reconstruction algorithm was interchangeable with standard knee MRI in terms of diagnostic concordance. However, reduced subjective image quality was observed. Future directions include modification of the loss function that is used during the neural network training procedure and alternative network architectures to improve image quality.

CLINICAL RELEVANCE/APPLICATION

Machine learning based MRI reconstruction promises novel possibilities for scan acceleration. Our initial experience applying this technique to knee MRI demonstrates protocol interchangeability but reduced subjective image quality.

SSG09-04 Automatic Vertebrae Localization and Identification in Spine CT Using Decision Forests

Tuesday, Nov. 28 11:00AM - 11:10AM Room: E450B

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PURPOSE

In clinical diagnosis and appropriate surgical planning in the spine, the fast recognition and characterization of vertebral bodies is a crucial step. Usually for radiologists it is a time consuming task that hinders the workflow, because they have to label them manually. For this reason, the main purpose of our work was to locate and identify vertebral bodies automatically in body CT scans by applying an Artificial Intelligence (AI) technique.

METHOD AND MATERIALS

A dataset of 200 CT scans with arbitrary field of view were collected. Due to the goal of the study, a wide range of pathological conditions was needed in order to enrich the algorithm. For the automatic localization and identification of vertebral bodies we used Decision Forests, an AI technique based on supervised learning. This means that we need both input and output data to train the forest. An in-house software application was used for labelling the scans by selecting the centroids of each vertebral body included. From the 200 scans 150 were used for training and 50 for test. From each training scan we randomly selected 50.000 voxels. Around each voxel a 3D cuboid was processed, where 126 intensity-based features were extracted as input data. The corresponding output data is the distance from the selected voxels to each vertebra. To test, 100.000 voxels were randomly selected from a previously unseen CT and features were extracted. Using our trained forest, we obtained the predicted distance from each voxel selected to each vertebra. Finally, using this information we could predict their position.

RESULTS

The algorithm was tested against 50 new cases obtaining a satifactory vertebrae classification with no human interaction. A mean performance of 95% for correct localization was achieved. The mean error distance between the real position of vertebrae and the tested one was of 10.5 mm on the thoracic region and of 15.4 mm on the lumbar one.

CONCLUSION

Automatic localization and identification of vertebral bodies can be addressed with excellent results by AI methods to improve diagnosis workflow and characterize bone structure. These methods can be used to address current barriers such as the automatic localization and segmentation of anatomical structures.

CLINICAL RELEVANCE/APPLICATION

Automatic localization and identification of vertebral bodies can help radiologists to perform diagnosis and bone characterization in a shorter period of time.

SSG09-05 Semantic Labeling of Musculoskeletal Radiographs Using Deep Learning

Tuesday, Nov. 28 11:10AM - 11:20AM Room: E450B

Awards
Student Travel Stipend Award

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PURPOSE

Deep convolutional neural networks (CNNs) are rapidly advancing techniques in computer vision that allow rapid, unsupervised feature learning and have potential clinical advantages including speed and consistency. Our goal is to develop and validate a deep CNN system to automatically learn and recognize common musculoskeletal radiographs.

METHOD AND MATERIALS

793 radiographs of major appendicular joints were exported and anonymized from PACS. Images were annotated with 13 class labels: AP and lateral views of the ankle, elbow, foot, hand, and knee, AP views of the pelvis, and AP and axillary views of the shoulder. To create a normalized dataset for training, we implemented an image preprocessing step that adjusts window/level settings based on image bit depth and sharpens the image by enhancing low contrast local image regions. We adapted a transfer learning approach and fine-tuned the weights of ImageNet's pre-trained AlexNet CNN to recognize 13 classes by continuing the backpropagation. For training and validation, we used a hold-out approach (793 training images, 154 validation images). The deep CNN was trained using Matconvnet on a 2.3GHz Intel Core i7 with 8GB of RAM and an NVIDIA GeForce GT 650M 285. Training parameters: Momentum 0.9, Weight decay 3e-4, Epoch size 50, and batch size 50. Performance accuracy was measured as percentage of correctly labeled class, and the top-5 error rate was the fraction for which the correct label was not among the five labels.

RESULTS

The deep CNN performed with an accuracy of 97.4% on the test dataset. The top-5 error rate was 0%.

CONCLUSION

We have implemented a deep CNN that automatically classifies radiographs of major joints using DICOM images from PACS. Future work could be extended to identify all radiographic images and views.

CLINICAL RELEVANCE/APPLICATION

Deep learning can enhance PACS through automated labeling of radiographs and identification of relevant comparisons, improving hanging protocols and radiologist workflow.

SSG09-06 Prediction of Osteoporotic Vertebral Fractures from Calcaneal Images using Deep Learning

Tuesday, Nov. 28 11:20AM - 11:30AM Room: E450B

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PURPOSE

The purpose of this work is to evaluate a classifier that predicts bone fragility as assessed by prevalent vertebral fractures shown on vertebral fracture assessment (VFA). The classifier uses the trabecular texture extracted from digital radiographic calcaneal images with a deep convolutional neural network (CNN). The performance of CNN-extracted features is compared to bone mineral density (BMD).

METHOD AND MATERIALS

The clinical dataset consists of digital radiographic images of the calcaneus obtained using a peripheral instantaneous X-ray Imager (PIXI) from 900 patients who had undergone vertebral fracture assessment and BMD measurements. For each calcaneal image, a region of interest (ROI) is manually identified and input to a CNN for trabecular texture extraction. Two classifiers based on different CNNs are evaluated: a CNN that has been pre-trained and a CNN that has been pre-trained then fine-tuned. Fine-tuning leverages data augmentation with images that have been generated using a CNN-based texture synthesis method. For both classifiers, the extracted features from CNN are input to a two-class support vector machine (SVM). Five-fold cross validation is used to assess the performance in predicting vertebral fracture, with area under the receiver operating characteristic curve (AUC) as the performance metric.

RESULTS

The SVM based on features extracted with a pre-trained-only CNN achieved AUC of 0.61 (95% CI: 0.57 - 0.63), which is similar to the one based on BMD (0.62, 95% CI: 0.52 - 0.73). The classifier using features extracted with a fine-tuned CNN is still being developed, but it is expected to perform significantly better than the features extracted with a pre-trained-only CNN as well as the BMD.

CONCLUSION

The comparable performance of the features extracted with a pre-trained CNN shows strong promise for using CNN-extracted trabecular texture to evaluate bone fragility in osteoporotic patients. Given the performance using the pre-trained CNN, significant improvement is expected for a fine-tuned CNN.

CLINICAL RELEVANCE/APPLICATION

Predicting the risk of fracture in osteoporotic patients is a challenging problem, which is clearly demonstrated by the relatively low AUC for classifier based on BMD, despite it being the current clinically-accepted method. Using CNN-extracted features to characterize bone quality and structure show great potential to enhance the current clinical standard.

SSG09-07 Detection and Measurement of Prevertebral Stripe in Cervical Lateral View Using Deep Learning

Tuesday, Nov. 28 11:30AM - 11:40AM Room: E450B

Participants
Young Han Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Sewon Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To show the feasibility of the deep-learning based convolutional neural networks (CNNs) measurement of prevertebral soft tissue thickness (PSTT) as a radiographic marker of cervical spine injury and to correlate CNNs measurements with radiologist's measurements.

METHOD AND MATERIALS

Following institutional review board approval, 200 cervical lateral radiographs were included for training dataset. The prevertebral lines and anterior vertebral lines were annotated by one musculoskeletal radiologist. Two separate pipelines were configured and

trained for extraction and measurement of PSTT at the levels of C2 and C6, using the U-net based CNNs. Consecutive 134 patients who were undertaken cervical lateral radiographs in emergency department were included for test dataset. In the test dataset, the PSTT were measured by the U-net based CNNs model trained from the 200 training dataset. The PSTT were also measured by a musculoskeletal radiologist as reference values. For statistical analyses, Pearson's correlation test and intraclass correlation (ICC) were conducted to correlate the measure values between the CNNs-based measurement and radiologist's measurement. Diagnostic performances of the CNNs-based measurement were evaluated.

RESULTS

U-net based CNNs successfully extract the PSTT (n=130/134, 97%). In the total 130 radiographs, the CNNs-based measurements showed a good correlation at the C2 (r=0.88, p<0.05 and ICC =0.94) and C6 (r=0.48, p<0.05 and ICC=0.62). There were false positives on CNNs measurement (positive on CNNs measurement and negative on radiologist's measurement) in eight radiographs. The detection sensitivity, specificity, and accuracy were 100%, 93.6%, and 96.8%.

CONCLUSION

The CNNs measurements can be clinically utilized in measurement of PSTT by training a deep learning-based pipeline for depicting the PSTT.

CLINICAL RELEVANCE/APPLICATION

The CNNs measurements can be a complementary tool providing timely accurate labels that only require rapid confirmation for busy physician or radiologist.

SSG09-08 Performance of Deep Convolutional Neural Network Based Classifiers in Automated Evaluation of Anterior Shoulder Dislocation and Occult Radial Head Fracture

Tuesday, Nov. 28 11:40AM - 11:50AM Room: E450B

Awards
Student Travel Stipend Award

Participants
Ali B. Syed, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
William B. Morrison, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, AprioMed AB; Patent agreement, AprioMed AB; Consultant, Zimmer Biomet Holdings, Inc
Paras Lakhani, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Anterior shoulder dislocation and occult radial head fracture are two common findings on Emergency Department (ED) radiography. Our purpose was to develop convolutional neural network (CNN) based classifiers for these diagnoses and characterize their performance.

METHOD AND MATERIALS

102 de-identified internal rotation radiographs of the shoulder were obtained (51 with anterior dislocation, 51 normal). Similarly, 97 de-identified lateral radiographs of the elbow were obtained, 47 of which showed anterior joint effusions in the presence of trauma; remaining 50 were normal. Diagnoses were verified by a board-certified radiologist. These data sets were augmented 12x via multiple rotations as well as contrast equalization and non-rigid deformation. Images were used to train classifiers using both AlexNet and GoogLeNet CNN architectures using the Caffe framework. 20% of the augmented data sets were used in validation. Separate test data sets consisting of 60 shoulder and 60 elbow radiographs (each 50% pathology, 50% normal) were used to assess performance. Receiver operating characteristic (ROC) curves were generated and area under the curve (AUC), sensitivity, and specificity were computed. Differences in AUCs were obtained with a statistical significance threshold of 0.05.

RESULTS

Shoulder dislocation classifier ROC curve demonstrated an AUC of 0.997 with a p-value of 3.7e-11, sensitivity of 96.7%, and specificity of 100%. The elbow classifier AUC was 0.50 with a sensitivity of 23.3% and a specificity of 83.3%.

CONCLUSION

Our shoulder dislocation classifier shows near-perfect accuracy and may be particularly useful to the growing number of non-radiologists that interpret radiographs in the emergency setting; such a classifier may also be useful in identifying shoulder dislocation as an incidental finding on other imaging (e.g. chest radiographs). In contrast, detection of elbow effusions is a task that demands higher visual discrimination and as such likely requires additional preprocessing and a greater number of training cases than present in our current study. Comparison of the results of our shoulder and elbow classifiers is illustrative of the strengths and weaknesses of currently available CNN architectures and training methods.

CLINICAL RELEVANCE/APPLICATION

Deep convolutional neural networks can detect anterior shoulder dislocation with near-perfect accuracy and can thus aid in expeditious diagnosis in an emergency setting.

SSG09-09 Deep Learning For Detection of Full Thickness Anterior Cruciate Ligament Tear

Tuesday, Nov. 28 11:50AM - 12:00PM Room: E450B

Participants
Peter Chang, MD, Bronx, NY (*Presenter*) Nothing to Disclose
Tony T. Wong, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Michael J. Rasiej, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the feasibility of an automated deep learning artificial intelligence algorithm to detect full thickness anterior cruciate ligament (ACL) tears.

METHOD AND MATERIALS

One hundred (N = 100) patients between 18 and 40 years old with a full thickness ACL tear were identified in a retrospective review of knee MRIs obtained between September 2013 and March 2016. A second control group of one hundred (N = 100) normal patients was identified with no ACL pathology. All two hundred ACL diagnoses were confirmed through visual inspection by a board-certified subspecialist musculoskeletal radiologist (MJR). For each exam with an ACL tear, coronal proton density (PD) non-fat suppressed sequences were manually annotated to delineate: (1) a bounding-box around the cruciate ligaments; (2) slices containing an ACL tear. Based on this, a two-step convolutional neural network (CNN) was trained to: (1) identify the ACL; (2) assign a binary classification to each patient depending on the presence or absence of an ACL tear (Figure 1). The CNN is based on a generative-adversarial network for semi-supervised learning utilizing feature-matching. Both 2D and 3D CNNs were evaluated.

RESULTS

The two hundred MR volumes yielded a total of 3184 coronal PD slices, 480 slices of which contained an ACL tear. Of the two tested architectures, the 3D CNN model performed better, classifying 89.5% of patients correctly based on a five-fold validation. The 2D CNN model classified 78% of patients correctly (417/480 slices). Both CNN models were trained for 500 epochs with a batch size of 32. The final trained 3D CNN can generate predictions for all 200 patients in 287 seconds (1.4 seconds per patient).

CONCLUSION

A deep learning CNN model can evaluate for the presence of a full thickness ACL tear with reasonable accuracy. A 3D model outperforms a 2D model, suggesting that detection of an ACL tear may be limited when using a single coronal MR slice and benefits from the context of adjacent slices. Further work will focus on evaluating deep learning models for assessing and quantifying lower grade ACL and other ligamentous injuries.

CLINICAL RELEVANCE/APPLICATION

Anterior cruciate ligament tears are commonly encountered injuries in sports medicine with significant morbidity. This is the first time a deep machine learning algorithm has been used to evaluate ACL injuries.

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SSG11

Neuroradiology (Molecular Neuroimaging: From Diffusion to Beyond)

Tuesday, Nov. 28 10:30AM - 12:00PM Room: N229

CT MR NR

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

Participants
Rajan Jain, MD, Hartsdale, NY (*Moderator*) Consultant, Cancer Panels; Royalties, Thieme Medical Publishers, Inc
Edward P. Quigley, MD, salt lake city, UT (*Moderator*) Nothing to Disclose

Sub-Events

SSG11-01 MR-NODDI Evaluating Amyotrophic Lateral Sclerosis: A Tract Based Spatial Statistics Analysis

Tuesday, Nov. 28 10:30AM - 10:40AM Room: N229

Participants
Rifeng Jiang, Fuzhou, China (*Presenter*) Nothing to Disclose
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Yunjing Xue, MD, Fuzhou, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Amyotrophic lateral sclerosis (ALS) is an incredibly lethal disease and resistant to therapy. Symptoms of ALS can be similar to those of a wide variety of other, more treatable diseases or disorders. The aim of this study is to use neurite orientation dispersion and density imaging (NODDI), a novel tool, to quantify changes of white matter (WM) skeleton in patients with ALS compared to healthy controls.

METHOD AND MATERIALS

Two shells of diffusion-weighted magnetic resonance images (shell 1: b=1000s/mm2, direction=25; shell 2: b=2500s/mm2, direction=25) were acquired from 12 patients with ALS and 12 age- and sex-matched healthy controls. FMRIB's Linear Image Registration Tool was used to register all diffusion-weighted volumes to their corresponding b = 0 s/mm2 volume, and to correct for motion and eddy currents. The Brain Extraction Tool was used to remove non-brain tissue, FSL's DTIFIT was used to calculate FA, and NODDI toolbox was used to calculate the intra-neurite volume fraction (Ficvf) and orientation dispersion index (ODI). FSL's Tract-Based Spatial Statistics (TBSS) tool was used to align individual FA maps to FSL's standard adult FA template. Following registration, the FA maps of all subjects were thinned to create white matter skeletons. Then, Ficvf and ODI maps were created and registered using the TBSS registrations of FA to the adult FA template, and the skeleton mask was applied to the registered images. The white matter skeletons differences in FA, Ficvf and ODI were compared between ALS patients and healthy controls.

RESULTS

In the TBSS analysis, significant FA reductions were demonstrated within the (pre)frontal WM, partial parietal WM, corpus callosum and partial corticospinal tract (with TFCE-correction). Similarly, significant Ficvf reductions were found within almost all the WM skeleton (with TFCE-correction), which was more extensive than that of FA. In contrast, ODI showed no significant changes in all the WM skeleton.

CONCLUSION

NODDI is a more potential tool to demonstrating the neurite density reductions for ALS patients. Significant Ficvf reductions can be observed within almost all the WM skeleton, which indicates the reductions of the neurite density in the corresponding WM. Ficvf found more extensive changes than FA, indicating Ficvf is a more sensitive parameter.

CLINICAL RELEVANCE/APPLICATION

NODDI will help lead to earlier diagnosis and treatment for ALS.

SSG11-02 Histogram Analysis of Diffusion Kurtosis Imaging of Nasopharyngeal Carcinoma: Correlation between Quantitative Parameters and Clinical Stage

Tuesday, Nov. 28 10:40AM - 10:50AM Room: N229

Participants
Xiao_quan Xu, Nanjing, China (*Presenter*) Nothing to Disclose

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PURPOSE

To evaluate the correlation between histogram parameters derived from diffusion-kurtosis (DK) imaging and the clinical stage of nasopharyngeal carcinoma (NPC).

METHOD AND MATERIALS

DK imaging data of forty-seven consecutive NPC patients were retrospectively analyzed. Apparent diffusion for Gaussian distribution (Dapp) and apparent kurtosis coefficient (Kapp) were generated using diffusion-kurtosis model. Histogram parameters, including mean, median, 10th, 90th percentiles, skewness and kurtosis of Dapp and Kapp were calculated. Patients were divided into low and high T, N and clinical stage based on American Joint Committee on Cancer (AJCC) staging system. Differences of histogram parameters between low and high T, N and AJCC stages were compared using t test. Multiple receiver operating characteristic (ROC) curves were used to determine and compare the value of significant parameters in predicting high T, N and AJCC stage, respectively.

RESULTS

High T-stage (T3/4) NPC showed significantly higher Kapp-mean (P=0.018), Kapp-median (P=0.029) and Kapp-90th (P=0.003) than low T-stage (T1/2) NPC. High N-stage NPC (N2/3) showed significantly lower Dapp-mean (P=0.002), Dapp-median (P=0.002) and Dapp-10th (P<0.001) than low N-stage NPC (N0/1). High AJCC-stage NPC (III/IV) showed significantly lower Dapp-10th (P=0.038) than low AJCC-stage NPC (I/II). ROC analyses indicated that Kapp-90th was optimal for predicting high T-stage (AUC, 0.759; sensitivity, 0.842; specificity, 0.607), while Dapp-10th was best for predicting high N- and AJCC-stage (N-stage, AUC, 0.841; sensitivity, 0.875; specificity, 0.807; AJCC-stage, AUC, 0.671; sensitivity, 0.800; specificity, 0.588).

CONCLUSION

DK imaging-derived parameters correlated well with clinical stage of NPC, therefore could serve as an adjunctive imaging technique for evaluating NPC.

CLINICAL RELEVANCE/APPLICATION

DK imaging-derived histogram parameters were useful for characterizing NPC, and correlated well with the clinical stage of the NPC patients. Dapp-10th was optimal for predicting the high N- and AJCC-stage, while Kapp-90th was most powerful for predicting the high T-stage. Our results suggested that DK imaging-derived parameters could be a potential imaging marker for pretreatment staging, and DK imaging could be a useful adjunctive imaging technique for evaluating NPC before treatment.

SSG11-03 Cerebral Sodium (23Na) Magnetic Resonance Imaging in Patients with Migraine vs Healthy Controls

Tuesday, Nov. 28 10:50AM - 11:00AM Room: N229

Participants
Melissa Ong, MD, Mannheim, Germany (*Presenter*) Nothing to Disclose
Alexander Schmidt, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Justus Benrath, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Evaluation of 23Na concentrations in patients with clinically manifest migraine vs. healthy controls.

METHOD AND MATERIALS

In this prospective, IRB-approved study we recruited 12 patients (all female; mean age 34±11 years) who have been clinically evaluated for migraine and who have filled out a questionnaire regarding onset of disease, length, intensity (scale 1-10) and frequency of attacks and accompanying aura, as well as 12 healthy controls (all female; mean age 34±11 years). Both groups underwent a cerebral 23Na-magnetic resonance imaging examination at 3.0T (TimTrio, Siemens Healthcare Sector). For each scan a non-contrast enhanced T1w MP-RAGE sequence for anatomical referencing and a 3D-density-adapted, radial gradient echo (GRE-) sequence for 23Na-imaging were acquired using a double-tuned (1H/23Na), dedicated head-coil. 23Na-sequences were reconstructed according to the MP-RAGE, allowing direct cross-referencing of regions-of-interest (ROI). Circular ROIs were placed in predetermined anatomic regions: anterior and posterior cerebrospinal fluid (CSF), grey and white matter (GM/WM), brain stem and cerebellum. External 23Na reference phantoms were used to calculate the 23Na tissue concentrations. 23Na concentrations of migraine patients and healthy controls were compared and statistically analyzed by Wilcoxon rank sum test.

RESULTS

Overall 23Na concentrations (in millimoles per liter) in the anterior CSF region of patients with manifest migraine were significantly higher with 79±7 vs. 69±4 in healthy controls (p=0.0001) (see figure 1). Similar findings were found for the posterior CSF region with 23Na concentrations of 85±6 in migraine patients vs. 63±8 in healthy controls (p=0.0013). No statistical difference was found for 23Na concentrations in the grey and white matter, brain stem and cerebellum.

CONCLUSION

Cerebral 23Na concentrations in CSF of migraine patients are significantly higher than in healthy controls.

CLINICAL RELEVANCE/APPLICATION

Cerebral 23Na MRI may be a potential imaging tool for the diagnosis of migraine.

SSG11-04 Leakage Correction improves Prognosis Prediction of Dynamic Susceptibility Contrast Perfusion MRI in Primary Central Nervous System Lymphoma

Tuesday, Nov. 28 11:00AM - 11:10AM Room: N229

Awards

Student Travel Stipend Award

Participants
Yeon Soo Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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PURPOSE

The purpose of this study is to evaluate whether CBV measurement with leakage correction from dynamic susceptibility contrast perfusion weighted image(DSC-PWI) can be useful for the prognosis prediction of primary CNS lymphoma(PCNSL).

METHOD AND MATERIALS

Among 130 patients with PCNSL from January 2007 to April 2016, 46 patients were classified by radiation therapy(RT) stratification:non-RT(n=16);RT group(n=30). Patients of both groups were reclassified into progression free survival(PFS) based subgroups by their PFS period:3 years criteria for RT group;1 year criteria for non-RT group. With a dedicated imaging processing program(NordicICE), the normalized cerebral blood volume(nCBV) map with or without leakage correction and leakage map were obtained. Those perfusion maps were co-registered with contrast enhanced T1 weighted image(CET1WI) and fluid attenuated inversion recovery(FLAIR). The total volume of interest(VOI) was drawn on co-registered images corresponding with enhancing lesion on CET1WI or hyperintensity lesion on FLAIR. Histogram analysis was used to calculate the corresponding parameters of the total VOIs. Student's t-test and Mann-Whitney test were used to evaluate significant difference of aforementioned imaging parameters between both groups. The PFS associated with nCBV was analyzed by Kaplan-Meier survival analysis.

RESULTS

The 75th percentile nCBV with leakage correction corresponding on CET1WI(T1nCBVL75%) had significant difference between the short(<3-year) and long(>=3-year) PFS subgroups of RT group(23.3%[7/30]vs76.7%[23/30],P<.05) and between the short(<1-year) and long(>=1-year) PFS subgroups of non-RT group(43.7%[7/16] s56.3%[9/16],P<.05). Patients of RT group with high T1nCBVL75%(> 5.3377) had shorter PFS than the others with low T1nCBVL75%(<= 5.3377)(P<.05). However, patients of non-RT group with high T1nCBVL75%(> 4.2243) had longer PFS than the others with low T1nCBVL75%(<= 4.2243)(P<.05).

CONCLUSION

Based on RT stratification, CBV with leakage correction has potential as a noninvasive biomarker for prognosis prediction of PCNSL to identify high risk patients and has different relationship with PFS based on the presence of combined RT. The high value of CBV with leakage correction correlates with shorter PFS in RT group and with longer PFS in non-RT group.

CLINICAL RELEVANCE/APPLICATION

Pretreated CBV value with leakage correction from DSC-PWI would be helpful to plan for therapeutic strategy in patients with PCNSL.

SSG11-05 Characterization of Parotid Tumors with Arterial Spin Labeling Perfusion-Weighted MR Imaging

Tuesday, Nov. 28 11:10AM - 11:20AM Room: N229

Participants
Ahmed Abdel Razek, MD, Mansoura, Egypt (*Presenter*) Nothing to Disclose
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PURPOSE

To characterize parotid tumors with arterial spin labeling perfusion-weighted MR imaging

METHOD AND MATERIALS

This study was conducted upon 44 consecutive patients (27M, 21 F aged 15-75 ys: mean 45ys) with parotid tumors that underwent arterial spin labeling perfusion-weighted MR imaging at 1.5 Tesla scanner (Ingenia Philips Nederland). Multi-phases arterial spin labeling with FEEPI sequence was applied. The applied scanning parameters: TR = 250o ms, TE =20 ms, flip angle =35degress, slice thickness = 6 mm, interslice gap=1 mm, NEX=1, FOV=25 cm X 20 cm, SENSE factor=2.5 and scanning time=4 minutes. There was reconstruction of 1200 source images. The tumor blood flow (TBF) of parotid tumors were calculated and correlated with histopathological findings.

RESULTS

The TBF of malignant parotid tumors (37.9±6.19 mL/100 g/min) was significantly different (P= 0.001) from that of benign parotid tumors (14.1±3.12 mL/100 g/min). The threshold values of TBF used in differentiating malignant from benign parotid tumors was 25.5 mL/100 g/min with area under the curve (AUC) of 0.90. The TBF of malignant parotid tumors was significantly different from that of Warthin's tumors (P = 0.001). The cutoff TBF used to differentiate malignancy from Warthin's tumors was 18.7 mL/100 g/min with AUC of 0.88. There was a significant difference in TBF between pleomorphic adenomas and Warthin's tumors (P= 0.041). The threshold values of TBF used in differentiating pleomorphic adenomas from Warthin's tumors was 15.2 mL/100 g/miny with AUC

of 0.88.

CONCLUSION

Arterial spin labeling perfusion-weighted MR imaging is non-invasive promising method that are used for differentiation of malignant from benign parotid tumors and for characterization of some benign parotid tumors.

CLINICAL RELEVANCE/APPLICATION

Arterial spin labeling perfusion-weighted MR imaging can be added to routine MR imaging for better characterization of parotid tumors

SSG11-06 Spectral Dual Energy CT Texture Analysis of Head and Neck Squamous Cell Carcinoma Tumor for Prediction of Cervical Nodal Metastasis

Tuesday, Nov. 28 11:20AM - 11:30AM Room: N229

Participants
Reza Forghani, MD, PhD, Cote-saint-Luc, QC (*Presenter*) Consultant, General Electric Company; Consultant, Real-Time Medical, Inc; Stockholder, Real-Time Medical, Inc; Committee member, Real-Time Medical, Inc
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PURPOSE

To evaluate a novel prediction model using dual energy CT (DECT) multi-energy texture feature analysis of head and neck squamous cell carcinoma (HNSCC) tumors to (1) predict the presence of associated cervical lymphadenopathy and (2) compare the accuracy of multi-energy versus single energy (65 keV) texture evaluation for endpoint prediction.

METHOD AND MATERIALS

87 patients with HNSCC having undergone a DECT scan of the neck were included in this study (64 untreated, 23 recurrent tumors). Texture analysis was performed using a commercial software (TexRAD®) by manually delineating a region of interest around the largest diameter of the tumor. Analysis and texture feature extraction was then performed on virtual monochromatic images (VMIs) ranging from 40 to 140 keV in 5 keV increments or VMIs at 65 keV alone. Random forests (RF) models were constructed using various histogram-based texture features for outcome prediction with internal cross-validation in addition to use of separate randomly selected training (70%) and validation (30%) sets. Sensitivity (Sens), specificity (Spec), positive predictive value (PPV), and negative predictive value (NPV) were determined for predicting positive versus negative nodal status in the neck.

RESULTS

When the entire patient population was evaluated, multi-energy texture analysis could predict the nodal status with an estimated Sens, Spec, PPV, and NPV of 77%, 75%, 77%, and 75%, respectively. Texture evaluation of VMIs at 65 keV only had a lower accuracy, with an estimated Sens, Spec, PPV, and NPV of 69%, 50%, 60%, and 60%, respectively. When the subset of untreated cases was evaluated, Sens, Spec, PPV, and NPV was 100%, 56%, 71%, and 100% using multi-energy analysis.

CONCLUSION

Multi-energy DECT texture analysis of HNSCC tumor is superior to texture analysis of single energy image sets at 65 keV alone and can be used to predict the nodal status in the neck with relatively good accuracy, providing information not currently available by routine clinical evaluation of the primary tumor.

CLINICAL RELEVANCE/APPLICATION

DECT texture analysis of the HNSCC tumor incorporated into radiomic models has the potential to predict neck nodal status with sufficient accuracy to preclude elective neck dissection in some cases.

SSG11-07 Advancing Precision Imaging of the Orbits with Higher Definition Digital PET/CT

Tuesday, Nov. 28 11:30AM - 11:40AM Room: N229

Participants
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Jun Zhang, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
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Michael V. Knopp, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study is to assess the clinical potential of digital photon counting PET (dPET) detector technology to enable higher definition imaging of the orbit and its associated structures and compare its imaging characteristics to conventional photomultiplier tube-based detector PET (cPET).

METHOD AND MATERIALS

Twenty oncology patients with no known orbital malignant or metastatic involvement agreed to participate in an ongoing intra-individual comparison of FDG PET imaging using pre-commercial release dPET/CT (Vereos) and cPET/CT (Gemini TF 64) systems. Standard whole-body cPET was performed using a target dose of 481 MBq FDG and imaged at ~75 min p.i. and investigational dPET was performed either at ~55 min or ~95 min p.i. Conventional PET and dPET images were reconstructed using voxel volumes of 4

mm3 (standard definition). Digital PET images were also reconstructed with smaller voxel volumes of 2 mm3 (high definition) and 1 mm3 (ultra-high definition). Intra-individual comparison of cPET/CT and dPET/CT image characteristics as well as overall image quality was performed by a blinded reader panel.

RESULTS

All 20 cPET and 60 dPET data sets were evaluable. No FDG-avid pathologic orbital lesions were identified. There was improved image quality with higher definition dPET/CT. Ultra-high definition dPET/CT images were rated best and enabled better delineation of the orbital soft tissue structures. Quantification of physiologic FDG uptake in orbital structures using higher definition dPET demonstrated slightly increasing SUVmax values which likely relate to the reduction in partial volume.

CONCLUSION

There exists an unmet clinical need to improve visualization and characterization of orbital soft tissue structures on FDG PET. Even with whole-body acquisitions, higher definition dPET/CT enables better visualization and characterization of normal orbital structures when compared with standard definition cPET/CT.

CLINICAL RELEVANCE/APPLICATION

Higher definition digital PET improves image quality and better delineates orbital structures which may allow for better lesion detectability especially for small, metabolically active lesions.

SSG11-08 Relationship between MRI and Optical Coherence Tomography (OCT) Measurements in Patients with Optic Nerve Atrophy

Tuesday, Nov. 28 11:40AM - 11:50AM Room: N229

Participants
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Nurhan Torun, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Alexander Brook, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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Rafeeque A. Bhadelia, MD, Chestnut Hill, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to: (1) Assess the relationship between MRI measurements of optic nerve (ON) area and OCT measurement of retinal nerve fiber layer (RNFL) thickness, and (2) Determine a threshold ON area which predicts clinical diagnosis of optic nerve atrophy.

METHOD AND MATERIALS

Twenty-six patients with suspected optic nerve atrophy (unilateral = 13; bilateral =13) who also had both an orbital MRI and an OCT study were retrospectively evaluated. An additional thirty-five patients who had received prior MR imaging (without OCT measurements) as part of a seizure protocol, and who had no listed ocular diagnoses, were included as controls. Age data was included and controls were selected to have an age distribution similar to case subjects. Coronal inversion-recovery images of orbital MRI were used to determine ON area at mid orbital level. RNFL thickness was determined on a Heidelberg Engineering Spectralis SD-OCT machine. Each eye was treated as a separate data point. Correlation coefficients were used to evaluate relationships, Mann-Whitney test to compare measurements, and ROC to investigate predictive accuracy.

RESULTS

No significant relationship between ON area and age was detected. A significant relationship was found between MRI measurements of ON area and OCT measurements of RNFL thickness ($r=0.61$; $p < 0.001$). There was a significant difference in ON area between subjects with optic nerve atrophy (3.5 ± 1.9 mm2; Mean ± SD) and controls (7.2 ± 2.8 mm2; $p < 0.001$). Selecting a threshold MRI-measured ON area of 4.4 mm2 had a sensitivity of 0.89 and a specificity of 0.91. The area under the ROC curve was 0.94.

CONCLUSION

MRI measurements of ON area correlate significantly with RNFL thickness measured by OCT. Our data also suggest that MRI-measured ON area < 4.4 mm2 has high sensitivity and specificity for predicting the presence of optic nerve atrophy, making it a potential diagnostic tool for radiologists.

CLINICAL RELEVANCE/APPLICATION

MRI measurement of optic nerve area can be used to predict the presence of optic nerve atrophy, making it a potential diagnostic tool for radiologists.

SSG11-09 Predictive Values of ASQ Imaging in Predicting Hypothyroidism in Hashimoto's Thyroiditis

Tuesday, Nov. 28 11:50AM - 12:00PM Room: N229

Participants
Ji Ye Lee, MD, Bucheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Hyun-Sook Hong, MD, PhD, Bucheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

ASQ (acoustic structure quantification) can provide objective and quantitative analysis of thyroid echogenicity. Our aim is to

investigate the clinical significance of ASQ imaging parameters whether it can predict progression of hypothyroidism in Hashimoto's thyroiditis (HT).

METHOD AND MATERIALS

We prospectively enrolled 92 lobes in 50 patients with HT who underwent ASQ imaging with 3 year follow up. Initial and 3 year follow up ASQ parameters including AV mode, AV average, AV SD, AV ratio, blue mode, blue average, blue SD and clinical data including thyroid function test were collected. Clinical and ASQ parameters were analyzed as possible predictors of hypothyroidism.

RESULTS

Patients who developed hypothyroidism showed lower AV mode (P=.003), lower AV average (P=.039), lower blue average (P=.02) and lower blue SD (P=.025) than patients with no change or improved thyroid function. Lower AV blue mode value (OR 0.98, P=.0019) and larger changes in AV ratio (OR 1.06, P=.0297) were significantly associated with hypothyroidism in HT.

CONCLUSION

Patients who progressed to hypothyroidism showed lower ASQ values at initial presentation. Initial ASQ parameters might be useful in stratifying the risk of hypothyroidism progression in patients with HT.

CLINICAL RELEVANCE/APPLICATION

ASQ imaging may be helpful for identifying patients at high risk for progression of hypothyroidism in HT.

LL31

Lunch and Learn: Gadolinium Based Contrast Agents: Updates and Understanding and Current Contrast Documentation Considerations: Presented by Bayer (invite-only)

Tuesday, Nov. 28 12:30PM - 1:30PM Room: S403A

Sub-Events

LL31A Gadolinium Based Contrast Agents: Updates and Understanding

PARTICIPANTS

Dr. Sheela Agarwal, M.D., Whippany, NJ;

LL31B Current Contrast Documentation Considerations

PARTICIPANTS

Joanne M. Hoener, RT.(R)(CT)(MR) - CIIP, Pittsburgh, PA

SSJ04

Cardiac (Coronary Artery Disease: Outcomes and Risk Stratification)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S504AB

CA CT MR

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

Participants
Jadranka Stojanovska, MD, MS, Ann Arbor, MI (*Moderator*) Consultant, Guerbet SA
Udo Hoffmann, MD, Boston, MA (*Moderator*) Research Grant, HeartFlow, Inc

Sub-Events

SSJ04-01 Low Coronary Endothelial Shear Stress (ESS) Measured from Computed Tomography Angiography (CTA) is Associated with Early Fibroatheroma, and High ESS is Associated with High-Risk Thin Cap Fibroatheroma as Determined by Histologic Examination

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S504AB

Participants
Anji Tang, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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Andreas Giannopoulos, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

ESS is associated with coronary plaque progression and modulates development of high-risk plaque features. However, the relationship between ESS and existing disease toward identifying the plaques at high risk of rupture has not been studied to date. We assessed whether ESS calculated from non-invasive coronary CTA can detect vulnerable plaque as determined by histopathologic examination.

METHOD AND MATERIALS

CTA was performed for 5 donor hearts with coronary artery disease. Histology was obtained every 1mm along the length of the major coronary arteries and coregistered to CTA using surgical knots and anatomic landmarks. Plaques were classified based on histology using the modified American Heart Association scheme: adaptive (AIT) and pathological (PIT) intimal thickening, fibrous (FIB), and, early (EFA), late (LFA) and thin-cap (TCFA) fibroatheroma. Resting-state ESS was calculated from CTA using a previously validated computational fluid dynamics (CFD) approach (non-Newtonian blood, flow proportional to myocardial mass and distributed using Murray's law). ESS was coregistered automatically to CTA, blinded to histology. Mean ESS at 0.5 mm intervals in each major artery was analyzed with one-way analysis of variance (ANOVA) to determine differences in ESS between plaque types. For plaque types associated with significantly different ESS, logistic regression and receiver operating characteristic analyses (ROC) were used to determine diagnostic accuracy of ESS to predict that plaque type.

RESULTS

214 histology sections with plaque were analyzed (31 AIT, 98 PIT, 37 FIB, 29 EFA, 9 LFA, 10 TCFA). Mean ESS differed significantly for TCFA vs all other types (p2.4 Pa to detect TCFA were 80%, 87.3%, and 86.9%, respectively. ESS detected EFA (ROC AUC=0.86, odds ratio=40.6/1Pa drop); sensitivity, specificity and diagnostic accuracy of ESS<1.1Pa to detect EFA were 86%, 75.9%, and 84.6%, respectively.

CONCLUSION

ESS from CTA detects EFA (low ESS2.4Pa). The former finding is in keeping with knowledge suggesting low ESS leads to early fibroatheromas. The latter finding implies a mechanical pathway (when high flow velocities and thus high ESS are present) in fibrous cap thinning and development of TCFAs.

CLINICAL RELEVANCE/APPLICATION

ESS from CTA detects thin-cap fibroatheroma and early fibroatheroma likely to progress to thin-cap. It can thus facilitate timely prevention or intervention, which no other non-invasive imaging offers.

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

SSJ04-02 Adjustment of CT-Fractional Flow Reserve Underestimation to Minimize 1-year Cardiac Events

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S504AB

Participants
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PURPOSE

CT-Fractional Flow Reserve (CT-FFR) is known to underestimate the FFR compared to invasive measurement, leading to considerable false-positive study results especially when the disease prevalence is low. The purpose of the study was to evaluate how an adjustment of CT-FFR's underestimation impacts the estimated clinical outcomes.

METHOD AND MATERIALS

This HIPAA-compliant, IRB-approved prospective study included 44 coronary arteries from 38 patients (67.8±9.6 yrs, ca score=347.7±459.3) who underwent a 1 heart-beat 320 row coronary CTA which showed 30-90% stenosis in at least one segment and also underwent invasive FFR. The CT-FFR was calculated onsite using a commercial software. We assessed the diagnostic accuracy of CT-FFR based on the receiver operating curve (ROC) using invasive FFR<=0.8 as a positive outcome. A hypothetical 1-year cardiac event incidence if revascularization (PCI) was decided based on CT-FFR was estimated, using previous evidences on incidences following invasive FFR (positive test (<=0.8) with PCI=0.03, without PCI=0.05, negative test (>0.8) with PCI=0.03, without PCI=0.01). We repeated the estimation with an adjustment of CT-FFR to minimize the deviation from invasive FFR, and assessed the change in the hypothetical cardiac events under four different disease prevalence (0.2, 1, 5, 10%).

RESULTS

A total of 16 vessels had significant ischemia (invasive FFR<=0.8). A cutoff CT-FFR of 0.8 achieved 94% sensitivity and 75% specificity (AUC of ROC=0.82), but it significantly underestimated the invasive FFR especially when CT-FFR was <0.7; estimated total cardiac events per 100,000 population was 158.7 under the 1% disease prevalence, 84.9 of which were events among patients with false-positive CT-FFR. After the adjustment of CT-FFR using a formula of 0.3X+0.634 for CT-FFR<0.7 to counteract its underestimation, the estimated total cardiac event decreased to N=123.5 at the 0.8 cutoff and was minimized to N=110 (30.5% reduction) at a 0.75 cutoff. When the disease prevalence was 0.2, 5, and 10%, the % reduction of the events was 31.5%, 25.4% and 19.5%.

CONCLUSION

Adjustment of CT-FFR to counteract the underestimation decreased the estimated 1-year cardiac events up to 31.5% depending on the disease prevalence.

CLINICAL RELEVANCE/APPLICATION

When using a CT-FFR to decide revascularization, underestimation should be adjusted to reduce cardiac events attributable to false positive results, especially when the disease prevalence is low

SSJ04-03 Sexual Dimorphism in the Association between Coronary Plaque Burden and Coronary Wall Thickness in Asymptomatic Coronary Artery Disease

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S504AB

Awards
Trainee Research Prize - Fellow

Participants
Khaled Z. Abd-Elmoniem, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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Reham M. Elgarf, BDS, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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Ahmed H. Hamimi, MD , Chevy Chase, MD (*Abstract Co-Author*) Nothing to Disclose
Colleen M. Hadigan, MD, MPH, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the relationship between coronary plaque burden measured by Computerized Tomography Angiography (CTA) and coronary wall thickness (VWT) using Magnetic Resonance Imaging (MRI) in a low/intermediate risk asymptomatic population. The study also is to assess the value of VWT-MRI as a surrogate marker of plaque burden alone or in tandem with traditional atherosclerosis risk factors.

METHOD AND MATERIALS

We prospectively evaluated 124 asymptomatic adults with one or more modifiable cardiovascular risk factors. All subjects signed

informed consent for this IRB approved study and underwent CTA and 3 Tesla (3T) VWT-MRI. Estimated risk for atherosclerotic disease, coronary calcification, and plaque burden scores including segment involvement (SIS), volume (SVS) and stenosis scores (SSS) were obtained for all subjects. Series of univariable and multivariable generalized nonlinear regression modeling with consideration for interactions with gender were performed to investigate the association of traditional atherosclerotic risk factors and VWT with plaque burden scores.

RESULTS

A total of 62 male and 62 age- and BMI-matched female asymptomatic subjects with low/intermediate Framingham score (FrS) <20% were successfully imaged. Age, gender, and VWT, individually, were significant predictors of all coronary plaque burden scores. Additionally, gender remained a significant effect modifier in all plaque burden scores. In women, VWT, while in men, age, were the only common statistically significant predictor of coronary plaque burden scores with a statistically significant interactions between VWT and sex for SIS (ß=0.792, P =0.024) and for SSS (ß=1.292, P =0.009).

CONCLUSION

In asymptomatic subjects with low/intermediate FRS there is evidence of a sex-dimorphic association between VWT and gender as a predictor of coronary plaque burden. MRI-based VWT could supplement traditional risk scores for CAD risk stratification in women. This is in line with the previous studies that demonstrated the suboptimal performance of CAD risk score models for women compared to men.

CLINICAL RELEVANCE/APPLICATION

Coronary wall thickness measured noninvasively by MRI is a surrogate for subclinical atherosclerosis in low and intermediate CAD risk asymptomatic women but not in a similar male population. This sex-specific difference is clinically relevant for CAD risk stratification, life style modification and therapy of CAD in women.

SSJ04-04 Prevalence of Unrecognized Myocardial Infarction Detected By Cardiac Magnetic Resonance and Its Relation to Coronary Artery Calcium Score in Asymptomatic Asian Cohort

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S504AB

Participants
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PURPOSE

To investigate the prevalence of unrecognized myocardial infarctions (UMIs) in asymptomatic Asian subjects, assessed with cardiac magnetic resonance (CMR), and to relate the findings to cardiovascular risk prediction scores and coronary artery calcium (CAC) scores.

METHOD AND MATERIALS

Total 519 asymptomatic subjects (male:female, 476:43; age, 54.54 ± 6.41) who underwent both CMR and CAC scoring CT, with their interval less than 1 year, were included. Those with prior hospital-reported cardiovascular event were not included. Framingham risk score (FRS), ACC/AHA risk score and CAC score were assessed based on clinico-laboratory results and imaging data. Comparison of variables between those with and without UMI was performed by use of Student's t-test, Mann-Whitney test, chi-square test and Fisher's exact test. The confidence level and cutoff value of CAC score was analyzed with the receiver operating characteristic (ROC) method.

RESULTS

Late gadolinium enhancement (LGE) indicating UMI was noted in 12 of 519 subjects (2.3%). However, none of them showed pathologic Q-wave or ST-segment change on electrocardiography (ECG). Among clinico-laboratory results and risk prediction scores, only CAC scores differed significantly between those with and without UMIs ($p < .001$). The prevalence of UMI was as follows: 10 of 275 (3.6 %) in subjects with CAC score > 0 and 2 of 244 (0.8 %) in subjects with CAC score = 0. Among those with CAC score > 0, area under the ROC curve of CAC score for predicting UMI was 0.868 (95% CI, 0.823 - 0.906; $p < .001$). A CAC score with cutoff value of 301 demonstrated a sensitivity of 80.0% (95% CI, 44.4%-97.5%), a specificity of 86.0% (95% CI, 81.3%-90.0%), and a negative predictive value of 97.9% (95% CI, 95.0%-99.5%) in predicting UMI.

CONCLUSION

The prevalence of UMI in asymptomatic Asian subjects was 2.3%. CMR was a sensitive tool in depicting UMI and was superior to ECG. Those with CAC score above 301 can be potential candidates of CMR for UMI screening, as high CAC score is predictive of UMI.

CLINICAL RELEVANCE/APPLICATION

Asymptomatic individuals with CAC score above 301 are potential candidates of CMR for UMI screening, as high CAC score is predictive of UMI detected on CMR.

SSJ04-05 Correlation between Haptoglobin Phenotypes and Myocardial Reperfusion Injury in Consecutive ST-Elevation Myocardial Infarction as Detected by Cardiac Magnetic Resonance

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S504AB

Participants
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PURPOSE

Primary percutaneous coronary intervention (pPCI) has significantly reduced cardiovascular mortality of ST-segment elevation myocardial infarction (STEMI) patients. Cardiac magnetic resonance (CMR) has emerged as the gold standard technique for the measurement of the myocardial salvage index (MSI) and microvascular obstruction (MVO) over the traditional risk stratification. Aim of this study is to evaluate the correlation between variants of haptoglobin and myocardial reperfusion injury as detected by CMR in consecutive STEMI patients who underwent successful pPCI.

METHOD AND MATERIALS

Consecutive STEMI patients reperfused by primary PCI were enrolled. For each patient, the characterization of different phenotypes of haptoglobin was evaluated. Moreover, a CMR was performed by 1 week after STEMI evaluating: left ventricle ejection fraction (LVEF), MSI and prevalence and amount of MVO. The primary endpoint of study was to evaluate the correlation between different phenotypes of haptoglobin and myocardial reperfusion injury as detected by CMR.

CONCLUSION

Different variants of haptoglobin may play a crucial role in cardiac repair responses by reducing oxidative stress, maintaining microvascular integrity and proper scar formation. Further studies should be performed to evaluate if different therapeutic strategies should be developed based on phenotypes of haptoglobin of patients.

CLINICAL RELEVANCE/APPLICATION

haptoglobin may play a crucial role in cardiac repair responses and could represent a theraputic target in order to reduce myocardial reperfusion injury.

SSJ04-06 Coronary to Pulmonary Artery Fistula in the Adult: Natural History and Management Strategies

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S504AB

Participants
Hokun Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the natural history of coronary-to-pulmonary artery fistula (CPAF) detected on coronary CT angiography (CCTA) and to propose potential treatment strategies.

METHOD AND MATERIALS

The institutional review board approved this retrospective study and informed consent was waived. 12,436 CCTA scans were performed in our institute between March 2009 and June 2016, and 74 patients were diagnosed as CPAF. Among them, patients with a follow-up of at least 2 years were retrospectively reviewed. Demographics, clinical history, prior cardiac testing, and reasons for CCTA were collected by a review of electronic medical records. The morphologic features of CPAF were analyzed, including vessel of origin site and number, size, and the presence of an aneurysmal sac. All patients were examined to what treatment they received after the diagnosis of CPAF. We investigated whether there were major adverse cardiac events (MACE), which was defined as the presence of death, myocardial infarction, and the need for revascularization or percutaneous intervention during the follow-up period.

RESULTS

48 patients had a follow-up period of more than 2 years. The mean age of the study population was 62 years (range 43-84, 39% male), and average follow-up period was 5.1 years. Common causes of CCTA were chest pain, palpitation, asymptomatic in order. Underlying diseases were hypertension, coronary artery disease, hyperlipidemia, and diabetes. The origin of CPAF was the left coronary artery in 22, the right coronary artery in one and both coronary arteries in 23 cases. More than half of the fistula sizes were less than 2 mm (26 cases, 62%). 12 cases were associated with an aneurysm (mean 12±7.5 mm). 4 cases underwent surgical ligation due to continued chest pain or having a larger aneurysm (range 12-19 mm). After the operation, they were free of a symptom. Another 44 patients were observed with optical medical treatments (OMT) and their symptom was controlled well. All

patients treated either surgery or OMT did not experience MACE during the follow-up period.

CONCLUSION

The natural course of CPAF detected by CCTA is usually benign. Optimal medical treatment is sufficient in most of the cases. Continued symptom and aneurysmal size are determinant for surgical ligation.

CLINICAL RELEVANCE/APPLICATION

As a treatment strategy for CPAF, OMT and observation are first and in most cases that are enough.

SSJ05

Science Session with Keynote: Chest (Lung Nodule/MRI)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: S404CD

CH MR OI

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

FDA Discussions may include off-label uses.

Participants

Yoshiharu Ohno, MD, PhD, Kobe, Japan (*Moderator*) Research Grant, Toshiba Medical Systems Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Fuji Pharma Co, Ltd; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Guerbet SA;
Andrew J. Plodkowski, MD, Syracuse, NY (*Moderator*) Nothing to Disclose
Jurgen Biederer, MD, Heidelberg, Germany (*Moderator*) Nothing to Disclose

Sub-Events

SSJ05-01 Chest Keynote Speaker: Focal Lung Lesions: The Potential Role of MRI for the Assessment of Malignancy

Tuesday, Nov. 28 3:00PM - 3:10PM Room: S404CD

Participants
Jurgen Biederer, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

ABSTRACT

In current practice, magnetic resonance imaging (MRI) of the lung is increasingly recognized as a valuable adjunct or even alternative to computed tomography (CT). Superior soft tissue contrast of morphologic sequences and the functional imaging capacities of MRI open new perspectives for detection and assessment of pulmonary malignancy. In a screening setting, applications range from lung MRI as the first choice screening modality to the role of an ad hoc on site test for the detailed evaluation of positive CT screening results with multi-parametric characterization of lung pathology. Malignant lung lesions, carcinoma, metastases, carcinoid and lymphoma usually show a nonspecific low or intermediate signal intensity on T1-weighted images and high signal intensity on T2-weighted images. Short tau inversion recovery (STIR) sequences achieve a sensitivity of approximately 80 % and a specificity of 60%. Dynamic contrast enhanced (DCE) MRI is based on the evaluation of contrast uptake in the assessed lesion after bolus injection. It achieves specificities of 50-95% and sensitivities of 50-100% with diagnostic accuracies of 75-94%, hence coming close to the accuracies of contrast enhanced MDCT and FDG PET/CT. As in dynamic CT, it can be assumed that DCE MRI of solid pulmonary lesions has a high negative predictive value in cases of very low or missing enhancement after intravenous contrast application. More recently, diffusion weighted imaging (DWI) has been advocated for the assessment of focal lung lesions. DWI yields sensitivities between 70% and 90% and specificities of 60-95% for malignancy. However, DCE and DWI MRI cannot yet be considered robust, highly standardized and simple techniques for clinical use. The applied protocols vary widely and solutions for basic problems such as compensation for respiratory motion and for the non-linearity of blood/tissue-signal with gadolinium-concentration are still subject to research. Further methods to evaluate tumor viability based on multi-parametric MRI are on an early, experimental level. The presentations comprised within this scientific session will contribute valuable insights into the further development, application, performance and diagnostic yield of these emerging techniques.

SSJ05-02 Diagnostic Performance of Diffusion-Weighted Imaging with Multiple Parameters for Assessment and Characterization of Pulmonary Lesions: A Meta-Analysis

Tuesday, Nov. 28 3:10PM - 3:20PM Room: S404CD

Participants
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Anren Kuang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Regarding DWI application in thoracic disease, several appropriate parameters have been reported, commonly including 5-point rank scale, lesion-to-spinal cord ratio (LSR) and apparent diffusion coefficient (ADC). This study aimed to evaluate the diagnostic performance of diffusion-weighted imaging (DWI) using these three parameters for the characterization of pulmonary lesions.

METHOD AND MATERIALS

After literature search in several databases (the PubMed, EMBASE, Cochrane library and China National Knowledge Infrastructure databases), two investigators independently selected studies, assessed methodological quality, and extracted data. On a per-lesion basis, we pooled and compared three parameters between malignant and benign pulmonary lesions. Then, we determined pooled sensitivity and specificity with individual 95% confidence intervals (CIs). In addition, the summary receiver operation characteristic curves (SROC) for DWI with area under the curve (AUC) and Q* index were constructed.

RESULTS

In total, 31 articles involving 2368 lesions were included. The score of 5-point scale of malignant and benign lesions were 3.83

(3.71-3.96) and 2.36 (2.18-2.54), respectively. The LSR of malignant and benign lesions were 1.15 (1.07-1.24) and 0.71 (0.62-0.79), respectively. The ADC values of malignant lesions and benign lesions were 1.23 (1.21-1.24) and 1.72 (1.68-1.77), respectively. All of three parameters differed significantly between malignant and benign lesions (Figure 1) ($p<0.05$). With a cut-off value of 3, the pooled sensitivity and specificity were 0.88 (0.84-0.91) and 0.75 (0.68-0.80) for 5-point scale. The SROC curve displayed AUC of 0.9107 and Q* index of 0.8429, respectively. For LSR, the pooled sensitivity, specificity, AUC and Q* index were 0.80 (0.75-0.85), 0.85 (0.76-0.92), 0.9159 and 0.8487, respectively. The ADC measurements yielded the pooled sensitivity of 0.84 (0.82-0.86), pooled specificity of 0.84 (0.81-0.87), AUC of 0.9198, and Q* index of 0.8532.

CONCLUSION

DWI can help to distinguish malignant from benign pulmonary lesions based on visual parameter (5-point scale), semiquantitative parameter (LSR) and quantitative parameter (ADC).

CLINICAL RELEVANCE/APPLICATION

In clinical practice, 5-point scale, LSR, and ADC were useful diagnostic parameters for pulmonary lesions, and the diagnostic performances of them did not show any significant differences.

SSJ05-03 Assessment of Intravoxel Incoherent Motion Diffusion-Weighted MR Imaging in Solitary Pulmonary Nodules: Comparison and Correlation with Dynamic Contrast-Enhanced MR Imaging

Tuesday, Nov. 28 3:20PM - 3:30PM Room: S404CD

Participants
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PURPOSE

To compare intravoxel incoherent motion (IVIM) and dynamic contrast-enhanced MR imaging (DCE-MRI) in their ability to discriminate lung cancer(LC) from benign pulmonary lesions.

METHOD AND MATERIALS

57 consecutive patients with solitary pulmonary nodules underwent DW-IVIM (multi-b-factor DWI with b values of 0, 20,50, 100, 150,200, 400, 600, and 1000 s/mm2) and DCE-3.0T MRI. ADCtotal, Tissue diffusivity (D), pseudo-diffusion coefficient (D*), and perfusion fraction (F) were calculated with mono--exponential and IVIM models. MER,Tmax, SLE and washout were calculated with semi-quantitative DCE analysis. Receiver operating characteristic (ROC) curves was constructed to estimate the diagnostic performance of both methods in differentiating diagnosis and the optimal cut-off values were obtained.

RESULTS

ADCtotal and D were significantly higher for benign lesions than for LC ([1.83?±?0.66]?×?10-3 mm2/s vs. [1.30?±?0.40]?×?10-3 mm2/s; P?=?0.005; [1.33?±?0.43]?×?10-3 mm2/s vs. [0.88?±?0.29]?×?10-3 mm2/s; P?=?0.002). D*was found to be significantly higher in LC than benignity ([50.65?±?46.08] ×?10-3 mm2/s vs. [19.68?±?30.54] ×?10-3 mm2/s; P?=?0.005). No difference was observed in F between LC and benignity (P?=?0.06).By DCE-MRI,Tmax were significantly shorter in LC than that of benignity([131.6?±?83.4]?s vs. [309.7?±?126.0]?s; P? **CONCLUSION**

Both IVIM model based on DWI and DCE-MRI were useful for discriminating benign lesions from malignant pulmonary nodules, and can provide quantitative diffusion and perfusion information by multiple parameters. We suggest that a combined DCE and IVIM could provide a more promising way in determination microstructure characteristics of solitary pulmonary nodules.

CLINICAL RELEVANCE/APPLICATION

Combination of DCE and IVIM could provide an alternative noninvasive method for diagnosis of SPN without radiation explosure.

SSJ05-04 How to Apply Computed Diffusion-Weighted Image for Improving Diagnostic Performance of Chest MR Imaging in Patients with Pulmonary Nodules?

Tuesday, Nov. 28 3:30PM - 3:40PM Room: S404CD

Participants
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PURPOSE

To determine the utility of computed diffusion-weighted image (cDWI) for improving diagnostic performance on chest MR imaging in patients with pulmonary nodules.

METHOD AND MATERIALS

61 consecutive patients (38 men and 23 women; mean age, 69.1±9.7 years) with 82 pulmonary nodules underwent DWIs,

transbronchial or CT-guided biopsies, surgical resection, pathological, microbaclterial and follow-up examinations. All DWI were obtained at a 3T MR system by using fast advanced spin-echo (FASE) sequence with b values at 0 and 1000s/mm2. As well as actual DWI at 1000s/mm2 (aDWI), cDWIs were generated at b value as 400 (cDWI400), 600 (cDWI600), 800 (cDWI800), 1000 (cDWI1000), 1500 (cDWI1500) and 2000 (cDWI2000) s/mm2 by commercially available software. According to results of pathological and follow-up examinations, all nodules were divided into malignant (n=41) and benign (n=41) nodule groups. Then, signal-to-noise ratio (SNR) and contrast ratio (CR) between nodule and thoracic muscles were determined by ROI measurement at each nodule. To compare image quality between aDWI and each cDWI, SNRs were compared by Dunnett multiple comparison test. To determine the utility of cDWI with aDWI, the logistic regression analysis was also performed with aDWI and all cDWIs. To compare diagnostic performance of pulmonary nodule, ROC analyses were performed among aDWI, each DWI and combined aDWI with appropreate cDWI determined by logistic regression analysis. Finally, sensitivity, specificity and accuracy were compared by McNemar's test.

RESULTS

SNRs of cDWI400 (p=0.002) and cDWI600 (p=0.008) were significantly higher than that of aDWI1000, although that of cDWI1500 (p<0.001) and cDWI2000 (p<0.001) were significantly lower than that of aDWI1000. Logistic regression analysis showed aDWI and cDWI600 were significant predictors for diagnosis of malignancy (p<0.05). Accuracy of aDWI with cDWI600 (86.6 [71/82] %) was significantly higher than that of aDWI (81.7 [67/82] %, p<0.05).

CONCLUSION

Computed DWI has a potential to improve diagnostic performance of DWI in patients with pulmonary nodules, when generated at appropriate b value.

CLINICAL RELEVANCE/APPLICATION

Computed DWI has a potential to improve diagnostic performance of DWI in patients with pulmonary nodules, when generated at appropriate b value.

SSJ05-05 The Value of Differential Diagnosis the Invasive Adenocarcinoma of Lung in 3T MRI

Tuesday, Nov. 28 3:40PM - 3:50PM Room: S404CD

Participants
ning zhang, shi Jiazhuang, China (*Presenter*) Nothing to Disclose

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PURPOSE

To investigate the value of magnetic resonance imaging (MRI) in differential diagnosis of invasive pulmonary adenocarcinoma (IPA) appearing as ground-glass nodules

METHOD AND MATERIALS

Retrospective analysis was performed on CT and MRI findings in patients with pulmonary ground-glass nodules from December 2014 to December 2016. All patients were undergo the surgery and pathologically proved, they were pre-cancerous lesions or clinical stage 1 of lung adenocarcinoma. The image features of the lesions were analyzed by two readers who did not know the pathological results. Maximum diameter, T2 signal intensity and ADC value were measured. According to the pathology, the lesions were divided into two groups. One included pre-invasive lesion (AAHs and AISs) and MIAs, another included IPAs. Compared the 3 indicators between two groups . All statistical analyses were performed using SPSS 21.0. The measurement data were analyzed by using two independent samples t test,If it was suitable for the normal distribution, otherwise using Mann-Whitney U test. Count data were compared using chi square test. Receiver operating characteristic (ROC) curve analysis were performed to evaluate diagnostic test.

RESULTS

A total of 34 participants (14 male, 57.1±14.7 year-old; 20 female, 54.9±10.1year-old) with 34 nodules were enrolled in the study. There were 15 cases in group A , including 4 AAH, 2 AIS and 9 MIA, and19 cases in group B. There was no significant differences in the age of patient and gender between the two groups. The maximum diameter of lesions in group A was significantly less than that in group B(9.9±2.6mm vs 13.1±2.7mm). The T2 signal intensity of lesions in group A was significantly lower than that in group B(93.0±8.3 vs 113.6±22.9).The ADC value in group A(1.0±0.2*10-3 mm2/s) was also significantly lower than that in group B (1.3±0.3*10-3 mm2/s). The best index to distinguish the two groups is the maximum diameter of lesions The optimal cut-off value for maximum diameter was 11.5mm (sensitivity, 73.7%; specificity, 73.3%).The AUC for maximum diameter was 0.791 (95% confidence interval: 0.640,0.942)

CONCLUSION

The maximum diameter of the nodule, T2 signal intensity and ADC value are helpful for differential diagnosis of invasive lung adenocarcinoma.

CLINICAL RELEVANCE/APPLICATION

The maximum diameter of the nodule, T2 signal intensity and ADC value are helpful for differential diagnosis of invasive lung adenocarcinoma.

SSJ05-06 Primary Tumor Cellularity Assessed on Diffusion Weighted MRI and Metabolism Assessed on PET/CT as Predictive Factors for Lymph Node Involvement in Non-Small Cell Lung Cancer (NSCLC)

Tuesday, Nov. 28 3:50PM - 4:00PM Room: S404CD

Participants
Lucio Calandriello, MD, Rome, Italy (*Presenter*) Nothing to Disclose
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PURPOSE

The aim of this study was to prospectively analyze the potential role of primary tumor apparent diffusion coefficient (ADC) derived from whole body MRI (WB-MRI) with diffusion weighted imaging (DWI) and metabolic parameters derived from FDG PET/CT in predicting pathologically assessed lymph node metastasis in non-small cell lung cancer (NSCLC) patients before treatment.

METHOD AND MATERIALS

Ethic committee approval was obtained for this prospective study as well as written informed consent from every patient. The study group comprised 32 consecutive patients (mean age: 67yrs) with histologically proven NSCLC (SCC n= 8 and AC n=24) who underwent 1.5 T WB-MRI with DWI and FDG PET/CT before treatment. Maximum diameter (maxTD) and minimum and mean ADC (ADCmin and ADCmean) of primary tumor were calculated on DWI images (b-values 0-1000). Maximum standardized uptake value (SUVmax), metabolic tumor volume (MTV) and total lesion glycolysis (TLG) were measured on FDG PET/CT. Presence of lymph node (LN) metastases was pathologically assessed and served as reference standard. Relationships between imaging metrics and LN status were evaluated using the Mann-Whitney U test. The area under the receiver operating characteristic (ROC) curve was used to evaluate accuracy.

RESULTS

Lymph node metastasis were documented in 11 patients (34%). There were significant correlations between primary tumor maxTD, ADCmean, MTV, TLG and presence of LN metastasis (p: 0.05, 0.05, 0.04 and 0.04 respectively). ADCmin and SUVmax were not associated with LN metastasis. On ROC curve analysis, the areas under the curve (AUC) for maxTD, ADCmean, MTV and TLG for were 0.71, 0.70, 0.71 and 0.73 respectively, for predicting LN status.

CONCLUSION

Parameters derived from pre-treatment WB-MRI with DWI (maxTD and ADCmean) and from FDG PET/CT (MTV and TLG) may serve as predictive biomarkers of lymph node metastasis in patients with non small cell lung cancer.

CLINICAL RELEVANCE/APPLICATION

Diffusion weighted MRI and FDG PET/CT functional characteristics of the primary tumor can be used for predicting pathologic lymph-node involvement in NSCLC patients.

SSJ07

Gastrointestinal (Radiomics)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E350

CT GI MR PH

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

Participants
Andrew D. Smith, MD,PhD, Jackson, MS (*Moderator*) President, Radiostics LLC; President, eRadioMetrics LLC; Patent holder, eRadioMetrics LLC; President, Liver Nodularity LLC; Patent holder, Liver Nodularity LLC; President, Color Enhanced Detection LLC; Patent holder, Color Enhanced Detection LLC
Kathryn J. Fowler, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

Sub-Events

SSJ07-01 Radiomics-Based Quantification and Classification of the Phenotype of Pancreas Cystic Neoplasms on Abdominal CT Images

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E350

Participants
Seyoun Park, Baltimore, MD (*Presenter*) Nothing to Disclose
Linda C. Chu, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Elliot K. Fishman, MD, Baltimore, MD (*Abstract Co-Author*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics Inc;

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PURPOSE

Pancreatic cystic masses are detected in greater than 2% of abdominal CTs, and they vary in malignant potential based on underlying pathologic diagnosis. Many of these cystic masses share overlapping imaging features and are difficult to confidently diagnose based on visual assessment of these imaging features. The purposes of this study are to quantify the phenotype pancreas cystic neoplasms and to use these radiomics features to classify different types of pancreatic cystic masses.

METHOD AND MATERIALS

This was an IRB-approved retrospective study. 103 patients with pathologically proven pancreatic cystic masses with preoperative dual-phase pancreatic protocol CT were identified from the radiology and pathology database from 2003 to 201 6. This included 60 intraductal papillary mucinous neoplasm (IPMN), 8 mucinous cystic neoplasm, 20 serous cystadenoma, 10 solid pseudopapillary epithelial neoplasm, and 5 pancreatic neuroendocrine tumor. Primary cystic masses and whole pancreas were manually segmented using dedicated software, the Medical Imaging Interaction Toolkit (MITK) . The phenotype of each cyst was expressed by 478 radiomics features, including the first order statistics, shape, texture, and textures from wavelet and Laplacian of Gaussian. Additional 10 statistics from the whole pancreas and 2 demographic features of age and gender were also used for the analysis of the types of cyst. The minimum redundancy maximum relevance feature selection was applied for feature dimension reduction.

RESULTS

Among the whole 490 features, thirty features were found for the binary classification of IPMN. The matching results to clinical outcomes show 0.883 of sensitivity and 0.721 of specificity with 81.6% of overall accuracy (AOC area: 0.873). For all five types, thirty-five features were extracted with 72.8% of correctly classified cases by 10-fold cross validation. Age, median and mean intensities of wavelets, and fractal dimension were highly ranked for the both classifications.

CONCLUSION

Radiomics features were significantly different among different types of pancreatic cystic neoplasms and were helpful for the classification of pancreatic cystic neoplasms.

CLINICAL RELEVANCE/APPLICATION

Radiomics features can be used for the classification of pancreatic cystic neoplasms.

SSJ07-02 Radiomics Approach to Characterize Microsatellite Instability (MSI): A CT-Based Radiomic Signature for the Detection of the MSI-H Phenotype in Colorectal Cancer

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E350

Participants
Yanqi Huang, Guangzhou, China (*Presenter*) Nothing to Disclose
Zaiyi Liu, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To develop and validate a CT-based radiomic signature for the preoperative detection of the MSI-H (high levels of microsatellite instability) phenotype in patients with colorectal cancer.

METHOD AND MATERIALS

Ethical approval by the institutional review board was obtained for this retrospective analysis, and the informed consent was waived. The primary cohort of this study consisted of 140 patients with clinicopathologically confirmed CRC, with data gathered from January to December 2011; while the independent validation cohort consisting of 114 consecutive patients collected from January to December 2012. 591 radiomic features were extracted from preoperative portal venous-phase computed tomography (CT) of CRC. Lasso regression model was used for data dimension reduction, feature selection, and radiomics signature building. The discrimination and calibration performance of the developed radiomics signature was assessed in primary cohort and then validated in the independent validation cohort.

RESULTS

After feature redcution and selection, 29 radiomics features were used to develop the radiomic signature. In both the primary and validation cohort, the radiomic signature was significantly associated with the MSI-H phenotype (P<0.001 for primary cohort; P=0.012 for validation cohort). The radiomic signature showed good discrimination, with a C-index of 0.914 (95%CI: 0.901, 0.927) in primary cohort and 0.702 (95%CI: 0.677, 0.727) in validation cohort. Good calibration of the radiomic signature was depicted in calibration curves in both the primary and validation cohort.

CONCLUSION

This study presents a CT-based radiomic signature that can be conveniently used to facilitate the preoperative individualized detection of MSI-H phenotype in CRC patients, which could be useful for informing patient prognosis and guiding the personalized therapy of CRC including adjuvant chemotherapy, targeted therapy, and immune checkpoint inhibitor therapy.

CLINICAL RELEVANCE/APPLICATION

The developed and validated CT-based radiomic signature could facilitate the preoperative individualized detection of MSI-H phenotype CRC, which further advances the role of MSI in informing patient prognosis and guiding the personalized therapy of CRC including adjuvant chemotherapy, targeted therapy, and immune checkpoint inhibitor therapy.

SSJ07-03 Comparison between Radiomics Analysis and Subjective Visual Assessment of T2-weighted MRI Images for the Identification Of >=T3 Rectal Cancer

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E350

Participants
Ines A. Santiago, MD, Lisbon, Portugal (*Presenter*) Nothing to Disclose
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Nickolas Papanikolaou, PhD, Lisbon, Portugal (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine if radiomics outperforms visual assessment based on T2-weighted imaging (T2-W) for the discrimination between <=T2 and >=T3 rectal cancer

METHOD AND MATERIALS

The study included all patients with rectal cancer who underwent total mesorectal excision as primary curative treatment, without neoadjuvant therapy, at our institution, between October 2013 and December 2016 (n=26, 14 males, mean age=67 years). Two patient groups were formed based on pathological stage, <=T2 (n=13) and >=T3 (n=13). All patients underwent staging MRI before surgery comprising T2-W imaging in axial, coronal and sagittal planes. T2-W images were blindly reviewed in consensus by 2 radiologists and primary tumors were classified as >=T3 or <=T2. A volume of interest (VOI) was drawn in consensus by the 2 radiologists, based on axial T2-W images, encompassing the whole primary tumor and corresponding datasets were analyzed using the PyRadiomics package. Wilcoxon-Mann-Whitney test was used to define the discriminating power between the 2 groups, of each of the 1831 features separately. Feature reduction was done using a cut-off correlation coefficient of 0.99 to remove redundant features. Multiple comparisons correction was done based on an FDR test. The best performing feature was selected, and its diagnostic accuracy was compared to that of visual radiological assessment using DeLong's test

RESULTS

23 radiomics features provided with statistically significant differences (p<0.05) between the 2 groups, while the best performing feature was the Low Gray Level Run Emphasis - GLRLM of the exponential of the original image with sensitivity, specificity and area under the ROC curve (AUROC) of 0.79, 0.92 and 0.92, respectively. Sensitivity, specificity and AUROC were 0.93, 0.67 and 0.80, respectively, for visual radiological evaluation. The performance difference between visual assessment and radiomics analysis was not statistically significant (p=0.21)

CONCLUSION

Our preliminary results indicate that radiomics analysis doesn't provide higher performance compared to visual radiological assessment for the identification of >=T3 rectal cancer based on T2-W images.

CLINICAL RELEVANCE/APPLICATION

Radiomics analysis and difficult issues in rectal cancer staging: applicability in the identification of >=T3 rectal cancer

SSJ07-04 Predicting Early Recurrence of Hepatocellular Carcinoma with Texture Analysis of Pre-Operative Magnetic Resonance Imaging: A Radiomics Study

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E350

Awards
Student Travel Stipend Award

Participants
Terrence C. Hui, MBBS,MRCS, Singapore, Singapore (*Presenter*) Nothing to Disclose
Tong Kuan Chuah, PhD, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose
Zi Lin Tan, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose
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Cher Heng Tan, MBBS, FRCR, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To study the feasibility of using texture analysis in pre-operative magnetic resonance imaging (MRI) to predict early recurrence (ER) in hepatocellular carcinoma (HCC) post-curative surgery.

METHOD AND MATERIALS

Institutional review board was obtained. A retrospective review of all patients who underwent hepatectomy between 1 Jan 2007 and 31 Dec 2015 was performed. Inclusion criteria: pre-operative MRI, tumor size >=1cm, new cases of HCC. Exclusion criteria: Loss-to-follow-up, ruptured HCCs, movement artifacts and previous hepatectomy or interval adjuvant therapy. Patients were divided into ER and late or no recurrence (LNR) groups. Early recurrence was defined as new foci of HCC within 730 days of curative surgery. Plain, diffusion-weighted, arterial and portovenous acquisitions were imported into MATLAB (Mathworks, Matick, MA, USA). Radiomics feature extraction was performed on the largest cross-sectional area of each tumor. MaZda software (version 4.6.2.0) was used to analyze 290 texture parameters and PRTools was used for feature selection.

RESULTS

Fifty-seven patients (49 male, mean age 66.5 years) were divided into ER (n=21) and LNR (n=36) groups. Differences in alpha-fetoprotein level (p=0.021), tumor size (p=0.011), restricted diffusion (p=0.01) and vascular invasion (gross and/or microvascular, p=0.047) between the 2 groups were found to be statistically significant. Texture analysis revealed 79% accuracy in classifying arterial images using 1-nearest neighbor using parameters S(1,0)Contrast or S(5,-5)Entropy. The parameter S(5,-5)Entropy has also resulted in 77% accuracy in classifying T2 images.

CONCLUSION

Early recurrence of HCC can be predicted on pre-operative MRI with 79% accuracy using the appropriate texture analysis parameter.

CLINICAL RELEVANCE/APPLICATION

Post-operative recurrence of HCC results in mortality and the time-to-recurrence duration is an independent prognostic factor of survival. The ability to identify these high-risk patients pre-operatively will potentially guide both surgical management, such as resecting a wider margin or liver transplantation, as well as post-operative surveillance and therapeutic interventions.

SSJ07-05 Quantification of Hepatocellular Carcinoma Heterogeneity with Multiparametric Magnetic Resonance Imaging

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E350

Awards
Trainee Research Prize - Resident

Participants
Stefanie Hectors, PhD, New York, NY (*Presenter*) Nothing to Disclose
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PURPOSE

To quantify heterogeneity in hepatocellular carcinoma (HCC) using multiparametric (mp) magnetic resonance imaging (MRI), and to

report preliminary data correlating quantitative MRI parameters with histopathology and gene expression in a subset of patients.

METHOD AND MATERIALS

Thirty-two HCC patients (M/F 26/6, mean age 59 years) with 39 HCC lesions were included in this prospective study. The mpMRI protocol consisted of diffusion-weighted imaging (DWI), blood-oxygenation-level-dependent (BOLD), tissue-oxygenation-level-dependent (TOLD) and dynamic contrast-enhanced (DCE)-MRI. Histogram characteristics [central tendency (mean, median) and heterogeneity (standard deviation, kurtosis, skewness) MRI parameters] in HCC and liver parenchyma were compared using Wilcoxon signed-rank tests. Histogram data was correlated between MRI methods in all patients and with histopathology and gene expression in 14 patients.

RESULTS

HCCs exhibited significantly higher intra-tissue heterogeneity vs. liver with all MRI methods (P<0.042). Although central tendency parameters showed significant correlations between MRI methods and with each of histopathology and gene expression, heterogeneity parameters exhibited additional complementary correlations between BOLD and DCE-MRI and with histopathologic hypoxia marker HIF1a and gene expression of Wnt target GLUL, pharmacological target FGFR4, stemness markers EPCAM and KRT19 and immune checkpoint PDCD1.

CONCLUSION

Histogram analysis combining central tendency and heterogeneity mpMRI features is promising for noninvasive HCC characterization on the imaging, histologic and genomics level.

CLINICAL RELEVANCE/APPLICATION

The proposed mpMRI approach could potentially be used to stratify hepatocellular carcinoma treatment and to noninvasively predict treatment outcome.

SSJ07-06 Prediction of Target Therapy Related Gene Expression Level for Hepatocellular Carcinoma: Preoperative Gd-EOB-DTPA Enhanced MRI and Histopathological Correlation

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E350

Participants
Kun Huang, Guiyang, China (*Presenter*) Nothing to Disclose
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Yingmei Jia, guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
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Zi-Ping Li, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Shiting Feng, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Our aim of the study is to investigate the feasibility of prediction for target therapy related gene expression level in hepatocellular carcinoma (HCC) using preoperative Gd-EOB-DTPA enhanced magnetic resonance imaging (MRI).

METHOD AND MATERIALS

91 patients with solitary HCC who underwent preoperative Gd-EOB-DTPA enhanced MRI were prospectively analyzed. Features including tumor size, signal homogeneity, tumor capsule, tumor margin, intratumoral vessels, peritumor enhancement in mid-arterial phase, peritumor hypointensity during hepatobiliary phase, signal intensity ratio on DWI and apparent diffusion coefficients (ADCs), T1 relaxation times and the reduction rate between pre- and post-contrast enhancement images were assessed. HCC target therapy related gene (B-Raf,Raf-1,VEGFR2,VEGFR3) expression level in excision specimens were evaluated using immunohistochemical staining. Correlation between these MRI features and B-Raf,Raf-1,VEGFR2,VEGFR3 gene expression level were analyzed by Rank sum test, Spearman correlation and multivariate logistic regression so as to establish a prediction model.

RESULTS

Univariate analysis showed that tumor incomplete or non capsule (p<0.001), intratumoral vessels (P=0.002) were significantly related with the B-Raf gene expression level, and tumor capsule status (p=0.001), intratumoral vessels (P=0.013) significantly correlated with the Raf-1 gene expression level. There was no significant association between the expression level of VEGFR2, VEGFR3 and all the MRI features. Multivariate logistic regression analysis demonstrated that incomplete tumor capsule (P=0.002, OR=11.870, 95% CI: 2.473~56.975) or non capsule (P=0.004, OR=15.750, 95% CI: 2.373~104.537) were independent risk factors of HCC with high B-Raf gene expression level, and incomplete tumour capsule (P< 0.001, OR=11.250, 95%CI: 3.206~39.474) or non capsule (P=0.040, OR=5.556, 95%CI: 1.078~28.635) were independent risk factors of HCC with high Raf-1 gene expression level.

CONCLUSION

It is feasible to predict the expression level of B-Raf and Raf-1 gene using preoperative Gd-EOB-DTPA enhanced MRI.

CLINICAL RELEVANCE/APPLICATION

Incomplete or non capsule, or presence of intratumoral vessels are potential indicator for the high expression of B-Raf and Raf-1. Gd-EOB-DTPA enhanced MRI may facilitate the determination for choosing gene therapy for the patient with HCC.

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SSJ08

Gastrointestinal (Liver-Fat/Iron)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E353A

BQ CT GI MR

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

FDA Discussions may include off-label uses.

Participants
Scott B. Reeder, MD, PhD, Madison, WI (*Moderator*) Institutional research support, General Electric Company; Institutional research support, Bracco Group; Founder, Calimetrix, LLC; Shareholder, Elucent Medical
Sheela Agarwal, MD, MS, New York, NY (*Moderator*) Employee, Bayer AG

Sub-Events

SSJ08-01 Comparison of Fat Quantification Accuracy between Spectral CT Imaging and IDEAL-IQ Techniques: A Phantom Study

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E353A

Participants
CEN CHEN, Wuhan, China (*Presenter*) Nothing to Disclose
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Hongran Liu, MD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

In this study, we used spectral CT with fat material decomposition technique and magnetic resonance (MR) IDEAL-IQ to quantify fat content. The goal of this study was to evaluate the accuracy of the two methods at different fat concentrations.

METHOD AND MATERIALS

(1) For the fat-water model (model A), a series of concentrations containing homogeneous mixed fat and water were prepared, with a fat content of 0.00, 0.02, 0.04, 0.08, 0.16, 0.32, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 1.00 ml/ml, respectively. For the liver-fat model (model B), eleven homogeneous liver and fat tissue mixed samples with various fat content from 0-1.0 g/g (with an interval of 0.1 g fat/g). (2) All samples were scanned on GE Discovery HD750 CT. Fat material decomposition technique (water-fat base) was further applied to measure the fat density (MFD). IDEAL-IQ was utilized on GE Discovery 750w MR scanner to obtain the measured fat fraction (MFF). A linear regression was performed to analyze the relationship between the MFD or MFF and the actual fat fraction (AFF).

RESULTS

Both spectral CT fat material decomposition method and MR IDEAL-IQ method resulted good linear relationship between the measured fat content and AFF. In model A, it showed as: R2MFD=0.9936, R2MFF=0.9987. In Model B, it showed as: R2MFD=0.9946, R2MFF =0.9941. For Both models it had a P value less than 0.001. In particular at a lower fat concentration range in model A (AFF between 0-16%), the results were R2MFD=0.8927 and R2MFF=0.9687. In this circumstances, MFF showed a stronger linear correlation with AFF compared to MFD while MFD value can be well normalized to obtain AFF by the corresponding correlation equation.

CONCLUSION

Both spectral imaging fat material decomposition and MR IDEAL-IQ techniques can provide accurate and reliable quantification of fat content for both water-fat and liver-fat models. In particular, MFF has a more significant correlation with AFF in the low fat content scenario.

CLINICAL RELEVANCE/APPLICATION

This study demonstrated the feasibility of using CT spectral imaging - fat material decomposition and MR IDEAL-IQ technique to precisely quantify the fat content. The results indicated promising clinical applications of using these methods to study the fat metabolism in different tissues or organs (e.g. brain, breast, liver and bone) that contain different fat concentration in the future.

SSJ08-02 Automated Prediction of Nonalcoholic Fatty Liver Disease Activity Score (NAS) with an Advanced Multiparametric Magnetic Resonance Elastography and Machine Learning Technology

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E353A

Participants
Meng Yin, Rochester, MN (*Presenter*) Intellectual property, Magnetic Resonance Innovations, Inc; Stockholder, Resoundant, Inc
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Vijay Shah, PhD, MS, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Richard L. Ehman, MD, Rochester, MN (*Abstract Co-Author*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

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PURPOSE

Liver stiffness has become the most accurate noninvasive imaging biomarker for detecting hepatic fibrosis. However, much less work has been done for assessing the NAFLD activity score (NAS) - which is a numerical sum of histologic grading of steatosis, inflammation, and ballooning in biopsy specimens. In animal models, we have found that the NAS can be predicted by training a machine learning algorithm with data sets of multiple parameters obtained from MR elastography (MRE) (e.g., storage and loss moduli, volumetric strain) and MRI-assessed proton density fat fraction (PDFF). In this study, we tested the same approach in a pilot clinical study to assess the potential to predict the NAS using multiparametric MRE.

METHOD AND MATERIALS

62 clinically obese patients who underwent bariatric surgery and 12 normal volunteers (BMI<30) were included. Multifrequency MRE was used to measure the various mechanical properties that correlate with ballooning and inflammation, while PDFF was used to quantify steatosis. Liver biopsies were obtained in patients for histologic grading and calculating NAS based on the NASH CRN criteria. From the MRE/MRI parameters, the three parameters that best and most significantly correlated with NAS were selected ($p<0.05$ for all three parameters). Several machine learning regression algorithms were tested to minimize cross-validation error in the training set. An ordinal logistic model was used for ordinal NAS outputs in a confusion matrix with subsequent ROC analyses.

RESULTS

The clinical model included 74 subjects: 62 obese (35 NAFLD and 27 NASH) and 12 healthy volunteers. Liver stiffness at 60 Hz, loss modulus at 30 Hz, and fat fraction were all significantly associated with the NAS in the effect tests for both linear and nonlinear (neural networks) predictions (Fig. a,b). The ordinal logistic model showed less than ±1 bias in 93% of subjects (69/74) in the resulting confusion matrix (Fig. c) and successfully distinguished each NAS score with excellent accuracy (AUROC>0.9 for all, Fig. d).

CONCLUSION

This preliminary study shows that multiparametric MRE/MRI can be used to accurately predict NAS score and represents a promising alternative to liver biopsy for NASH diagnosis and monitoring.

CLINICAL RELEVANCE/APPLICATION

Multiparametric MR elastography, coupled with machine learning, can provide a noninvasive prediction of the NAFLD activity score (NAS), which is an important metric for assessing 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/ Richard L. Ehman, MD - 2016 Honored EducatorSudhakar K. Venkatesh, MD, FRCR - 2017 Honored Educator

SSJ08-03 A Simple Template-Matching Method for Liver Proton-Density Fat Fraction Determination by Multiecho Gradient-Echo MR Imaging

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E353A

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PURPOSE

Proton-density fat fraction (PDFF) is an accepted quantitative imaging biomarker of liver steatosis. However, the complexity of PDFF calculation by nonlinear curve-fitting has been a barrier to more widespread adoption. The purpose of this study was to validate a simple template-matching method for liver PDFF determination as an alternative to the conventional curve-fitting method.

METHOD AND MATERIALS

This is a secondary analysis of an IRB-approved, HIPAA-compliant clinical trial of diabetic adults undergoing liver MRI. Liver MRI

This is a secondary analysis of an IRB-approved, HIPAA-compliant clinical trial of diabetic adults undergoing liver MRI. Liver MRI exams were performed at 3T using 3D spoiled gradient echo sequence, acquired at 6 echo times (TEs): 1.05, 1.84, 2.63, 3.42, 4.21, 5.01ms. The T1-bias was minimized by flip angle 2 deg for repetition time 6.2ms. On the reconstructed magnitude images, a region of interest (ROI) was placed on the liver. ROI's mean signal magnitudes were recorded for each TE.The multiecho data were analyzed by two different methods: conventional nonlinear curve-fitting using a multipeak fat spectral model, and template-matching, as follows. First, a library of signal templates (synthetic 6-element signal vectors) was pre-generated for a 2D parameter grid: PDFF 0-50% and R2* 0-1000ms. Second, the observed 6-echo signal vector was compared to each template by vector inner-product. The template resulting in the maximum inner-product was selected as the "match". Computation times for both methods were recorded.

RESULTS

51 subjects (mean age 35 yrs, range [36-71] yrs) underwent liver MRI, 40 of which completed both pre- and post-treatment MRI. All available 91 MRI exams were analyzed. Figure 1 shows near-perfect linear regression agreement between the template-matching and curve-fitting liver PDFF values. The intercept and slope were slightly different from 0 and 1, respectively (p=0.006 and <0.001), but their small effect sizes are likely not clinically relevant. Bland-Altman (Figure 2) analysis demonstrates that template-matching has <1% error margin in absolute PDFF. Per-ROI computation time was 0.9ms and 19.6ms for template-matching and curve-fitting, respectively.

CONCLUSION

Liver PDFF calculation using template-matching is equivalent to curve-fitting within 1% error margin in absolute PDFF.

CLINICAL RELEVANCE/APPLICATION

Template-matching permits simple liver PDFF calculation without complex nonlinear curve-fitting and may facilitate more widespread use worldwide.

SSJ08-04 Dual-Layer Detector Spectral CT versus Magnetic Resonance Imaging for the Assessment of Iron Overload in Myelodysplastic Syndromes and Aplastic Anemia

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E353A

Participants
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PURPOSE

To investigate the performance of dual-layer detector spectral CT for iron deposition in myelodysplastic syndromes and aplasic anemia,and to compare the results to MRI T2* imaging

METHOD AND MATERIALS

Thirty patients with clinical history of myelodysplastic syndromes and aplasic anemia underwent T2*-weighted hepatic and cardiac MRI on a three-tesla MRI scanner (Ingenia, Philips, Netherlands) and were scanned on a 128-row spectral detector CT (IQon, Philips, Netherlands) latterly. T2* values of liver and septal muscle were calculated with a dedicated software tool (CMR Tools©, Imperial College). HU differences (ΔHU) in liver and septal muscle were calculated between the lower (50 kVp) and higher (120 kVp) energy resulted from mono-energetic spectral imaging ranging from 40 to 200 keV, which was based on spectral base image (SBI). Regression and correlation analyses were conducted between T2* and HU differences (ΔHU) in the liver and cardiac muscle.

RESULTS

Table time for spectral CT was significantly shorter compared to MRI (mean: 3.3 min vs. 25.2 min). Liver and cardiac T2* were 13.68 ± 12.52, 27.89 ± 35.01ms,respectively. Liver and cardiac signal intensity ratio to muscle were 0.650.44,1.44 ± 0.60,respectively. Liver and cardiacΔHU were 3.12 ± 1.89, 2.35 ±2.89 Hu, respectively. The results showed strong (r = 0.8 and P <0.05) linear correlation between liver T2* and liver ΔHU, and moderate linear correlation (r = 0.61 and P <0.05) between cardiac T2* and cardiac ΔHU. Strong linear correlation (r = 0.85 and P <0.05) was found between liver to muscle (L/M) signal intensity ratio and ΔHU, and moderate linear correlation (r = 0.65 and P <0.05) between heart to muscle (H/M) signal intensity ratio and cardiac ΔHU.

CONCLUSION

Dual-layer detector spectral CT seem to be equivalent valuable for evaluating liver and myocardial iron overload, compared to MRI T2* imaging, which might help in patient staging based on the severity of iron overload.

CLINICAL RELEVANCE/APPLICATION

Dual-layer detector spectral CT might help in patient with iron overload.

SSJ08-05 Non-invasive Quantification and Grading of Liver Iron Content with Spectral CT: An Iron Overload Rabbit Model Study

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E353A

Participants
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PURPOSE

To assess the accuracy of spectral CT in liver iron concentration (LIC) quantification and grading at different clinically significant LIC thresholds.

METHOD AND MATERIALS

Fifty-one rabbits of iron-loaded model were established by intravenous injection of iron dextran. Abdomen CT was then performed with fast kilovolt peak switching dual energy CT. Hepatic iron concentration (HIC) imaging was derived from an iron/water, two-material decomposition using gemstone spectral imaging analysis. Hepatic attenuation on 40 Kev and 140 Kev monochromatic energy image were measured. The difference between 40 Kev and 140 Kev (ΔH) was calculated. Ex vivo hepatic pathology was obtained and postmortem assessment of LIC was conducted on inductively-coupled plasma (ICP) spectrometer. The correlations between CT measurements (HIC and ΔH) and LIC were analyzed. HIC was fitted against LIC to build linear regression. Then the prediction accuracy of the regression was tested. Diagnostic performance of HIC and ΔH in discriminating different LIC thresholds (1.8, 3.2, 7.0, 15.0mg/g dry tissue) were evaluated by receiver operating characteristic (ROC) analysis.

RESULTS

According to the pathological analysis, the iron staining increased with increasing dose of injected dextran iron. LIC was from 0.20 to 39.59mg/g measured by ICP. HIC (range, -37.41-118.03 mg/mL) had a positive linear correlation with LIC(r^2=0.943,P<0.001). The predicted HIC obtained by derived equation calculation showed a high consistency with ICP results. For discriminating clinically significant LIC thresholds (1.8, 3.2, 7.0, 15.0mg/g dry tissue), ROC analysis revealed that the corresponding optimal cutoff value of HIC was -17.56, -0.92, 7.6, 48.28 mg/mL. With the cutoff value of HIC= 48.28 mg/mL, the highest sensitivity (100%) and specificity (100%) were obtained at LIC threshold of 15.0mg/g dry tissue. HIC showed no significant differences with ΔH at different clinically iron accumulation thresholds (P>0.05).

CONCLUSION

HIC was highly linear with titrated LIC in the iron overload rabbit models. HIC could quantify LIC and had high accuracy for grading LIC especially at graveness iron accumulation situation.

CLINICAL RELEVANCE/APPLICATION

With excellent diagnostic performance for discriminating clinically significant LIC thresholds, HIC imaging might be used to guide iron chelation therapy in the clinical practice in the future.

SSJ08-06 Virtual Unenhanced Algorithms for Fast-Kilovolt Switching Dual-Energy CT: Comparison Between Dedicated and Non-dedicated Softwares for Assessment of Liver Fat Content

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E353A

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PURPOSE

In fast kV-switching dual-energy CT (DECT), a new multi-material decomposition (MMD) algorithm developed for the quantification of liver fat content includes virtual unenhanced (VUE) algorithm based on the attenuation coefficient of liver tissue. This study aims to compare the accuracy of the dedicated and non-dedicated VUE algorithms for liver fat content estimation.

METHOD AND MATERIALS

Forty-seven patients with suspected hepatic steatosis (BMI, 18-40) underwent unenhanced and tri-phase dynamic contrast-enhanced DECT scans within 4 weeks prior to liver biopsy. Hepatic fat volume fraction (FVF, %) images using MMD and CT attenuation value (CTav, HU) images using non-dedicated VUE were generated from DECT data. FVF and CTav were compared with histologic steatosis grade (0-3, as defined by the non-alcoholic fatty liver disease activity score [NAS] system) using Jonckheere-Terpstra trend tests. Agreement of the measurement between real- and virtual unenhanced images was assessed using generalized estimating equation (GEE) model and Bland-Altman analysis.

RESULTS

NAS steatosis scores were score 0 in 11 patients; 1 in 21; 2 in 12; and 3 in 3. FVF increased and CTav decreased with increasing histologic steatosis grade (trend test, P < .001 for each). GEE models revealed that scan phase was significantly associated with CTav (ß = 0.8; P < .016) but not with FVF (ß = 0.06; P =.730). The differences between real non-contrast-enhanced and contrast-enhanced FVFs for arterial, portal venous, and equilibrium phases tended to be larger (limits of agreement, -8.4 to 9.5) but there was no systemic bias. Bland-Altman analysis of real non-contrast-enhanced and each of three contrast-enhanced CTav showed significant proportional bias (r = -0.38 to -0.44; P < .001 for all).

CONCLUSION

VUE in MMD algorithm for the quantification of liver fat content is more accurate than CT attenuation value calculated with non-dedicated VUE.

CLINICAL RELEVANCE/APPLICATION

The MMD algorithm is a promising technique for less-invasively assessment of hepatic fat content, as fat volume fraction data can be derived from the contrast-enhanced scan, eliminating the need for a separate non-contrast CT scan to derive fat volume fraction.

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SSJ09

Gastrointestinal (Biliary Imaging)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E353C

GI MR

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

Participants
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Sub-Events

SSJ09-01 Novel Radiologic Model to Predict Disease Severity of Primary Sclerosing Cholangitis: Association of Quantitative Liver Volume with Mayo Risk Score

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E353C

Awards
Student Travel Stipend Award

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PURPOSE

To evaluate the association of absolute total liver (T), lobar (right and left; R, L), and caudate volume (C), as well as ratios of left lobe and caudate to total liver volume (L/T and C/T) with the disease severity of PSC as determined by Mayo score. The second aim was to develop a novel radiologic model to predict Mayo score.

METHOD AND MATERIALS

This HIPAA compliant, retrospective single center study included 79 PSC patients who were imaged between 2000 and 2017. T, R, L and C were measured using Advantage Workstation (GE) on the imaging study (MR/CT) within an average of 4 months of risk score calculation. L/T and C/T ratios were then calculated. Patients were stratified into group A (low and intermediate risk; Mayo score <2) and group B (high risk; Mayo score >=2). The differences in liver volumes between the 2 groups were assessed using T test. Regression analysis was performed to test the correlation between the liver volumes and Mayo score. To assess the prognostic performance of liver volume, area under the receiver operating characteristic (AUC-ROC) curve was evaluated. P value <0.05 was considered significant.

RESULTS

Our cohort included 49 males and 30 females with the mean age of 43, with no significant differences in age between males and females (p=0.74). T, L, and C were significantly higher in group B than in group A (p<0.05). However, the difference in R was not significant (p=0.07). The differences of L/T and C/T between Group A and B were statistically significant (p<0.005). L/T had the best positive correlation with Mayo score (r=0.55). Linear regression analysis identified L/T as a significant variable for predicting Mayo score, with the prediction model as follows (p<0.001): Mayo risk score= 5.6*(L/T) - 1.5 L/T showed good ability to distinguish between mild/moderate and severe PSC patients (AUC-ROC 0.8).

CONCLUSION

Patients with severe PSC have larger total liver, left lobe, and caudate volume, and higher left and caudate to total ratio compared to patients with mild/moderate disease. Left lobe to total liver volume ratio was associated with Mayo score and it may be used to predict disease severity in patients with PSC.

CLINICAL RELEVANCE/APPLICATION

Novel volumetric liver measurements correlate with Mayo scores and may potentially be useful in supplementing Mayo score and predicting disease severity.

SSJ09-02 Postprandial Changes in Flow Dynamics of the Bile within the Common Bile Duct: Evaluation with Cine Dynamic MRCP and a Spatially Selective IR Pulse

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E353C

Participants
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PURPOSE

To evaluate the influence of oral ingestion in flow dynamics of the bile within the common bile duct in healthy subjects by using cine dynamic MRCP and a spatially selective IR pulse non-invasively.

RESULTS

The median grading score of antegrade bile flow after oral ingestion (score=0.85-1.18) was significantly (P<0.01) higher than that before oral ingestion (score=0.53), indicating that bile excretion was stimulated by oral ingestion. Grading score of antegrade bile flow showed a maximum peak of 1.18 at 26 minutes after ingestion, and then, began to gradually decline with a statistical difference (P<0.01). Contraction of gallbladder was associated with increased grading score of antegrade bile flow after oral ingestion with a statistical significance (p<0.01). Regarding reversed bile flow, there were no significant differences in median grading score before (0.18) and after (0.15-0.23) oral ingestion, suggesting that oral ingestion has little affect on the function of oddi sphincter.

CONCLUSION

Non-invasive cine dynamic MRCP using spatially selective IR pulse showed potential for evaluating postprandial changes of flow dynamics of bile as a physiological reaction.

CLINICAL RELEVANCE/APPLICATION

Cine dynamic MRCP using spatially selective IR pulse may contribute to the assessment of flow dynamic changes of the bile such as the impaired bile excretion in patients with digestive malabsorption.

SSJ09-03 Intrahepatic Cholangiocarcinoma: Can Imaging Phenotypes Predict Survival and Tumor Genetics?

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E353C

Participants
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PURPOSE

On CT, intrahepatic cholangiocarcinomas (ICC) are phenotypically heterogeneous tumors. The purpose of this study was to investigate the associations between CT imaging phenotypes, patient survival and known genetic markers. We hypothesize that visibly different tumor subtypes may be associated with survival or known genetic pathways of ICC.

METHOD AND MATERIALS

An institutional review board approved,HIPAA-compliant,retrospective study was performed with 66 patients who had surgically resected ICC. Preprocedure CT images of ICC were assessed using predominantly qualitative radiographic descriptors while blinded to tumor genetics and patient clinical data. Associations between radiographic features and overall survival (OS) and disease free survival (DFS) were performed with Cox proportional hazards regression and visualized with Kaplan Meier plots. The associations between radiographic features and imaging pathways (IDH1, Chromatin and RAS-MAPK) were assessed with Fisher's Exact test and the Wilcoxon Rank sum test, where appropriate and corrected for multiple comparisons within each pathway using the False Discovery Rate correction.

RESULTS

Three imaging features were significantly associated with a higher risk of death: necrosis (HR:2.95 95%CI:1.44-6.04, p=0.029), satellite nodules (HR:3.29, 95%CI:1.35-8.02, p=0.029), and vascular encasement (HR:2.63, 95%CI:1.28-5.41, p=0.029). Additionally, with each increase in axial size, the risk of death increased (HR:1.14, 95%CI:1.03-1.26, p=0.029). Similar to findings for OS, satellite nodules (HR:3.81, 95%CI:1.88-7.71, p=0.002) and vascular encasement (HR:2.25, 95%CI:1.24-4.06, p=0.019) were associated with increased risk of recurrence/death. No significant associations were found between radiographic features and genes in the IDH1, Chromatin or RAS-MAPK pathways (p=0.63-84).

CONCLUSION

This preliminary analysis of resected ICC suggests associations between CT imaging features and OS and DFS. No association was identified between imaging features and currently known genetic pathways.

CLINICAL RELEVANCE/APPLICATION

Intrahepatic cholangiocarcinomas are heterogeneous on CT and have qualitative radiographic features associated with survival. Possible associations with tumor genetics were not identified.

SSJ09-04 Multiparametric Response Assessment of Unresectable Intrahepatic Cholangiocarcinoma Treated with TACE: Role of Contrast Enhanced 3-D Volumetric Functional MRI Using Apparent Diffusion Coefficient Maps

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E353C

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PURPOSE

To assess multiparametric changes in 3-D volumetric functional parameters on contrast enhanced MRI and DWI in predicting early response of unresectable intrahepatic cholangiocarcinoma (iCCA) after transcatheter arterial chemoembolization (TACE).

METHOD AND MATERIALS

This retrospective IRB-approved, HIPAA-compliant study with waived patient consent included 94 patients (mean age, 68±12 years; 40 men) with unresectable iCCA. All patients underwent baseline and follow up MRI after TACE, and were followed up until death or December 2016. Index lesions were analysed for changes in anatomical (RECIST, volume) and functional (viable tumor, tumor burden, ADC) volumetric MR parameters. Overall survival (OS) was used to stratify cohort into low (<=15 months) and high (>15 months) OS groups. Changes in MRI and confounding clinical parameters were compared between the two groups. Their effect on OS was assessed using Cox-regression and Kaplan-Meier analysis. P <0.05 was considered significant.

RESULTS

Tumor volume did not show significant change after TACE (P=0.07) while RECIST diameter showed a small change (-2.6 mm, P=0.02). Mean absolute and percent viable tumor volume, and mean tumor burden decreased (P<0.0001, for each) while mean ADC increased (P<0.0001) after TACE. The only parameter showing significantly different change between low and high OS groups was mean ADC, both absolute (215.4±260.5 x 10-6 mm2/s vs 341.9±313.5 x 10-6 mm2/s; P=0.040) and percent (12.8±14.7 % vs 28.8±27.4 %; P=0.001) change. In Cox regression analysis, significant effect on survival outcomes was seen for percent ADC change adjusted for confounding clinical parameters. (Hazard ratio, 0.93; P<0.05). Significant differences in survival were noted when percent change in mean ADC cut off of 25%, 30% and 35% were used to classify responders and non-responders (log rank test, P=0.035, 0.019 and 0.001, respectively).

CONCLUSION

After TACE, iCCA lesions showed increase in volumetric ADC (19.9%), decrease in viable tumor volume (25.9%), and decrease in percent viable tumor volume (16.3%). Thresholds of 25%, 30% and 35% change in ADC resulted in survival differences with a 7% reduction in risk of death for a unit increase in percent ADC change.

CLINICAL RELEVANCE/APPLICATION

Volumetric functional MR changes can allow individualization of TACE therapy in iCCA with prediction of early oncologic response and overall survival. These may be utilized in future clinical trials.

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/ Ihab R. Kamel, MD, PhD - 2015 Honored Educator

SSJ09-05 Influence of Cholecystectomy on the Flow Dynamic Pattern of Bile in the Extrahepatic Bile Duct: Assessment by Cine-Dynamic MRCP with Spatially-Selective IR Pulse

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E353C

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PURPOSE

To evaluate the influence of cholecystectomy on the flow dynamic pattern of bile in the extrahepatic bile duct by using cine-

dynamic MRCP with spatially-selective inversion-recovery (IR) pulse non-invasively.

RESULTS

Antegrade bile flow was observed more frequently in the cholecystectomy group than in the non-cholecystectomy group (5.1 times vs 2.9 times, P=0.005). Mean grading score of antegrade bile flow was significantly greater in the cholecystectomy group than in the non-cholecystectomy group (mean grade, 0.33 vs 0.21; P=0.007). These facts suggested that antegrade bile flow is probably generated by increased intraductal pressure of CBD collecting bile, and that the common bile duct plays function of the gallbladder such as contraction and buffering. Regarding reversed bile flow, there were no significant differences in the frequency and grading score between cholecystectomy group and non-cholecystectomy group, suggesting that contraction pressure in the sphincter of Oddi is extremely higher than CBD pressure even in patients after cholecystectomy.

CONCLUSION

Antegrade bile flow was observed more frequently and predominantly in patients after cholecystectomy in cine-dynamic MRCP with a spatially selective IR pulse probably due to the increased intraductal pressure of CBD collecting the bile while reversed bile flow was observed equivalently because of the preserved function of Oddi sphincter.

CLINICAL RELEVANCE/APPLICATION

Cine-dynamic MRCP with a spatially selective IR pulse may play a role in evaluating the alteration of bile flow pattern in patients with postcholecystectomy syndrome and sphincter of Oddi dysfunction.

SSJ09-06 Can MRI Distinguish Between Hepatocellular Carcinoma, Intrahepatic Cholangiocarcinoma and Biphenotypic Tumors?

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E353C

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PURPOSE

Accurate differentiation between hepatocellular carcinoma (HCC), intrahepatic cholangiocarcinoma (ICC) and biphenotypic tumors (BPT) at imaging is clinically important but often a challenge. The purpose of this multi reader study was to assess the ability of contrast enhanced multiphase MRI to differentiate between HCC, ICC, and BPT.

METHOD AND MATERIALS

Patients with histologically confirmed HCC, ICC or BPT and who had undergone liver MRI were identified using pathology and radiology databases. Patients with therapy prior to imaging were excluded. MRI studies were reviewed by 4 abdominal radiologists blinded to tumor type. Disagreement was resolved by majority and if necessary, a blinded fifth reader. Readers reviewed imaging findings of each tumor on T2W, DWI and T1W images. Dynamic enhancement (arterial, portal and delayed phase) characteristics were reviewed and 1 of 4 enhancement patterns (see figure) was assigned to each tumor. The most likely diagnosis (HCC, ICC or BPT) was recorded. Fisher's exact test was used to compare proportions. Krippendorff's a was used to compare variability amongst readers.

RESULTS

MRI exams from 50 patients (age 64±12 years, 19M, 31F) with 24 HCC, 20 ICC and 6 BPT were included. 20 (83%) HCC, 3 (50%) BPT and 19 (95%) ICC were correctly identified. 21 (88%) HCC had type 1 and 18 (90%) ICC had type 2 enhancement pattern while BPT showed a mix of type 1 (33%), type 2 (50%) and type 4 (17%) enhancement. Type 1 was seen more frequently in HCC than ICC or BPT and type 2 was seen more frequently in ICC than in HCC. Rate of T2 hyperintensity was seen more frequently in ICC than BPT (100% vs 66%), while washout was seen more frequently in HCC compared to either BPT and ICC (83% versus 0% and 5% respectively). Capsule was seen more frequently in HCC than ICC (58% vs 5%) ($p<0.05$ for all listed comparisons). Krippendorff's a ranged from 0.308 to 0.515 for individual findings and was 0.739 for final diagnosis.

CONCLUSION

While characteristic enhancement patterns allow accurate diagnosis of HCC and ICC, BPT were more diverse in their enhancement pattern and therefore more difficult to diagnose. BPT should be considered in the differential diagnosis of a hepatic mass which lacks characteristic features of HCC or ICC such as T2 hyperintensity, washout or capsule.

CLINICAL RELEVANCE/APPLICATION

Biphenotypic tumors cannot be accurately differentiated from HCC and ICC using multiphasic MRI.

SSJ10

Genitourinary (Imaging of Pregnancy)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E351

GU MR OB

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

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Sub-Events

SSJ10-01 Symptomatic Fibroids in Pregnancy: MR Imaging Features and Differentiation from Non-Symptomatic Fibroids

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E351

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To evaluate MRI findings of symptomatic fibroids causing acute lower abdominal and/or pelvic pain in pregnancy and compare them with non-symptomatic fibroids.

METHOD AND MATERIALS

MRI studies of pregnant patients with uterine fibroids performed for acute lower abdominal and/or pelvic pain between 1/2010-9/2016 were retrospectively evaluated. Patient age, gestational age, fibroid size, fibroid number, fibroid location, signal intensity of the fibroid relative to myometrium on T1- weighted imaging, T2-weighted imaging, and diffusion weighted imaging (DWI), and ADC values were recorded along with final discharge diagnoses. Kruskal-Wallis and chi-squared tests compared continuous and categorical variables, respectively, between symptomatic and non-symptomatic fibroids.

RESULTS

Twenty-seven pregnant patients (mean age of 33 [range: 24-47] and mean gestational age of 18 [range: 4-33]) with a total of 57 fibroids comprised the study cohort, with 13 fibroids in 13 patients ultimately identified as the cause of pain based on clinical examination and final discharge diagnoses. Larger size (5.8 versus 3.4 cm in diameter, $p = 0.00012$), T2 hyperintensity relative to myometrium ($p = 0.000049$), and hyperintensity on DWI ($p = 0.00054$) were significantly associated with symptomatic fibroids. ADC values were slightly lower in symptomatic fibroids but not statistically significant (1401 versus 1493 x 10-6 mm2/s, $p = 0.32$). No difference in T1 signal intensity was seen between symptomatic and non-symptomatic fibroids ($p = 0.73$).

CONCLUSION

MRI characteristics of fibroids causing acute pain in the setting of pregnancy have not previously been described, with the exception of T1 hyperintensity seen with red degeneration. In our cohort, larger size and hyperintensity on DWI and T2-weighted imaging relative to myometrium are significantly associated with symptomatic fibroids. These imaging features may also be useful indicators of fibroid degeneration.

CLINICAL RELEVANCE/APPLICATION

MR signal characteristics associated with symptomatic fibroids are described in our cohort of pregnant patients presenting with acute pain, and may be useful indicators of fibroid degeneration.

SSJ10-02 Malformations of Cortical Development Associated with Corpus Callosum Dysgenesis (CCD): Diagnostic Value of Fetal MRI in Prenatal Counseling

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E351

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To define the diagnostic role of fetal MRI in the assessment of cortical dysplasias and other malformations of the developing cerebral cortex, in fetuses with different forms of Agenesis of the Corpus Callosum (ACC).

METHOD AND MATERIALS

104 MR images of fetal CNS with a US suspicion of ACC were retrospectively reviewed. Fetal MRI was performed at 1.5 T Magnetom Avanto (Siemens, Erlangen, Germany) without mother-fetal sedation. Polymicrogyria, lissencephaly, schizencephaly, subependymal heterotopias and migration disorders were evaluated. Cortical findings were compared to three types of ACC (complete agenesis, partial agenesis and hypoplasia). Genetic tests were collected. Post-natal MRI or fetopsy for diagnostic confirmation were collected.

RESULTS

On 104 fetuses, fetal MRI was able to detect cortical malformations in 32 cases even in early gestational ages (<24GW). The mean Gestational Weeks (GW) at MR diagnosis was 26 (range: 22-36GW). MR imaging found 13/32 polymicrogyria, 7/32 lissencephaly, 5/32 schizencephaly, 4/32 subependymal heterotopias and 3/32 neuronal migration disorders. 22/32 had complete ACC, 4/32 had partial ACC and 6/32 had CC hypoplasia. Statistically significant correlations ($p<0.005$) between complete ACC, focal polymicrogyria and cortical dysmorphism affecting frontal lobes were found.

CONCLUSION

Fetal CNS MRI can detect cortical development malformations in complex ACC, providing further information for the clinician to assess the severity of perinatal outcome.

CLINICAL RELEVANCE/APPLICATION

MRI is a useful tool in improving obstetrical genetic prenatal counselling to predict pregnancy and fetal prognosis.

SSJ10-03 The Safety of MR Imaging at 3.0 T in Fetuses: Is Fetal Birth Weight or Hearing Impaired?

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E351

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To evaluate the effects of magnetic resonance imaging at 3.0 T during pregnancy on fetal growth and neonatal hearing in healthy newborns who are at low risk for congenital hearing impairment and brain or chromosomal abnormalities.

METHOD AND MATERIALS

This single-center retrospective case-control study was IRB approved. Informed consent was waived. 81 consecutive healthy newborns who were exposed to MR imaging at 3.0 T while in utero and were born between January 2011 and January 2016 were included. Each MR exposed newborn was matched 1:2 by birth date to a randomly selected healthy control newborn who was not exposed to MR imaging as a fetus. A total of 162 control newborns were included. For each MR exposed newborn, the estimated gestational age at MR exposure was recorded. For each MR exposed and control newborn, infant birth weight was recorded. In concordance with national guidelines, neonatal hearing screening was performed using auditory brain stem response. All hearing tests for the MR exposed and control neonates were recorded. Comparison of the average birth weight between the two groups was performed using an unpaired Student *t* test. The prevalence of hearing impairment was compared between the two groups by using Fisher's exact test.

RESULTS

The average estimated gestational age of fetal MR exposure was 148 days (range 35 days to 265 days). There was no significant difference in average birth weight between the MR exposed and control neonates; 3398 grams vs. 3510 grams, respectively [$P = 0.06$]. The prevalence of hearing impairment in the MR exposed neonates was 0% (0 out of 81); the prevalence of hearing impairment in the control group was 1.8% (3 out of 162). There was no significant difference between the two groups [$P = 0.55$].

CONCLUSION

This study showed no evidence that fetal exposure to MR imaging at 3.0 T is associated with fetal growth restriction or neonatal hearing impairment.

CLINICAL RELEVANCE/APPLICATION

The data from this study suggests that fetal exposure to MR imaging at 3.0 T is safe.

SSJ10-04 Use of a Telerobotic Ultrasound System for Prenatal Imaging

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E351

Awards
Trainee Research Prize - Resident

Participants
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PURPOSE

To determine the feasibility of using a telerobotic ultrasound system to remotely perform prenatal ultrasound examinations and generate images of diagnostic quality, and determine the acceptability of the system to patients and sonographers.

METHOD AND MATERIALS

Thirty participants (mean gestational age 22.8 weeks, range 15-36 weeks) were prospectively recruited. Participants underwent a limited examination (consisting of biometry, placental location, and amniotic fluid; n=21) or detailed examination (biometry, placental location, amniotic fluid, and fetal anatomic survey; n=9) performed using a conventional ultrasound system (EPIQ 5, Philips). This was immediately followed by an equivalent examination performed by a different sonographer using a telerobotic system consisting of a robotic arm (MELODY System, AdEchoTech), ultrasound unit (SonixTablet, BK Ultrasound), and videoconferencing system. Using this system, radiologists or sonographers remotely control all ultrasound settings and fine movements of a transducer from a distance. Telerobotic images were read independently from conventional images. Patients and sonographers were surveyed to assess acceptability of the system.

RESULTS

A paired sample t-test showed no statistically significant difference between conventional and telerobotic measurements of fetal head circumference or single deepest vertical pocket of amniotic fluid; however, a small but statistically significant difference was observed in measurements of biparietal diameter, abdominal circumference, and femur length (p-values <0.05). Intraclass correlations displayed excellent agreement (>0.90) between telerobotic and conventional measurements of all four biometric parameters. Of 21 fetal structures included in the anatomic survey, 82% (range 68-100%) of the structures attempted were sufficiently visualized using the telerobotic system. Ninety-seven percent of patients strongly or somewhat agreed they would be willing to have another telerobotic examination in the future.

CONCLUSION

The telerobotic ultrasound system assessed is feasible for performing prenatal ultrasound examinations. Telerobotic ultrasound systems may allow for the development of satellite ultrasound clinics in rural, remote, or low-volume communities, thereby increasing access to prenatal imaging.

CLINICAL RELEVANCE/APPLICATION

Telerobotic sonography may increase access to prenatal imaging for patients in rural, remote, or low-volume communities.

SSJ10-05 Magnetic Resonance Imaging Evaluation of Invasive Placentation: Accuracy and Impact on Delivery Management

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E351

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To assess accuracy and reproducibility of Magnetic Resonance Imaging (MRI) findings in the diagnosis of Invasive Placentation (IP) in high risk patients. To evaluate the impact of interventional radiological assistance (IRA) on delivery outcomes.

METHOD AND MATERIALS

Twenty-one patients (mean age 36.05 years) with risk factors for IP underwent 1.5T MR examination. Images were reviewed by two readers. Gold standard was histology in 11 and obstetrical diagnosis in 10 patients. Sensitivity and specificity of MRI findings were calculated and reproducibility was estimated with Cohen's K-test. Impact of eventual IRA was evaluated regarding multiple maternal-child factors during and after delivery.

RESULTS

IP was found in 13 patients (61.90%), placenta accreta/increta in 10 (47.62%) and percreta in 3 (14.29%). MRI had sensitivity of 100% and specificity of 87.5%. MRI findings with higher sensitivity were placental heterogeneity, uterine bulging, black intraplacental bands, myometrial interruption and thinning of the uterine-placental interface. Findings with higher specificity were uterine scarring, placental heterogeneity, myometrial interruption and tenting of the bladder. MRI inter-rater agreement was high (K=1). IRA was performed in 10 women among 13 with diagnosis of IP, with global positive impact on delivery's outcome. Factors with statistical significant difference ($p<0.05$) were: blood loss (1405 ml vs 3080 ml), days in surgical intensive care unit (1 vs 3), APGAR at first minute (6.11 vs 4) and overall days of hospitalization (12.00 vs 41.77).

CONCLUSION

MRI is an accurate and reproducible tool in prenatal diagnosis of IP and can be used to plan safe delivery in an appropriate setting with eventual IRA, that positively affects delivery's outcomes.

CLINICAL RELEVANCE/APPLICATION

MRI is extremely accurate in the diagnosis of invasive placentation and it has a strong indication in high risk patients allowing to plan delivery with eventual interventional radiological assistance.

SSJ10-06 The Ringed Placenta on Fetal MRI: 11 Cases Linked with Fetal Ventral Body Wall Defects

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E351

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Fetal MRI is increasingly used in high-risk pregnancies not just for diagnosis and treatment planning, but also for prognostication of neonatal outcomes. Ventral Body Wall Defects (VBWD) of variable manifestation are well-recognized on fetal MR imaging and have been described in the literature. In more severe cases, outcomes can be highly variable, and counseling in these cases can be extremely challenging. We present here a pattern of abnormal placental MRI signal not previously described, which we found to correlate with extremely high mortality in patients born with VBWD. Specifically, we identified abnormal T1 hyperintense signal in the placenta in a multi-ringed pattern in several cases of fetal VBWD which correlated with extremely high mortality. We have termed this finding, the "ringed placenta."

METHOD AND MATERIALS

A local database of prenatal imaging studies was used to retrospectively review prenatal cases with MR imaging which demonstrated the characteristic appearance of ringed placenta in patients with VBWD. Electronic medical records were also used to follow up on the outcome of the patients identified as having these same areas of signal abnormality.

RESULTS

The "ringed placenta" appearance was identified in 11 fetal MRI studies, with the neonates later confirmed at birth to have VBWD. On pathology, these placentae were variably described as containing massive perivillous hemorrhage, intervillous thrombosis, villous edema, and diffuse chorionic villitis. Out of the 11 identified cases, only one neonate survived beyond 3 months of life.

CONCLUSION

This work presents cases of VBWD in the fetus, demonstrating the presence of T1 hyperintense ringed patterns in the placenta, which correlate with subsequent high perinatal mortality. Given the pathologic findings, this MRI appearance may be secondary to global placental ischemia with reperfusion hemorrhage. In evaluating VBWD patients, accurate prognostic information can be critical for appropriate parental counseling, and it may also affect the approach to perinatal management. Further studies will be necessary to better evaluate the prognostic accuracy of this MR imaging sign.

CLINICAL RELEVANCE/APPLICATION

This novel sign may enable improved planning and more accurate counseling for parents, many of whom face very high levels of uncertainty during the pre-natal management of complex fetal anomalies.

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SSJ11

Genitourinary (Imaging of Benign Gynecological Disease)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E353B

GU MR

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

Participants
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Sub-Events

SSJ11-01 Structured vs Narrative Reporting of Pelvic MRI for Fibroids: Impact on Treatment Planning

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E353B

Awards
Student Travel Stipend Award

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PURPOSE

To evaluate the usefulness of MRI reporting of uterine fibroids using a structured disease-specific template vs narrative reporting for planning fibroid treatment by gynecologists and interventional radiologists.

METHOD AND MATERIALS

This is a HIPAA-compliant, IRB-approved study with informed consent waived given its retrospective nature. In April 2016, a structured reporting template for fibroid MRI examinations was developed in collaboration between gynecologists, interventional radiologists and diagnostic MRI radiologists. Study population included 29 consecutive women who underwent myomectomy for uterine fibroids and a pelvic MRI prior to implementation of structured reporting; and 42 consecutive women with MRI for uterine fibroids after implementation of structured reporting. Subjective evaluation by gynecologists and radiologists and objective evaluation for the presence of 19 key features were performed to assess the clarity and usefulness of the reports for treatment planning. Statistical analysis was performed using the Student t test, Fisher exact test and Wilcoxon signed-rank test.

RESULTS

More key features were absent from the narrative reports 7.3±2.5 (range 3-12) than from structured reports 1.2±1.5 (range 1-7), ($p<0.0001$). Compared to narrative reports, gynecologists and radiologists deemed structured reports both more helpful for surgical planning (gynecologists: 8.5±1.2 vs. 5.7±2.2, ($p<0.0001$); radiologists: 9.6±0.6 vs. 6.0±2.9, ($p<0.0001$)) and easier to understand (gynecologists: 8.9±1.1 vs. 5.8±1.9, ($p<0.0001$); radiologists: 9.4±1.3 vs. 6.3±1.8, ($p<0.0001$)).

CONCLUSION

Structured fibroid MRI reports miss less key features essential for treatment planning than narrative reports. Gynecologists and radiologists described structured reports to be more helpful for treatment planning and easier to understand.

CLINICAL RELEVANCE/APPLICATION

Structured reports for uterine fibroid MRI are more helpful, easier to understand and miss less key features essential for procedural planning than narrative reports.

SSJ11-02 Efficacy of Vaginal and Rectal Distension Using Gel in MRI for Deep Pelvic Endometriosis

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E353B

Participants

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PURPOSE

To study MR performance without and with per vaginal (PV) and per rectal (PR) gel distension for the detection of posterior compartment deep pelvic endometriosis (DPE).

METHOD AND MATERIALS

IRB approval and informed consent were obtained for this prospective study.Female patients presenting with clinically suspected DPE to a single centre underwent MRI to map their disease. Multiplanar T2 and axial T1W images were acquired without and with PV and PR gel. Each patient went on to laparoscopy.8 expert readers from 6 countries, all blinded, recorded sites of disease on 2 datasets with a minimum of 10 days between the readings. Each dataset comprised a mixture of without and with gel studies. Findings were collated and compared with gold standard laparoscopic data. MR performance without and with PV/PR gel was evaluated by calculating sensitivity, specificity, positive and negative predictive values. Variability between readers was calculated using the Fleiss' kappa coefficient.

RESULTS

Posterior compartment disease was recorded in a total of 22 sites in 9 women (mean age 34.8 years) in whom complete imaging and surgical data were available. With 8 readers, this gave a total of 176 potential sites of disease to be detected across all reads. 107 of 176 locations were identified on MR without gel and 139 of 176 with gel distension. There was a significant improvement in sensitivity, PPV and NPV between MR images without and with PV/PR gel distension for all regions assessed (p=0.006, 0.029 and 0.002 respectively). There was no statistically significant difference in specificity between groups.Interobserver concordance was substantial with a Fleiss' kappa coefficient of 0.76 without and 0.74 with gel distension.

CONCLUSION

Vaginal and rectal distension with gel significantly improved the sensitivity of MR for the detection of DPE.

CLINICAL RELEVANCE/APPLICATION

The use of PV/PR distension in MRI for DPE remains controversial. This study, with 8 expert readers, showed a significant improvement in sensitivity, PPV and NPV following the administration of gel.

SSJ11-03 Accuracy of Non-Contrast CT in Characterizing Simple Cysts in Late Post-Menopausal Patients: Do We Really Need to Perform an Ultrasound in All Cases?

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E353B

Participants
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PURPOSE

Contrast enhanced CT (CECT) is accurate at characterizing simple appearing cysts with benign features relative to US. We sought to determine the accuracy of non-contrast CT (NCCT) in characterizing adnexal lesions found in late postmenopausal (>55 years) women and whether a probably benign adnexal cyst >1 cm on NCCT needs further US evaluation in all cases as is the case with current ACR guidelines.

METHOD AND MATERIALS

We performed an IRB approved HIPAA compliant retrospective review of 101 patients with 110 ovarian lesions found on NCCT with an associated CECT (reference standard) within 180 days (median: 7 days, 72% within 30 days). NCCT and CECT images were reviewed by different readers, blinded to the images from the other modality and patients' clinical information. Readers characterized each lesion by presence/absence of complex features (e.g., solid component, mural nodules and septae) and then classified lesions as simple cystic, complex cystic, solid-cystic or solid. Lesion classifications and characteristics were compared between modalities using Bhapkar's or the sign test. Cohen's kappa was used to assess agreement between modalities.

RESULTS

The average age was 68 years ± 10 (SD). Of 110 lesions, 72 (65%) were simple cysts, 22 (20%) were complex cysts, 9 (8%) were

solid-cystic and 7 (6%) were solid on CECT compared with 49 (45%), 39 (35%), 13 (12%), and 9 (8%) for the same categories, respectively, on NCCT. There was overall moderate agreement in lesion classification (kappa: 0.56), though more cysts were simple-appearing on CECT than NCCT (65% vs. 45%, p<0.001). This was primarily due to the increased number of perceived mural nodules (1% vs. 13%, p=0.01) and septae (12% vs. 37%, p<0.001) seen on NCCT compared with CECT. Of 49 simple cysts by NCCT, 48 were found to be simple cysts on CECT (PPV = 98.0%, 95% CI: 87.8-99.9%). Of 61 non simple cystic lesions by NCCT, 37 were also found to be non-simple cystic lesions on CECT (NPV = 60.7%, 95% CI: 48.3-73.0%).

CONCLUSION

Our study confirms the high accuracy of non-contrast CT in characterization of simple cysts seen in late postmenopausal women. On the other hand, non-simple cystic lesions were not as accurately characterized.

CLINICAL RELEVANCE/APPLICATION

Non-contrast CT accurately characterizes simple cysts; so if incidentally detected, these may not need further imaging characterization. Non-simple cysts may still need further imaging workup.

SSJ11-04 DTI and Tractography Correlated With Symptoms and Site of Pelvic Endometriosis

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E353B

Participants
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PURPOSE

The aim of the present study was to evaluate the sacral nerve roots aspects by the means of DTI tractography in women with endometriosis and to analyze the correlation between DTI abnormalities, the presence and intensity of different pain symptoms, and the endometriotic lesions found at surgery.

METHOD AND MATERIALS

In 2 years time, we enrolled 66 women affected by endometriosis and scheduled for surgery; they were asked for the presence of dysmenorrhea, deep dyspareunia and/or chronic pelvic pain (CPP), intensity of pain was recorded on a Visual Analog Scale (VAS) score. MRI was performed on 3T Magnet,DTI sequences was acquired and a 3D reconstruction of S1, S2 and S3 was achieved . FA was calculated for every root as described. Univariate analysis was performed collecting also data from the following laparoscopy.

RESULTS

DTI of sacral roots revealed a regular and homogeneous appearance in 17 (25.8%) patients, while 44 (66.7%) women showed abnormalities in microstructure reconstructions, consisting mainly of fiber irregularities and disorganization combined with the loss of the simple unidirectional course. In 5 (7.6%) women the reconstruction of the sacral roots was not possible. Pathological DTI was significantly associated with the severity of dysmenorrhea and CPP , but no association with dyspareunia (Pv=0.398) or dyschezia (Pv=0.738) was found. Furthermore, a higher duration of pain was significantly associated with a pathological DTI. Adhesions in Douglas Pouch resulted significantly associated with pathological DTI (Pv=0.001), as well as DIE (Pv=0.001) and tubo-ovarian adhesions.

CONCLUSION

Pathological DTI of the sacral nerves is associated to the presence of CPP, but also it is related to the type and the site of endometriosis being obliteration of the cul-de-sac, tubo-ovarian adhesions and DIE responsible of DTI abnormalities. This new noninvasive method may help both clinicians and surgeons to select a better and more personalized therapeutic approach or select those patients who might benefit from alternative treatments, such as presacral neurectomy, anaesthetic nerve infiltration, neurostimulation or different types of pain killers that target neuropathic pain

CLINICAL RELEVANCE/APPLICATION

DTI alteratons may help to select an alternative therapeutic approach such as presacral neurectomy, anaesthetic nerve infiltration, neurostimulation or different types of pain killers that target neuropathic pain

SSJ11-05 Virtual Histerosapingography in Daily Practice in 14200 Cases

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E353B

Participants
Carlos Capunay, MD, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
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PURPOSE

To illustrate the typical findings of virtual hysterosalpingography(VHSG) by MDCT in daily practice and the differential diagnosis with

To illustrate the typical findings of virtual hysterosalpingography(VHSG) by MDCT in daily practice and the differential diagnosis with other pathologies in patients studied between 2006 and 2014

METHOD AND MATERIALS

We evaluated the V-HSG studies of 14200 patients derived from our institution. Studies were performed using 64,128 and 256 multislice CT scanners. Scanning parameters were: On 64-row CT: slice thickness of 0.9 mm 120 kV and 100-250 mAs, with an average duration of each scan of 3.6 seconds. On 128 and 256-slice CT: slice thickness of 0.6 mm and a reconstruction interval of 3 mm, 80 kV and 100-150 mAs, with an average duration of each scan of 1.3 seconds. A a dilution of low-osmolality iodinated contrast (10-20 ml) was instilled into the uterine cavity. Images were analyzed using multiplanar reconstructions, 3D and virtual endoscopy.The duration of the CT scan, the radiation exposure and the degree of discomfort of the patients were documented.

RESULTS

The scan time was 3.5 and 1.3 seconds using 64-slice or 128-256-slice CT scanners respectively. The mean radiation dose was 0.9 and 0.3 mSv using 64-slice or 128-256-slice CT scanners respectively for each scan. In the cervical region were identified parietal irregularities (22%), thickening of folds (8%), polyps (7%), diverticula (5%), stenosis (5%) and sinechiaes (1%). In the uterine cavity were visualized polyps (35%), submucosal myomas (7%) and adhesions (3%). In addition changes were observed in the wall of the uterus: myomas (15%), malformations (3.2%), adenomyosis (5%) and cesarean section (12%). Fallopian tubes showed hidrosalpinx in 5% cases ;unilateral (3.4%) and bilateral (1.6%). Patients reported no or mild discomfort in 85% of the cases.

CONCLUSION

The VHSG allowed a proper assessment of the internal genital organs, providing useful diagnostic information on infertility and other gynecological disorders. The technique is painless, well tolerated by patients with low doses of radiation. These advantages place this modality as a valid alternative algorithm study in patients with infertility

CLINICAL RELEVANCE/APPLICATION

Virtual hysterosalpingographyis an useful diagnostic tool to obtain information on infertility and other gynecological disorders.

SSJ11-06 Prospective Comparison of 3D FIESTA versus 2D SSFSE MRI in Evaluating Pelvic Floor Dysfunction Disease

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E353B

Participants
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PURPOSE

To compare fast imaging employing steady state acquisition (FIESTA) sequence with single shot fast spin echo (SSFSE) sequence in terms of acquisition time, image quality, artifacts, and lesion detection.

METHOD AND MATERIALS

Fifty-three patients (mean age, 49 years; range, 21-81 years) suspected pelvic floor dysfunction disease (PFDD) were enrolled in this study and underwent high resolution dynamic magnetic resonance defecography (MRD). The MR imaging protocol included static T2-wighted fast spin-echo sequence in three planes and a single sagittal dynamic sequence of FIESTA and SSFSE for rest, left and defecation phase. The acquisition time of dynamic sequence was calculated. The sagittal data sets of FIESTA were compared with SSFSE data sets with respect to image quality, artifacts, and lesion detection. Quantitative values of acquisition time and lesion detection and qualitative analyses of image quality and artifacts were analyzed by using a paired Student's t test and the Kappa test, respectively.

RESULTS

Mean acquisition time of FIESTA sequence (80-slice/53 seconds) was significantly shorter than that of SSFSE sequence (40-slice/57 seconds) ($p<0.05$). More pelvic organ prolapse (39/53 VS. 22/53) and rectocele (21/53 VS. 11/53) were detected with FIESTA than SSFSE ($p<0.05$). There was no significant difference between FEISTA and SSFSE in image quality and artifacts (kappa=0.905, $p>0.05$). Readers preferred the FIESTA sequence for showing more details.

CONCLUSION

For time savings and the versatility of showing greater degree of lesions without compromise of image quality, the near real-time continuous imaging with FIESTA sequence should be included in MRD protocols to better evaluate pelvic floor dysfunction disease.

CLINICAL RELEVANCE/APPLICATION

We recommend that FIESTA sequence should be included in MRD protocols to better assess pelvic floor dysfunction disease.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

SSJ15

Musculoskeletal (Muscle and Nerve)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E450B

MR MK

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

Participants
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Soterios Gyftopoulos, MD,MSc, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

SSJ15-01 Multi-Parametric MRI Characterization of Changes in Skeletal Muscles with Aging

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E450B

Participants
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PURPOSE

To evaluate age-related characteristics of thigh muscles by applying multi-parametric quantitative MRI and to investigate relationships between age and the parameters.

METHOD AND MATERIALS

Ninety-five healthy subjects (47 men, 48 women; median, 47 years; IQR, 39-58 years) with normal body mass index (18.5-24.9) were included for this prospective study. No subject had muscle disorder, diabetes, history of operation or trauma in the thigh region or was on medication. Age groups were as follows: 30-39 years (n=25), 40-49 years (n=25), 50-59 years (n=25), 60-69 years (n=20). Multi-parametric (intravoxel incoherent motion (IVIM) diffusion-weighted imaging (DWI), diffusion tensor imaging (DTI), multi-echo Dixon imaging, and dynamic contrast-enhanced (DCE)) MRI was acquired at 3.0 T. Parametric maps were evaluated by two radiologists independently in the following muscles: (1) anterior compartment: rectus femoris, vastus lateralis, medialis and intermedius; (2) medial: adductor longus and magnus; (3) posterior: biceps femoris, semitendinosus and semimembranosus. Significance of differences in multiple parameters in three thigh compartments between four age groups was determined by one-way analysis of variance (ANOVA) with post hoc Tuckey. Strength of relationships between multiple parameters and age was evaluated using Pearson correlation analysis. Interrater reliability was also assessed.

RESULTS

Significant differences between different age groups were appreciated for ADC, true diffusion (D), fractional anisotropy and Ve of anterior compartment muscles, as well as fat percentages of all three compartments ($p<0.05$). Moreover, fractional anisotropy and Ve in anterior compartment ($r=0.428$, 0.309, respectively) and fat percentages in all three compartments ($r=0.481$, 0.475, and 0.667, respectively) showed positive relationships to age ($p<0.05$). Interrater reliabilities were excellent (ICC, 0.786-0.992, $p=0.000$ for all).

CONCLUSION

Our study suggests that a number of MRI parameters are associated with age-related changes in thigh muscles. These parameters may reflect histologic and microstructural alterations in aging muscles.

CLINICAL RELEVANCE/APPLICATION

Multi-parametric MRI offers potential for non-invasive characterization of histologic changes in aging skeletal muscles. Our study provides a baseline data for further research on sarcopenia.

SSJ15-02 Fibrosing versus Non-Fibrosing Scleroderma-Related Myopathy: Role of Thigh Muscle MRI

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E450B

Participants
Shivani Ahlawat, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Filippo Del Grande, MD, MBA, Baltimore, MD (*Abstract Co-Author*) Speaker, Siemens AG; Speaker, Bayer AG; Institutional research collaboration, Siemens AG;
Parvinder Sujlana, MD, Newport News, VA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Systemic sclerosis (SSc)-associated myopathy has variable clinical outcomes. SSc patients with fibrosing myopathy (FM) have a rapidly progressive course and higher mortality than those with non-fibrosing myopathy (NFM). The purpose of our study was to describe MRI features in patients with SSc that may be predictive of FM and therefore, patient outcome.

METHOD AND MATERIALS

Following IRB approval, patients with SSc myopathy were included who had undergone a rheumatologic evaluation, thigh MRI and muscle biopsy. MRI included T1-weighted, STIR and DWI with ADC mapping (b-values 0,800 s/mm2) of both thighs. Two musculoskeletal radiologists (in consensus), without knowledge of histopathological findings, evaluated 36 individual muscles in each patient for the presence of intramuscular edema, fascial edema, fatty replacement and atrophy on all sequences using a 4-point score (absence,mild,moderate,maximal). Each patient was categorized by histologic results, as having FM (endomysial/perimysial fibrosis) or NFM (necrosis/inflammation etc.), and comparison of the two groups was performed.

RESULTS

There were 11 patients with FM (mean age 47; 9 women/2 men) and 14 with NFM (mean age 51; 10 women/4 men). Comparing STIR muscle appearance in FM (n=356) and NFM (n=498), intramuscular edema (65%(232/356) vs 49%(245/498), p<0.0001) and fascial edema (22%(79/356)vs17%(84/498), p=0.07), respectively, were more common in FM. DWI showed a greater difference in muscle signal in FM compared with NFM, at low b-value (54%(133/246) vs.23% (64/280), p<0.0001) and high b-value (46% (113/246) vs. 23%(65/280), p<0.0001) images, respectively. Minimum, average and maximum ADC values were not different between the two groups. NFM had chronic changes more often than FM, with fatty replacement (45%(223/498) vs. 26%(92/356), p=< 0.0001) and atrophy (52%(261/498) vs. 33%(118/356), p=< 0.0001), respectively.

CONCLUSION

In patients with SSc-related myopathy, intramuscular and fascial edema (as identified by STIR and DWI) on thigh MRI are more common in FM than NFM, while markers of chronic muscle damage are more often associated with NFM, potentially related to the rapid and fatal course of FM.

CLINICAL RELEVANCE/APPLICATION

Thigh muscle MRI maybe serve as an adjunct tool to distinguish between fibrosing and non-fibrosing SSc related myopathy and as such serve as a biomarker for prognosis.

SSJ15-03 Pudendal Nerve Entrapment: Comparing Pudendal MRI with Surgical Findings, Lessons Learned

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E450B

Participants
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PURPOSE

To evaluate the performance of pudendal MRI in patients with pudendal nerve entrapment (PNE) in comparison with transgluteal pudendal neurolysis, which is the gold standard for detection of PNE caused by scar, dilated vessels, or both.

METHOD AND MATERIALS

We performed a retrospective chart review to obtain basic patient information, operative report data, and presurgical pudendal MRI findings. All patients underwent a dedicated pudendal MRI with and without contrast performed on a 1.5T scanner. Surgical and MRI data were categorized by side (left, right, or bilateral), location [anatomically narrowed spaces, either Alcock's canal (AC) or the interligamentous space (ILS)], and surgical pathology (scar, dilated vessels, or both). Data underwent sensitivity analysis, and descriptive statistics were computed using R (www.r-project.org).

RESULTS

391 patients had dedicated pudendal MRIs between 8/2010 and 12/2016. We identified 67 patients who underwent transgluteal pudendal neurolysis after MRI. There were 55 women and 12 men, whose age ranged 24 to 77 years, mean age 51. 40 surgeries were on the left side; 21 were on right side; and 6 were bilateral. The surgeons saw 70 total scars (51 in ILS, 10 in AC, and 9 in both ILS and AC) and 16 dilated vessels (12 in ILS, 2 in AC, 2 in both ILS and AC). 64 (91%) of the scars and 13 (81%) of the dilated vessels were not discernable on MRI. Only 3 (4%) MRI findings of scar and only 2 (13%) MRI findings of dilated vessels matched findings seen at surgery exactly. Though not exactly quantified at the time of surgery, small scars (<= 2 mm thickness) and mildly dilated vessels (<= 3 mm diameter) predominated the findings at surgery.

CONCLUSION

Pelvic MRI with pudendal protocol has a low detection rate of small scars and mildly dilated vessels in the interligamentous space and in Alcock's canal. In spite of the limitations of current MRI technique, from our experience, clinicians should continue to use MRI to assess for unexpected causes of pudendal nerve entrapment.

CLINICAL RELEVANCE/APPLICATION

This study quantifies the detection rate of scars and dilated vessels to further clarify the role of pelvic MRI with pudendal protocol in patients with clinically determined pudendal nerve entrapment.

SSJ15-04 Will Pre-Operative Combined MRI and HRUS Redefine Brachial Plexus Imaging? A Comparative Study of Pre-Operative MRI versus HRUS in Assessing C5, C6 Viable Root-Stump Length, a Predictor of Intra-Plexal Nerve Grafting

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E450B

Awards
Student Travel Stipend Award

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

MRI is the preferred imaging modality for the traumatic brachial plexus (BP) imaging. From a surgeon's perspective locating viable root stumps is important as they are a source of axons for intra-plexal grafting. Hence predicting its presence preoperatively is of high priority. We argue that the presence of a viable nerve root stump is better assessed pre-operatively with high resolution ultrasonography (HRUS) rather than MRI in patients undergoing BP surgery. This study was undertaken to compare the diagnostic accuracy of combining HRUS with MRI versus MRI alone in the preoperative assessment of viable nerve root stumps of the BP.

METHOD AND MATERIALS

After approval by the institutional review board 56 adult patients with unilateral BP injury who were planned for BP nerve surgery between July 2015 to April 2016 and consented for this prospective study were included. This cohort underwent pre-operative imaging using both MRI and HRUS and an analysis for the presence of viable nerve roots and its length if present were done using the above two modalities. Undisrupted plexuses were deemed as "continuous" while discontinuous plexuses with "viable" root stumps were termed as "present" and those without as "absent". A viable stump was one with preserved epineurium and fascicular architecture and devoid of pre-ganglionic injury. Stump lengths were measured using both imaging modalities and compared with intraoperative (IO) measurements for their concordance.

RESULTS

We observed a greater agreement between the HRUS and IO findings in categorizing BP root stumps (Kappa value 0.70) as compared to MRI and IO (Kappa value 0.42). Similarly, there was a higher correlation (intra-class correlation-ICC) of the stump length measured, between HRUS and IO (0.94) than that of MRI and IO (0.53).

CONCLUSION

Combining HRUS with MRI in the pre-operative assessment of patients with adult BP injury can predict better, the presence of viable nerve root stumps as well as accurately measure its length compared to MRI alone.

CLINICAL RELEVANCE/APPLICATION

Knowing the quality of the root stump pre-operatively will help the surgeon in choosing an appropriate nerve grafting procedure and have possible better clinical outcomes. Hence, all pre-operative BP imaging protocols should include HRUS imaging along with standard MRI sequences for a comprehensive radiological evaluation.

SSJ15-05 Parsonage-Turner Syndrome: Not a Brachial Plexitis

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E450B

Participants
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PURPOSE

Parsonage-Turner syndrome (PTS) - commonly known as neuralgic amyotrophy and brachial neuritis - is described etiologically as a 'brachial plexitis,' implying diffuse plexus involvement, but recent electrodiagnostic research suggests otherwise. We sought to characterize lesion distribution in PTS using high-resolution MRI.

METHOD AND MATERIALS

We searched our institution's MRI database for patients with a clinical diagnosis of PTS. Two radiologists specializing in peripheral nerve MRI independently evaluated signal characteristics and morphology of the brachial plexus on high-resolution MRI, including terminal branches of the plexus, as well as peripheral nerves when imaged. A physiatrist with expertise in PTS reviewed all charts to confirm the diagnosis of PTS using history, exam, and electromyographic (EMG) findings of complete/near-complete motor loss.

RESULTS

24 patients (18 M, 6 F; age 41 ± 15 years) had >=1 clinically involved nerves: suprascapular (15), long thoracic (7), axillary (5), radial (2), anterior interosseous (2), thoracodorsal (1), phrenic (1), musculocutaneous (1), and median nerve branch to pronator

teres (1). 75% of patients developed severe weakness following a prodrome of sudden-onset intense pain, while 25% had onset >12h following a surgical procedure. Mean time between symptom onset and initial EMG was 5.5 ± 4.6 months and 8 ± 6.7 months between onset and MRI. On MRI, the plexus proper appeared normal in 21/24 patients; in 3 others, T2-weighted signal hyperintensity was seen immediately proximal to the terminal branch take-off. Focal caliber decreases of terminal branches, suggesting intrinsic constrictions, were detected in 19/24. Hyperintensity and enlargement of involved peripheral nerves were present in all patients, except the phrenic nerve (too small to identify). MRI inter-reader agreement was nearly perfect (Cohen's kappa = 0.833).

CONCLUSION

MRI findings, corroborated by EMG, localize abnormalities to the plexus branches and peripheral nerves, suggesting PTS is a mononeuropathy multiplex rather than a diffuse brachial plexitis.

CLINICAL RELEVANCE/APPLICATION

'Brachial plexitis' is a misnomer that erroneously implies diffuse plexal involvement. Accurate disease terminology may improve diagnosis and management.

SSJ15-06 T1 and T2* MRI Mapping for Detection of Early Tendon Degeneration: A Phantom Study

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E450B

Participants
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Michael A. Fischer, MD, Stockholm, Sweden (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To quantitatively assess early tendon degeneration using T1 and T2* mapping in healthy and chemically degenerated bovine flexor hallucis tendons

METHOD AND MATERIALS

Twelve cadaveric specimens unterwent MRI at 3T before and after chemical tendon degeneration. Fibre cross-linking or protein denaturation resembling the first or the second step of tendon degeneration was chemically induced in a total of 10 tendons. A variable-echo-time sequence and variable-flip angle sequence was used for T2* mapping and T1 mapping respectively. Each scan (untreated and treated tendons) was repeated twice at different time points and T1 and T2* times were correlated with different grades of early tendon degeneration. Standard T1- and T2-weighted spin-echo (SE) sequences were acquired for visual assessment of tendon texture. Degree of tendon degeneration was verified by histopathological analysis.

RESULTS

The degree of tendon cross-linking and denaturation ranged from mild to strong. T1 times were reproducible, showing no difference between scan 1 and 2 for untreated and treated tendons (both, $P<0.01$). The mean T1 and T2* times were significantly different between normal and degenerated tendons ($P<0.01$) and correlated well with the degree of tendon degeneration ($R=0.86$, $P<0.05$). Standard T1 and T2 SE sequences showed no visual signal differences both in treated and untreated tendons.

CONCLUSION

T1 and T2* mapping has the potential to detect and quantify early tendon degeneration before changes in tendon structure become visible on standard MR sequences.

CLINICAL RELEVANCE/APPLICATION

Early tendon degeneration in symptomatic patients might be diagnosed much earlier as with routine MR sequences.

SSJ16

Musculoskeletal (Cartilage)

Tuesday, Nov. 28 3:00PM - 4:00PM Room: E451A

MK MR

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

Participants
Daniel B. Nissman, MD, MPH, Raleigh, NC (*Moderator*) Royalties, John Wiley & Sons, Inc; Royalties, Wolters Kluwer nv
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Sub-Events

SSJ16-01 Evaluation of Knee Cartilage Composition using T2 Mapping Sequences at 3T in Patients with Early Osteoarthritis Treated with Intra-articular Platelet-Rich-Plasma (PRP) Injections

Tuesday, Nov. 28 3:00PM - 3:10PM Room: E451A

Participants
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Francesco Arrigoni, Coppito, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To define the ability of T2 mapping sequences to evaluate the efficacy of PRP injections characterizing qualitatively and quantitatively knee cartilage composition in patients with early osteoarthritis

METHOD AND MATERIALS

40 patients (17 men, 23 women, mean age 35.8 years), with clinical suspicion of tibiofemoral and patellofemoral chondropathy were examined on a 3T MRI scanner. T1WI, T2WI, and PDWI sequences were used for morphological evaluation of cartilage lesions, using a modified WORMS score. T2 mapping sequences were used for the qualitative and quantitative analysis of cartilage by means of color-scale representation and ROI measurements of T2 relaxation time values. Patients were assigned to 2 groups: 20 patients (group A) were treated with intra-articular PRP injections (3 times, 3 weeks apart), 20 patients (group B, control) were submitted to conservative therapy. MRI follow-up was performed at 6 months

RESULTS

Before treatment the two study groups were homogeneous in terms of age, sex and BMI. The morphologic evaluation showed mean WORMS score of 8.4 (pre-treatment) and 6.6 (post-treatment) in Group A ($p < 0.0001$). In Group B mean WORMS scores were 8.6 (pre-treatment) and 7.9 (post-treatment) ($p = 1,323$). Mean T2 relaxation times values in Group A were 51.39 ms (pre-treatment) and 44.19 ms (post-treatment) ($p < 0.001$). In Group B, 51.86ms (pre-treatment) and 50.7ms (post-treatment) ($p = 0.274$)

CONCLUSION

Our imaging results confirm the clinical evidence of the efficacy of PRP injections for the treatment of knee osteoarthritis. Evaluation of cartilage T2 relaxation times provides additional quantitative information that may not be directly discernible from standard morphological sequences

CLINICAL RELEVANCE/APPLICATION

Cartilage repair is a challenging clinical issue. The efficacy of novel therapies aiming at tissue regeneration (such as PRP) is strictly dependent on early detection of cartilage pathology and a close monitoring of the treatment effects. Characterization of the cartilage matrix composition with T2 relaxation time measurements could potentially help in prevention of OA progression, allowing better monitoring of the disease and treatment-related changes in the cartilage matrix over time

SSJ16-02 Articular Cartilage Reliably Predicts Symptomatic Osteoarthritis Progression from T2 Maps Using Transport-Based Morphometry

Tuesday, Nov. 28 3:10PM - 3:20PM Room: E451A

Awards
Trainee Research Prize - Medical Student

Participants

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PURPOSE

Articular cartilage in the knee undergoes early biochemical changes in the development of osteoarthritis (OA). We determine whether texture change in articular cartilage as assessed by T2 maps is a reliable predictor of future symptomatic osteoarthritis.

METHOD AND MATERIALS

70 subjects (39 progressors, 31 controls) were chosen from the Osteoarthritis Initiative (OAI) database (age = 58.5 ± 9.2, BMI = 27.2 ± 4.8). At baseline, subjects had no evidence of OA either clinically (Western Ontario and McMaster Universities Arthritis Index (WOMAC) <10) or radiographically (Kellgren-Lawrence score <=2). On 3-year follow up, progressors were identified as subjects with >10 increase in WOMAC from baseline. Femoral cartilage was segmented from baseline T2 maps and co-registered. The transport-based morphometry (TBM) technique was applied to characterize T2 spatial variation within each subject individually and compared to a common template image. A penalized linear discriminant analysis classifier was constructed in the transport space and test accuracy in predicting symptomatic OA progression was determined using complete leave-two-out cross-validation. Characteristic patterns of injury were visualized through inverse TBM transformation.

RESULTS

TBM enables 86.2% test accuracy in predicting future symptomatic OA three years in advance of symptoms using T2 spatial variation of articular cartilage (sensitivity=86.6%, specificity=85.9%, Cohen's kappa = 0.72), significantly outperforming classification based on age and BMI alone. By defining signature patterns of injury in the femoral cartilage, we found that a central defect in the medial condyle and diffuse fissuring in the medial aspect of the lateral condyles were predictive of future OA.

CONCLUSION

The development of symptomatic OA can be reliably predicted based on the T2 map of knee articular cartilage using TBM, yielding the highest accuracy to date when compared to other predictive studies. In addition, TBM enables visualization of signature patterns of injury that are predictive of future OA for the first time.

CLINICAL RELEVANCE/APPLICATION

The early changes in T2 spatial variation revealed by TBM enhance our understanding of OA progression and yield markers that may be used prognostically and monitor success of disease-modifying therapies in the future.

SSJ16-03 Are Different Weight Loss Regimens in Obese and Overweight Individuals Associated With Different Degrees of Cartilage Degeneration Over 96 Months? Data from the Osteoarthritis Initiative

Tuesday, Nov. 28 3:20PM - 3:30PM Room: E451A

Participants
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Gabby B. Joseph, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
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Thomas M. Link, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, InSightec Ltd; Research Grant, InSightec Ltd; Royalties, Springer Nature; Consultant, Springer Nature; Research Consultant, Pfizer Inc;

PURPOSE

To investigate MR-based cartilage biochemical degeneration and morphologic joint abnormalities over 96 months in overweight and obese subjects with stable weight and weight loss and to assess how these changes are affected by different weight loss regimens.

METHOD AND MATERIALS

Subjects with a BMI>25kg/m2 from the Osteoarthritis Initiative (n=760; age 62.6±9.0y; 465 females) with risk factors for or radiographic mild to moderate osteoarthritis were included. Subjects losing weight (>5% of baseline BMI; N=380) were frequency matched to controls with stable weight (N=380) and categorized into groups regarding the weight loss method (diet and exercise, diet only, exercise only). 3T MRI of the right knee was performed at baseline, 48- and 96-months. T2 relaxation time changes of cartilage composition, including laminar and texture analysis as well as morphological knee abnormalities, assessed with Whole-Organ-Magnetic-Resonance-Imaging-Scores (WORMS) were analyzed using mixed random effects models to calculate associations between amount of weight loss and regimen.

RESULTS

Progression of cartilage WORMS was significantly lower in the weight loss group compared to controls (P<0.001) over 96 months. Subjects with weight loss showed significantly less T2-value increase in the bone layer of all compartments (P<0.03, for each) compared to the controls with stable weight, suggesting less cartilage degeneration over 96 months in the subjects with weight loss compared to their controls. Rates of increase in cartilage T2 averaged over all compartments were lowest in the diet and diet and exercise groups compared to the stable weight group (P=0.042 and P=0.003, respectively). Weight loss through exercise alone showed no significant difference in change of T2 over 96 months compared to subjects with stable weight (P=0.56).

CONCLUSION

Results suggest that cartilage degeneration is slowed through weight loss in obese and overweight subjects over 96-months. This

protective effect was, however, only found in subjects losing weight through diet and combined exercise and diet programs.

CLINICAL RELEVANCE/APPLICATION

MR-based knee cartilage T2 measurements and semiquantitative grading allow monitoring of the protective effect of weight loss on joint health and are useful to determine which weight loss regimen is most beneficial in overweight and obese patients.

SSJ16-04 Type 2 Diabetes Patients show Accelerated Cartilage Matrix Degeneration Compared to Age, Gender and BMI-matched Diabetes Free Controls: Data from the Osteoarthritis Initiative

Tuesday, Nov. 28 3:30PM - 3:40PM Room: E451A

Participants
Jan Neumann, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Felix C. Hofmann, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Michael C. Nevitt, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Charles E. McCulloch, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Gabby B. Joseph, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Nancy E. Lane, Sacramento, CA (*Abstract Co-Author*) Nothing to Disclose
Ursula R. Heilmeier, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Alexandra S. Gersing, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Benedikt J. Schwaiger, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Kenneth Tang, BA, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Thomas M. Link, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, InSightec Ltd; Research Grant, InSightec Ltd; Royalties, Springer Nature; Consultant, Springer Nature; Research Consultant, Pfizer Inc;

PURPOSE

The relationship between osteoarthritis (OA) and type 2 diabetes mellitus (T2DM) is poorly understood with both diseases showing common risk factors. The purpose of this study was therefore to longitudinally investigate over 24 months cartilage matrix changes measured with MR-based T2 relaxation time including texture measurements in patients with T2DM compared to diabetes-free controls.

METHOD AND MATERIALS

Patients were recruited from the Osteoarthritis Initiative. In total 196 subjects with T2DM were group-matched for age, sex, BMI and Kellgren-Lawrence score with 196 diabetes free controls. T2DM was ascertained either by self-report or by use of anti-diabetic medication. Knee cartilage semi-automatic segmentation was performed on 2D multi-slice multi-echo spin-echo sequences; Cartilage T2 maps were calculated using a mono-exponential decay model. Texture of cartilage T2 maps was obtained with grey level co-occurrence matrix analysis, calculating the spatial distribution of neighboring pixels within the cartilage for contrast, variance, and entropy. Conditional logistic regression analysis was used to compare cross-sectional and changes in T2 and texture parameters between both groups.

RESULTS

Averaged over all compartments, subjects with T2DM increased almost twice as fast as the control group in the global knee T2 values (mean T2 (ms) [95% CI]: 1.77 [1.51,2.03] and 0.98 [0.68,1.28], respectively ($p<0.001$). The 24-month cross-sectional analysis showed significantly higher T2 values in subjects with diabetes in the global knee ($p=0.009$), patella ($p=0.01$), medial tibia ($p=0.02$), and lateral tibia (0.006). Moreover, T2DM showed texture parameters consistent with increased cartilage matrix inhomogeneity at baseline for contrast, variance and entropy ($p<0.05$) and after 24 months for contrast and variance ($p<=0.05$).

CONCLUSION

Subjects with T2DM showed a significantly faster increase in T2 values when compared to diabetic-free controls, and had also significantly higher T2 values in the cross-sectional analysis at 24 months, indicating an accelerated degeneration of the cartilage matrix. Furthermore, T2DM subjects showed more heterogeneous cartilage texture composition at both time points.

CLINICAL RELEVANCE/APPLICATION

Altered cartilage composition and collagen architecture in subjects with T2DM and accelerated cartilage matrix deterioration, suggest that T2DM is an important risk factor for OA.

SSJ16-05 MRI-Based Indicators of Patella Cartilage Volume Loss over 24-Month Interval: Initial Assessment Using Data from the FNIH OA Biomarkers Consortium

Tuesday, Nov. 28 3:40PM - 3:50PM Room: E451A

Participants
Christopher Sereni, MD, Worcester, MA (*Presenter*) Nothing to Disclose
Nima Hafezi Nejad, MD, MPH, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Frank W. Roemer, MD, Erlangen, Germany (*Abstract Co-Author*) Chief Medical Officer, Boston Imaging Core Lab LLC; Director of Research, Boston Imaging Core Lab LLC; Shareholder, Boston Imaging Core Lab LLC; ;
Ali Guermazi, MD, PhD, Boston, MA (*Abstract Co-Author*) President, 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
Shadpour Demehri, MD, Baltimore, MD (*Abstract Co-Author*) Research support, General Electric Company; Research Grant, Carestream Health, Inc; Consultant, Toshiba Corporation;

PURPOSE

To investigate whether key patellofemoral alignment indicators on 3T magnetic resonance imaging (MRI) are associated with baseline cartilage volume differences and 2-year progression of patella cartilage volume loss.

METHOD AND MATERIALS

One index knee from each of 600 subjects in the Osteoarthritis Biomarkers Consortium FNIH project were included. Four key patellofemoral alignment markers were assessed on baseline imaging including: tibial tuberosity-trochlear groove distance (TT-TG), Insall-Salvati (IS) ratio, trochlear groove depth (TGD) and presence or absence of superolateral Hoffa's fat pad edema. Patella cartilage volume was determined at baseline and 24-month follow up MRI using validated automated software. Cross-sectional analysis of baseline data was performed by comparing cartilage volumes for each alignment index, with abnormal values considered TT-TG greater than 15 mm, IS ratio greater than 1.4, TGD greater than 3 mm, and presence of fat pad edema. Multivariable logistic regression analysis was performed with odds-ratios determined for future cartilage volume loss, adjusted for age, gender, BMI and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

RESULTS

On baseline cross-sectional analysis, abnormal IS ratio and abnormal TGD were associated with lower baseline patella cartilage volume (IS ratio: 2445 mm3 vs 2664 mm3, p:0.028; TGD: 2697 mm3 vs 2369 mm3 p<0.001). Multivariate logistic regression analysis showed only presence of superolateral Hoffa's fat pad edema to be predictive of significant 2-year interval decrease in patellofemoral cartilage volume (OR: 1.82, p: 0.003).

CONCLUSION

Presence of superolateral Hoffa's fat pad edema is associated with 2-year progression of patella cartilage volume loss. Furthermore, subjects with abnormal IS ratio and TGD had lower baseline patella cartilage volumes, suggestive of cartilage loss prior to initiation of this study.

CLINICAL RELEVANCE/APPLICATION

Routine indicators of patellofemoral alignment on MRI could allow for prediction of future patellofemoral cartilage loss.

SSJ16-06 Comparison of T2 Relaxation Values in Subtalar Cartilage between Patients with Lateral Instability of the Ankle Joint and Healthy Volunteers

Tuesday, Nov. 28 3:50PM - 4:00PM Room: E451A

Participants
Hyun Su Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Young Cheol Yoon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

calmuri@naver.com

PURPOSE

To evaluate the difference between the T2 relaxation values of the subtalar cartilage in patients with lateral instability of the ankle joint and the values in healthy volunteers.

METHOD AND MATERIALS

Twenty-seven ankle magnetic resonance imaging (MRI) examinations of 26 patients who underwent lateral ankle ligament repair between January 2011 and November 2013 were included. The datasets of previously enrolled healthy volunteers, 13 ankle MRI examinations of 12 volunteers, were used as a control group. Two radiologists independently measured the T2 relaxation values of the cartilage in the posterior facet of the subtalar joint comprising of eight compartments as follows: central calcaneus anterior (CCA), central calcaneus posterior (CCP), central talus anterior (CTA), central talus posterior (CTP), lateral calcaneus anterior (LCA), lateral calcaneus posterior (LCP), lateral talus anterior (LTA), and lateral talus posterior (LTP). The T2 relaxation values of the patient group were compared with those of the control group using linear regression analysis. Interobserver agreement and intraobserver agreement for the measurement were calculated using the intraclass correlation coefficient (ICC).

RESULTS

Readers found significantly higher mean T2 relaxation values in all compartments except that in LTP compartment measured by reader 1. For reader 1, the CCA findings were 44.9 for patients and 40.5 for healthy volunteers (p=0.002); CCP, 46.0 and 40.8 (p=0.002); CTA, 50.1 and 46.0 (p=0.001); CTP, 52.8 and 46.3 (p<0.001); LCA, 43.7 and 39.1 (p=0.002); LCP, 45.1 and 38.8 (p<0.001); LTA, 50.8 and 47.5 (p=0.019); and LTP, 50.4 and 47.6 (p=0.085). For reader 2, the CCA findings were 45.5 for patients and 41.5 for healthy volunteers (p=0.005); CCP, 45.8 and 40.1 (p<0.001); CTA, 49.7 and 45.6 (p=0.009); CTP, 52.7 and 47.0 (p<0.001); LCA, 44.3 and 39.2 (p<0.001); LCP, 45.8 and 38.8 (p<0.001); LTA, 50.4 and 47.6 (p=0.040); and LTP, 52.9 and 48.0 (p=0.002). Interobserver agreement and intraobserver agreement were excellent for all measurements (ICC>0.75).

CONCLUSION

The T2 relaxation values of the subtalar cartilage were significantly higher in patients with lateral ankle instability compared with those of healthy volunteers.

CLINICAL RELEVANCE/APPLICATION

Quantitative T2 mapping in the subtalar joint is feasible and may have a role for diagnostic evaluation of cartilage degeneration in patients with lateral ankle instability.

RC401

Pulmonary Vascular Imaging

Tuesday, Nov. 28 4:30PM - 6:00PM Room: N227B

CH CT MR VA

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

FDA Discussions may include off-label uses.

For information about this presentation, contact:

jerasmus@mdanderson.org

Sub-Events

RC401A Imaging of Acute Pulmonary Embolism

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

For information about this presentation, contact:

johnny.vlahos@stgeorges.nhs.uk

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.

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/ Ioannis Vlahos, MRCP, FRCR - 2015 Honored Educator

RC401B 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) To outline the role of CT and MR imaging in the diagnostic work-up and management of patients with suspected chronic pulmonary embolism and pulmonary hypertension (PH). 2) To list the CT and MRI features of PH. 3) To illustrate diseases that cause PH and have typical imaging findings.

Active Handout:Carole Jeanne Dennie

http://abstract.rsna.org/uploads/2017/17000299/Active RC401B.pdf

RC401C 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.

RC401D 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

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/2017/17000303/Active RC401D.pdf

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RC404

Ligamentous Injuries of the Knee: Mechanistic Approach with Emphasis on MR Imaging

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E450A

MR MK

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

Participants
Donald L. Resnick, MD, Del Mar, CA (*Director*) Nothing to Disclose
Donald L. Resnick, MD, Del Mar, CA (*Presenter*) Nothing to Disclose
Tetyana A. Gorbachova, MD, Huntingdon Vy, PA (*Presenter*) Nothing to Disclose
Robert D. Boutin, MD, Davis, CA (*Presenter*) Nothing to Disclose
Brady K. Huang, MD, San Diego, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

GorbachT@einstein.edu

LEARNING OBJECTIVES

1) To delineate the MR imaging features typical of a variety of ligamentous injuries of the knee. 2) To illustrate how MR imaging findings, including those related to abnormalities in the subchondral bone of the femur, tibia, and/or patella, provide critical clues to the specific mechanism involved in these ligamentous injuries. 3) To define the characteristic MR imaging features associated with translational, angular, and rotational mechanisms that lead to injury of the anterior and posterior cruciate ligaments and the medial and lateral supporting structures of the knee.

ABSTRACT

This course will emphasize a mechanistic approach to ligamentous injuries of the knee, emphasizing MR imaging. Individual speakers will use this approach in their discussions of such injuries with attention focused on the anterior cruciate and posterior cruciate ligaments and the medial and lateral supporting structures. The importance of the distribution and pattern of bone injury, expecially that in the subchondral region of the femur, tibia, and/or patella, will be illustrated with analysis of hyperextension, hyperflexion, and translational, angular, and rotational injuries, among others.

RC409

Imaging of the Colorectum

Tuesday, Nov. 28 4:30PM - 6:00PM Room: E350

CT GI MR

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

LEARNING OBJECTIVES

1) Differentiate between and choose options for patient bowel catharsis. 2) Learn about the value of and options for fecal and fluid tagging. 3) Optimize bowel distension. 4) Select the proper CT scan technique and parameters. 5) Optimize radiation dose, keeping it ALARA (as low as reasonably achievable). 5) Have new ideas on increasing referrals appropriately for CT colonography. 6) Be more familiar with current billing rules for screening and diagnostic CT Colonography. 7) Have increased knowledge on workflow optimization tasks for an improved CT Colonography program. 8) Review Clinical Background relevant to preoprative MRI of rectal cancer.9) Demonstrate key MRI technique and anatomy critical for preoperative staging. 10) Discuss use of structured reporting and highlight salient points to be included in MRI report. 11) Review Clinical Anatomy relevant to MRI of anorectal fistulas. 12) Demonstrate key MRI technique and anatomy critical for detecting and classifying anorectal fistulas. 13) Discuss use of standardized reporting and highlight salient points to be included in MRI report.

SAM

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Sub-Events

RC409A CT Colonography: Practical Tips

Participants
Kevin J. Chang, MD, Sharon, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Kevin.J.Chang@gmail.com

LEARNING OBJECTIVES

1) Differentiate between and choose options for patient bowel catharsis.2) Learn about the value of and options for fecal and fluid tagging.3) Optimize bowel distension.4) Select the proper CT scan technique and parameters.5) Optimize radiation dose, keeping it ALARA (as low as reasonably achievable).

RC409B Improving Your CT Colonography Workflow

Participants
Cecelia Brewington, MD, Dallas, TX (*Presenter*) Research Grant, Toshiba Medical Systems Corporation

For information about this presentation, contact:

cecelia.brewington@utsouthwestern.edu

LEARNING OBJECTIVES

1) Have new ideas on increasing referrals appropriately for CT colonography. 2) Be more familiar with current billing rules for screening and diagnostic CT Colonography. 3) Have increased knowledge on workflow optimization tasks for an improved CT Colonography program.

RC409C Rectal Cancer: Preoperative MRI Staging

Participants
Kartik S. Jhaveri, MD, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review Clinical Background relevant to preoprative MRI of rectal cancer. 2) Demonstrate key MRI technique and anatomy critical for preoperative staging. 3) Discuss use of structured reporting and highlight salient points to be included in MRI report.

RC409D MR Imaging of AnoRectal Fistulas

Participants
Mukesh G. Harisinghani, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review Clinical Anatomy relevant to MRI of anorectal fistulas. 2) Demonstrate key MRI technique and anatomy critical for detecting and classifying anorectal fistulas. 3) Discuss use of standardized reporting and highlight salient points to be included in MRI report.

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RC417

Emerging Technologies: Imaging and Management of Pain

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S505AB

MR NM

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

Participants
Sandip Biswal, MD, Stanford, CA (*Moderator*) Stockholder, SiteOne Therapeutics Inc; Scientific Advisory Board, SiteOne Therapeutics Inc; Research Grant, General Electric Company;

SAM

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Sub-Events

RC417A Challenges in Pain Diagnosis: A Pain Specialist's Perspective on the Potential of Imaging

Participants
Vivianne Tawfik, MD, PhD, Stanford, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the basics of pain transmission. 2) Understand the current challenges of pain diagnosis. 2) Identify patients suffering from chronic pain in whom specialized imaging studies add diagnostic value. 3) Develop a multidisciplinary team to better evaluate and treat complex pain conditions.

RC417B MR Imaging of Peripheral Nerves in Patients with Pain

Participants
Cynthia T. Chin, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

cynthia.t.chin@ucsf.edu

LEARNING OBJECTIVES

1) Understand the anatomy of the peripheral nerves, brachial and lumbosacral plexus. 2) Know the MRI sequences that best demonstrate normal and abnormal nerve. 3) Understand the variety of diseases that affect the peripheral nervous system. 4) Apply diffusion imaging to evaluate peripheral nerve disease.

Active Handout:Cynthia T. Chin

http://abstract.rsna.org/uploads/2017/16001538/Active RC417B.pdf

RC417C PET/MRI of Inflammation and Pain Generators

Participants
Sandip Biswal, MD, Stanford, CA (*Presenter*) Stockholder, SiteOne Therapeutics Inc; Scientific Advisory Board, SiteOne Therapeutics Inc; Research Grant, General Electric Company;

LEARNING OBJECTIVES

1) Understand the challenges of current conventional imaging approaches in diagnosing peripheral pain generators. 2) Understand the basis for identifying specific molecular and cellular biomarkers of pain and how these biomarkers can be exploited with molecular and cellular imaging techniques. 3) Demonstrate clinical PET/MR or advanced MRI approaches in identifying pain generators.

ABSTRACT

Chronic pain is now the mostprevalent disease in the world. The chronic pain sufferer is currently faced with a lack of objective tools to identify the source of their pain. The goal of this session is to describe new clinical molecular imaging and emerging molecular/cellular imaging methods to more accurately localize chronic pain generators/drivers so that we may objectively identify and more intelligently act upon the cause in a pain sufferer. Successful imaging of pain is relying heavily upon a multidisciplinary effort that include expertise from of a number of scientists and clinicians in the fields of synthetic chemistry, radiochemistry, magnetic resonance physics/engineering, molecular pain neurobiology, clinical pain, radiology and others. A number of clinical and emerging pre-clinical approaches in positron emission tomography (PET) and magnetic resonance imaging (MRI) will be described. These imaging methods will demonstrate how the site of increased physiologic or inflammatory activity can potentially be used to more accurately identify and localize pain generators.

RC423

Molecular Imaging Mini-Course: Advanced Molecular Imaging

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S504AB

MI MR NM PH

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

FDA Discussions may include off-label uses.

Sub-Events

RC423A Novel Tracers

Participants
Timothy R. DeGrado, PhD, Rochester, MN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the major considerations when developing a novel molecular imaging probe. 2) Compare the strengths and weaknesses of the various imaging modalities with regard to probe development and implementation. 3) Define appropriate experiments for probe validation. 4) Gain an understanding of the process of translation of a probe to clinical practice.

ABSTRACT

Molecular imaging is rapidly advancing as new imaging biomarkers are invented to allow noninvasive assessment of biochemical function. Those who embark on the process of developing novel probes come to know the excitement of imaging biological processes for the first time, but are also well aware of the great effort and many pitfalls that can impede progress. This introductory lecture will provide an overview of the process of molecular imaging probe conception, development, preclinical validation, and translation. Specific examples will be used to illustrate the presenter's experience with meeting these challenges.

RC423B Novel Instrumentation (PET/MR)

Participants
Ciprian Catana, MD, PhD, Charlestown, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Distinguish the technical approaches that have been proposed for integrating PET and MRI for the purpose of simultaneous data acquisition. 2) Evaluate the latest methodological developments in PET/MRI for improving PET data quantification. 3) Incorporate simultaneous PET/MRI techniques into research and clinical projects.

RC423C Molecular Imaging with MR

Participants
Peter D. Caravan, PhD, Charlestown, MA (*Presenter*) Research Grant, Pfizer Inc;

LEARNING OBJECTIVES

1) To describe the strengths and limitations of molecular MR imaging. 2) To list the different classes of molecular MR imaging probes and provide examples of each. 3) To understand the process for clinical translation of a novel molecular imaging probe.

ABSTRACT

Magnetic resonance imaging is considered by some to be too insensitive a technique for molecular imaging. Despite some limitations, molecular MR imaging offers a number of advantages compared to other molecular imaging modalities in terms of temporal and spatial resolution, deep tissue imaging, lack of ionizing radiation, shelf-stable molecular probes, complementary functional and anatomic information, and in some cases, equisite sensitivity. Here, we will describe with examples the strengths and limitations of molecular MR, different classes of molecular MR probes, and opportunities for clinical translation of promising preclinical data.

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RC429

The Added Value of DWI in Clinical Practice

Tuesday, Nov. 28 4:30PM - 6:00PM Room: S402AB

BQ MR

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

FDA Discussions may include off-label uses.

Participants
Hero K. Hussain, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

Sub-Events

RC429A Diffusion Weighted Imaging in the Evaluation of Inflammatory Bowel Disease

Participants
Stuart A. Taylor, MBBS, London, United Kingdom (*Presenter*) Research Consultant, Robarts Clinical Trials, Inc

For information about this presentation, contact:

stuart.taylor1@nhs.net

LEARNING OBJECTIVES

1) To explain the histopathological changes in inflammatory bowel disease that underpin changes in diffusion weighted imaging. 2) To describe the advantages and pitfalls of adding diffusion weighted imaging to standard MR enterography protocols. 3) Appraise the current role of diffusion weighted imaging in the diagnosis and staging of inflammatory bowel disease.

RC429B Whole Body DWI for Tumor Detection and Assessment of Response

Participants
Anwar R. Padhani, MD, FRCR, Northwood, United Kingdom (*Presenter*) Advisory Board, Siemens AG Speakers Bureau, Siemens AG Researcher, Siemens AG Speakers Bureau, Johnson & Johnson

LEARNING OBJECTIVES

1) To provide a rationale for the use of whole body MRI when evaluating malignant disease extent and for therapy response assessment. 2) To show how measurements are acquired distinguishing between tumor detection (core) and response assessment (comprehensive) protocols that are MET-RADS compliant. 3) To highlight and review the MET-RADS response assessment guidelines. 4) To provide the scientific evidence and illustrate by case reviews the efficacy of WB-MRI comparing with PET/CT, bone and CT scans including areas of potential synergy. 5) To highlight specific clinical indications for WB-MRI use and highlight patient and clinical pathway altering benefits and limitations.

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RC429C DWI Beyond ADC

Participants
Bachir Taouli, MD, New York, NY (*Presenter*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA

For information about this presentation, contact:

bachir.taouli@mountsinai.org

LEARNING OBJECTIVES

1) Review strengths and limitations of ADC quantification outside the brain. 2) Review the potential added value of non-mono exponential processing methods, including IVIM, stretched exponential and kurtosis for diffusion quantification outside the brain.

ABSTRACT

Recent advances in MRI hardware and software have made diffusion-weighted imaging (DWI) an important part of MRI protocols outside the brain. In this presentation, we will review the current data on exponential and non-monoexponential diffusion models outside the brain, particularly for oncologic applications.

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RCB41

Prostate MRI (Hands-on) Course will be repeated Monday, Tuesday, Wednesday and Thursday from 8am-10am

Wednesday, Nov. 29 8:00AM - 10:00AM Room: S401CD

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
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Siemens AG
Roel D. Mus, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Geert M. Villeirs, MD, PhD, Ghent, Belgium (*Presenter*) Nothing to Disclose
Marloes van der Leest, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Renske L. van Delft, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Rianne R. Engels, Cuijk, Netherlands (*Presenter*) Nothing to Disclose
Leonardo K. Bittencourt, MD, PhD, Rio De Janeiro, Brazil (*Presenter*) Investor, Healfies LLC
Joseph J. Busch, MD, Chattanooga, TN (*Presenter*) Nothing to Disclose
Baris Turkbey, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Daniel J. Margolis, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Antonio C. Westphalen, MD, Mill Valley, CA (*Presenter*) Scientific Advisory Board, 3DBiopsy LLC ; Research Grant, Verily Life Sciences LLC
Philippe A. Puech, MD, Lyon, France (*Presenter*) Nothing to Disclose

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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 30 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. PLEASE NOTICE: Based on last year's experience we expect this course to be very popular. We only have 50 computes, and two spots per computer. Only the first 100 people will be accepted in the room. The front rows are reserved for beginners. In case you have experience with prostate MR: Please take a seat at the computers in the back of the room. We will not have space for any additional listeners this year.The coursebook can be found as handout to this course. Please take it with you to the course on your tablet or other device.

Active Handout:Renske Lian van Delft

http://abstract.rsna.org/uploads/2017/16002005/Active RCB.pdf

MSES41

Essentials of Cardiac Imaging

Wednesday, Nov. 29 8:30AM - 10:00AM Room: S100AB

CA CT MR

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

Sub-Events

MSES41A Cardiac MRI: From Basics to Practice

Participants
Isabel B. Oliva, MD, New Haven, CT (*Presenter*) Author, Reed Elsevier; Editor, Reed Elsevier

LEARNING OBJECTIVES

1) Understand the basics of cardiac MRI acquisition. 2) Recognize normal anatomy. 3) Learn the MR findings of common cardiomyopathies.

ABSTRACT

This course will review the basics of cardiac MRI acquisition including imaging planes and sequences. We will review normal cardiac anatomy and discuss the findings of the most common cardiomyopathies.

Active Handout:Isabel Borges Oliva

http://abstract.rsna.org/uploads/2017/17000033/Active MSES41A.pdf

MSES41B Spectral CT

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

Honored Educators

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

MSES41C Cardiac MR of Acute MI: Imaging Patterns and Prognostic Implications

Participants
Marco Francone, MD, Rome, Italy (*Presenter*) Speakers Bureau, Bracco Group

For information about this presentation, contact:

marco.francone@uniroma1.it

LEARNING OBJECTIVES

1) To review basic pathophysiology of the ischemic cascade preceding acute myocardial infarction, integrating pathological models with CMR imaging findings. 2) To illustrate spectrum of findings and relative significance of different patterns of tissue necrosis depicted with CMR. 3) To understand added value of MR in the setting as a prognostic indicator of adverse remodeling and major events following myocardial infarction.

ABSTRACT

Current therapeutic strategies in ST-elevation acute myocardial infarction (STEMI) aim to recanalize culprit vessel within the shortest temporal window in order to restore myocardial blood flow within the ischemic territory and save the highest amount of myocardial tissue according to the so-called "open-artery" theory.As a matter of fact, a large spectrum of tissue changes may occur following acute necrosis, ranging between the occurrence of the so-called "aborted infarction" which is characterized by a predominantly edematous injury with minimal necrotic component up to the presence of extensive microvascular damage with no-reflow within the area-at-risk.Cardiac MR represent imaging technique of choice for the in-vivo depiction of STEMI allowing to comprehensively evaluate functional impairment and tissue changes characterizing the processs consisting with direct visualization and quantification of necrotic region and corresponding edematous area representing the area-at-risk.Relevant prognostic implications derive from CMR imaging of myocardial infarction affecting functional recovery and patient's prognosis.Present lecture will review different aspect of CMR imaging in STEMI, from pathophysiology to STEMI imaging patterns with corresponding impact on patient's prognosis.

MSES41D CT Calcium Scoring

Participants

Rozemarijn Vliegenthart, MD, PhD, Groningen, Netherlands (*Presenter*) Instutional Research Grant, Siemens Healthineers

For information about this presentation, contact:

r.vliegenthart@umcg.nl

LEARNING OBJECTIVES

1) To discuss latest results on the diagnostic and prognostic value of the coronary calcium score. 2) To learn about the impact of CT calcium scoring on cardiovascular risk stratification. 3) To understand the role of CT calcium scoring in asymptomatic individuals and symptomatic patients.

ABSTRACT

Accurate identification of asymptomatic individuals who will later suffer a coronary event is challenging. Risk-factor based algorithms to estimate cardiovascular risk in the general population are neither very sensitive nor specific. Evaluation of the extent of coronary atherosclerotic plaque by CT calcium scoring can improve risk prediction and risk stratification. Multiple large-scale prospective studies have shown the strong predictive value of the calcium score for coronary heart disease. The calcium score improves cardiovascular risk stratification beyond cardiovascular risk factors in asymptomatic individuals, in particular in those at intermediate risk, and reduces over- and undertreatment. Whether management based on the calcium score reduces the incidence of coronary events is being studied in the Dutch ROBINSCA trial. In symptomatic patients, in particular those with atypical symptoms of chest pain, there is increasing interest in the zero calcium score to exclude relevant coronary artery disease. In this presentation, the latest results and status of CT calcium scoring will be discussed.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

MSSR41

RSNA/ESR Hybrid Imaging Symposium: The ABCs of Hybrid Imaging (An Interactive Session)

Wednesday, Nov. 29 8:30AM - 10:00AM Room: S402AB

MR NM PH

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

FDA Discussions may include off-label uses.

Participants
Alexander Drzezga, MD, Cologne, Germany (*Moderator*) Consultant, Siemens AG; Consultant, Bayer AG; Consultant, General Electric Company; Consultant, Eli Lilly and Company; Consultant, The Piramal Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company; Speakers Bureau, Eli Lilly and Company; Speakers Bureau, The Piramal Group
Katrine Riklund, MD, PhD, Umea, Sweden (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) What you need to know about PET-physics. 2) How MR physics influence image quality in hybrid imaging.

Sub-Events

MSSR41A What You Need to Know about PET-Physics

Participants
Jan Axelsson, Umea, Sweden (*Presenter*) Founder, Dicom Port AB

LEARNING OBJECTIVES

1) To understand the basics of physics in PET imaging. 2) To learn about the different approaches of PET attenuation correction. 3) To learn about potential artefacts in hybrid imaging.

ABSTRACT

This lecture gives a basis to understand the underlying mechanism to why PETCT image quantitation sometimes fails. Examples and false PET uptakes, explanation on the underlying mechanism, and rules of thumb how you may reveal if an uptake is physiological will be given.

MSSR41B How MR Physics Influence Image Quality in Hybrid Imaging

Participants
Ciprian Catana, MD, PhD, Charlestown, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn about MR artefacts influencing PET image quality. 2) Understand the complexity of physics in MR-PET. 3) Learn about MR for attenuation and motion correction.

MSSR41C Interactive Case Discussion

Participants
Jan Axelsson, Umea, Sweden (*Presenter*) Founder, Dicom Port AB
Ciprian Catana, MD, PhD, Charlestown, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how to identify common MR artefacts. 2) Learn how to identify common PET artefacts. 3) Learn how to identify common CT artefacts.

RC503

Adult Congenital Heart Disease

Wednesday, Nov. 29 8:30AM - 10:00AM Room: S404CD

CA CT MR

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

Participants
Dianna M. Bardo, MD, Phoenix, AZ (*Moderator*) Speaker, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Author, Thieme Medical Publishers, Inc

For information about this presentation, contact:

dbardo@phoenixchildrens.com

LEARNING OBJECTIVES

1) Recognize the most common congenital heart disease (CHD) findings in adults with unsuspected CHD. 2) Recognize findings of CHD in patients with know CHD and the findings which may trigger surgical intervention. 3) Know the commonly performed surgical procedures for palliation of CHD. 4) Understand why CT is an important imaging modality and is complementary to echo and MR for adult patients with CHD.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC503A Coronary Artery Fistulas and Other Abnormal Connections

Participants
Jonathan D. Dodd, MD, Dublin 4, Ireland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

To recognize, analyze and report the important findings for coronary artery fistulas. To recognize, analyze and report the important findings of unroofed coronary sinus To recognise, analyse and report the important findings of partial anomalous pulmonary venous return

ABSTRACT

Coronary artery fistulas are important coronary anomalies that may present in adult life and are essential to recognize on cardiac CT, MRI and even on routine chest CT. The clinical presentations, diagnosis and treatment options for coronary artery fistulas will be described. Several additional abnormal vascular connections that can be identified on CT and MRI will also be presented, ranging from normal variants to hemodynamically insignificant connections to major shunts. A spectrum of the most common abnormal vascular connections will be covered with a focus on unroofed coronary sinus and partial anomalous pulmonary venous return and recognition of these important entities as well as potential treatment options.

RC503B CT of Complex Congenital Cardiac Anomalies

Participants
Linda B. Haramati, MD, MS, Bronx, NY (*Presenter*) Spouse, Board Member, Kryon Systems Ltd

For information about this presentation, contact:

lharamati@gmail.com

LEARNING OBJECTIVES

1) To recognize complex congenital heart disease on chest CT scans performed for other indications. 2) To tailor cardiac CT protocols and reconstructions to answer specific clinical questions for patients with treated congenital heart. 3) disease-specifically congenitally corrected transposition of the great arteries, Ebstein anomaly and tetralogy of Fallot. 4) To provide information that guides therapy related to longstanding complications of congenital heart disease and its treatment.

ABSTRACT

Advances in treatment of congenital heart disease has resulted in prolonged survival of patients with congenital heart disease. These patients present for imaging to radiologists with general chest complaints and for dedicated cardiac imaging to resolve specific clinical questions. This lecture will focus on three complex congenital heart disease diagnoses; congenitally corrected transposition of the great arteries, Ebstein anomaly and tetralogy of Fallot. The chest CT findings of complex congenital heart disease should be recognized by radiologists in practice. Adults with milder spectrum complex congenital heart disease may initially be diagnosed during adulthood. Those who have had successful childhood treatment often fall through the gaps in care during the transition from pediatric to adulthood. Proper recognition of these diagnoses is of great importance and radiologists who are not subspecialized in cardiac imaging have the opportunity to greatly contribute to the care of these patients. Additionally, cardiac CT

is a good alternative to MRI in answering crucial questions that arise during clinical care and on echocardiography. Emphasis will be placed on indications for CT, technical tips to achieve diagnostic images and on demonstrating complications that require intervention.

RC503C Role of MRI in Adult CHD Management

Participants
Mini V. Pakkal, FRCR,MBBS, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC503D Multimodality Approach to Congenital Heart Disease Diagnosis

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

For information about this presentation, contact:

matthias_gutberlet@hotmail.com

LEARNING OBJECTIVES

1) To understand the non-ivasive assessment of surgically corrected Congenital Heart Disease (CHD) with different imaging modalities (x-ray, echocardiography, MDCT and MRI). 2) To understand the use of different non-invasive imaging modalities for the assessment of pathologic/postsurgical anatomy, ventricular function, flow quantification and tissue characterization using typical clinical examples. 3) To be able to choose the right imaging strategy for different CHD.

ABSTRACT

Transthoracic echocardiography remains the working-horse in children and adults with CHD. However, cross-sectional imaging modalities are getting more and more important, especially in adults with CHD. The number of patients with a lack of an adequate acoustic window for transthoracic echocardiography is increasing with age. The need for regular follow-up examinations is high in patients with CHD. Therefore, especially Cardiac Magnetic Resonance Imaging (CMR) with all its different options without the burden of radiation exposure is very benefitial and a good alternative to echocardiography and sometimes even better than echo. However, if mainly the correct depiction of the pathologic anatomy, especially after surgically corrected CHD, has to be evaluated or the patient is in a critical condition MDCT is the imaging modality of choice also in CHD. Of course, in these very young patients it is of utmost importance to use all methods to reduce radiation exposure. In a case based manner the pros an cons of the different imaging modalities and techniques available will be described during the refresher course.CHD after surgical correction like Tetralogy of Fallot and D-Transposition of the Great Arteries (TGA) will be covered as well as often accidentally discoverd CHD like partially anomalous pulmonary venous return.

RC504

Musculoskeletal Series: MRI of Small Joints

Wednesday, Nov. 29 8:30AM - 12:00PM Room: S406B

MR MK

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

FDA Discussions may include off-label uses.

Participants
David A. Rubin, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose
Hilary R. Umans, MD, Ardsley, NY (*Moderator*) Nothing to Disclose
Stacy E. Smith, MD, Weston, MA (*Moderator*) Nothing to Disclose
Connie Y. Chang, MD, Boston, MA (*Moderator*) Nothing to Disclose
Ogonna K. Nwawka, MD, New York, NY (*Moderator*) Research Grant, General Electric Company

For information about this presentation, contact:

rubinda@wustl.edu

LEARNING OBJECTIVES

1) Learn some of the unique technical challenges associated with MR imaging of smaller joints in the body, and will be exposed to typical and atypical appearances of disorders in the hand, wrist, fingers, thumb, foot, and ankle.

Sub-Events

RC504-01 Small Joint Technique

Wednesday, Nov. 29 8:30AM - 8:55AM Room: S406B

Participants
David A. Rubin, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rubinda@wustl.edu

LEARNING OBJECTIVES

1) To better understand the proper use of RF coils and patient positioning to maximize image quality and minimize imaging artifacts when performing MR of small joints in the body.

RC504-02 Ankle

Wednesday, Nov. 29 8:55AM - 9:20AM Room: S406B

Participants
Stacy E. Smith, MD, Weston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC504-03 Efficient High-Resolution MRI of Ankle Injuries: Comparison of a Novel 10-min 3D TSE Protocol against a 20-min 2D TSE Standard of Reference

Wednesday, Nov. 29 9:20AM - 9:30AM Room: S406B

Participants
Benjamin Fritz, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
Susanne Bensler, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Gaurav K. Thawait, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Steven E. Stern, Brisbane, Australia (*Abstract Co-Author*) Nothing to Disclose
Jan Fritz, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG; Scientific Advisor, Siemens AG; Scientific Advisor, Alexion Pharmaceuticals, Inc; Speaker, Siemens AG

For information about this presentation, contact:

jfritz9@jhmi.edu

PURPOSE

To test the hypothesis that MRI of the ankle with a 4-fold accelerated 10-min 3D CAIPIRINHA SPACE prototype protocol is non-inferior to a 2-fold accelerated 2D TSE standard for the diagnosis of internal derangement.

METHOD AND MATERIALS

Following institutional review board approval and informed consent, 70 symptomatic patients underwent ankle MRI using a 3T MRI system and boot-shaped surface coil. Six axial, sagittal and coronal IW and T2FS 2D TSE (20 min) and two sagittal isotropic IW and T2FS 3D TSE (10 min) pulse sequences were acquired. The novel 2x2-acclerated 3D SPACE TSE sequences used bi-directional parallel imaging and a CAIPIRINHA sampling pattern. The 70 2D/3D TSE data sets were separated into 140 anonymized and randomized individual studies. In each of the 140 studies, two musculoskeletal radiologists independently evaluated 6 joints, 12 ligaments, 9 tendons, and 9 bones for integrity and diagnostic confidence. Descriptive statistics, inter-rater reliability, inter-modality concordance, and diagnostic confidence test were applied. A p-value of <0.05 was considered significant.

RESULTS

The overall inter-rater reliability was high with > 80% of matching ratings. The rater agreement was significantly higher for 3D TSE ($p<0.05$). The degree of diagnostic concordance between 2D and 3D TSE was high with a Kendall's coefficient W for cartilage of 0.784, ligaments of 0.732, tendons of 0.810, and bone of 0.847. Raters diagnosed a total of 116 cartilage defects on 2D and 109 on 3D images, 35 ligament tears on 2D and 65 on 3D, 18 tendon tears on 2D and 20 on 3D, and 137 bone abnormalities on 2D and 149 on 3D. The disagreements between 2D and 3D diagnoses for cartilage, ligaments, tendons, and bones were 15.7%, 4.5%, 1.4%, and 5.5%, respectively. The readers' diagnostic confidence was significantly higher for 3D TSE ($p<0.05$).

CONCLUSION

A novel 10-min 3D CAIPIRINHA SPACE MRI protocol is at least equivalent for the diagnosis of internal derangement of the ankle when compared to a 20-min 2D TSE standard of reference. Rater concordance and confidence were significantly higher for 3D TSE studies, indicating a higher rater definitiveness and possibly increased accuracy.

CLINICAL RELEVANCE/APPLICATION

Rapid 3D CAIPIRINHA SPACE TSE MRI is at least equivalent to a 2D TSE MRI reference standard for the diagnosis of internal ankle derangement and holds promise to substantially improve the efficiency of ankle MRI exams.

RC504-04 MRI Evaluation of Midtarsal (Chopart) Joint Sprain in the Setting of Acute Ankle Injury

Wednesday, Nov. 29 9:30AM - 9:40AM Room: S406B

Awards
Student Travel Stipend Award

Participants
William Walter, MD, New York, NY (*Presenter*) Nothing to Disclose
Zehava S. Rosenberg, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Anna Hirschmann, MD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Erin F. Alaia, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elisabeth R. Garwood, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

william.walter@nyumc.org

PURPOSE

Midtarsal sprain is commonly misdiagnosed and may cause joint instability and chronic pain. Our study describes the normal MRI appearance of Chopart joint, determines patterns and frequency of osseous and ligamentous injuries, and evaluates prospective diagnosis and interobserver agreement for diagnosing midtarsal sprains in patients with acute ankle injuries.

METHOD AND MATERIALS

Two patient cohorts were created based on retrospective PACS searches (2/2014-8/2016): atraumatic controls and patients who obtained MRIs <8 weeks from ankle injury. MRIs were retrospectively reviewed in consensus for rmidtarsal sprains. Two radiologists independently reviewed the cases for midtarsal ligament and bony injuries, with attention to the dorsal calcaneocuboid, bifurcate, short and long plantar, and dorsal talonavicular ligaments. Interobserver agreement (kappa) was calculated. Prospective radiology reports and interobserver agreement were reviewed.

RESULTS

MRIs were reviewed from 47 patients with acute ankle injury (26 female, 21 male; mean age = 35 years, range 19-80). MRIs of 16 controls were also reviewed. Normal dorsal calcaneocuboid and calcaneocuboid component of the bifurcate ligaments were variably seen. The remaining normal ligaments were always seen. 11 patients (23%) had midtarsal sprain (8 acute/subacute, 1 probable, and 2 old). Six (67%) of the 9 recent sprains had concomitant lateral collateral ligament injury. 89% of osseous injuries were reported prospectively but 83% of ligament injuries were missed. Substantial interobserver agreement (kappas = 0.62-0.81) was achieved for diagnosis of midtarsal sprain.

CONCLUSION

Midtarsal sprains are commonly associated with acute ankle and lateral collateral ligament injuries. Presently, the entity is often unrecognized by musculoskeletal radiologists. Greater familiarity with the MRI spectrum of ligamentous and osseous injury at Chopart joint is important for accurate diagnosis and appropriate clinical management.

CLINICAL RELEVANCE/APPLICATION

Midtarsal sprains are often clinically misdiagnosed and overlooked on imaging. Radiologists should consider the diagnosis, especially in patients who have failed conservative management for presumed lateral ankle sprain and it should be sought in all lateral ankle sprains. Although conservative management is most common, surgical repair has been reported in the literature and shows promise to address chronic instability following midtarsal sprain.

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/ Zehava S. Rosenberg, MD - 2014 Honored Educator

RC504-05 Regional Variations of Ankle and Hindfoot Cartilage T2 Mapping Normative Values in Asymptomatic Subjects at 3.0 T MRI

Wednesday, Nov. 29 9:40AM - 9:50AM Room: S406B

Participants
Angela Chang, BS, Vail, CO (*Abstract Co-Author*) Nothing to Disclose
Carly Lockard, MS, Vail, CO (*Presenter*) Nothing to Disclose
Richard C. Shin, MD, Pasadena, CA (*Abstract Co-Author*) Nothing to Disclose
Thomas Clanton, MD, Vail, CO (*Abstract Co-Author*) Research funded, Siemens AG; Research funded, Smith & Nephew plc; Research funded, Arthrex, Inc; Research funded, Ossur HF
Charles P. Ho, MD, PhD, Vail, CO (*Abstract Co-Author*) Research funded, Siemens AG Research funded, Smith & Nephew plc Research funded, Arthrex, Inc Research funded, Ossur HF Scientific Advisory Board, Rotation Medical, Inc

For information about this presentation, contact:

clockard@sprivail.org

PURPOSE

To establish joint-specific methodology and baseline T2 values for ankle/hindfoot joint cartilage in asymptomatic subjects for clinical application in detecting ankle/hindfoot cartilage degeneration.

METHOD AND MATERIALS

Unilateral ankle scans with sagittal plane T2 mapping (TR: 1810 ms, TE: 10.7,21.4,32.1,42.8,53.5 ms; voxel size: 0.47×0.47×2.0 mm) were acquired at 3.0 T in 30 asymptomatic subjects, aged 23 - 64 years, with the ankle in neutral. All subjects provided informed consent and completed a subjective ankle symptom and function questionnaire and clinical exam. Images were manually segmented by two raters (a 3rd year medical student and a musculoskeletal radiologist) to separate the cartilage surfaces (tibiotalar, middle and posterior talocalcaneal, talonavicular, calcaneocuboid; proximal and distal articular surfaces). Regional median T2 was calculated for each subject and then the means and standard deviations of all subject medians were found. A 2-sample t-test was used to test for significant differences in mean T2* between regions. The anterior talocalcaneal joints were not analyzed due to small segmented volume and inconsistent visualization.

RESULTS

The tibial-side tibiotalar cartilage had the lowest mean T2 (39±3 ms) and was significantly different than the tibiotalar talar-side, posterior talocalcaneal, middle talocalcaneal calcaneal-side, and calcaneocuboid calcaneal-side regions. The middle talocalcaneal calcaneal-side cartilage had the highest mean T2 (44±6 ms) and was significantly different than the talonavicular and tibial-side tibiotalar cartilage. Significant differences were also found between the tibiotalar talar-side cartilage and the talonavicular navicular-side cartilage.

CONCLUSION

Baseline T2 values for ankle/hindfoot joint cartilage regions were established. Mean T2 differed significantly for several ankle/hindfoot joint cartilage regions. These differences in normative ankle/hindfoot cartilage mean T2 should be considered when using T2 mapping to evaluate for ankle/hindfoot cartilage degeneration.

CLINICAL RELEVANCE/APPLICATION

T2 mapping may enable early cartilage degeneration detection. Regional differences in asymptomatic ankles/hindfeet should be considered when using T2 mapping to evaluate patients.

RC504-06 Ligament Evaluation of the Hind and Midfoot: Better Depiction by using Dixon Method in Ankle MRI

Wednesday, Nov. 29 9:50AM - 10:00AM Room: S406B

Participants
Esther Koh, Chonju, Chonbuk, Korea, Republic Of (*Presenter*) Nothing to Disclose
Eun Hae Park, Jeon Ju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eunha Jeong, JEON-JU, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Weon Jang, Jeonju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Soo Song, MD, Jeonju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sol ki Kim, Chonju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

kohesther@naver.com

PURPOSE

To determine if ankle magnetic resonance (MR) imaging using Dixon technique helps to depict hind and midfoot ligaments compared with those achieved without using Dixon technique.

METHOD AND MATERIALS

From July to December 2015 ankle MRI using Dixon technique of 48 ankles was obtained from 25 asymptomatic healthy volunteers. Twenty-three ligaments from hind and midfoot were chosen for evaluation. Two experienced reviewers separately rated the depiction of 23 ligaments from 7 sequences; axial T1-weighted image, axial, coronal, and sagittal T2-weighted Dixon in-phase image (represented as conventional T2-weighted image) and water phase image (represented as conventional fat-suppressed T2-weighted image). The images were divided in to two sets. Set 1 was MRI using Dixon technique which composed of all 7 sequences. Set 2 represented conventional MRI composed of subsets with 4 different sequences including 2 nonfat-suppressed and 2 fat-

suppressed plane. Ligaments were divided in to two groups. Major ligament included ATFL, CFL, PTFL, Lisfranc ligament, deltoid ligament, spring ligament. Other ligaments were categorized as minor ligament. The depiction rate was calculated using generalized estimating equations.

RESULTS

The depiction rate was significantly higher on set 1 compared with set 2; 91.3% versus 73.2 %, respectively. This was consistently observed for major ligament; 96.4% versus 76.1% ($p<0.005$). In set 2, the depiction rate was higher for subset with nonfat-suppressed axial and sagittal plane compared with those with axial and sagittal plane and coronal and saggital plane (82.7%, 77.6%, 70.7%, respectively).

CONCLUSION

For better depiction of hind and midfoot ligaments, all three axial, coronal and sagittal plane with non-fat suppressed sequences are required. The Ankle MRI using Dixon technique yielded better depiction rate of hind and midfoot ligaments by supplying both nonfat-suppressed and fat-suppressed sequences in single scan.

CLINICAL RELEVANCE/APPLICATION

Imaging of hind and midfoot ligament has few important points. Since ligaments of ankle and foot vary in their direction the optimization of plane of imaging is important. In addition, choosing right sequences are essential. By applying Dixon technique we can obtain multidirection multisequences in given time compared with conventional MR and this enables better delineation of ligaments of hind and midfoot.

RC504-07 Foot

Wednesday, Nov. 29 10:00AM - 10:20AM Room: S406B

Participants
Hilary R. Umans, MD, Ardsley, NY (*Presenter*) Nothing to Disclose

Active Handout:Hilary Ruth Umans

http://abstract.rsna.org/uploads/2017/17000351/Active RC504-07.pdf

LEARNING OBJECTIVES

1) To review optimal MRI technique in imaging the distal forefoot. 2) To review normal anatomy and MRI appearance of the Hallucal-Sesamoid Complex and Metatarsophalangeal joints. 3) To review the etiology, clinical symptoms, physical exam findings and MRI correlates of Lesser Metatarsophalangeal joint Plantar Plate tear and Turf Toe. 4) To review the spectrum of painful soft tissue masses that may occur around the metatarsophalangeal joints and toes and their MRI appearance. 5) To review the spectrum of other painful conditions that affect the metatarsophalangeal joint region and hallucal sesamoids and their MRI imaging findings. 6) To review the relevant role of radiographs, ultrasound and computed tomography in diagnosis of distal forefoot pathology.

RC504-08 Wrist

Wednesday, Nov. 29 10:30AM - 10:50AM Room: S406B

Participants
Laura W. Bancroft, MD, Orlando, FL (*Presenter*) Author with royalties, Wolters Kluwer nv

For information about this presentation, contact:

laura.bancroft.md@flhosp.org

LEARNING OBJECTIVES

1) Review normal anatomy of the triangular fibrocartilage complex, intrinsic and extrinsic ligaments, and tendons on the wrist. 2) Evaluate pathology of the bones, TFCC, ligaments and tendons.

RC504-09 Magnetic Resonance Arthrography of the Wrist: Does Injection of the Distal Radioulnar Joint Alter Management?

Wednesday, Nov. 29 10:50AM - 11:00AM Room: S406B

Awards
Student Travel Stipend Award

Participants
Nathaniel B. Meyer, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Corrie M. Yablon, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Yoav Morag, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Jon A. Jacobson, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Steven Haase, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

nbmeyer@med.umich.edu

PURPOSE

Magnetic resonance arthrography (MRA) of the wrist is commonly performed with a single radiocarpal joint (RCJ) injection dilute gadolinium (Gd) contrast. At our institution, if no contrast extends from the RCJ into the distal radioulnar joint (DRUJ) through the triangular fibrocartilage (TFC), then an additional injection of the DRUJ using iodinated contrast is performed to assess for a partial non-communicating, or one-way valve full thickness tear of the TFC. Although the literature has shown DRUJ injections improve the detection of such tears, it is unknown whether this alters surgical management. The aim of this retrospective study was to see if a clinical benefit is derived from the inclusion of a DRUJ injection in wrist MRA.

METHOD AND MATERIALS

The radiology database was searched for all wrist MRA's performed from January 2011 - May 2016. Fluoroscopic arthrogram reports were reviewed for findings of contrast extension through the TFC from the radiocarpal injection. MRA reports were reviewed on patients who subsequently underwent wrist arthroscopy or open surgical exploration. The presence of all types of TFCC tears was noted, including non-communicating peripheral tears extending from the DRUJ into the TFCC. Findings were correlated with surgical reports and interventions were noted.

RESULTS

A total of 282 patients underwent wrist MRA. Thirty-five of 282 patients underwent wrist arthroscopy or open exploration. Twenty-one of 35 surgical patients had DRUJ injections in addition to a RCJ injection. Of these, 5 patients had suspected non-communicating peripheral TFCC tears with possible extension to the DRUJ on MRA. Two of these 5 patients went on to surgical repair of the peripheral tear; however, both of these patients' tears were identified on arthroscopy using a radiocarpal portal. In no cases was the DRUJ inspected arthroscopically.

CONCLUSION

Our preliminary data suggests that DRUJ injection during wrist MRA does not alter surgical management. All surgical findings via open repair or radiocarpal arthroscopy were identified on single compartment RCJ injection.

CLINICAL RELEVANCE/APPLICATION

Distal radioulnar joint injection does not alter surgical management in patients with suspected TFCC injury and can be omitted during MRA of the wrist.

RC504-10 Primary Dorsal Ulnotriquetral Ligament Injury: An Uncommon yet Distinct Cause of Ulnar-Sided Wrist Pain

Wednesday, Nov. 29 11:00AM - 11:10AM Room: S406B

Participants
Mathieu Boily, MD, Montreal, QC (*Presenter*) Nothing to Disclose
Rehana Jaffer, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Emilie Sandman, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Alison C. Simioni, PhD, Westmount, QC (*Abstract Co-Author*) Nothing to Disclose
Paul Martineau, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Ulnar-sided wrist pain is a common presenting complaint. Determining the specific cause of ulnar-sided wrist pain is a challenge, largely due to the intricacy of the wrist's anatomy. One possible cause of ulnar-sided wrist pain is primary damage to the dorsal ulnotriquetral (DUT) ligament. Here, we tested this hypothesis. First, we identified a subgroup of patients with DUT ligament injury (confirmed at surgery) to devise specific MRI criteria for primary DUT ligament injury. Then, we retrospectively examined wrist arthrogram studies, using the aforementioned MRI criteria to detect the existence of primary DUT ligament pathology.

METHOD AND MATERIALS

Seventy-four MRI wrist arthrogram studies (46 male) were examined. Two fellowship trained musculoskeletal radiologists evaluated the arthrograms independently, without knowledge of previous clinical notes, MRI or surgical reports. Each study was examined for the following criteria: 1) DUT ligament abnormality (i.e. thickening, increased signal), 2) localized ulnar-sided wrist synovitis, 3) focal triquetral bone marrow edema, and 4) adjacent triquetral bone erosion. Other ulnar-sided wrist abnormalities were noted.

RESULTS

Abnormal DUT ligament was detected in 36.5% (27/74) of the wrist arthrogram studies. Of the 27 abnormal DUT ligament arthrograms, 7% (2/27) showed combined findings of localized ulnar-sided synovitis, adjacent triquetral bone marrow edema and erosion, suggesting primary DUT ligament pathology. In contrast, 93% (25/27) showed other ulnar-sided pathology (e.g. triangular fibrocartilage (13/25), extensor carpi ulnaris (5/25) pathology or a combination of both (7/25)) and were free of synovitis, triquetral bone marrow edema and erosion, suggestive of secondary or reactive DUT ligament pathology. MRI's were normal in 15/74 cases. Interobserver agreement was very good (K=0.89)

CONCLUSION

These findings argue that primary isolated injury to the DUT ligament is an uncommon, yet distinct source of ulnar-sided wrist pain. Secondary DUT ligament abnormalities are more common and associated with triangular fibrocartilage and extensor carpi ulnaris pathology.

CLINICAL RELEVANCE/APPLICATION

Primary and secondary DUT abnormalities can be identified on MR arthrograms. Primary DUT injury has specific clinical and MRI findings and should be included in the differential diagnosis of ulnar sided wrist pain. Its diagnosis is important as surgical intervention may be indicated in some cases.

RC504-11 Fingers

Wednesday, Nov. 29 11:10AM - 11:35AM Room: S406B

Participants
Rosemary J. Klecker, MD, Columbus, OH (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To review the normal anatomy of the fingers including the pulley and capsule ligaments and the tendons. 2) To review MR Imaging technique of fingers. 3) To review etiology, clinical symptoms and physical findings with MR Imaging correlation of ligament, tendon and bone pathology. 4) To review the spectrum of painful conditionditions that affect the fingers. 5) To review the relevent and complimentary role of radiographs, ultrasound, and computed tomography in the diagnosis of pathological conditions of the finger.

RC504-12 Thumb

Wednesday, Nov. 29 11:35AM - 12:00PM Room: S406B

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

LEARNING OBJECTIVES

1) To describe relevant normal anatomy of the thumb including tendons, ligaments and pulleys. 2) To review MR Imaging technique of the thumb. 3) To improve knowledge of common pathologies affecting the thumb including trauma (tendon and ligaments - Stener's lesion), arthropathies, inflammatory conditions and tumors. 4) To describe how other imaging modalities (ultrasound, plain films, CT) can be complimentary to assist in diagnosing pathology of the thumb.

RC508

Emergency Radiology Series: Current Imaging of the Acute Abdomen

Wednesday, Nov. 29 8:30AM - 12:00PM Room: S405AB

CT ER GI MR

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

Participants
Michael N. Patlas, MD, FRCPC, Hamilton, ON (*Moderator*) Nothing to Disclose
John J. Hines JR, MD, New Hyde Park, NY (*Moderator*) Nothing to Disclose
Douglas S. Katz, MD, Mineola, NY (*Moderator*) Nothing to Disclose
Mariano Scaglione, MD, Castel Volturno, Italy (*Moderator*) Nothing to Disclose
Ferco H. Berger, MD, Toronto, ON (*Moderator*) Nothing to Disclose

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Sub-Events

RC508-01 Imaging of Acute Pancreatitis

Wednesday, Nov. 29 8:30AM - 9:00AM Room: S405AB

Participants
Jorge A. Soto, MD, Boston, MA (*Presenter*) Royalties, Reed Elsevier

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LEARNING OBJECTIVES

1) Review the appropriate terminology that should be implemented when describing glandular and peri-glandular findings in acute pancreatitis, following the revision of the Atlanta classification. 2) Identify the importance of glandular necrosis in defining the prognosis of acute pancreatitis. 3) Illustrate specific situations where MR can be a valuable tool in the evaluation of acute pancreatitis.

Honored Educators

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RC508-02 Abdominal Tomogram: Ultra-Low Dose CT of the Abdomen Has Replaced Abdominal Plain Films in the Emergency Department

Wednesday, Nov. 29 9:00AM - 9:10AM Room: S405AB

Participants
Patrik Rogalla, MD, Toronto, ON (*Presenter*) Institutional Research Grant, Toshiba Medical Systems Corporation
Tanya Spiegelberg, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
James Hong, RT, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Sam Sabbah, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Silvio G. Bruni, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Janet Pereira-Ross, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Joanna Talotta, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Corwin Burton, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Jerry Plastino, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Christin Farrell, Toronto, ON (*Abstract Co-Author*) Employee, Toshiba Medical Systems Corporation
Bernice E. Hoppel, PhD, Vernon Hills, IL (*Abstract Co-Author*) Employee, Toshiba Medical Systems Corporation
Ravi Menezes, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To analyse the impact of replacing abdominal plain films (APF) in the Emergency Department (ED) with ultra-low dose CT (Abdominal Tomogram) on workflow, turn-around times (TAT), radiation dose and recall rate.

METHOD AND MATERIALS

Over a period of 50 days, all APFs (Group I; Carestream DRX Evolution, GE Optima/Definium) ordered by the ED for the four most common non-trauma indications (abdominal pain NYD, rule out free air, bowel obstruction, or constipation) were analysed in respect to wait time (time from ordering to exam execution), report TAT (time from exam completion to verified report, TAT) during day and night time, radiation dose per patient and recall rate (subsequent standard dose CT for the same indications within 48 hours). Over the following period of 50 days, all requests for APFs for the same four indications were converted to Abdominal Tomograms (Group II; Toshiba Aquilion One, 135 kV, 20-40 mAs weight based, AIDR-3D, 3 mm axials and MPRs, 10 cm coronals), analysed by using the same metrics and compared to Group I. The dose-area-product on APFs was converted to mSv by applying a factor of 0.21 mSv/Gycm2, the dose-lengths-product in CT was converted to mSv with a conversion factor of 0.016 mSv/mGycm.

RESULTS

There was no difference in demographics between the groups (Group I: 243 patients, 127/116 w/m, 64±19y), Group II: 235 patients, 124/111 w/m, 64±20y). 1 to 6 views (mean, 2.6±0.9) were required to complete the X-ray exam. Mean wait times and TAT for Group I/II during the day were 222±379/39±49 and 267±317/107±78 min, and at night 235±269/38±58 and 549±345/328±197 min (all p<.0001); radiation doses were 2.85±9.1/1.5±0.6 mSv (p<.0001), and the recall rates were 29/11% (p<.0001), respectively. In one patient, the AT was repeated due to insufficient dose.

CONCLUSION

The conversion of APFs to Abdominal Tomograms for non-trauma ED patients has improved wait times and report TAT, decreased radiation dose and lowered the recall rate.

CLINICAL RELEVANCE/APPLICATION

Replacing abdominal X-rays by ultra-low-dose CTs for non-trauma indications may help improve the workflow and decision making in the Emergency Department.

RC508-03 CT and MR Imaging of Appendicitis

Wednesday, Nov. 29 9:10AM - 9:40AM Room: S405AB

Participants
Perry J. Pickhardt, MD, Madison, WI (*Presenter*) Co-founder, VirtuoCTC, LLC; Stockholder, Cellectar Biosciences, Inc; Stockholder, SHINE Medical Technologies, Inc; Stockholder, Elucent Medical; Advisor, Check-Cap Ltd; Research Grant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Assess the relative advantages and disadvantages for CT and MR imaging in the setting of suspected appendicitis. 2) Compare the diagnostic performance of CT and MR for both appendicitis and alternative conditions. 3) Describe the increasing use of MR for abdominal imaging in the ED setting.

Honored Educators

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RC508-04 Imaging of Gangrenous Appendicitis: Do Dual Energy Virtual Monoenergetic Images Add Clinical Value?

Wednesday, Nov. 29 9:40AM - 9:50AM Room: S405AB

Participants
Mohammed F. Mohammed, MBBS, Vancouver, BC (*Abstract Co-Author*) Speaker, Siemens AG; Employee, X-Ray Teleradiology Services
Khaled Y. Elbanna, MBChB, FRCR, Vancouver, BC (*Presenter*) Nothing to Disclose
Tejbir S. Chahal, BSc, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose
Rawan Abu Mughli, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose
Savvas Nicolaou, MD, Vancouver, BC (*Abstract Co-Author*) Institutional research agreement, Siemens AG
Faisal Khosa, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Appendicitis remains the most common acute surgical condition of the abdomen. One unique form of this disease is gangrenous appendicitis. This form carries a very high perforation risk which leads to an increase in morbidity and mortality.There have been numerous publications on the role of CT in the diagnosis of acute appendicitis, however the accuracy of CT in diagnosing gangrenous appendicitis is less established. In our study, we propose that the use of Dual Energy (DE) and spectral imaging techniques can improve diagnostic accuracy of acute gangrenous appendicitis.

METHOD AND MATERIALS

For this retrospective, IRB-approved study, the hospital RIS was queried for all abdominopelvic CT scans performed in the emergency department between January 1, 2013 to December 31, 2016 that were positive for appendicitis on histopathology. Non DECT studies and those with frank perforation, phlegmon or peri-appendicular abscess formation were excluded. A total of 236 cases were included in our study. 40 keV VMI and 120 kVp simulated images were reviewed by two abdominal radiologists in a randomized fashion who were blinded to the results of the histopathology for presence of gangrene. Sensitivity, specificity, positive

and negative likelihood ratios and interobserver agreement were calculated for each set of images. Confidence was rated on a 5 point Likert scale with 1 being completely uncertain and 5 being absolutely confident.

RESULTS

59.7 % (141) of patients were male. The mean age of patients was 43.5 ± 1.2 years. 51 patients (21.6 %) were positive for gangrenous appendicitis on histopathology.The sensitivity, specificity, positive and negative likelihood ratios, confidence and interobserver agreement for 40 keV VMI were 100 %, 80.5 %, 5.1, 0, 5 and 0.99 respectively ($p < 0.0001$), compared to 21.6 %, 95.1 %, 4.4, 0.82, 3.75 and 0.98 respectively ($p < 0.0001$) for 120 kVp simulated images.

CONCLUSION

Review of 40 keV VMI reconstructions adds significant clinical value to the DECT of the abdomen and pelvis for assessment of acute appendicitis as well as the presence of gangrene within the appendix.

CLINICAL RELEVANCE/APPLICATION

40 keV VMI reconstructions should be reviewed along side the simulated 120 kVp in cases of suspected appendicitis to diagnose or exclude presence of gangrenous appendicitis.

RC508-05 Risk Stratification of Non-Diagnostic Ultrasounds to Guide Management and CT Utilization in Pediatric ED Patients Suspected of Acute Appendicitis

Wednesday, Nov. 29 9:50AM - 10:00AM Room: S405AB

Awards
Student Travel Stipend Award

Participants
Gary X. Wang, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose
Pallavi Sagar, MBBS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Randheer Shailam, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Ari Cohen, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Michael S. Gee, MD, PhD, Jamaica Plain, MA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Though ultrasound (US) is the initial imaging test of choice for pediatric ED patients suspected of acute appendicitis, its ability to guide management is limited by its inability to visualize the appendix in some patients. Here, we study the feasibility of risk-stratifying patients with non-diagnostic US to guide CT use and ED management.

METHOD AND MATERIALS

This study was performed in a tertiary care academic hospital with a pediatric ED. Structured reporting is used for pediatric appendicitis US. Non-visualized appendix is designated "low probability" or "concerning" for appendicitis based on absence or presence of concerning secondary findings: right lower quadrant fat stranding, enlarged lymph nodes, free fluid, and/or tenderness. Designation of "concerning" is at the interpreting radiologist's discretion. Technically limited exams can be called "indeterminate". An IRB approved retrospective electronic medical record review identified ED patients < 19 y.o. who received appendicitis US from December, 2016 to March, 2017. Age, gender, imaging results, clinical outcomes, and operative and pathology reports were analyzed.

RESULTS

305 patients underwent US (avg. age 11 ± 4 y.o., 56% female). 69 (22%) were ultimately diagnosed with appendicitis. US diagnosed 23% (n = 54) of normal appendix and 64% (n = 44) of appendicitis PPV = 0.92, NPV = 0.98). 202 (66%) exams were non-diagnostic: 72 (36%) "low probability", 18 (9%) "concerning", and 41 (20%) "indeterminate"; 71 (35%) were not given a category ("no comment"). Appendicitis was less likely with "low probability" vs "concerning" (5/72, 7% vs. 7/18, 39%; $p < 0.01$, Fisher's exact test) but not significantly different vs. "indeterminate" (5/41, 12%; $p = 0.49$) or "no comment" (7/71, 10%; $p = 0.56$). CT was used after US in 13/18 (72%) of "concerning" vs. 13/72 (18%) of "low probability" patients, was positive for appendicitis in 6/13 (46%) vs. 2/13 (15%), and suggested an alternate diagnosis in 4 (22%) vs 0.

CONCLUSION

In pediatric ED patients, non-diagnostic appendicitis US can be stratified as low and high risk for acute appendicitis based on secondary findings. CT obtained in patients after low-risk US very rarely showed appendicitis and did not offer an alternate diagnosis of symptoms.

CLINICAL RELEVANCE/APPLICATION

For pediatric ED patients suspected with acute appendicitis, risk-stratification of non-diagnostic ultrasound exams is feasible and can be used to guide further management and CT utilization.

RC508-06 How Reliably Can We Identify the Appendix on Unenhanced Ultra-Low-Dose CT in the Era of Iterative Reconstruction? Factors Influencing Residents' Accuracy in the Identification of the Normal Appendix

Wednesday, Nov. 29 10:00AM - 10:10AM Room: S405AB

Participants
Arif Deniz Ordu, MD, Augsburg, Germany (*Presenter*) Nothing to Disclose
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Andreas Adam, MD, Augsburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian Scheurig-Muenkler, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas J. Kroencke, MD, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine factors influencing the accuracy in the identification of the normal appendix on ultra-low-dose CT by residents with on-call experience.

METHOD AND MATERIALS

We included 163 consecutive patients presenting to the ED over a 5 month period who were referred for an unenhanced ultra-low-dose CT of the abdomen for urolithiasis (2nd-gen. Dual-Source CT, auto-kV- and auto-mAs-selection). A model-based iterative algorithm was used for image reconstruction. As reference standard, two faculty radiologists in consensus evaluated all CT datasets and all information from the electronic health records to determine if patients had had prior appendectomy and digitally marked the appendix if identified. Two residents blinded towards this reference standard and all clinical information independently analyzed all datasets using multiplanar reformations for the presence of the appendix and marked it if identified. Residents' markings were compared with the reference standard and classified as correct or incorrect. Receiver-Operating-Characteristic analyses were used to quantify the predictive value of BMI, CTDI and Image Noise for the correct identification of the appendix.

RESULTS

35 patients were excluded due to uncertain AE-status. Of the remaining 128 patients (80 men, median age 47, median DLP 46mGy*cm), 56 had had prior appendectomy. Interobserver agreement was high (88% of cases, κ=0.75). Readers had a sensitivity, specificity and accuracy of 91%, 88%, 90% and 92%, 91%, 91%, respectively. The subgroup of patients with incorrect identification of the appendix had lower BMI (23.5±4 vs. 28±7kg/m², p=0.02) and tendencies towards lower CTDI (0.91±0.3 vs. 1.21±0.6mGy,p=0.1) and lower DLP (43±13 vs. 53±25mGy*cm,p=0.16) but there was no difference in image noise (15.9±3.8 vs. 15.9±3.6HU,p=1.0). BMI had high predictive value for an incorrect identification of the appendix (AUC=0.73,p< 0.01), while image noise lacked any measurable effect (AUC=0.52,p=0.84).

CONCLUSION

The normal appendix or its absence can be correctly identified on unenhanced ultra-low-dose CT scans(<<1 mSv) in the vast majority of cases by residents with on-call experience. Low BMI was a strong predictor for misclassification, while image noise lacked any measurable effect in the observed ranges.

CLINICAL RELEVANCE/APPLICATION

Unenhanced ultra-low-dose CT appears promising for the initial CT workup of patients with right lower quadrant pain particularly in patients with higher BMIs.

RC508-07 Imaging of Colonic Emergencies

Wednesday, Nov. 29 10:20AM - 10:50AM Room: S405AB

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

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LEARNING OBJECTIVES

1) Identify acute colonic conditions that may cause a patient to present to the emergency department. 2) Utilize CT to characterize colonic emergencies and to correlate these findings with plain film and fluoroscopy. 3) Compare the underlying causes and imaging findings of colonic emergencies, broadly: inflammation, infection, ischemia, obstruction, perforation, and hemorrhage. 4) Assist referring clinicians in guiding treatment, particularly when stratifying patients into operative or non-operative management.

Honored Educators

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RC508-08 Ultrasound for the Diagnosis of Acute Appendicitis in the Emergency Department: Imaging Trends and Utility Over 6+ Years

Wednesday, Nov. 29 10:50AM - 11:00AM Room: S405AB

Participants
Stella Lam, MD, Boston, MA (*Presenter*) Nothing to Disclose
Robin B. Levenson, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Andrew T. Colucci, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Karen S. Lee, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Assess the imaging utilization and diagnostic accuracy of ultrasound (US) in the diagnosis of appendicitis in adults in an urban, tertiary care Emergency Department (ED) over a 6+-year period.

METHOD AND MATERIALS

Retrospective analysis was performed on consecutive patients, age 17 years and older, who underwent US to assess for

Retrospective analysis was performed on consecutive patients, age 17 years and older, who underwent US to assess for appendicitis from January 2010 to October 2016, in the ED. Data recorded include patient demographics, imaging findings, additional imaging performed within 24 hrs of initial US, surgeon experience, surgical pathology, and final discharge diagnosis. US findings were categorized as normal appendix, appendix not visualized(NV), and acute appendicitis. Sensitivity, specificity, positive and negative predictive values(PPV and NPV, respectively) for US in the diagnosis of appendicitis were calculated. Pearson's Chi-squared test was also used.

RESULTS

736 patients were included (mean age 28 years, range 17-72 years), 637 females and 99 males. The appendix was seen on US in 106 (14.4%) cases. When the appendix was seen and abnormal, the rate of appendicitis was significantly greater than when the appendix was not seen (94.8% vs 7.3 %, p<0.001). Appendix was seen more frequently in patients with appendicitis than in patients without (61.7% vs 5.2% ,p<0.001). Appendix visualization rate was lower in females than in males (10.7% vs 38.4%, p<0.001). There was no significant difference(p=0.07) in rate of follow-up CT between male and non-pregnant females. Sensitivity, specificity, PPV, and NPV of US for appendicitis were 98.6%, 87.5%, 94.8%, and 96.5%, respectively, when the appendix was seen. When cases with NV appendices were considered negative for appendicitis (n=630), sensitivity, specificity, PPV, and NPV of US for appendicitis were 60.8%, 99.4%, 94.8%, and 92.9%, respectively. Follow-up CT to further assess for appendicitis was performed in 53% after US showed normal or NV appendix and in 63% after an US positive for appendicitis.

CONCLUSION

In the ED, US is more commonly used to assess for appendicitis in females than in males. In our experience, the appendix is seen infrequently on US, but when seen, most are positive for appendicitis.

CLINICAL RELEVANCE/APPLICATION

US should be considered as an initial imaging tool in ED patients suspected of having acute appendicitis. When the appendix is seen on US, the diagnostic accuracy of US for appendicitis is high, and subsequent CT imaging may not be necessary.

RC508-09 MRI as the First Line Imaging Study for Suspected Appendicitis in Pregnancy

Wednesday, Nov. 29 11:00AM - 11:10AM Room: S405AB

Participants
Brandon Andrew, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Christiane M. Hakim, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Bestoun Ahmed, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Jason Chang, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
William Gourash, RN, Pittsburgh, PA (*Abstract Co-Author*) Research funded, Medtronic plc; Research funded, Johnson & Johnson
Balasubramanya Rangaswamy, MD, Pittsburgh , PA (*Presenter*) Nothing to Disclose

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PURPOSE

To compare the accuracy of ultrasound (US) and MRI in pregnant patients with clinical suspicion of acute appendicitis, with the goal of determining whether MRI can be used as first line imaging modality.

METHOD AND MATERIALS

We performed an IRB approved retrospective study of 210 consecutive pregnant patients with clinical suspicion of acute appendicitis at a single center over a four year period. Patients underwent US as first line imaging as per ACR recommendations using graded compression technique. MRI was performed when diagnostic uncertainity remained. MRI was chosen as first line imaging in just one patient. Non contrast MRI was performed on GE Excite HDx 1.5T magnet with dedicated body Phase Array coil. Central re-review of the imaging was done. Final diagnosis was based on operative records, pathology reports, discharge summaries and follow up visits. Sensitivity and specificity for US and MRI were calculated.

RESULTS

Eight patients out of 210 (3.8%) were found to have acute appendicitis. 209 patients underwent US and 65 patients underwent MRI. The appendix visualization rates for US and MRI respectively were 1.4% (3 out of 209) and 84.6% (55 out of 65) respectively. Sensitivity and specificity for the diagnosis of appendicitis by US were 37.5% and 100% and by MRI were 100% and 100%. All appendixes visualized on US had appendicitis. No patient with a normal appendix on MRI or with nonvisualization of appendix on MRI had appendicitis.

CONCLUSION

Timely diagnosis of acute appendicitis in pregnant patients is vital to avoid serious complications. This large retrospective study showed lower US sensitivity in visualization and diagnosis of appendicitis when compared to MRI.

CLINICAL RELEVANCE/APPLICATION

MRI could be considered as a first line imaging modality for the assessment of pregnant patients with high clinical suspicion of acute appendicitis in institutions where MRI is readily available. We acknowledge the cost and duration of MRI.

RC508-10 Imaging of Right Upper Quadrant Pain

Wednesday, Nov. 29 11:10AM - 11:40AM Room: S405AB

Participants
Jennifer W. Uyeda, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review common causes of right upper quadrant pain with reasonable differential diagnoses and their imaging apperances. 2) Improve basic knowledge and skills relevant to clinical practice in evaluating right upper quadrant pain. 3) Describe common

diagnoses and important secondary findings on various imaging modalities that are helpful for the evaluation of acute or emergent right upper quadrant pain.

RC508-11 Utility of Ultrasound Examination Following Computed Tomography in the Setting of Acute Non-Traumatic Abdominal Pain

Wednesday, Nov. 29 11:40AM - 11:50AM Room: S405AB

Awards
Student Travel Stipend Award

Participants
David Li, MD, Hamilton, ON (*Presenter*) Nothing to Disclose
Kristopher W. McLean, MD, MSc, Milton, ON (*Abstract Co-Author*) Nothing to Disclose
Michael N. Patlas, MD, FRCPC, Hamilton, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess the utility of abdominal and/or pelvic ultrasound (US) examination following abdominal/pelvic computed tomography (CT) in providing new clinical information or changing the management for adult patients in the emergency department (ED) presenting with acute non-traumatic abdominal pain.

METHOD AND MATERIALS

Among all adult patients who presented to the ED at an academic medical center over a three-year time period, those who underwent a contrast-enhanced CT examination of the abdomen/pelvis followed by an US study of the abdomen and/or pelvis within 72 hours were selected for the IRB-approved retrospective review. Patients presenting in the setting of trauma and those who underwent surgical or radiologic intervention in the intervening time period were excluded. The proportions of US exams that were either concordant or discordant with the initial CT were determined, with note made of any relevant added clinical information in concordant cases. Useful added information included changes in treatment or management, or narrowing or clarification of the differential diagnosis. The Chi-square test was used to compare the utility of US examinations suggested by the radiologist with those independently requested by the nonradiologist.

RESULTS

319 cases between July 1, 2013 and June 30, 2016 satisfied the study criteria. 312 cases (97.8%) included US examinations that were concordant with the initial CT. From these 312 concordant cases, 100 (32.1%) provided relevant additional clinical information and 212 (67.9%) provided no additional information. Out of the 319 total cases, the radiologist suggested the follow-up US examination in 90 instances (28.2%) compared to 229 independently ordered by the nonradiologist (71.8%). US examinations suggested by the radiologist had a much higher proportion of added utility compared to those ordered by the nonradiologist (70.0% vs 19.2%, $p < 0.001$).

CONCLUSION

A high rate of concordance exists between CT and US examinations in the setting of acute non-traumatic abdominal pain, with a low rate of relevant additional clinical information. US examinations suggested by the radiologist were more likely to provide more utility than those independently ordered by the nonradiologist.

CLINICAL RELEVANCE/APPLICATION

Selective use of US exams following CT in ED patients with acute non-traumatic abdominal pain may help reduce strain on healthcare resources, given the high rate of agreement between studies.

RC508-12 Accuracy of MRI for Diagnosis of Internal Hernia in Pregnant Women with Prior Roux-En-Y Gastric Bypass

Wednesday, Nov. 29 11:50AM - 12:00PM Room: S405AB

Participants
Satheesh Krishna, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Matthew D. McInnes, MD, FRCPC, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Nicola Schieda, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Sabarish Narayanasamy, MBBS,MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Ania Z. Kielar, MD, Ottawa, ON (*Abstract Co-Author*) Research Grant, General Electric Company

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PURPOSE

Internal hernia (IH) is a life-threatening complication following Roux-en-Y gastric bypass surgery (RGB). With 80% of bariatric surgeries performed in women, IH can occur during pregnancy since the enlarging uterus can predispose to bowel herniation through mesenteric defects. Although CT is the standard of care for diagnosis of IH, MR is preferred in pregnant women. The purpose is to evaluate the accuracy of MRI for diagnosis of IH in pregnant women with prior RGB.

METHOD AND MATERIALS

With IRB approval, 15 consecutive pregnant women (n=8 with surgery proven IH; n=7 without IH) with prior RGB who were referred for MRI to rule out IH between December 2009 and July 2016 were identified. Two blinded fellowship-trained abdominal radiologists (R1/R2) retrospectively identified on MRI, presence or absence of 15 established features of IH which have been previously described on CT. Final diagnosis of IH was evaluated both subjectively and using two models previously validated on CT

(M1=mesenteric swirl and small bowel obstruction (SBO); M2= "beaking" of superior mesenteric vein (SMV) and SBO). Diagnostic accuracy and interobserver agreement were calculated for each feature as well as for subjective and model based diagnosis of IH, and Chi-square analysis was used for comparison between them.

RESULTS

There were no differences in the patient age, gestational age or time since RGB (p=0.68, 0.35, 0.55) between the two groups. The signs with best accuracy and interobserver agreement were beaking of SMV (accuracy=86.7%/ 86.7% (R1/R2); kappa=1.00), mesenteric swirl (accuracy=80.0%/86.7%(R1/R2); kappa=0.86) and engorgement of mesenteric vessels (accuracy=80.0%/73.3% (R1/R2); kappa=0.84). The rest of the signs had either low accuracy, poor interobserver agreement or both. Overall accuracy with subjective assessment, M1 and M2 was 80.0%/ 86.7% for each of the 3 methods for R1/R2. (Sens/spec for R1/R2 in Table 1). There was no difference in accuracy between the three methods (p=0.92).

CONCLUSION

MR for diagnosis of IH in preganancy using subjective assessment and 2 models previously validated for CT demonstrates comparable diagnostic accuracy to that reported with CT.

CLINICAL RELEVANCE/APPLICATION

In our small cohort, MRI for diagnosis of IH in pregnancy demonstrates comparable accuracy to CT in non-pregnant patients. We propose that MR is a suitable alternative in pregnant patients.

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/ Ania Z. Kielar, MD - 2017 Honored Educator

RC509

MR Advances in Oncologic Imaging

Wednesday, Nov. 29 8:30AM - 10:00AM Room: E353A

MR OI

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

FDA Discussions may include off-label uses.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC509A Diffusion-Weighted MR Imaging

Participants
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG

LEARNING OBJECTIVES

1) Discuss conventional response criteria and their limitations after loco-regional therapy. 2) Illustrate the basic concept of DWI and ADC. 3) Highlight the advantages of volumetric assessment compared to linear measurements. 4) Discuss novel DWI volumetric criteria in quantifying response and predicting patient survival.

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/ Ihab R. Kamel, MD, PhD - 2015 Honored Educator

RC509B MR Elastography

Participants
Sudhakar K. Venkatesh, MD, FRCR, Rochester, MN (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Learn basic concept of tissue stiffness. 2) Tumor stiffness and why its different from normal tissues. 2) Technique of MR elastography. 3) Application of MR elastography for detection and characterization of tumors.

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/ Sudhakar K. Venkatesh, MD, FRCR - 2017 Honored Educator

RC509C PET/MR

Participants
Alexander R. Guimaraes, MD, PhD, Portland, OR (*Presenter*) Consultant, Agfa-Gevaert Group

LEARNING OBJECTIVES

1) Discuss why MRI & PET are complementary in Cancer Imaging. 2) Discuss the pitfalls and solutions in clinical FDG PET MRI including: a. Billing b. Workflow c. Interpretation d. Motion compensation. 3) Advanced Techniques and tracers.

ABSTRACT

This course is designed to update the attendee on novel PET/ MRI technology and the benefits of PET/MRI in oncology. 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). Novel PET tracers allow for interrogation of various targets associated with malignant processes at the cellular level.

RC509D New MR Contrast Agents

Participants
Rajan T. Gupta, MD, Durham, NC (*Presenter*) Consultant, Bayer AG; Speakers Bureau, Bayer AG; Consultant, Invivo Corp.;

Consultant, Halyard Health, Inc; Consultant, Siemens AG

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LEARNING OBJECTIVES

1) Learn about some of the new MR contrast agents as well as their potential uses in the oncologic and non-oncologic setting.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

RC512

Vascular Series: MR Angiography: New Techniques and Their Application

Wednesday, Nov. 29 8:30AM - 12:00PM Room: N227B

MR VA

ARRT Category A+ Credits: 4.00
AMA PRA Category 1 Credits ™: 3.25

FDA Discussions may include off-label uses.

Participants

Vincent B. Ho, MD,MBA, Bethesda, MD (*Moderator*) Institution, In-kind support, General Electric Company
Tim Leiner, MD, PhD, Utrecht, Netherlands (*Moderator*) Speakers Bureau, Koninklijke Philips NV; Research Grant, Bayer AG;
Thomas K. Foo, PhD, Niskayuna, NY (*Moderator*) Employee, General Electric Company
Martin R. Prince, MD, PhD, New York, NY (*Moderator*) Patent agreement, General Electric Company; Patent agreement, Hitachi, Ltd; Patent agreement, Siemens AG; Patent agreement, Toshiba Medical Systems Corporation; Patent agreement, Koninklijke Philips NV; Patent agreement, Nemoto Kyorindo Co, Ltd; Patent agreement, Bayer AG; Patent agreement, Lantheus Medical Imaging, Inc; Patent agreement, Bracco Group; Patent agreement, Mallinckrodt plc; Patent agreement, Guerbet SA ; Patent agreement, Topspins, Inc; Stockholder, Topspins, Inc

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LEARNING OBJECTIVES

1) To review the latest MR techniques for vascular imaging. 2) Learn how to optimize MR Angiography pulse sequences. 3) Review a spectrum of Vascular Disease on MRI/MRA.

Sub-Events

RC51201 Non-Contrast MRA

Wednesday, Nov. 29 8:30AM - 9:05AM Room: N227B

Participants
Martin R. Prince, MD, PhD, New York, NY (*Presenter*) Patent agreement, General Electric Company; Patent agreement, Hitachi, Ltd; Patent agreement, Siemens AG; Patent agreement, Toshiba Medical Systems Corporation; Patent agreement, Koninklijke Philips NV; Patent agreement, Nemoto Kyorindo Co, Ltd; Patent agreement, Bayer AG; Patent agreement, Lantheus Medical Imaging, Inc; Patent agreement, Bracco Group; Patent agreement, Mallinckrodt plc; Patent agreement, Guerbet SA ; Patent agreement, Topspins, Inc; Stockholder, Topspins, Inc

RC512-02 The Influence of Obesity on the Image Quality and Accuracy of Noncontrast Quiescent-Interval Single-Shot Lower Extremity MRA in Patients with Peripheral Artery Disease: A Comparison with CTA and Digital Subtraction Angiography

Wednesday, Nov. 29 9:05AM - 9:15AM Room: N227B

Participants
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Presenter*) Research Grant, Siemens AG
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Carlo N. De Cecco, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG
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Taylor M. Duguay, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
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Pal Suranyi, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Domenico De Santis, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Marwen Eid, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Georg Apfaltrer, MD, Thal, Austria (*Abstract Co-Author*) Nothing to Disclose
Philipp L. von Knebel Doeberitz, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Body habitus may significantly affect CT angiography (CTA) image quality. This study aimed to evaluate the influence of obesity on

the image quality and accuracy of non-contrast quiescent interval single-shot (QISS) MR angiography (MRA) in patients with peripheral artery disease (PAD) compared to CTA and digital subtraction angiography (DSA).

METHOD AND MATERIALS

Forty-six patients (64±12 years, 25 male) with PAD underwent lower extremity CTA with a third-generation dual-source dual-energy CT and 1.5T MRA using a prototype QISS sequence (FOV 400x260mm2, TR/TE 3.5/1.4ms, flip angle 90°, acquisition length 144mm). DSA was performed within 50 days. Eighteen arterial segments per patient were analyzed. Patients were grouped (Gr) based on body mass index (BMI; kg/m2): Gr1: <30 (normal and overweight); and Gr2 >30 (obese). Subjective image quality (5-point Likert scale) and degree of stenosis (<= or >50%) were evaluated by two readers and compared by Mann-Whitney U-testing. Sensitivity and specificity of MRA and CTA to detect >50% stenosis were calculated using the McNemar-test.

RESULTS

The average BMI in Gr1 (n=25) and Gr2 (n=21) were 23.4±3.4 and 34.9±3.5kg/m2 (P<0.0001). Of 828 arterial segments, 37 (4.4%; 20 in Gr1 and 17 in Gr2, P=0.1087) and 71 (8.5%; 26 in Gr1 and 45 in Gr2, P=0.0191) were excluded from MRA and CTA evaluation, respectively (P<0.0001). Subjective image quality in MRA was rated similar in Gr1 and Gr2 (4.2 [3.8-4.6] vs 4.0 [3.7-4.3], P=0.0764), while a significant difference was observed between groups with CTA images (Gr1 4.5 [4.3-4.7], Gr2 3.9 [3.7-4.1], P=0.0247). The sensitivity and specificity of MRA for >50% stenosis were similar between the groups (Gr1 85.4% and 97.0%, vs 84.2% and 96.1%, respectively). However, higher sensitivity (88.1% vs 85.9%) and specificity (96.2% vs 90.8%) were measured with CTA in Gr1 compared to Gr2.

CONCLUSION

Body habitus significantly affects image quality and consequently reduces diagnostic accuracy of CTA for the detection of >50% arterial stenosis. Obesity, however, has no influence on QISS MRA, establishing it as a potential advantageous alternative for the visualization of lower extremity arterial anatomy in obese patients.

CLINICAL RELEVANCE/APPLICATION

QISS MRA is a potential alternative for the non-contrast evaluation of the lower extremity arteries with comparable diagnostic accuracy to CTA, especially in patients with larger body habitus.

RC512-03 Simultaneous Acquisition of MR Angiography and Diagnostic Images on Contrast-Enhanced View-Sharing Multi-Arterial Phases

Wednesday, Nov. 29 9:15AM - 9:25AM Room: N227B

Participants
Yoshifumi Noda, MD,PhD, Gifu, Japan (*Presenter*) Nothing to Disclose
Satoshi Goshima, MD, PhD, Gifu, Japan (*Abstract Co-Author*) Nothing to Disclose
Kimihiro Kajita, Gifu, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroshi Kawada, MD, Gifu, Japan (*Abstract Co-Author*) Nothing to Disclose
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Masayuki Matsuo, Gifu, Japan (*Abstract Co-Author*) Nothing to Disclose
Tomohiro Namimoto, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Norihiro Shinkawa, MD, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose
Masataka Nakagawa, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Toshinori Hirai, MD, PhD, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose
Yasuyuki Yamashita, MD, Kumamoto, Japan (*Abstract Co-Author*) Consultant, DAIICHI SANKYO Group

PURPOSE

To prospectively evaluate the feasibility of magnetic resonance angiography (MRA) during abdominal dynamic contrast-enhanced MR imaging and to compare the contrast effect and conspicuity of aortic branches in MRA between gadobutrol and gadoterate meglumine.

METHOD AND MATERIALS

Institutional review board approval was obtained for this prospective multi-center HIPAA-compliant study and written informed consent was obtained from all patients. At three institutions, a total of 88 patients (46 men and 42 women; age range, 36-84 years; mean 64.4 ± 11.0 years) with known and suspected upper abdominal disease performed view-sharing dynamic contrast-enhanced MR imaging with five arterial phases. The axial, maximum intensity projection (MIP), and volume-rendered images (VR) angiography was generated by the first or second arterial phase images. The artery-to-muscle signal intensity ratio (SIR) and conspicuity of aortic branches were evaluated. Conspicuity of focal pancreatic lesions were evaluated on fourth or fifth arterial phase images and compared between gadobutrol and gadoterate meglumine.

RESULTS

View-sharing multi-arterial phase imaging was successfully performed in all patients. The SIRs of common hepatic artery (*P = 0.0051) and left renal artery (RA) (P = 0.045), vascular conspicuities of right and left hepatic arteries (P = 0.010 and 0.030) and right and left RAs on axial (P = 0.0065 and 0.036), and that of gastroduodenal artery on MIP (P = 0.039) in gadobutrol were significantly higher than those in gadoterate meglumine. No significant differences were observed in the depiction of all aortic branches on VR images (P = 0.12-0.98) and the conspicuity of focal pancreatic lesions (P = 0.73) between gadobutrol and gadoterate meglumine.*

CONCLUSION

Simultaneous acquisition of MRA and diagnostic images was feasible in contrast-enhanced upper abdominal MR imaging, and aortic branches were clearly visualized on MRA.

CLINICAL RELEVANCE/APPLICATION

Simultaneous acquisition of MRA and diagnostic images was feasible in contrast-enhanced upper abdominal MR imaging without significant differences in contrast effect and conspicuity regardless of contrast material with different r1 value.

RC512-04 Coronary CT Angiography and Carotid MRI Improve Phenotyping of Disease Extent Compared to AHA Risk Score Alone

Wednesday, Nov. 29 9:25AM - 9:35AM Room: N227B

Awards
Student Travel Stipend Award

Participants
Ashley Chorath, BS, Philadelphia, PA (Presenter) Nothing to Disclose
Younhee Choi, BS, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Evrim B. Turkbey, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Mark A. Ahlman, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Christopher Sibley, Bethesda, MD (Abstract Co-Author) Employed by Merck
Songtao Liu, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Anna E. Zavodni, MD, MPH, Hamilton, ON (Abstract Co-Author) Nothing to Disclose
Veit Sandfort, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
David A. Bluemke, MD, PhD, Bethesda, MD (Abstract Co-Author) Research agreement, Siemens AG; Research support, Siemens AG; Research agreement, Carestream Health, Inc; Research support, Carestream Health, Inc

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PURPOSE

Novel anti-atherosclerotic therapies promise marked reduction of LDL levels, but therapy costs are high, suggesting the need for precise identification of at-risk patients. The purpose of this study was to determine the relationship between cardiovascular risk (2013 ACC/AHA risk) and actual plaque phenotype assessed directly using CT and MR imaging in the coronary and carotid arteries.

METHOD AND MATERIALS

In an interventional study asymptomatic subjects eligible for statin therapy underwent coronary calcium scoring (CAC), coronary CT angiography (CTA) and MRI of the carotid artery. Quartiles were calculated for non-calcified plaque (NCP), CAC, carotid wall volume and were compared to AHA risk quartiles. Characteristics of patients with an AHA risk score misclassification of two or more quartiles were compared. Models were fitted to predict carotid plaque based on AHA risk and coronary imaging tests. C-statistics and net reclassification improvement (NRI) were calculated.

RESULTS

206 subjects were enrolled (60% men, mean age 65). There was fair correlation between average carotid wall plaque (Kendall's tau=0.30), NCP (tau=0.23), and CAC (tau=0.34, all p<0.001). However, AHA risk alone misclassified plaque extent in comparison to direct measurement by carotid wall volume, CAC, and NCP in 25.7%, 23.8% and 29.1% of subjects, respectively. On average 11.75% of the subjects were under-classified and 12.25% over-classified. 31 subjects (15.04%) were under-classified in two or more imaging methods. Subjects who were under-classified in all methods were younger and over-classified patients were older (p<0.001). Correlation between carotid wall volume and CAC was low (tau=0.17, p=0.004). When predicting carotid plaque based on AHA risk, there was no significant improvement when adding CAC to the model, while the addition of NCP led to significant improvement (AUC of 0.75 and 0.79, respectively, NRI 0.52, p=0.001).

CONCLUSION

Approximately 25% of patients have large discrepancies between ACC/AHA risk and the actual plaque burden measured with noninvasive imaging. These results suggest that treatment based on risk score models alone may result in substantial over- and under-treatment of at-risk individuals.

CLINICAL RELEVANCE/APPLICATION

Imaging shows that the risk score substantially over- or underestimates plaque in some asymptomatic patients. This may be relevant to novel anti-atherosclerotic therapies with high treatment costs.

RC51205 MR Biomarkers for Vascular Disease

Wednesday, Nov. 29 9:35AM - 10:10AM Room: N227B

Participants
Albert De Roos, MD, Leiden, Netherlands (Presenter) Nothing to Disclose

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LEARNING OBJECTIVES

1) Learning MRI techniques for assessing vascular biomarkers. 2) Focus on aortic distensibility and vascular stiffness. 3) Clinical implications of vascular function related to end-organs. 4) Focus on aortic stiffness and brain disease.

ABSTRACT

Vascular biomarkers assessed by MRI techniques may contribute to better risk stratification and understanding the pathophysiological interaction between the vasculature and end-organs. MRI is well suited to assess vascular morphology and function in territories that may be difficult to explore with other imaging techniques (e.g. proximal aorta). Stiffening and distensibility of the proximal aorta can be directly assessed using standard MRI techniques.Stiffening of the aorta is one of the earliest manifestations of disease and plays a central role in causing increased pulsatility to the brain and other end-organs. Aortic function also interacts with heart function and perfusion and may be a contributory factor in causing heart failure. The focus of this presentation will be on the role of vascular biomarkers in causing end-organ disease in the heart and brain.

RC51206 Comprehensive MRA: Morphology and Function

Wednesday, Nov. 29 10:20AM - 10:55AM Room: N227B

Participants
Tim Leiner, MD, PhD, Utrecht, Netherlands (Presenter) Speakers Bureau, Koninklijke Philips NV; Research Grant, Bayer AG;

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LEARNING OBJECTIVES

1) To understand the role of MRA in the clinical workup of patients with peripheral vascular disease. 2) To learn about MRI techniques such as flow and perfusion that provide functional information about the peripheral circulation in addition to anatomical assessment. 3) To learn how to interpret information obtained with these adjunctive MRA techniques. 4) To learn how these MRI techniques can be incorporated into a clinical scanning protocol.

RC512-07 Automated Detection and Labeling of the Intracranial Arterial Tree in Routine MR Angiography: A Machine Learning Approach Enhanced with Structural Saliency

Wednesday, Nov. 29 10:55AM - 11:05AM Room: N227B

Participants
Li Chen, BS, Seattle, WA (Presenter) Nothing to Disclose
Jie Sun, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Niranjan Balu, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Thomas S. Hatsukami, MD, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV
Mahmud Mossa-Basha, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Kristi D. Pimentel, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Jenq-Neng Hwang, Seattle, WA (Abstract Co-Author) Nothing to Disclose
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PURPOSE

Intracranial arteries constitute a complex network with considerable anatomical variations. Automated detection and labeling of the various segments of the intracranial arterial tree allow time-efficient characterization of regional differences in distal distributing arteries in routine MR angiography, which are overlooked in clinical review but may afford novel information on vascular health.

METHOD AND MATERIALS

Algorithm Vessels on time-of-flight (TOF) MRA were enhanced by Frangi filter and traced by open-curve snake to acquire topology of arteries. Bifurcations of interest (BoI) were classified so that arteries could be labeled indirectly. Besides positional and directional features, we introduced structural saliency, a weighted index calculated from regional graph structure and vessel likelihood to improve detection performance of BoI. A model graph calculated with multivariate Gaussian distribution from previously labeled cases was used to match unlabeled cases by calculating Gaussian probability density from each feature. Maximum a posteriori estimation was used to label BoI to the type with highest possibility. Arteries are then labeled according to BoI types in both ends . Validation Performance of the algorithm was tested on 48 clinical cases with vascular disease (59±13 years, 32 males). Arteries were also labeled manually by experienced reader as ground truth. Using leave-one-out validation, we calculated accuracy of BoI labeling with and without structural saliency.

RESULTS

The proposed algorithm could identify and classify major arteries of brain MRA. The percent of BoI labels agreed with ground truth was 96.1%, but the percent dropped to 93.8 % without using structural saliency as one of the features.

CONCLUSION

An automatic algorithm for detecting and labeling intracranial arteries was developed, which can generate regional measures of cerebrovascular structure from routine MR angiography for additional insights into cerebral arteries and it is also a promising framework to develop additional neuroradiology tools that use vascular structural information.

CLINICAL RELEVANCE/APPLICATION

Automatically labeling intracranial arteries is beneficial for description of vascular structures and provide valuable information for the identification of geometric risk factors of vascular disease.

RC512-08 Time-resolved Magnetic Resonance Angiography at 3 Tesla in Active Dorsi-and Plantarflexion of Suspected Popliteal Artery Entrapment Syndrome

Wednesday, Nov. 29 11:05AM - 11:15AM Room: N227B

Participants
Yoo Jin Lee, MD, Charlottesville, VA (Presenter) Nothing to Disclose
Patrick T. Norton, MD, Charlottesville, VA (Abstract Co-Author) Nothing to Disclose
Jessie Jahjah, MD, Charlottesville, VA (Abstract Co-Author) Nothing to Disclose
Klaus D. Hagspiel, MD, Charlottesville, VA (Abstract Co-Author) Research Grant, Siemens AG

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PURPOSE

Popliteal artery entrapment syndrome (PAES) is an important diagnostic consideration in younger patients with exertional calf pain. PAES is diagnosed when popliteal artery deviation or stenosis is present on angiography during active dorsi or plantar flexion. Cross-sectional imaging can demonstrate the anatomical cause and type of PAES. At our institution, positional stress time resolved contrast-enhanced MRA in active plantar and dorsiflexion (STR-MRA) along with axial MRI is routinely performed for the evaluation of suspected PAES. We aim to analyze the utility of stress TR-MRA for the diagnosis of PAES.

METHOD AND MATERIALS

Between 5/2010 and 9/2015, 51 patients underwent coronal STR-MRA on a 3T scanner (TWIST; Trio or Skyra, Siemens Medical Solutions, Germany): spatial resolution 1.3 x 1.3 x 2mm, temporal resolution 2.1 sec. MIP images were used for analysis. Axial anatomical sequences of the popliteal fossa included a pre and post contrast T1 fat suppressed 3D radio-frequency-spoiled 3D GRE sequence (VIBE) as well as a T1 TSE and STIR sequences. Presence, degree, and length of popliteal arterial or venous deviation and stenosis as well as anatomical causes were documented and the type of PAES was recorded according to the classification of Whelan and Rich. Initial presentation, management, and clinical / surgical outcomes were also documented using electronic medical records.

RESULTS

STR-MRA for 102 limbs were obtained, all technically successful without motion artifact. 25/102 (25%) limbs in 15/51 (29%) patients showed deviation or stenosis of the popliteal artery during stress. 9 patients had bilateral findings. The degree of stenosis ranged from 10% to 100% (mean 45%), and the length from 15mm to 85mm (mean 38mm). The type of PAES in the 25 affected limbs were: type 4 (n=1, 4%), type 5 (n=7, 28%), type 6 (n=15, 60%), deviation without stenosis (n=2, 8%). DSA was performed in 8 patients and correlated with STR-MRA in 100%. Entrapment release surgery was performed in 9 limbs in 7 patients, all of which had positive STR-MRA findings. Six patients responded to surgery with significant clinical improvement.

CONCLUSION

Evaluation of patients with suspected PAES with STR-MRA and MRI allows reliable non-invasive identification of vascular abnormalities and classification of PAES.

CLINICAL RELEVANCE/APPLICATION

Time-resolved stress MRA in conjunction with MRI allows comprehensive assessment of patients with suspected PAES.

RC512-09 Impact of Field Strength on Feasibility of Decreased Temporal Resolution in Intracranial 4D Flow MRI

Wednesday, Nov. 29 11:15AM - 11:25AM Room: N227B

Participants
Maria Aristova, BEng, Chicago, IL (Presenter) Nothing to Disclose
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Can Wu, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Pierre-Francois Van de Moortele, Minneapolis, MN (Abstract Co-Author) Nothing to Disclose
James C. Carr, MD, Chicago, IL (Abstract Co-Author) Research Grant, Astellas Group; Research support, Siemens AG; Speaker, Siemens AG; Advisory Board, Guerbet SA
Kamil Ugurbil, Minneapolis, MN (Abstract Co-Author) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (Abstract Co-Author) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;
Susanne Schnell, Chicago, IL (Abstract Co-Author) Nothing to Disclose

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PURPOSE

Dual-venc 4D flow MRI provides comprehensive cerebrovascular blood flow assessment with high velocity dynamic range. However, long scan times limit this approach particularly for large target regions. By comparing flow values from single-timepoint to standard multi-timepoint dual-venc 4D flow MRI at 3T and 7T, we characterize the tradeoff between temporal resolution, coverage and scan time to identify clinically acceptable parameters.

METHOD AND MATERIALS

ECG-gated dual-venc 4D flow MRI was acquired at 3T in 15 healthy volunteers covering Circle of Willis at two temporal resolutions: 7 cardiac phases (MTP: 103.6ms) and 1 cardiac phase (1TP: 725.2ms). 5 subjects were also scanned at 7T. All images were corrected for concomitant gradient terms, eddy currents and background noise. Phase-contrast angiograms were extracted from each data set to generate a 3D segmentation of main intracranial vessels and streamlines to visualize blood flow. For each scan, net flow and peak velocity were calculated with analysis planes at main intracranial vessels. Net flow ratios between inlet and outlet at vessel branch points characterize flow conservation. Streamline continuity was assessed qualitatively. Noise was determined using velocity standard deviation in static tissue.

RESULTS

1TP scan time was comparable to MTP with 3-fold increased volumetric coverage and no significant difference in streamline continuity ($p=0.14$ at 3T, 0.48 at 7T) or image noise ($p=0.11$ at 3T, 0.08 at 7T) at 3T or 7T. Noise was 53% lower in 7T scans. Bland-Altman analysis shows mean difference (offset) between MTP and 1TP peak velocity measurements differs significantly from 0 ($p<10-4$ at 3T and 7T) and difference varies with mean value (nonzero slope, $p<10-6$ at 3T and 7T). However, net flow offset and slope are significant ($p<0.05$) at 3T but not 7T ($p>0.1$). Net flow ratio had no significant offset at any vessel branch point at 3T or 7T.

CONCLUSION

MTP and 1TP data have better net flow agreement and internal consistency at 7T than 3T, with no significant continuity or noise difference between MTP and 1TP data at either field. At 7T, decreasing temporal resolution while recovering consistent net flow values would suffice for many applications.

CLINICAL RELEVANCE/APPLICATION

High-field, low temporal resolution intracranial 4D flow MRI could provide accurate flow distribution assessment in arteriovenous malformation or aneurysm, especially in post-surgical monitoring.

RC51210 MRA at 3T or Higher Field Strength

Wednesday, Nov. 29 11:25AM - 12:00PM Room: N227B

Participants
Winfried A. Willinek, MD, Trier, Germany (Presenter) Speakers Bureau, Bayer AG; Speakers Bureau, Bracco Group; Speakers Bureau, General Electric Company; Speakers Bureau, Koninklijke Philips NV; Speakers Bureau, Sirtex Medical Ltd

LEARNING OBJECTIVES

1) Identify advantages and disadvantages of MRA at 3T and higher field strength. 2) Practice solutions and new techniques to overcome limitations. 3) Acces the results of new research related to high field MRA. 4) Apply technical innovations to clinical practice.

RC517

Emerging Technology: Elastography - Opportunities and Challenges

Wednesday, Nov. 29 8:30AM - 10:00AM Room: S505AB

GI MR US

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

FDA Discussions may include off-label uses.

Participants
Juergen K. Willmann, MD, Stanford, CA (*Moderator*) Research Consultant, Bracco Group Research Grant, Siemens AG Research Grant, Bracco Group Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Advisory Board, Lantheus Medical Imaging, Inc Advisory Board, Bracco Group

For information about this presentation, contact:

Willmann@stanford.edu

LEARNING OBJECTIVES

1) To understand how elastography measurements are integrated into the management of patients with chronic liver disease. 2) To learn imaging techniques and protocols of ultrasound and MR elastography. 3) To compare US and MR elastography in assessing liver fibrosis. 4) To review emerging clinical indications of US and MR elastography. 5) To understand limitations of current elastography techniques.

Sub-Events

RC517A Elastography of the Liver: What the Clinician Wants to Know

Participants
Mindie Nguyen, MD, Stanford, CA (*Presenter*) Consultant, Intercept Pharmaceuticals, Inc; Consultant, Johnson & Johnson; Consultant, Gilead Sciences, Inc; Consultant, Alynam Pharmaceuticals, Inc; Consultant, Dynavax Technologies Corporation; Research Grant, Johnson & Johnson; Research Grant, Gilead Sciences, Inc; Research Grant, Bristol-Myers Squibb Company

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC517B Ultrasound Elastography: How and When?

Participants
Juergen K. Willmann, MD, Stanford, CA (*Presenter*) Research Consultant, Bracco Group Research Grant, Siemens AG Research Grant, Bracco Group Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Advisory Board, Lantheus Medical Imaging, Inc Advisory Board, Bracco Group

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LEARNING OBJECTIVES

1) Understand the clinical indications of ultrasound elastography (USE). 2) Learn about the various techniques and imaging protocols of USE. 3) Review the diagnostic accuracy of USE in the assessment of elasticity in liver fibrosis and other clincal applications in the body. 4) Compare USE with MR elastography. 5) Understand current limitations of USE.

ABSTRACT

Ultrasound elastography (USE) is a general term for various techniques available for objectively and quantitatively assessing tissue stiffness using ultrasonic techniques, creating noninvasive images of mechanical characteristics of tissues. Elastography is based on the fact that the elasticity of a tissue is changed by pathological or physiological processes. For example, cancer or fibrosis associated with various disease processes including chronic liver disease or chronic pancreatitis result in increased tissue stiffness.Recently, various USE techniques have been cleared by the FDA and all major ultrasound companies offer different approaches of measuring tissue stiffness on their ultrasound machines.The objective of this talk is to familiarize the audience with the clinical indications, imaging techniques and protocols, interpretation, diagnostic accuracy, and limitations of the various USE technique for assessment of tissue stiffness, with special focus on assessment of fibrosis in chronic liver disease.

RC517C MR Elastography: How and When?

Participants
Richard L. Ehman, MD, Rochester, MN (*Presenter*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;

LEARNING OBJECTIVES

1) To be able to understand the basic physical principles of MR Elastography (MRE). 2) To be able to describe the clinical indications for MRE in liver disease. 3) To be able to describe published evidence on the diagnostic performance of MRE in assessing

liver fibrosis. 4) To be able to compare ultrasound based elastography to MRE. 5) To be able to describe the current limitations of MRE.

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 L. Ehman, MD - 2016 Honored Educator

RC522

MRI: Imaging for Radiation Treatment Guidance and Verification

Wednesday, Nov. 29 8:30AM - 10:00AM Room: S105AB

MR RO PH

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

Participants
John E. Bayouth, PhD, Madison, WI (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the main concepts of MRI-guided radiation therapy. 2) Understand the advantages and limitations of MRI-guided radiotherapy systems currently in use or under development. 3) Understand the use of in-room MRI guidance for management of intr- and inter-fraction variations in anatomy.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC522A In-Room MRI for Treatment Guidance

Participants
John E. Bayouth, PhD, Madison, WI (*Presenter*) Nothing to Disclose

RC522B Integrating MRI: The Clinician Perspective

Participants
Caroline Chung, MD, FRCPC, Houston, TX (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how MRI can be integrated into the clinical workflow of radiation treatment delivery. 2) Learn about the potential benefits of integrating MRI at each step of radiotherapy: treatment planning, radiation delivery and response assessment. 3) Appreciate the challenges of using MRI for radiation treatment guidance and ongoing research to overcome these challenges.

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RC529

MR Imaging of Rectal Cancer Before and After Therapy and Recent Advances in Imaging (An Interactive Session)

Wednesday, Nov. 29 8:30AM - 10:00AM Room: E451A

BQ 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

RC529A 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) Highlight Key Relevant Clinical Backgroud of Imaging in rectal cancer. 2) Review Structured Reporting Template for Rectal Cancer Evaluation with MRI. 3) Demonstrate Key Points for Reporting of MRI of rectal cancer staging.

RC529B Response to Chemoradiotherapy: How Do We Assess?

Participants
Marc J. Gollub, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the available methods ro 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.

RC529C MRI as a Prognostic Biomarker and Guide to New Therapies

Participants
Regina G. Beets-Tan, MD, PhD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose

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MSSR42

RSNA/ESR Hybrid Imaging Symposium: Hybrid Imaging in the Female (An Interactive Session)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: S402AB

BR GU MR NM

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

Participants
Alexander Drzezga, MD, Cologne, Germany (*Moderator*) Consultant, Siemens AG; Consultant, Bayer AG; Consultant, General Electric Company; Consultant, Eli Lilly and Company; Consultant, The Piramal Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company; Speakers Bureau, Eli Lilly and Company; Speakers Bureau, The Piramal Group
Katrine Riklund, MD, PhD, Umea, Sweden (*Moderator*) Nothing to Disclose

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Sub-Events

MSSR42A Pelvic Tumors

Participants
Farrokh Dehdashti, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn about different tracers. 2) Understand how to interpret hybrid imaging examinations of the pelvis. 3) Learn about the role of hybrid imaging in staging, treatment evaluation and follow-up.

ABSTRACT

This presentation summarizes the literature in PET/CT and PET/MRI in the evaluation of the three most common gynecologic malignancies: cervical, endometrial and ovarian cancers. The advantages and challenges of each hybrid modality will be briefly discussed. In addition to clinically used 2-[18F]fluoro-2-deoxy-D-glucose (FDG), novel tracers that are currently used for research purposes in these malignancies will be briefly discussed.

MSSR42B Breast Cancer

Participants
Osman Ratib, MD, PhD, Geneva, Switzerland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn about pathophysiology and relation to different tracers. 2) Understand how to interpret hybrid imaging examinations of the breast. 3) Learn about the role of hybrid imaging in staging, treatment evaluation and follow-up.

MSSR42C Interactive Case Discussion

Participants
Farrokh Dehdashti, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Osman Ratib, MD, PhD, Geneva, Switzerland (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how to interpret hybrid imaging in female pelvic tumours. 2) Understand how to interpret hybrid imaging in breast cancer. 3) Learn how to avoid common pitfalls.

ABSTRACT

Imaging is critical for staging, determining prognosis and treatment strategy, and in predicting prognosis in gynecological malignancies. In this case presentation session, common clinical applications of PET/CT and PET/MRI in the evaluation of the most common gynecologic malignancies will be presented. In addition, the advantages and disadvantages of each hybrid modality will be illustrated and discussed.

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SSK04

Cardiac (General Topics, MRI)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: S504AB

CA MR

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

Participants
Anil K. Attili, MD, Saline, MI (*Moderator*) Nothing to Disclose
Daniel Ocazionez, MD, Houston, TX (*Moderator*) Nothing to Disclose
Charles S. White, MD, Baltimore, MD (*Moderator*) Consultant, Koninklijke Philips NV

Sub-Events

SSK04-01 Safety of MRI in Patients with Conditional or Non-Conditional Pacemaker or Other Implantable Cardiac Electronic Devices (ICED): A Systematic Review

Participants
Giovanni Di Leo, San Donato Milanese, Italy (*Presenter*) Travel support, Bracco Group
Moreno Zanardo, MSc, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Simone Schiaffino, MD, Bogliasco, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco Secchi, MD,PhD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco Sardanelli, MD, San Donato Milanese, Italy (*Abstract Co-Author*) Speakers Bureau, Bracco Group; Research Grant, Bracco Group; Advisory Board, Bracco Group; Speakers Bureau, Bayer AG; Research Grant, Bayer AG; Advisory Board, General Electric Company

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PURPOSE

To review the MRI safety in patients carrying a pacemaker or other ICEDs.

METHOD AND MATERIALS

A search was performed on March 2017 using MEDLINE/EMBASE for articles on the MRI safety in ICED carriers. Keywords included MRI, pacemaker, implantable cardioverter defibrillator, cardiac electronic device, safety, and adverse events (AEs). We extracted: number of patients, age, device dependency, field strength, specific absorption rate (SAR), studied body region, technical ICED parameters, and follow-up time.

RESULTS

Of 493 articles, 53 were analyzed for a total 6,237 exams in 5,394 patients. Design was prospective in 49 (4 randomized). Devices were MRI non-conditional in 32 studies (2,889 patients), conditional in 16 (1,708 patients), mixed in 5 (797 patients). Patients were device-dependent in 1 study, independent in 22, mixed in 18, and not defined in 12. Field strength was 0.2T in 1 study, 0.5T in 3, 1.5T in 45, 2T in 1, 3T in 2, mixed in 1. The studied body region was thoracic in 27 studies, non-thoracic in 16, and mixed in 10. SAR was limited in 39 studies, not limited in 5, not reported in 9. Follow up was 0-6 months in 32 studies, >6 months in 6, and not reported in 15. No fatal events occurred. Five studies reported clinically relevant AEs: atrial arrhythmias (6 patients), intolerable heating (5 patients), perforation (4 patients), lead dislodgements (3 patients), and generator failure with immediate replacement (1 patient), for a total of 19 AEs, 7 in patients with MRI conditional ICED, 9 in patients with non-conditional, and 3 in patients with an undefined ICED, for a total of 19 clinically relevant AEs. Twenty studies reported technical AEs, mainly power-on reset and battery voltage reduction. Two studies showed significant changes of atrial sensing, 4 of ventricular sensing, 3 of atrial pacing capture threshold (PCT), 4 of ventricular PCT, 6 of atrial lead impedance, 7 of ventricular lead impedance, and 9 of battery voltage.

CONCLUSION

Considering 6,237 MRI exams in 5,394 device-dependent or non-dependent carriers of conditional or non-conditional ICED, a very low rate of clinically relevant AEs was reported. The risk/benefit ratio is largely positive, also for non-conditional ICED.

CLINICAL RELEVANCE/APPLICATION

Patients carrying ICED should not be denied thoracic or nonthoracic MRI a priori, included patients with non-conditional devices. MRI may be performed safely under controlled conditions.

SSK04-02 Diagnostic Performance of Minimally Invasive Autopsy for Detection of Ischemic Heart Disease

Wednesday, Nov. 29 10:40AM - 10:50AM Room: S504AB

Participants
Ivo Wagensveld, MSc, Leiden, Netherlands (*Presenter*) Nothing to Disclose
Britt Blokker, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Andrea Pezzato, Verona, Italy (*Abstract Co-Author*) Nothing to Disclose
Piotr A. Wielopolski, PhD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Jan von der Thusen, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Gabriel P. Krestin, MD, PhD, Rotterdam, Netherlands (*Abstract Co-Author*) Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Siemens AG Consultant, Bracco Group Scientific Advisor, Zebra Medical Vision Ltd Advisory Board, Quantib BV
M.G. Myriam Hunink, MD, PhD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
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Annick C. Weustink, MD, PhD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In this study we investigated the performance of minimally invasive autopsy (MIA) to diagnose ischemic heart disease in clinically deceased patients

METHOD AND MATERIALS

In 99 adult cases with written consent for conventional autopsy (CA) and MIA, diagnostic accuracy of MIA and CA was calculated for acute and chronic myocardial ischemia. MIA consisted of total-body postmortem MR (PMMR) and CT (PMCT), combined with CT-guided biopsies of myocardial lesions. PMMR and PMCT were independently read by two radiologists with expertise in cardiac radiology. Calcium score (Agatston) and ROC curve for the prediction of acute and chronic ischemia were calculated for each case. CA including macroscopy and microscopy was the gold standard.

RESULTS

CA detected 34 cases of acute ischemia. Sensitivity of PMMR for acute ischemia was 0.50 (CI: 0.33-0.67) and specificity was 0.92 (CI: 0.86-0.99). PMMR combined with biopsy improved sensitivity to 0.97 (CI: 0.91-1.00) and specificity to 0.95 (CI: 0.9-1.00). CA detected 40 cases of chronic ischemia. Sensitivity of PMMR for chronic ischemia was 0.35 (CI: 0.20-0.50) and specificity was 1.00. PMMR combined with biopsy improved sensitivity for chronic ischemia to 0.90 (CI: 0.81-0.99) but specificity was lowered to 0.75 (CI: 0.63-0.86). Calcium score was a fair predictor for chronic ischemia (AUC=0.73, $p<0.001$), but a poor predictor for acute ischemia (AUC=0.61, $p=0.073$).

CONCLUSION

MIA shows high diagnostic accuracy for detection of acute and chronic myocardial ischemia. Importantly, our results show that postmortem imaging needs to be combined with CT-guided biopsies to achieve the highest performance.

CLINICAL RELEVANCE/APPLICATION

This study shows that minimally invasive autopsy (MIA) has high diagnostic performance to detect ischemic heart disease which is a very common cause of death in clinically deceased patients.

SSK04-03 Left Bundle Branch Block: Usefulness of MRI in the Evaluation of Regional Left Ventricular Dyssynchrony and in the Detection of Previous Myocardial Infarction with Late Enhancement

Wednesday, Nov. 29 10:50AM - 11:00AM Room: S504AB

Participants
Marco Di Girolamo, MD, Rome, Italy (*Presenter*) Nothing to Disclose
Giuseppe Muscogiuri, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Stefano Fierro, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco B. Tagliaferro, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG
Michele Rossi, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Left bundle branch block (LBBB) is a common cardiac conduction abnormality diagnosed on ECG. LBBB can be a primary abnormality of the cardiac electrical conduction system or it can be secondary to other cardiogical pathologies such as myocardial infarction and cardiomyopathies. The presence of LBBB per se cannot be used as a single diagnostic criteria for the diagnosis of previous myocardial infarction. Aim of this study was to evaluate the mechanical left ventricular dyssynchrony with high temporal resolution cine MRI and to evaluate the presence of late-enhancement (LE) in order to diagnose previous myocardial infarction.

METHOD AND MATERIALS

38 patient with LBBB underwent cardiac MRI using a 1.5 T magnet (Magnetom Sonata, Siemens). The MRI protocol consisted of a left ventricular trueFISP functional study followed by Late Enhancement data sets acquired 10-15 minutes after iv administration of 0.2mmol/kg BW of extracellular Gd contrast agent. We used a segmented Inversion Recovery Turbo-FLASH sequence (TR:8ms;TE:4ms;TI:250-320ms;sl.thick:8mm). Different pattern of LE were related to the underlying pathology as stated by clinical and other diagnostic imaging features.

RESULTS

We detected a characteristic dyssynchronous ventricular contraction with septal flattening during early ventricular systole in all the patients, tenting of mitral valve apparatus in 5 pts and functional mitral regurgitation in 2 pts. In 1 pt we found the characteristic functional features of dilated cardiomyopathy with no myocardial area of LE. In 8 pts we found areas of LE (transmural in 3 pts and subendocardial in 5 pts) with typical patterns of myocardial infarction (MI). The location of MI was septal in 4 pts, infero-septal in 2 pts, lateral in 1pt, and superior in 1 pt. In 30 patients we found a reduction of the ejection fraction (75%).

CONCLUSION

Cardiac MRI is a useful diagnostic tool in the evaluation of LBBB when the assessment of ventricular dyssynerygy on echocardiography is not technically feasible and when the area of a previous myocardial infarction cannot be determined.

CLINICAL RELEVANCE/APPLICATION

MRI is a useful diagnostic tool in the evaluation of LBBB when US assessment of ventricular dyssynerygy isn't feasible and a previous possible myocardial infarction has to be determined.

SSK04-04 Utility of Native Myocardial T1 Mapping as a Diagnostic Tool for Ischemic and Non-Ischemic Cardiomyopathy

Wednesday, Nov. 29 11:00AM - 11:10AM Room: S504AB

Participants
Krishna S. Kapoor, Austin, TX (*Presenter*) Nothing to Disclose
Sanjaya Viswamitra, MD, Bengaluru, India (*Abstract Co-Author*) Nothing to Disclose
Sankar Neelakantan, MD , Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Bhavana Nagabhushana Reddy, MBBS, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Anitha Kini, DMRD,MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Sunitha P Kumaran, MBBS, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Anju Das Thulasi Das, DMRD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Gurudat R. Shenoy, MBBS, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Aishwarya K. Mahendrakar, MBBS, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Srikanth Sola, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Native myocardial T1 mapping measures interstitial fibrosis and provides prognostic information in patients with cardiomyopathy. We sought to determine the diagnostic utility of native T1 mapping in identifying common cardiomyopathies - ischemic (CAD), dilated cardiomyopathy (DCM), and hypertrophic cardiomyopathy (HCM) - compared with the reference standard late gadolinium enhancement (LGE).

METHOD AND MATERIALS

We enrolled consecutive adult subjects referred for CMR evaluation of ischemic or non-ischemic cardiomyopathy. CMR was performed on a 1.5T magnet using standard cine, LGE, and native T1 mapping using a modified Look-Locker inversion recovery sequence. We compared the diagnostic accuracy of native T1 mapping versus LGE of the mid septum as well as all 16 segments of the left ventricle for etiology of cardiomyopathy.

RESULTS

We evaluated 1,950 myocardial segments in 130 subjects (mean age 48±11 years, 80% male; 90 CAD, 29 DCM, 11 HCM). Mid septal T1 values were similar in CAD vs. DCM and HCM (1051±51 msec, 1064±36, 1068±22 respectively, p=0.17). T1 values in segments with fibrosis on LGE were significantly lower than segments without fibrosis, regardless of etiology (1057±65 msec with fibrosis vs. 1042±52 without fibrosis, p<.0001). T1 values were markedly reduced in CAD in segments with lipomatous metaplasia (968±17 msec). However, the diagnostic accuracy of native T1 mapping in identifying the etiology of cardiomyopathy was poor. For a threshold T1 value of < 1024 msec in any segment, the AUC for identifying CAD vs. HCM or DCM was 0.565, sensitivity 39%, specificity 78%, PPV 86%, NPV 28%). There was no association between T1 values and standard imaging indices of disease severity (ejection fraction, total myocardial scar, myocardial mass).

CONCLUSION

Compared with LGE, native T1 mapping has limited diagnostic accuracy in distinguishing between etiologies of cardiomyopathy, likely due to considerable overlap of values in CAD, DCM, and HCM. There was no association between T1 values and severity of cardiomyopathy, as measured by ejection fraction, total myocardial scar (CAD), or myocardial mass (HCM).

CLINICAL RELEVANCE/APPLICATION

Native T1 mapping is a useful tool for tissue characterization. However, its utility to distinguish between ischemic, dilated, or hypertrophic cardiomyopathies is limited.

SSK04-05 References Values of Myocardial Strain Measurement Using Cardiovascular Magnetic Resonance Tissue Tracking for Both Ventricles in Asymptomatic Asian Cohort: Association with Cardiovascular Risk Factors

Wednesday, Nov. 29 11:10AM - 11:20AM Room: S504AB

Participants
Hye Na Jung, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sung Mok Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Min Jae Cha, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji-Won Hwang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyun Su Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yeon Hyeon Choe, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To provide the reference values of myocardial deformation parameters of both ventricles using cardiovascular MR with tissue tracking (CMR-TT) in asymptomatic Asian subjects and to evaluate the association of deformation parameters and Framingham risk score (FRS).

METHOD AND MATERIALS

We enrolled 120 asymptomatic healthy adults who underwent CMR, and all subjects demonstrated normal left ventricular systolic

We enrolled 129 asymptomatic healthy adults who underwent CMR, and all subjects demonstrated normal left ventricular systolic function. We assessed the FRS of all study population. Commercial software was used to derive myocardial deformation parameters of both ventricles from short-axis cine views and apical two-, three-, and four-chamber views. The reference value of each strain parameter was determined as mean value of every individual. The linear regression analysis was performed between all strain parameters and FRS. Iota coefficient for the inter-rater agreement of strain parameters was also calculated.

RESULTS

In total 129 patients, the reference values of left ventricle (LV) were 48.90 ± 9.05 for radial, -22.30 ± 2.33 for circumferential and -19.76 ± 2.22 for longitudinal global strain. The reference values of right ventricle (RV) were 18.63 ± 6.52 for radial, -10.60 ± 3.33 for circumferential and -25.06 ± 3.01 for longitudinal global strain. The median FRS was 7 (interquartile range 4-11). The LV strain parameters were significantly associated with FRS in univariate linear regression analysis: radial strain, beta = -0.155, p = 0.002; circumferential strain, beta = 0.56, p = 0.005; longitudinal strain, beta = 0.423, p = 0.043. However, RV strain parameters were not significantly associated with FRS: radial strain, p = 0.74; circumferential strain, p = 0.76; longitudinal strain, p = 0.09. The iota coefficient of all strain parameters were 0.915 for LV ($p < 0.001$) and 0.715 for RV ($p < 0.001$), respectively.

CONCLUSION

We present the reference values of strain parameters of both ventricles in asymptomatic Asian subjects. In contrast to RV parameters, LV strain parameters assessed by CMR-TT show significant association with FRS.

CLINICAL RELEVANCE/APPLICATION

We suggest reference values of myocardial strain parameters of both LV and RV assessed by CMR-TT in asymptomatic subjects and LV strain paramters show significant association with Framingham risk scores.

SSK04-06 Cardiac Magnetic Resonance Using Late Gadolinium Enhancement Imaging and T1 Mapping Predicts Poor Outcome in Patients with Atrial Fibrillation after Catheter Ablation Therapy

Wednesday, Nov. 29 11:20AM - 11:30AM Room: S504AB

Participants
Julian A. Luetkens, MD, Bonn, Germany (*Presenter*) Nothing to Disclose
Caroline A. Wolpers, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Beiert, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Hendrik Meendermann, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Abou Daye Natalie, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
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Darius Dabir, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Rami Homsi, 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
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Georg Nickenig, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Hans H. Schild, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Jan W. Schrickel, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Rene Andrie, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Success rates for ablation therapy in patients with atrial fibrillation (AF) vary widely and patient selection criteria are poorly defined. We aimed to determine the pre-procedural value of cardiac magnetic resonance (CMR) and laboratory biomarkers of fibrosis for the prediction of poor response to ablation therapy.

METHOD AND MATERIALS

Left atrial (LA) late gadolinium enhancement (LGE) and LA T1 mapping were performed during pre-procedural CMR. Patients were categorized by four different fibrosis stages based on the percentage of LA wall enhancement on LGE-CMR (Utah stages I-IV). Plasma levels of relaxin and myeloperoxidase (MPO) and serum levels of MMP-mediated cardiac specific titin (TIM) and MMP-mediated collagen type IV (C4M) were obtained prior to ablation therapy. Poor outcome was defined by the reoccurrence of AF during 1-year follow-up (90 days blanking period). Univariate and multivariate cox proportional-hazards regression was used to identify significant predictors of AF recurrence.

RESULTS

A total of 61 patients were included in this prospective study (mean age: 60.3 + 12.5 years, 65.6% male). After 1-year follow-up AF reoccurred in 20 (32.8%) of all patients. Patients with a reoccurrence of AF showed a higher mean percentage of LA wall enhancement (26.7 ± 12.5 % vs. 17.0 ± 7.7 %; P<0.001), higher LA T1 relaxation times (857 ± 112 ms vs. 747 ± 91 ms; P<0.001), and higher plasma level of relaxin (0.7 ± 1.4 pg/ml vs. 0.4 ± 0.9 pg/ml; P=0.010). No significant differences were found in plasma concentrations of MPO and serum concentrations of TIM and C4M. In a multivariate analysis, poor ablation outcome was best predicted by advanced fibrosis stage (stage III and IV) (hazard ratio 5.487; P=0.001) and higher T1 relaxation times (hazard ratio 1.007; P=0.001). Plasma relaxin was not an independent predictor of poor outcome.

CONCLUSION

Pre-procedural CMR is a valuable tool for prediction of poor response to catheter ablation therapy in patients with AF. It offers various imaging techniques for outcome prediction and might be valuable for a better patient selection prior to ablation therapy.

CLINICAL RELEVANCE/APPLICATION

Pre-procedural CMR using LGE and T1 mapping might be useful for the prediction of poor response of patients with AF undergoing ablation therapy.

SSK04-07 Association between Abdominal Adiposity and Subclinical Measures of Left-Ventricular Remodeling and Diastolic Dysfunction in Diabetics, Prediabetics and Normal Controls without History of

Cardiovascular Disease as Measured by MR Imaging

Wednesday, Nov. 29 11:30AM - 11:40AM Room: S504AB

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PURPOSE

Local, abdominal fat depots may be related to alterations in cardiac function and morphology due to a metabolic linkage, which could be further accelerated in diabetic patients. Therefore we aimed to determine their association with subtle cardiac changes and the potential interaction with hyperglycemic metabolic states.

METHOD AND MATERIALS

Subjects from the general population without history of cardiovascular disease (CVD) underwent 3 Tesla cardiac and body magnetic resonance imaging. Measures of abdominal adiposity such as hepatic proton-density fat fraction (PDFFhepatic), subcutaneous (SAT) and visceral abdominal fat (VAT) as well as established cardiac LV measures including LV remodeling index (LVCI) were derived. Associations and interactions were determined using linear regression analysis based on standard deviation normalized predictors.

RESULTS

Among 374 subjects (56.2±9.1 years, 58% males), 49 subjects had diabetes, 99 subjects had prediabetes and 226 represented normal controls. Only subtle cardiac alterations were observed (e.g. LVCI: 1.13±0.30). In multivariable analysis, VAT and PDFFhepatic were independent predictors of increased LVCI (ß=0.11 and 0.06, respectively), decreased LV end-diastolic volume (ß=-6.70 and 3.23, respectively), and LV stroke volume (ß=-3.91 and -2.20, respectively). In contrast, SAT was not associated. Hyperglycemic state or HbA1c-levels did not modify the associations between VAT or PDFF and LV measures (interaction term: all p>=0.29)

CONCLUSION

Particularly VAT, but also fatty liver are independently and incrementally associated with early LV remodeling and diastolic dysfunction in a general western population without history of CVD. Although a metabolic connection is suggestive, no interaction with the diabetic status was revealed for these important associations.

CLINICAL RELEVANCE/APPLICATION

Since LV remodeling and diastolic dysfunction is a precursor of heart failure and worse outcome, imaging-based quantification of VAT or fatty liver in patients without previous CVD could improve risk stratification and thus preventive medicine to avoid complications from heart failure in a very early state.

SSK04-08 Aortic Dimensions and Subclinical Atherosclerosis in Former National Football League Athletes

Wednesday, Nov. 29 11:40AM - 11:50AM Room: S504AB

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PURPOSE

To evaluate whether past participation in the National Football League (NFL) is associated with increased prevalence of ascending aortic dilation and coronary artery calcium (CAC) on cardiac CT.

METHOD AND MATERIALS

This is a retrospective, cross-sectional study of 206 former National Football League (NFL) athletes compared with 759 matched male subjects from the XXX Heart Study (XHS) older than 40 years old with body mass index >= 20 kg/m2. Mid-ascending aortic dimensions were obtained from non-contrast, multidetector cardiac-gated CT scans performed as part of a screening protocol (NFL)

or as part of the XHS. CAC scores were obtained using the Agatston method. Multivariate logistic regression was performed to evaluate predictors of aortic size > 4.0 cm, CAC>0, and CAC>100 in each cohort.

RESULTS

Compared to the control group, former NFL athletes had significantly larger ascending aortic diameters (3.8±0.5 vs. 3.4±0.4 cm; p<0.0001). A significantly higher proportion of former NFL players had an aorta of >4.0 cm (29.6% versus 8.6%, p<0.0001). After adjusting for age, race, body surface area, systolic blood pressure, history of hypertension, current smoking, diabetes, and lipid profile the former NFL players still had significantly larger ascending aortas (p<0.0001). Former NFL players were twice as likely to have an aorta > 4.0 cm after adjusting for the same parameters. CAC scores were similar in both groups as was the distribution across CAC score categories (CAC=0, 1-100, and >100).

CONCLUSION

While CAC scores are similar between former NFL athletes and controls, ascending aortic dimensions are significantly larger in former NFL athletes even after accounting for their size, age and cardiac risk factors. Whether this translates to an increased risk is unknown and requires further evaluation.

CLINICAL RELEVANCE/APPLICATION

Past exposure to the hemodynamic effects of repetitive strenuous exercise among elite athletes may have lasting effects on aortic dimensions.

SSK04-09 Diagnostic Value of Cardiac Magnetic Resonance Imaging for Cardiac Mass in Children

Wednesday, Nov. 29 11:50AM - 12:00PM Room: S504AB

Participants
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PURPOSE

The aim of this study is to evaluate the diagnostic value of cardiac magnetic resonance imaging(CMR) for cardiac mass in children.

METHOD AND MATERIALS

One hundred and eleven patients who were diagnosed cardiac mass by echocardiography were recommended to perform cardiac MRI from September 2006 to August 2016. Fifty patients (34 boys and 16 girls) who underwent both cardiac MRI, echocardiography and had histopathologic results or confirmed based on clinical diagnosis were enrolled in this study. Patient age ranged from 0.2 months to 183.2 months and the median age was 44.7 months (3.7y). All MRI examinations were performed on a 1.5 T clinical MRI system. A cine balanced steady-state free procession (b-SSFP) imaging, T1and T2 weighted imaging, first-pass perfusion (resting) imaging, post gadolinium T1W and late gadolinium-enhanced imaging were included in the scanning protocol. The characteristics of cardiac masses were reviewed, and the location of cardiac mass was identified. The comparison of diagnostic accuracy between echocardiography and cardiac MR using Chi-square was made.

RESULTS

Thirty-two cases(32/50) were confirmed by histopathologic results and in which twenty-three cases were correctly diagnosed by cardiac MRI, eighteen cases(18/50) were diagnosed based on clinical evidence and in which fourteen cases were correctly diagnosed by cardiac MRI. Benign tumors accounted for 86%(43/50) and malignant tumor accounted for 14%(7/50). Cardiac mass could be located in any part of heart (chamber, wall and epicardium) and most cardiac masses located in the ventricles and outflow tracts. Accurate rate of echocardiography for cardiac mass is 100% (but no characteristic diagnosis except myxoma). Accurate rate of echocardiography for mass characteristics is 6% (3/50) and accurate rate of CMR for mass characteristics is 74% (37/50). CMR provided significantly higher accuracy of pathologic diagnoses compared to echocardiography (p <0.0001).

CONCLUSION

CMR imaging is becoming a major imaging modality for assessment of cardiac mass in children and can provide the tissue characteristics and have higher accuracy for diagnosis of cardiac mass in children.

CLINICAL RELEVANCE/APPLICATION

Cardiac mass is rare in children. The imaging modalities for it mainly include echocardiography and CMR. CMR can provide accurate characteristics and is becoming a major modality for assessment.

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SSK06

Science Session with Keynote: Gastrointestinal (Advanced Liver MRI Techniques)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: E350

GI MR

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

Participants
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Scott B. Reeder, MD, PhD, Madison, WI (*Moderator*) Institutional research support, General Electric Company; Institutional research support, Bracco Group; Founder, Calimetrix, LLC; Shareholder, Elucent Medical

Sub-Events

SSK06-01 Gastrointestinal Keynote Speaker: Advances in Liver MRI Techniques

Participants
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SSK06-02 Compressed-Sensing Accelerated Isotropic 3D MRCP: Feasibility Study in Patients with Pancreatobiliary Disorders

Wednesday, Nov. 29 10:40AM - 10:50AM Room: E350

Participants
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PURPOSE

to prospectively compare image quality of compressed-sensing (CS) accelerated 3D MR cholangiopancreatography (MRCP) to conventional navigator-triggered (NT) 3D MRCP, in patients with pancreatobiliary disorders.

METHOD AND MATERIALS

Sixty-two patients (38 men and 24 women, median age, 56 years, range, 24-84 years) underwent 3D MRCP at 3T. Three protocols were performed in each patient: a CS-accelerated breath-hold (BH) protocol based on a prototype sequence; a CS-accelerated NT protocol based on a prototype sequence, and a conventional NT protocol. Acquisition time of each protocol was recorded. Image quality of predefined segments of the pancreatobiliary tree was rated on a 5-point scale by two radiologists independently, who were blinded to the acquisition protocols.

RESULTS

Acquisition time for the CS-BH protocol was 17 seconds, for CS-NT was 134.1±33.5 seconds, both significantly shorter than the conventional NT protocol (364.7±78.4 seconds, both $p<0.01$). Severe respiratory motion artifacts was significantly reduced with the CS- BH protocol (4.8%, compared to 11.3% and 16.1% for CS-NT and conventional NT protocol, respectively), while overall image quality of the biliary tree was higher($p<0.05$, compared to both NT protocols). However, CS-BH was less efficient in depicting pancreatic ducts. Overall image quality of the pancreatic duct was better with the CS-NT protocol ($p<0.05$, compared to CS-BH and conventional NT protocols). Acceptable or better image quality (score>=3) of the entire pancreatic duct (head, body and tail) was achieved in 90.9% patients with CS-NT, 78.2% with CS-BH, and in 83.6% with conventional NT protocol.Acceptable or better image quality for the entire pancreatobiliary tree was achieved with in 95.2% patients with CS-BH +CS-NT protocol, compared to 82.3% with the conventional NT protocol.

CONCLUSION

CS-accelerated 3D MRCP is feasible in routine patients. The protocol is time-efficient and overall image quality is superior than the conventional approach.

CLINICAL RELEVANCE/APPLICATION

CS-accelerated BH and NT 3D MRCP are both feasible in clinical routine. CS-BH-MRCP is free from respiratory movement artifacts and has better image quality for the biliary tree. CS-NT-MRCP can be used to assess pancreatic ducts, when they are not

adequately depicted with CS-BH. The combined CS-BH and CS-NT protocol achieves high success rate for imaging the entire pancreaticobiliary tree, while the acquisition time is still reduced.

SSK06-03 Evaluation of HCC Response to Locoregional Therapy: Validation of MRI-Based Response Criteria Against Explant Pathology

Wednesday, Nov. 29 10:50AM - 11:00AM Room: E350

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PURPOSE

To evaluate the performance of various magnetic resonance imaging (MRI) response criteria for the prediction of complete pathologic necrosis (CPN) of hepatocellular carcinoma (HCC) post locoregional therapy (LRT) using explant pathology as reference.

METHOD AND MATERIALS

We included 61 patients (M/F 46/15, mean age 60y) who underwent liver transplantation after LRT with transarterial chemoembolization plus radiofrequency or microwave ablation (n=56), or 90Yttrium radioembolization (n=5). MRI was performed within 90 days of liver transplantation. Three independent readers assessed the following criteria: RECIST, EASL, mRECIST, percentage of necrosis on subtraction images, and diffusion-weighted imaging (DWI) [qualitative (signal intensity) and quantitative (apparent diffusion coefficient, ADC)]. Degree of necrosis was retrospectively assessed at histopathology. Intraclass correlation coefficient (ICC) and Cohen's kappa were used to assess inter-reader agreement. Logistic regression and ROC analyses were used to determine imaging predictors of CPN. Pearson correlation was performed between imaging criteria and pathologic degree of tumor necrosis.

RESULTS

97 HCCs (mean size 2.3±1.3 cm) including 28 with CPN were evaluated. There was excellent inter-reader agreement (ICC 0.77-0.86, all methods). EASL, mRECIST, percentage of necrosis and qualitative DWI were all significant ($p<0.001$) predictors of CPN, while RECIST and ADC were not. EASL, mRECIST and percentage of necrosis performed similarly (AUCs 0.810-0.815) while the performance of qualitative DWI was lower (AUC 0.622). Image subtraction demonstrated the strongest correlation ($r=0.71-0.72$, $p<0.0001$) with pathologic degree of tumor necrosis.

CONCLUSION

EASL/mRECIST criteria and image subtraction have excellent diagnostic performance for predicting CPN in HCC treated with LRT, with image subtraction correlating best with pathologic degree of tumor necrosis. Thus, MR image subtraction is recommended for assessing HCC response to LRT.

CLINICAL RELEVANCE/APPLICATION

Image subtraction is recommended for assessing HCC response to LRT when performing MRI. RECIST and ADC should not be used for prediction of CPN.

SSK06-04 Clinical Feasibility of Implementing DCE-MRI in Routine Liver MRI Using Golden-Angle Radial Sparse Parallel MRI: Preliminary Results

Wednesday, Nov. 29 11:00AM - 11:10AM Room: E350

Participants
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PURPOSE

To investigate clinical feasibility of implementing dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) in routine liver MRI using Golden-angle Radial Sparse Parallel (GRASP) MRI.

METHOD AND MATERIALS

In this IRB-approved ongoing prospective study, 25 patients who were scheduled for liver biopsy or resection have been enrolled and informed consent was obtained from all patients. Liver MRI was performed using incoherent undersampling technique at 3T. A standard dose of extracellular contrast media was injected, and T1-weighted images (T1WI) were obtained using incoherent undersampling technique in free-breathing. Images were reconstructed to achieve either 13.3- or 3.3-second time resolution. On 13.3-second time resolution T1WI with respiratory gating, motion and overall image quality were assessed on four-point scale by two radiologists in consensus, and 3.3-second time resolution T1WI was analyzed using software of dual-input single compartment

model.

RESULTS

In 25 patients, motion artifact was 1.5±0.5, 2.1±0.3, 1.0±0.3 and 1.0±0.0 on pre, arterial, portal venous and delayed phase which indicated no significant motion artifact. Overall image quality was 3.9±0.6, 3.5±0.5, 3.9±0.3, and 3.8±0.4, respectively. In all patients, perfusion analysis was done successfully. After excluding one patient who was treated with chemoembolization, patients with advanced fibrosis (n=7, >=F2) showed substantially high arterial fraction (67.0±17.1%) than patients with no or early fibrosis (n=18, F0-1) who had arterial fraction of 44.7±27.6% (P<0.05).

CONCLUSION

GRASP technique allowed implementation of DCE in routine liver MRI by obtaining high time-resolution and sufficient spatial resolution.

CLINICAL RELEVANCE/APPLICATION

Implementation of DCE-MRI in routine MRI would facilitate its application for various organs and contribute to non-invasive diagnosis and monitoring by displaying hemodynamic information of lesions.

SSK06-05 An Experimental Study on the Assessment of Renal Fibrosis by Using Magnetic Resonance T1rho Imaging

Wednesday, Nov. 29 11:10AM - 11:20AM Room: E350

Participants
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PURPOSE

To correlate magnetic resonance (MR) T1 relaxation time in the rotating frame (T1rho or T1ρ) with degree of renal fibrosis in a rat model of unilateral ureteral obstruction (UUO).

METHOD AND MATERIALS

This study was approved by the institutional animal care and use committee. UUO was created in each of 36 rats. UUO-A group with 6 rats, longitudinal T1rho value was performed before the UUO (day 0) and on days 1, 3, 5, 10, and 15 after the UUO and was followed by histopathologic analysis (one rat died on 11 days after the UUO). Six rats from UUO-B group (n = 30) were examined at each of five time points on days 0, 1, 3, 5 and 10 after the UUO. Four rats from Sham group (n = 12) were examined on days 1, 5, and 15 after UUO. Hematoxylin-eosin, Masson trichrome staining and a-smooth muscle actin (a-SMA) were performed. T1rho Sequences with Stretched adiabatic as Spin lock pulse type. Spin lock time: 1, 27, 54 ms,with 3.0T clinical MR scanner.

RESULTS

Histopathologic examination revealed typical renal fibrosis on the side with UUO. The T1rho values increased over time on the UUO side, Mean T1rho value with day 0, 1, 3, 5, 10, and 15 after the UUO were 142.23±8.69, 149.53 ±9.38, 172.53 ±13.53, 181.05 ±17.34, 216.31 ±22.64, 228.47 ±26.95ms, respectively. Sham rats were 140.28 ±7.19, 137.74 ±9.38, 138.89 ±17.76 ms, respectively. Mean T1rho value associated positively ($r = 0.868$ $P < 0.001$) with a-SMA expression level.

CONCLUSION

Our study shows that the degree of renal fibrosis was correlated with degree of increase with T1rho value in model induced by UUO.

CLINICAL RELEVANCE/APPLICATION

MR-T1rho may become a noninvasive imaging tool for the diagnosis of renal fibrosis.

SSK06-06 Histologic Characteristics of Hepatocellular Carcinoma with Irregular Rim-Like Arterial Phase Enhancement

Wednesday, Nov. 29 11:20AM - 11:30AM Room: E350

Participants
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PURPOSE

To examine the histopathologic characteristics of hepatocellular carcinoma (HCC) with irregular rim-like arterial phase enhancement, which has been reported to be associated with more aggressive tumor behavior.

METHOD AND MATERIALS

Institutional review board approved this retrospective study and waived the informed consent. Our subjects were 84 pathologically

confirmed HCCs in 84 patients who underwent curative hepatic resection after gadoxetate-enhanced magnetic resonance (MR) imaging between January 2008 and February 2013. Two abdominal radiologists independently reviewed the MR images and classified HCCs into two categories: HCC showing irregular rim-like arterial enhancement (IRE-HCC) or HCC showing hypovascularity or diffuse arterial enhancement (non-IRE-HCC). We assessed and compared their clinical and pathologic characteristics, using a representative whole-section slide of each case. Differences in disease-free survival were analyzed using the Kaplan-Meier method with the log-rank test. The chi-square, Fisher exact test, or Mann-Whitney test was used to compare the variables.

RESULTS

Of the 84 HCCs, 22 and 51 were classified as IRE-HCCs and non-IRE-HCCs by both reviewers, respectively. Classification was discordant in the remaining 11 patients. IRE-HCC showed, compared to non-IRE-HCC, poorer five-year disease-free survival after curative resection (33.6% vs. 60.3%; P = .030), more frequent microvascular invasion (91% vs. 35%). IRE-HCCs were also associated with lower microvascular density (227 vs. 437 per mm2), more frequent sinusoidal microvascular pattern (55% vs. 0%), larger necrotic area (15% vs. 0%), and larger stromal area (8.3% vs. 2.2%), suggesting more hypoxic and fibrotic microenvironment, and exhibited higher expression of immunomarkers of hypoxia (CAIX, 64% vs. 8%) and stemness (K19 protein, 27% vs. 6%). P-values were < .001 for all comparisons except for K19 (P = .018). Discordant tumors showed intermediate features between IRE-HCC and non-IRE-HCC.

CONCLUSION

Irregular rim-like arterial enhancement of HCC is associated with hypoxic and fibrotic tumor microenvironment which are related with hypoxia and stemness marker expression and poor prognosis.

CLINICAL RELEVANCE/APPLICATION

IRE-HCCs may be associated with worse clinical outcome and histopathologic features related to aggressive biologic behavior, compared to non-IRE-HCCs.

SSK06-07 Impacts of Adding Recent CT Arterial Phase Images On Diagnostic Performances of Gadoxetic Acid-Enhanced MRI in Assessment of HCC

Wednesday, Nov. 29 11:30AM - 11:40AM Room: E350

Participants
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PURPOSE

To investigate impacts of adding recent CT arterial phase findings on diagnostic performances of gadoxetic acid-enhanced MRI in the assessment of hepatocellular carcinoma (HCC)

METHOD AND MATERIALS

We retrospectively identified 1272 patients (1026 men, 246 women; mean age, 56.6 years) with pathologically confirmed 1490 nodules (1370 HCCs, 60 dysplastic nodules, 39 combined HCC and cholangiocarcinomas, 13 cholangiocarcinomas, 8 nodules with other pathologies) between January 2008 and December 2016 with the following inclusion criteria: patients with chronic hepatitis or liver cirrhosis who had pathologically confirmed focal hepatic lesions; who underwent both multiphase CT and gadoxetic acid-enhanced MR I within 120 days before the pathologic exams; and the size of lesions <= 3 cm. We compared the enhancement patterns on arterial phase imaging between the two imaging modalities. The sensitivity and 95% confidence interval (C.I.) for detecting arterial hyperenhancement in patients with HCCs on a per-nodule basis was compared between the MRI only analyses and the CT+MRI analyses using generalized estimated equations based on a binary logistic regression model to account for data clustering and dependency, as some patients had more than one nodules.

RESULTS

The mean time interval between MRI and CT was 16.5 days. Among the 1490 nodules, 1361 nodules (91.3 %) had the same arterial enhancement patterns both on CT and MRI. In the remaining 129 nodules (105 HCCs and seven non-HCC lesions) with the different enhancement patterns between CT and MRI, arterial hyperenhancement was detected only by CT in the majority of cases (86.8%, 112/129). The sensitivity in detecting arterial hyperenhancement in HCC was significantly improved in the CT+MRI analyses (92.4 %; 95% C.I., 90.9 to 93.7) compared to the MRI only analyses (84.7 %; 95% C.I., 82.2 to 87.0) (P<0.001).

CONCLUSION

Adding recent CT arterial phase findings can improve the detection of arterial hyperenhancement of gadoxetic acid-enhanced MRI in the evaluation of HCC.

CLINICAL RELEVANCE/APPLICATION

Arterial phase findings on recent CT images can serve a substitute for suboptimal arterial phase MR images on gadoxetic acid-enhanced MRI in the assessment of HCC.

SSK06-08 A Prospective and Long-Term Follow-Up Study of Non-Hypervascular Hypointense Nodules on the Hepatobiliary Phase of Gadoxetic Acid-Enhanced MRI

Wednesday, Nov. 29 11:40AM - 11:50AM Room: E350

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PURPOSE

To investigate the incidence of non-hypervascular hypointense nodules on the hepatobiliary phase (HBP) of gadoxetic acid-enhanced MRI and to identify the incidence of arterial hypervascular transformation and associated features in a prospective cohort with a long-term follow-up

METHOD AND MATERIALS

A prospective surveillance study included 407 cirrhosis patients at high risk for HCC who underwent one to three, biannual screening examinations with gadoxetic acid-enhanced MRI between November 2011 and August 2014. Among them, 40 patients were identified to have 63 hypovascular hypointense nodules on HBP of gadoxetic acid-enhanced MRI. Follow-up contrast-enhanced MRI and CT were reviewed to identify hypervascular transformation (median follow-up period, 45 months). Univariate and multivariable Cox proportional hazards model with robust standard errors for clustered data were used to investigate the association between arterial hypervascular transformation and clinical and imaging features with respect to nodule size, signal intensity on T1-, T2-, diffusion-weighted, portal and delayed phase images, and intratumoral fat.

RESULTS

The incidence of non-hypervascular hypointense nodules on HBP in the prospective cohort was 9.8 % (40/407). On follow-up images, the 1-, 3-, and 5-year cumulative incidences of hypervascular transformation were 6.4, 12.8, and 24.3 %, respectively. Univariate analyses revealed the size >= 1cm and hyperintensity on T1-weighted images as significant risk factors for hypervascular transformation. According to the multivariable analysis, the size >= 1cm was independently associated with hypervascularization with a hazard ratio HR of 12.6 (P=.02). The 5 year-cumulative incidence of nodules >= 1cm in size (52.5%) was more than 10 folds compared to that of nodules smaller thant 1cm (4.4%).

CONCLUSION

Our study demonstrates the incidence of non-hypervascular hypointense nodules on HBP and hypervascular transformation in a prospective cohort. Non-hypervascular hypointense nodules >= 1cm in size are strongly associated with hypervascular transformation.

CLINICAL RELEVANCE/APPLICATION

Non-hypervascular hypointense nodules on HBP >= 1cm in size should be cautiously followed up with their culmulative incidence of hypervascular transformation in mind.

SSK06-09 High-Precision Computed Diffusion Weighted Images for the Diagnosis of Hepatocellular Carcinoma

Wednesday, Nov. 29 11:50AM - 12:00PM Room: E350

Participants
Motonori Akagi, MD, Hiroshima, Japan (*Presenter*) Nothing to Disclose
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PURPOSE

Diffusion-weighted images (DWI) obtained with higher b-values yield better contrast between tumor and background normal tissue. Computed DWI (c-DWI) can calculate high b-value images from DWI obtained at lower b-values. However, the image quality of c-DWI may be degraded due to mis-registration between image acquisitions with different b-values. We developed high-precision c-DWI (hc-DWI) in which mis-registration was reduced by applying non-rigid registration technique to real DWI (r-DWI) with different b values. We tested our hypothesis that hc-DWI can improve image quality in diagnosing hepatocellular carcinoma (HCC) compared to conventional c-DWI (cc-DWI).

METHOD AND MATERIALS

In 75 patients with HCCs we acquired r-DWIs with b-value at 150, 600, and 1000 s/mm2. We defined the r-DWI acquired with b = 1000 s/mm2 as standard. C-DWIs with b-value at 1500 s/mm2 were calculated with DWIs at b-values of 150 and 600 s/mm2. For generating hc-DWI we used a non-rigid image registration for avoiding mis-registration of two different b-value images and an image filter to remove abnormal values from the apparent diffusion coefficient map.Two radiologists evaluated the image quality of each DWI by consensus reading using a 3-point scale where 1 = poor (non-diagnostic), 2 = fair (diagnostic but blurred margin), 3 = good (good quality and sharp margin). They also evaluated the signal intensity of HCC using a 3-point score where 1 = not visible, 2 = discernible, and 3 = clearly visible and calculated the contrast ratio (CR) between HCC and the surrounding liver parenchyma.

RESULTS

Image quality was better with hc-DWI compared to cc-DWI ($p < 0.01$). The visual score of HCC was also better with hc-DWI compared to cc-DWI ($p < 0.01$). In addition, the CR for HCC was significantly higher in hc-DWI compared to cc-DWI (mean value: 2.6 and 2.1 for hc-DWI and cc-DWI, $p < 0.01$).

CONCLUSION

Image quality, subjective visual score, and CR of HCC was higher in hc-DWI compared to cc-DWI.

CLINICAL RELEVANCE/APPLICATION

Hc-DWI may be useful for characterization of HCC compared to cc-DWI.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

SSK07

Science Session with Keynote: Gastrointestinal (Quantitative Imaging and Machine Learning)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: E353A

BQ GI IN MR

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

FDA Discussions may include off-label uses.

Participants
Srinivasa R. Prasad, MD, Houston, TX (*Moderator*) Nothing to Disclose
Aya Kamaya, MD, Stanford, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSK07-01 Gastrointestinal Keynote Speaker: Is There a Role of Machine Learning in Oncology?

Participants
Garry Choy, MD, MS, Boston, MA (*Presenter*) Nothing to Disclose

SSK07-02 Machine Learning-Based Radiogenomics in Metastatic Colon Cancer: Association between Quantitative Tumor MRI Radiomic Features and KRAS Mutation Status

Wednesday, Nov. 29 10:40AM - 10:50AM Room: E353A

Participants
Dania Daye, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

Assessment of KRAS mutation status is essential for prognosis assessment and for guiding treatment decisions in patients with metastatic colon cancer. This study investigates the association between quantitative tumor MRI features and KRAS mutation status in this patient population.

METHOD AND MATERIALS

In this IRB-approved retrospective study, we identified 52 patients with stage 4 colon cancer with hepatic metastases reported on abdominal MRI studies performed from 2007-2013. KRAS mutation status was ascertained from the medical record. The largest hepatic lesion was identified on the portal venous phase T1-weighted fat-suppressed post-contrast images and manually segmented. MR radiomic feature vectors were extracted from each lesion using quantitative morphological and texture analysis. Univariate logistic regression analysis was used to assess for independent contribution of 18 extracted morphological features and 32 extracted texture features to mutation status prediction. A linear support vector machine (SVM) machine learning technique was applied to the extracted imaging phenotype vector to predict tumor mutation status. The classifier was trained and tested using 10-fold cross validation to avoid overfitting. ROC analysis and the area under the curve (AUC) were used to assess classification performance.

RESULTS

60% (19/31) of patients had tumors with KRAS mutations. Tumor circularity and tumor coarseness exhibited significant differences in mean values between KRAS-wildtype and KRAS-mutated tumors ($p<0.001$ and $p=0.01$, respectively). Univariate regression revealed six features independently association with KRAS mutation status: tumor circularity ($p=0.003$), solidity ($p=0.006$), eccentricity ($p=0.03$), coarseness ($p=0.03$), shade ($p=0.01$), and GLCM matrix standard deviation ($p=0.04$). A trained SVM model that included the tumor morphologic and texture features resulted in an area under the ROC curve of 0.95.

CONCLUSION

Quantitative tumor MRI features exhibit significant association with KRAS mutation and may contribute to predicting KRAS status in colon cancer patients.

CLINICAL RELEVANCE/APPLICATION

Tumor MRI radiomic analysis may aid in non-invasively assessing tumor genetic status and may aid in informing treatment choices and personalizing therapeutic decisions in patients with colon cancer.

SSK07-03 A Deep Neural Network for Liver Volumetry in Contrast Enhanced MRI

Wednesday, Nov. 29 10:50AM - 11:00AM Room: E353A

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To establish a fully automated, reliable, and novel liver volumetry in contrast enhanced MRI based on deep learning algorithms.

METHOD AND MATERIALS

Data-sets of Gd-EOB-DTPA-enhanced liver MR images of 48 participants were assembled, consisting of 44 training and 4 validation cases. All imaging was performed using a clinical whole-body 3-T system (Magnetom Skyra, Siemens Healthcare). For segmentation, a T1-weighted volume-interpolated breath-hold examination (VIBE) sequences with fat suppression covering the entire liver, acquired during one breath-hold during the hepatobiliary phase (20 min after contrastinjection), was used.The current gold standard of manual liver segmentation was accepted as ground truth. Image Segmentation was performed by a resident physician with 5 years of experience in hepatobiliary imaging. Furthermore, 9 of the training images have been segmented by a second reader (5 years of experience) to determine the expert intraclass correlation coecient (ICC), dice index, and overlap. The neural network topology is loosely based on U-Net.

CONCLUSION

This study presents a fully automated liver volumetry scheme in MR imaging. It is evaluated in comparison to the gold standard manual volumetry. The neural network achieves a higher concordance with the ground truth than two expert readers agree in terms of ICC, dice index, and overlap. The results are highly competitive to current studies, in example Huynh et al. found an ICC of 0.94.

CLINICAL RELEVANCE/APPLICATION

This scheme provides an accurate automatic liver segmentation in MRI; hence it would serve as a useful tool for radiologists for treatment planning, especially for patients undergoing liver surgery.

SSK07-04 The Value of Texture Analysis on Perfusion-Weighted Magnetic Resonance Imaging for Malignancy Characterization of Hepatocellular Carcinoma

Wednesday, Nov. 29 11:00AM - 11:10AM Room: E353A

Participants
Jie Chen, Chengdu, China (*Presenter*) Nothing to Disclose
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PURPOSE

To explore the performance of texture analysis on perfusion-weighted magnetic resonance imaging (PW-MRI) in evaluating the malignancy of hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

Thirty-one surgically confirmed HCC patients were prospectively included and examined using a 3.0 Tesla MR scanner. The perfusion data was acquired using a prototype radial stack-of-stars three-dimensional spoiled gradient echo pulse sequence with golden-angle radial sampling schemes over the course of 6.25 minutes. Post-processing of PW-MRI data was performed on an in-housed software (Omini-Kinetics, GE Healthcare) to generate the Ktrans, Kep, Ve and AUC parametric maps using the Extended Tofts liner model. Texture analysis was then performed on those parametric maps using the same software. A total of 75 texture features were calculated for each perfusion results. The Edmondson-Steiner classification of HCC were histopathologically determined. Texture parameters were correlated with the Edmondson-Steiner grade of HCC. Receiver operation characteristic (ROC) analysis of discriminating low-grades (grade 1 and 2) from high-grades (grade 3 and 4) HCC was conducted for identified texture parameters.

RESULTS

The MinIntensity of Ktrans (r=-0.433, P=0.015), Kep (r=-0.409, P=0.022) and Ve (r=-0.384, P=0.033) maps, and the MinIntensity (r=-0.451, P=0.011), skewness (r=0.623, P<0.001), kurtosis (r=0.412, P=0.021) and uniformity (r=-0.55, P=0.001) of AUC maps showed week to moderate correlations with the Edmondson-Steiner grades of HCC. The skewness and kurtosis of AUC were significantly lower in low-grades HCC than in high-grades HCC, while the uniformity of AUC were significantly higher in low-grades HCC than in high-grades HCC. The areas under the ROC curve for the skewness, kurtosis and uniformity of AUC in differentiating high-grades from los-grades HCC were 0.868, 0.789 and 0.719, respectively.

CONCLUSION

Texture features based on PW-MRI, in particular the skewness of AUC, offer a potential avenue toward preoperative evaluation of HCC malignancy.

CLINICAL RELEVANCE/APPLICATION

Texture features of perfusion imaging can reflect the intratumoral heterogeneity of blood supply and cellular density, thereby

Texture features of perfusion imaging can reflect the intratumoral heterogeneity of blood supply and cellular density, thereby providing a reliable marker of lesion's potential malignancy.

SSK07-05 Hepatocellular Carcinoma: Texture Analysis of Preoperative CT Images as a Potential Marker of Disease-Free Survival

Wednesday, Nov. 29 11:10AM - 11:20AM Room: E353A

Participants
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PURPOSE

To investigate the performance of CT textural analysis (CTTA) in characterizing malignancy of hepatocellular carcinoma and predicting disease-free survival (DFS).

METHOD AND MATERIALS

Institutional review board approved this retrospective study, with a waiver of informed consent. From January 2009 to January 2015, 81 patients with single HCC underwent preoperative contrast-enhanced CT with same protocol and vender. Texture features of the largest tumor cross-sectional area from portal phase liver CT images were assessed by using TexRAD software which employed a filtration-histogram technique. Mean value of positive pixels (MPP), entropy, kurtosis, skewness, and standard deviation (SD) of the pixel distribution histogram were derived from the images without filtration and with filter values corresponding to fine, medium, and coarse texture scale. The texture features were compared between groups with different histologic grade using Student's t-test and Mann-Whitney test. Kaplan-Meier analysis was performed to determine the relationship between CTTA and DFS. The Cox proportional hazards model was used to assess the independence of texture parameters from other known clinical and imaging parameters.

RESULTS

SD and MPP quantified from fine to coarse texture on CT images showed significant associations with the histologic grade ($P<.05$). Univariate analysis identified most CT texture features across the different filters - fine, medium and coarse texture scales were significant univariate markers of DFS. Also a number of known clinical and imaging parameters such as tumor size, vascular invasion, the average intensity of tumor, the level of AFP and PIVKA were significant univariate markers of DFS. A Cox regression model including all significant univariate markers identified that CTTA (fine texture scale - kurtosis: $p=0.037$, skewness: $p=0.015$), and tumor size ($P<0.001$) were independent predictors of DFS.

CONCLUSION

CTTA could act as a prognostic biomarker in HCCs and play a key complementary role as an adjunct with other known clinical and imaging markers in better risk stratification of these patients.

CLINICAL RELEVANCE/APPLICATION

CTTA is a significant marker of disease-free survival in patients with HCCs. Their role as a prognostic biomarker can be a useful adjunct to improve stratification of HCC patients.

SSK07-06 HCC Treated With 90Yttrium Radioembolization: Can Pre-Treatment and 6week Post-Treatment Volumetric ADC Histogram Measurements Predict Subsequent Tumor Response?

Wednesday, Nov. 29 11:20AM - 11:30AM Room: E353A

Participants
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PURPOSE

To assess the potential of volumetric ADC (vADC) histogram measurements obtained before and 6 weeks (6w) post-treatment for prediction of hepatocellular carcinoma (HCC) response to 90Yttrium radioembolization (RE).

METHOD AND MATERIALS

22 patients (M/F 15/7, mean age 65y) who underwent lobar RE (right lobe n=15; left lobe n=7) were included. All patients underwent MRI pre-treatment and 6w and 6 months (6m) after RE using a routine liver MRI protocol including DWI. Two readers assessed tumor response 6m after RE in consensus. Definition of complete tumor response, partial tumor response, stable disease, and progression of HCC lesions was based on modified RECIST criteria (mRECIST) for each index tumor. vADC histogram parameters (mean, median, mode, min, max, kurtosis and skewness) were obtained by placing regions of interest (ROIs) on the ADC map covering the whole index tumors. One reader placed the ROIs at baseline and 6w after treatment. Changes in tumor vADC (ΔvADC) histogram parameters were calculated. Data was evaluated using Mann-Whitney U test and receiver operating characteristics

analysis.

RESULTS

26 HCC lesions (mean size 3.4±2.4 cm) were assessed (18 patients with 1 tumor, 4 patients with 2 tumors). Response at 6m was as follows: complete response (CR, 8 tumors), partial response (PR, 3 tumors), stable disease (SD, 13 tumors) and progression (PD, 2 tumors). vADC mean, median, mode (1.76-1.81 vs. 1.23-1.34 x10-3 mm2/s) and ΔvADC median and ΔvADC max (30-43% vs. 2-9%) at 6w were significantly higher in CR/PR vs. SD/PD (p=0.013-0.032), while there was no significant difference at baseline. vADC mean, median, ΔvADC mean and ΔvADC max at 6w were significant predictors of CR/PR (AUC 0.752-0.788; p=0.014-0.031) and of CR (AUC 0.750-0.861; p=0.004-0.046) after RE. vADC median threshold of 1.377 x10-3 mm2/s at 6w had a sensitivity of 81.8% and a specificity of 66.7% for prediction of PR/CR and ΔvADC median threshold of 19.2% had a sensitivity of 87.5% and a specificity of 83.3% for prediction of CR.

CONCLUSION

vADC mean, median, ΔvADC mean and ΔvADC max at 6w are significant predictors of subsequent response in HCCs treated with RE, while pre-treatment vADC did not have any predictive value.

CLINICAL RELEVANCE/APPLICATION

Our results suggest that vADC histogram measurements at 6w post RE are early biomarkers and allow prediction of treatment response.

SSK07-07 Development of CT Derived Biomarker for Gastrointestinal Stromal Tumor; Comparison with FDG-PET and DWI

Wednesday, Nov. 29 11:30AM - 11:40AM Room: E353A

Participants
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PURPOSE

Gastrointestinal stromal tumor (GIST) is the most common mesenchymal tumor of the gastrointestinal tract. It has been reported that 18F-Fluorodeoxyglucose-positron emission tomography (FDG-PET) and diffusion-weighted MRI (DWI) can be biomarkers to evaluate malignant potential of GIST. But considering availability of FDG-PET and DWI, development of CT derived biomarker would be valuable. The texture analysis such as fractal analysis of the medical image has been reported to be a potential biomarker for malignancies, reflecting structural heterogeneity of the tumor. The purpose of this study is to evaluate the usefulness of CT fractal analysis in preoperative assessment of malignant potential of GIST, comparing with FDG-PET and DWI.

METHOD AND MATERIALS

We retrospectively identified 43 patients (20 M / 23W; median age: 65) with GISTs who received FDG-PET, DWI, and contrast-enhanced (CE) CT before surgery. Tumor SUV and ADC were measured from FDG-PET and DWI. Regarding CT analysis, fractal analysis was applied to portal-phase CE-CT image with use of a plugin software of ImageJ (NIH), and fractal dimension (FD) of the tumor was measured. These tumor parameters were compared with the risk classification of GIST, and diagnostic values of these parameters for malignant potential of GIST were evaluated.

RESULTS

According to modified Fletcher classification, 9 patients were categorized as the high risk, and the other 34 cases were categorized as the very low or low risk (26) or the intermediate risk (8). Tumor FD of high risk group was significantly higher than that of the other risk groups (very low, low, and intermediate risk) ($P<0.05$). The areas under the ROC curves (AUCs) of tumor FD, ADC and SUV for prediction of high risk group were 0.84, 0.86 and 0.82, respectively. From this ROC curve analysis, 1.11(FD), 1.21(ADC), and 4.16(SUV) were the best cut-off value to predict the high risk GIST patients with a highest accuracy (85.7%, 71.4% and 83.3%, respectively).

CONCLUSION

Diagnostic value of CT fractal analysis for prediction of high risk GIST is comparable with FDG-PET and DWI. In terms of cost and availability, CT fractal analysis can be a most beneficial imaging biomarker for the management of GIST.

CLINICAL RELEVANCE/APPLICATION

CT fractal analysis can be a noninvasive, economical and widely applicable biomarker for preoperative risk stratification of GIST, and it would help select an optimal therapy for patients with GISTs.

SSK07-08 CT-Based Radiomic Signature Preoperatively Predicts Lymphovascular Invasion in Patients with Advanced Gastric Cancer

Wednesday, Nov. 29 11:40AM - 11:50AM Room: E353A

Participants
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PURPOSE

To develop and validate a machine learning based radiomics signature for preoperative prediction of lymph vascular invasion (LVI) in patients with advanced gastric cancer (AGC).

METHOD AND MATERIALS

In this ethical-approved retrospective study, we collected a primary cohort consisting of 152 patients gathered from July 2011 to December 2013 and a time-independent validation cohort consisting of 95 patients from January 2014 to July 2015. 273 texture features were extracted from venous-phase CT of AGC. Then, we adopted minimum redundancy maximum relevance (mRMR) algorithm to reduce the feature dimension as well as identify a radiomics signature for predicting LVI. We built a support vector machine (SVM) model to yield a quantitative risk score for LVI. The classification performance of the SVM model was evaluated by univariate analysis, multivariate analysis and receiver operator characteristics (ROC) analysis in the primary cohort and validated in the time-independent validation cohort.

RESULTS

The 5-feature-based radiomics signature was an independent predictor for LVI in AGC ($P<0.001$ for both primary and validation cohorts). The radiomics signature showed strong discriminatory power for LVI prediction with an AUC of 0.764 (95% CI: 0.685-0.843; sensitivity: 0.844; specificity: 0.618) in the primary cohort. In addition, the radiomcs analysis achieved competitive generalization performance with an AUC of 0.744 (95% CI: 0.640-0.848; sensitivity: 0.818; specificity: 0.600) in validation cohort.

CONCLUSION

Machine learning by means of SVM in combination with texture features can be used to associate with the status of LVI. The radiomics signature may serve as a potential non-invasive tool for the preoperative LVI prediction in patients with AGC.

CLINICAL RELEVANCE/APPLICATION

Machine learning based radiomics signature has potential in the preoperative non-invasive prediction of lymphvascular invasion and facilitate the clinical strategy.

SSK07-09 Comparison of Current Response Criteria in Patients with HCC Treat with Targeted Therapy Using a 3D Quantitative Analysis

Wednesday, Nov. 29 11:50AM - 12:00PM Room: E353A

Participants
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PURPOSE

The aim of this study was to compare existing available non-three-dimensional methods (Response Evaluation Criteria in Solid Tumors [RECIST], modified RECIST [mRECIST], European Association for Study of the Liver [EASL]) with three-dimensional (3D) quantitative methods of the index tumor as early response markers in predicting patient survival after targeted therapy.

METHOD AND MATERIALS

This study was a retrospective single-institution HIPAA-compliant. A total of 88 patients with hepatocellualr carcinoma (HCC) treated with targeted therapy was enrolled (in 76 men and 12 women; mean age, 61 years ± 7 [standard deviation] ; Range, 22-88 years). CT scans before and after targeted therapy were analyzed. Six response assessment methods (RECIST, mRECIST, EASL and 3D methods of volumetric RECIST [vRECIST], modified vRECIST [vmRECIST] and quantitative EASL [qEASL]) were used to classify all patients as responders or nonresponders by following standard guidelines for the uni- and bidimensional measurements and by using the formula for a sphere for the 3D measurements. 3D quantitative tumor assessments were performed using an in-house software prototype (3D Quantitative Imaging, MGH, USA).The Kaplan-Meier method with the log-rank test was performed for each method to evaluate its ability to help predict survival of responders and nonresponders. Uni- and multivariate Cox proportional hazard ratio models were used to identify covariates that had significant association with survival.

RESULTS

The 3D quantitative tumor assessments of vRECIST (hazard ratio,0.6; 95% confidence interval [CI]: 0.4, 1.2; P=0.03), vmRECIST (hazard ratio,0.6; 95% CI: 0.3, 0.9; P=0.04), and qEASL (hazard ratio,0.5; 95% CI: 0.3, 0.6; P=0.002) showed a significant difference in survival between responders and nonresponders groups, whereas the uni- and bidementional measurements of RECIST (hazard ratio,0.5; 95% CI: 0.3, 0.9; P=0.08), mRECIST (hazard ratio,0.6; 95% CI: 0.3, 1.0; P=0.07), and EASL(hazard ratio,0.7; 95% CI: 0.3, 0.8; P=0.06) did not show a significant difference between these groups.

CONCLUSION

Compared with the uni- and bidementional measurements, the 3D-based imaging biomarkers vRECIST, vmRECIST and qEASL could

be used to predict patient survival early after targeted therapy.

CLINICAL RELEVANCE/APPLICATION

Volumetric quantification is sensitive to detect early change of HCC and to accurately assess treatment response.

SSK08

Gastrointestinal (Colon Cancer and CT Colonography)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: E353B

CT GI MR OI

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

FDA Discussions may include off-label uses.

Participants
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David J. Lomas, MD, Cambridge, United Kingdom (*Moderator*) Nothing to Disclose
Lorenzo Mannelli, MD, PhD, New York, NY (*Moderator*) Speaker, Bracco Group Speaker, General Electric Company

Sub-Events

SSK08-01 Multilevel Determinants of Adenoma Detection Rate at CT Colonography (CTC) Screening: Association with Radiologist Experience and Patient-Related Factors

Participants
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PURPOSE

In a large randomized trial the overall adenoma detection rate appeared to be similar between CTC and sigmoidoscopy (FS). CTC achieved a higher detection than FS in the proximal colon, while the reverse was true for the distal colon. To assess the relationship between radiologist experience and adenoma detection rate at CTC screening.

METHOD AND MATERIALS

Post-hoc analysis of a RCT, examining the diagnostic performance of radiologists in relation with previous CTC experience. Radiologist experience was classified according to the total number of CTC performed before the trial (i.e, <200, 200-1,000, >1,000). Multilevel logistic regression was used to model the influence of reading volumes and patient characteristics on the probability to detect adenomas. Patient factors included gender, previous CRC screening, CRC family risk, and image/distension quality. Analyses were performed separately for each of the following lesions: all adenomas (ADR), distal adenomas (DADR), proximal adenomas (PADR), advanced histology (i.e. >=10-mm, villous histology or high grade dysplasia). A 6-mm cut-off was used for post-CTC referral to colonoscopy.

RESULTS

2593 CTC (1266 F; age, 58-60) were read by 7 radiologists. In detail, 1337 (51.5%), 584 (22.5%), and 672 (26.0%) were read by radiologists with reading volumes<200, 200-1000, and >1000, respectively. The average ADR, DADR and PADR were 8.0% (95% CI: 7.0-9.1%; range, 5.8-8.7%), 5.0% (95% CI:4.3-5.9%, range, 2.1-8.4%), and 5.1% (95% CI:4.2-6.3, range, 4.4-5.4%), respectively. Radiologist experience appeared to be related with DADR (OR, >1000 vs <=1000:1.49; 95% CI: 1.04-2.13), but not with PADR (OR,>1000 vs. <=1000:0.91; 95% CI:0.64-1.29). The association of radiologist experience with distal location appeared to be statistically significant also for advanced adenomas (OR,>1000 vs. <=1000, 1.73; 95% CI:1.08-2.88). In multivariate analysis, volumes>1000, male gender, excellent/good image quality and no previous colonoscopy were significantly associated with greater odds of detecting distal adenomas.

CONCLUSION

According to our data, distal adenomas, including those with advanced histology, could be missed by less experienced radiologists (<1000 CTC).

CLINICAL RELEVANCE/APPLICATION

High reading volumes, greater than 1000 CTCs, may be required to achieve high adenoma detection rates in the distal colon. Optimization of training methods is critical to ensure a consistent high-quality level at CTC screening.

SSK08-02 Effect of Iterative Model Reconstruction algorithm on Radiologist's Performance in CT Colonography

Wednesday, Nov. 29 10:40AM - 10:50AM Room: E353B

Participants

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PURPOSE

To assess radiation dose and image quality of CT colonography (CTC) at 100 kVp with iterative model reconstruction algorithm (IMR) at 20 mAs compared with filtered back projection (FBP) at 50 mAs.

METHOD AND MATERIALS

Thirty-two patients suspected with colon adenomatous polyp or adeno-carcinoma were enrolled in this study. All of patients underwent CTC examination at 50mAs in supine position and 20mAs with prone position with the same tube voltage at 100 kVp about two hours before fibro-colonoscope. Images were reconstructed using FBP and IMR. Two radiologists independently evaluated image quality. Qualitative image quality was assessed with a five-score scale. Image noise, signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), and effective radiation dose were recorded and calculated. Qualitative and quatitative values were analysed by using Wilcoxon signed rank test and the paired t test, respectively.

RESULTS

Totally 38 colon polyps or adeno-carcinoma were detected in fibro-colonoscope examination. For 20 mAs with IMR (A group) and 50 mAs with FBP (B group), there is no statistically significant difference in lesion detection (reader 1: 35/38 vs 36/38, and reader 2: 31/38 vs. 33/38, p>0.05). However, qualitative image quality scores (3.9 vs 2.5), image noise ([12.77± 0.91] HU vs. [50.04±5.45] HU), SNRs (3.13±0.28 vs. 1.02±0.20) and CNRs (81.42±6.11 vs. 19.93±1.46) were significantly superior of 20 mAs with IMR, respectively (p<0.05) . Compared with B group, radiation dose of A group decreased significantly (0.42±0.03 mSv vs. 1.07±0.12mSv).

CONCLUSION

Image quality of CTC using 20 mAs with IMR reconstruction could be comparable to 50 mAs with FBP at the same tube voltage while with no significant detection of poply, and radiation dose of the former was only 0.42 mSv, which was reduced by about 39.3%.

CLINICAL RELEVANCE/APPLICATION

This preliminary study helps to reduce the radiation dose of patients undergoing CTC examination with IMR algorithm.

SSK08-03 Feasibility of Computer-Aided CT Colonography in a Single-Position Reading

Wednesday, Nov. 29 10:50AM - 11:00AM Room: E353B

Participants
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PURPOSE

To evaluate the performance of computer-aided single-position reading of full-cathartic CT colonography (CTC) in detecting polyps from patients at average or high risk of colorectal cancer.

METHOD AND MATERIALS

A total of 266 CTC cases were sampled from a multi-center CTC trial for patients at average or high risk of colorectal cancer. The patients underwent cathartic bowel preparation with 2L polyethylene glycol solution and fecal tagging by 20mL sodium diatrizoate, followed by automated CO2 insufflation. A computer-aided detection (CADe) system trained with cases independent from this study was used to review the CTC cases. Two experienced readers (>=600 CTC cases reading experience) reviewed the cases for >=6 mm lesions in supine-only reading mode, in which only the supine scans of these cases were interpreted and CADe was used as a second reader. The per-patient sensitivity and area under the receiver operating characteristic curve (AUC) were compared in the detection of adenomas and carcinomas between the unaided and CADe-aided supine-only readings, and between the CADe-aided supine-only reading and the conventional unaided dual-position reading result of the original trial.

RESULTS

There were 35 and 28 patients with 6-9 mm and >=10 mm adenomas/carcinomas, respectively. The corresponding average per-patient sensitivities (AUCs) for CADe-aided supine-only reading were 82.9% (0.89) and 90.9% (0.95), respectively, whereas those of unaided dual-position reading were 82.9% (0.88) and 92.9% (0.96), respectively. The differences of sensitivities and AUCs at each size range were not statistically significant (sensitivities: Fisher's exact test, P>0.7; AUCs: two-sided t-test, P>0.3). For 6-9 mm lesions, the per-patient sensitivity (AUC) of CADe-aided supine-only reading was 82.9% (0.89), higher than that of unaided supine-only reading of 71.4% (0.85) (sensitivity: McNemar's test, P<0.01; AUC: one-sided t-test, P<0.05).

CONCLUSION

In full-cathartic CTC, CADe-aided single-position reading yields an equally high performance in detecting adenomas and carcinomas as that of conventional supine-prone reading. In single-position reading, the use of CADe significantly improves the detection of polyps 6-9 mm in size.

CLINICAL RELEVANCE/APPLICATION

Computer-aided single-position reading has potential to allow one-position scanning in CTC, thereby effectively halving the radiation

Computer-aided single-position reading has potential to allow one-position scanning in CTC, thereby effectively halving the radiation dose and reading time of conventional dual-position reading.

SSK08-04 Dual-Energy CT Colonography Using Dual-Layer Spectral Detector Computed Tomography: Feasibility of Virtual Monochromatic Imaging for Electronic Cleansing

Wednesday, Nov. 29 11:00AM - 11:10AM Room: E353B

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PURPOSE

We investigated the utility of virtual monochromatic imaging (VMI) using dual-layer spectral detector CT on the electronic cleansing in fecal-tagging CT colonography.

METHOD AND MATERIALS

This study included 30 patients who underwent fecal-tagging CT colonography performed on a novel dual-layer detector spectral CT scanner. Conventional 120-kVp images and VMI at 40-, 50-, and 60-keV were reconstructed. Quantitative image quality parameters, i.e. CT attenuation of tagged fluid and image noise, were compared and the visual image quality was scored on a four-point scale. We recorded the number of the colon segments with appropriate CT attenuation of tagged fluid (>= 300 HU) for each patient and used these data to compare the reconstructions. The performance of the electronic cleansing was also assessed semi-quantitatively using a four-point scale.

RESULTS

The mean CT attenuation of tagged fluid was significantly higher on VMI than conventional 120-kVp images. There was no significant difference in image noise among the reconstructions. The number of colon segments with appropriate CT attenuation of tagged fluid was significantly higher on VMI than conventional 120 kVp images. Significant higher score of the subjective image quality and the performance of the electronic cleansing were observed on VMI than conventional 120 kVp images.

CONCLUSION

With dual-layer spectral detector CT, the use of VMI can yield significantly better image quality of fecal-tagging CT colonography and improve the performance of the electronic cleansing.

CLINICAL RELEVANCE/APPLICATION

VMI using dual-layer spectral detector CT can improve image quality of fecal-tagging CT colonography and provide more accurate diagnostic information.

SSK08-05 Inter-Observer Agreement Using a Coding System for Reporting Virtual Colonoscopy

Wednesday, Nov. 29 11:10AM - 11:20AM Room: E353B

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PURPOSE

A coding system is utilised at our UK institution for reporting virtual colonoscopy/CT colonography (CTC) examinations. The C coding refers to the intra-colonic findings, whereas the E coding refers to extra-colonic findings, both on a scale from 1 to 5. The purpose of this study was to validate the coding system by assessing the inter-observer variability of two independent readers using the same coding system to summarise the CTC findings.

METHOD AND MATERIALS

A retrospective study was performed of all CTCs in our University Teaching Hospitals NHS Trust in the UK, which performs the largest number of examinations at any single institution throughout Europe, over a 3 month period (01/07/16 - 30/09/16). Our standard practice is for each study to be read initially by an advanced practitioner radiographer with a final report issued by a consultant radiologist. The report coding issued by the different readers was analysed and compared.

RESULTS

626 CTCs (mean age 69 years) were selected for inclusion. 57 studies were excluded either as they were not coded, not read by a radiographer prior to consultant report or rated as an inadequate study by either reader. The percentage agreement between radiographer findings and radiologist report was 92.3% for C coding and 50.6% for E coding. Interobserver agreement Kappa statistic was calculated to be 0.77 (95% CI 0.703-0.830) for C coding and 0.27 (95% CI 0.206-0.324) for E coding.

CONCLUSION

There is high inter-observer agreement between medical and non-medical readers for C coding suggesting it is a precise and easy to follow method of classifying colonic findings. The greater variability for E coding may be due to difficulty in classifying extra-

colonic findings but also reflective of the skill set between the two types of readers.

CLINICAL RELEVANCE/APPLICATION

The use of a report scoring system highlights important CTC findings so that the clinical teams can expedite arrangement of the appropriate further management and if necessary multi-disciplinary team discussion. The study shows that our scoring system is easy to use and demonstrates high inter-observer agreement for the intr-colonic findings, which is required for the system to be valid.

SSK08-06 Assessment of the Neoadjuvant Chemoradiation Outcomes in Patients with Clinical T1/T2 Rectal Cancer Using the MRI Tumor Regression Grade

Wednesday, Nov. 29 11:20AM - 11:30AM Room: E353B

Participants
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PURPOSE

To analyze magnetic resonance imaging (MRI) tumor regression grade (mrTRG) for predicting the outcomes after the neoadjuvant chemoradiation in patients with clinical T1/T2 rectal cancer.

METHOD AND MATERIALS

Between 2012 and 2016, we retrospectively registered 39 patients with clinical T1/T2 rectal cancer who had undertaken either the total mesorectal excision (TME) or local excision after the neoadjuvant chemoradiation. Initial rectal MRI was analyzed to determine the mural involvement of the primary tumor (partial or transmural involvement) and both initial and post-treatment rectal MRI were reviwed for mrTRG. Surgical pathologic assessment including Mandard grade was used to evaluate the tumor regression after the neoadjuvant treatment and Mandard grade 1 was considered as pathologic complete response (pCR). Associations of mrTRG and the degree of mural involvement with Mandard grade and pathologic T stage (pT) were analyzed.

RESULTS

Out of 39 patients, 20 patients had mrTRG 1 and 19 patients had mrTRG 2-4 (mrTRG2=11, mrTRG3=6, mrTRG4=2). Sixty-five percent (13/20) of mrTRG 1 patients showed pCR, and this positive predictive value of mrTRG 1 was higher than observed pCR rate (18/39, 46.2%). The odds of accomplishing pCR were 5.2 times higher for mrTRG 1 than they were for mrTRG 2-4 (95% confidence interval (CI): 1.3 - 20.5, p=0.019). Univariate analysis of the degree of mural involvement indicated that the difference in probability of pCR did not reach the significance (odds ratio (OR)=1.1, 95% CI=0.3-3.9, p=0.882). Ninety percent (18/20) of mrTRG 1 patients had early stage cancer (pT0, pTis and pT1) after the preoperative chemoradiation. Univariate analysis demonstrated that mrTRG1 group was significantly more likely to have early stage cancer than was mrTRG2-4 group (OR=8.1, 95% CI=1.5-45.1, p=0.017), while the OR of partial involvement of the primary tumor was not statistically significant (OR=3.6, 95% CI=0.8-16.3, p=0.103).

CONCLUSION

mrTRG 1 can be used as a supportive factor to predict the complete response after the neoadjuvant chemoradiation in patients with clinical T1/T2 rectal cancer. Moreover, mrTRG seem to deduce pathologic early stage rectal cancer which can be the candidate for local excision rather than TME.

CLINICAL RELEVANCE/APPLICATION

mrTRG can be a supportive tool to predict the complete response and to identify pathologic early stage cancer after the neoadjuvant chemoradiation in clinical T1/T2 rectal cancer patients.

SSK08-07 Influence of Iterative Reconstruction and Slice Thickness on Texture Analysis

Wednesday, Nov. 29 11:30AM - 11:40AM Room: E353B

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PURPOSE

To assess the variability of texture analysis parameters on CT scans depending on the iterative reconstruction technique and the slice thickness.

METHOD AND MATERIALS

To date, ten patients (M/F=4/6, mean age 71 yo) with liver metastases were retrospectively included in this study (1 patient with a GIST, 1 patient with a pancreatic cancer, 8 patients with a colorectal cancer). All patients had a CT-scan at a portal venous phase after injection of Iomeron 350, using a Philips system (ICT256). The standard reconstruction parameters included an iDose4 reconstruction with a 2 mm-slice thickness. Four additional reconstructions were performed: iDose4 with 1 and 5 mm-slice thickness, and iDose2 and 6 with a 2 mm-slice thickness. Using LIFEx software v3.0, a region of interest (ROI) was drawn by one radiologist, on one of the reconstruction. The ROI contained the largest diameter of the liver metastases (max 5 lesions /patient, lesion diameter > 1cm). The ROI was copied and pasted on the images from other reconstructions. Mean, standard deviation, skewness, kurtosis and entropy of each ROI were obtained. Variability between iterative reconstructions and slice thicknesses was

assessed using coefficient of variation (CV), and Bland and Altman limits of agreement (BALA) (percentage of difference).

RESULTS

Forty-eight liver metastases were analyzed. Between iterative reconstructions, all the parameters, except skewness, had a good reproducibility (CV<8%). The mean was the less variable parameter with a CV<1% and BALA thinner than [-4.38%;2.36%], while skewness was the less reproducible parameter with a CV of 25.5% and BALA until [-135.3%;48.18%]. For all texture parameters, the variability was higher between slice thicknesses than between iterative reconstructions, but still acceptable for all parameters (CV<18%) except for skewness. Skewness had a very low reproducibility between slice thicknesses with a CV of 954% and BALA until [-846.5%;1103%].

CONCLUSION

Texture parameters, mostly skewness, show some variability depending on the iterative reconstruction and moreover on the slice thickness.

CLINICAL RELEVANCE/APPLICATION

Texture analysis is a more and more used method, especially for tumor follow-up and assessment of treatment response. Variability related to the CT acquisition parameters needs to be taken into account to avoid incorrect conclusion.

SSK08-08 Changes in the Diagnostic Accuracy of Radiologists and Residents for Rectal Cancer Staging by using Diffusion Weighted Imaging

Wednesday, Nov. 29 11:40AM - 11:50AM Room: E353B

Participants
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PURPOSE

To analyze the influence of Diffusion Weighted Imaging (DWI) on the diagnostic accuracy for the staging of Rectal Cancer (RC), regional lymph nodes (LN) and primary tumor (T) in Radiologists with different degree of expertize

METHOD AND MATERIALS

The study included 50 patients with Magnetic Resonance Imaging (MRI) for RC staging, all with same technique (1.5 T) and later total mesorectal excision. Initial diagnosis (32) and post-neoadyuvancy cases (28, MRI after treatment) were included (ID and PN respectively). The histological stage was used as Gold Standard. 10 Radiologist reviewed individually all cases, blinded to any data but the presence of RC: 3 experienced in RC staging (ER); 3 experienced in other areas (NER); and 4 Residents (RR). Each reading had 2 phases: 1st analyzing just T2 and T2 High Definition sequences (T2HD); after a month washout period, 2nd reading with DWI and T2HD. The staging followed AJCC 7th ed. guidelines. Malignant LN were defined as heterogeneous internal signal/irregular borders. The results were pooled by experience groups for statistical analysis. Area under ROC curves were used to determine accuracy of positive LN, stage greater than I and T greater tan 2. Also, ponderated Kappa with respect to the histological results. All calculations were made in the different reviews and then made again after spliting them into ID and PN patients groups.

RESULTS

Due to their length the results have been summarized in the attached charts. Differences after use of DWI (increase/decrease) in group accuracy and Kappa regarding Gold Standard are shown.

CONCLUSION

There is a significant decrease of accuracy for local and N staging in all Radiologists with the use of DWI (also present in Kappas), more uniform in the experienced ones but for local stage in PN cases. Residents' accuracy for N highly increase in ID cases, while decreasing in PN. This could be due to a better detection of the LN, but with difficult interpretation of the changes secondary to treatment. On the contrary, all Radiologists show an increase in accuracy for T stage with DWI in ID cases (also PN in experienced ones), while decreasing in the rest. This could be due to a decrease in the overstaging of desmoplastic reaction or fibrosis in PN, with difficult interpretation of the latter for unexperienced ones.

CLINICAL RELEVANCE/APPLICATION

DWI could be functioning as a confounding factor in RC, especially in N and global staging.

SSK08-09 Role of CT-Colonography for Detection and Characterization of Synchronous Proximal Colonic Lesions in Patients with Stenosing Colorectal Cancer

Wednesday, Nov. 29 11:50AM - 12:00PM Room: E353B

Participants
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PURPOSE

To evaluate the clinical usefulness of CT Colonography (CTC) immediately after incomplete Optical Colonoscopy (OC) for occlusive colorectal cáncer (CCR), in the detection of synchronous carcinomas and advanced adenomas and their impact in the management of patients.

METHOD AND MATERIALS

Posterior to incomplete OC,165 patients (mean age of 71 years) with occlusive colonic carcinoma underwent subsequent CTC. 135 patients had distal CRC and 29 proximal. Experienced radiologists prospectively analyzed the presence of syncronous carcinomas and colorectal polys. 164 patients underwent colorectal resection. We retrospectively analyzed the surgical outcome and the follow-up of patients.

RESULTS

Seventeen syncronous tumors were detected in 11 patients (6,6%). Eight in the proximal and nine in distal colon. Eigth patients had only one synchronous tumor and three patients had several tumors (2, 3 and 4 synchronous carcinomas, respectively). Nineteen polypoid lesions > 2 cm were detected in 10 patients, seventeen were tubulo-villous adenomas with high-grade displasia and two were tubulo-villous adenomas with low-grade displasia. Twenty one patient (12.72%) had pediculated and sesil polyps in the remainig colorectum not explored in the OC, that required OC and exeresis between 1 and 6 months after surgery. After CTC, surgeons modified initial surgical plan in 22 patients (13,3%) and the follow-up in 25 patients (15,15%). 13 patients with obstructive cancer couldnt be correctly assesed, 8 because of defficient colonic distension and 5 due to great amount of feces. Gross lesions were discharged, nevertheless we recommended vigilance during surgical procedure and posterior.

CONCLUSION

Detection of all synchronous CRC and adenomatous polys, before surgery is very important, as the number and location of tumors may affect the surgical procedure and the subsequent management of patients. In our series, CTC changed surgical management and surveillance in 47 patients (28,45%). CTC is a technically robust and the most practical method to evaluate the colon proximal to an occlusive cancer, even in patients with metallic stent placement in acute neoplastic colonic obstruction.

CLINICAL RELEVANCE/APPLICATION

This exhibit exposes the use of CT-Colonography to evaluate all the colon in obstructing colorectal cancers with incomplete Optical Colonoscopy and their ability to detect synchronous cancers and advanced adenomas.

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SSK09

Genitourinary (New Methods in Prostate Imaging and Intervention)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: E450B

GU MR OI

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

FDA Discussions may include off-label uses.

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Ronaldo H. Baroni, MD, Sao Paulo, Brazil (*Moderator*) Nothing to Disclose
Temel Tirkes, MD, Indianapolis, IN (*Moderator*) Nothing to Disclose

Sub-Events

SSK09-01 A New System to Spatially Align In Vivo MRI with Ex Vivo MRI and Whole-Mount Histopathology for Integrated Prostate Cancer Research

Participants
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PURPOSE

The development and validation of multi-parametric MRI (mp-MRI) for prostate cancer (CaP) diagnosis relies on comparisons with histopathology (HP) and accurate spatial alignment is critical. In this study, we develop and evaluate a new system that combines patient-specific molds and ex vivo MRI of the resected prostate to align in vivo (InV) MRI, ex vivo (ExV) MRI, and whole-mount (WM) HP in CaP patients.

METHOD AND MATERIALS

Patients who underwent radical prostatectomy were studied. InV-MRI was obtained prior to surgery (mean = 77 days) at 3 T (Trio/Verio/Skyra/Prisma, Siemens) using an external array and an endorectal coil. The protocol included 3D T2w MRI, on which the prostate was contoured in 3D to print a patient-specific mold before surgery. Within 30 min after surgery, the fresh whole prostate specimen was placed in a patient-specific mold and underwent ExV-MRI at 3 T (Prisma, Siemens) using a knee coil. The protocol included high-resolution T2w MRI to evaluate spatial alignment with in vivo 3D T2w MRI and WM slides. Immediately afterwards, the prostate was sectioned in the mold along slits (4.5-mm steps) to create WM slides. InV-MRI was registered to ExV-MRI using a mutual information based rigid 3D algorithm. A non-rigid algorithm was used to register WM slides to ExV and InV MRI. A radiologist matched 2D slice locations and annotated corresponding non-cancerous landmarks on all three image sets. The WM to ExV-MRI slice offset error was recorded. In the matched slices, 2D target registration error (TRE) between the landmarks was calculated.

RESULTS

In all patients (N=10, mean 64.7 years, mean PSA 6.17 ng/ml), ExV-MRI was successfully completed (mean time 116 min). The mold and ExV-MRI had no adverse impact on WM HP. The mean slice offset error was 1.36 mm (<1.5-mm MRI slice thickness). Mean 2D TRE was (mean±SD): 1.9±1.1 mm for InV vs. ExV MRI, 1.6±0.9 mm for WM vs. ExV MRI, and 2.1±1.4 mm for WM vs. InV MRI.

CONCLUSION

We have successfully integrated the new system with our clinical workflow to achieve excellent spatial alignment among InV-MRI, ExV-MRI, and WM slides with 2D TRE of 1-2 mm. This can enable MRI-WM comparisons and integrated research in CaP.

CLINICAL RELEVANCE/APPLICATION

The new system achieves excellent spatial alignment among in vivo MRI, ex vivo MRI, and whole-mount histopathology for integrated research in prostate cancer.

SSK09-02 An Objective Tool for Diagnosing Prostate Cancer and Benign Prostatic Hyperplasia: Radiomics Features Extracted from Diffusion-Weighted Imaging

Wednesday, Nov. 29 10:40AM - 10:50AM Room: E450B

Participants
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PURPOSE

To evaluate the usefulness of radiomics features indistinguishing prostate cancer (PCa) from benign prostatic hyperplasia (BPH) based on diffusion-weighted imaging (DWI) sequence without subjective factors.

METHOD AND MATERIALS

This retrospective study was approved by local IRB, and written informed consent was waived. 200patientswere enrolled followed by surgery or biopsy within one month in this study(100 were PCa and 100 were BPH)High-throughput extraction and analysis of the radiomics features based on DWI included five procedures: 1) 2D region of interest (ROI) was sketched along the edge of the whole prostate at the slice with the maximum diameter of the lesion by a 3-year experienced radiologist.2) 396 radiomics features, including size and shape based-features, histogram, GLCM as well as GLRLM texture features were automatically generated from A.K.(Analysis-Kinetics, GE Healthcare). 3) Feature reduction was conducted based on Kruskal-Wallis test and auto-correlation analysis with $|r|>0.9$ using R.4)90 PCa and 90 BPH selected randomly in 200 patients were used for supervise Model-learning using Logistic Regression. 5)10 PCa and 10 BPH were used and compared with pathologic diagnosis and receiver operating characteristics (ROC) were used to assess the efficiency of model.

RESULTS

K-W test showed that 233 radiomic parameters had significant difference between PCa and BPH groups, auto-correlationanalysis reduced them into 47 potential predictors which used for diagnostic model building. The area under the curve (AUC) of Logisticregression model in discriminating the two groups was 0.894, sensitivity and specificity were respectively 92.2% and 86.7%, with 85% diagnosis accuracy rate.

CONCLUSION

Radiomics features of DWI performed well indistinguishing PCa from BPH, which could help objectively and quantitatively evaluate tumor heterogeneity, and have prospect of being an independent &non-invasive efficient diagnostictool.

CLINICAL RELEVANCE/APPLICATION

Compared with traditional manual method, Radiomics features not only could lighten the visual fatigue for radiologist but also raise the precision of diagnosis.

SSK09-03 Diagnosing Prostate Cancer through Non-Invasive Estimation of Prostate Tissue Composition Using Hybrid Multidimensional MRI

Wednesday, Nov. 29 10:50AM - 11:00AM Room: E450B

Awards
Student Travel Stipend Award

Participants
Aritrick Chatterjee, PhD, Chicago, IL (*Presenter*) 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; Speaker, Bracco Group; ;
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PURPOSE

This study proposes to use Hybrid Multidimensional MRI (HM-MRI) to measures the change in ADC and T2 as a function of TE and *b*-value, respectively. This interdependence is used as a source of information about the underlying tissue microstructure. Specifically, we analyzed HM-MRI data to identify signal contribution from epithelial, stromal and luminal compartments in each image voxel. We evaluated whether this compartmental analysis can distinguish prostate cancer (PCa) from normal tissue.

METHOD AND MATERIALS

Patients (n=21) with confirmed PCa underwent preoperative 3T MRI. Axial images using HM-MRI were acquired with TE = 47, 75, 100 ms and *b*-values of 0, 750, 1500 s/mm2, resulting in a 3×3 array of data associated with each voxel. Volumes of tissue components- stroma, epithelium and lumen were calculated by fitting the hybrid data to a three compartment signal model, with distinct ADC and T2 associated with each compartment. Volume fractions, and conventional ADC and T2 were measured for ROIs on sites of prostatectomy verified malignancy (n=28) and normal tissue (n=71). ROC analysis was used to evaluate the performance of various parameters in differentiating PCa from benign tissue.

RESULTS

HM-MRI data from PCa showed significantly increased fractional volumes of epithelium (48.8±9.2 vs 23.2±7.1%) and reduced lumen (14.0±5.2 vs 26.4±14.1%), stroma (37.2±9.1 vs 50.5±15.7%), ADC (0.86±0.18 vs 1.30±0.23μm2/ms) and T2 (76.3±22.9 vs

104.2±47.1ms) as compared to normal tissue. These trends and values measured by HM-MRI are similar to those reported in previous histological studies. The volume fractions of epithelium (0.65), stroma (-0.44) and lumen (-0.39) show significantly higher Spearman correlation coefficient with Gleason score as compared to T2 (-0.29) and ADC (-0.32). Area under the ROC curve was highest for epithelium (0.99), followed by lumen (0.80), stroma (0.79) and T2 (0.71).

CONCLUSION

Fractional volumes of prostatic lumen, stroma, and epithelium change significantly when cancer is present. These parameters can be measured non-invasively using HM-MRI and these novel quantitative parameters have the potential to improve PCa diagnosis and determine the aggressiveness of PCa.

CLINICAL RELEVANCE/APPLICATION

Prostate tissue composition estimated non-invasively using HM-MRI has better diagnostic accuracy of detecting PCa compared to conventional T2 and ADC values.

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

SSK09-04 Temporal Changes in MRI Appearance of the Prostate after Focal Ablation

Wednesday, Nov. 29 11:00AM - 11:10AM Room: E450B

Participants
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Hedvig Hricak, MD, PhD, New York, NY (*Abstract Co-Author*) Board of Directors, Ion Beam Applications, SA
Oguz Akin, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of our study was to retrospectively evaluate and categorize temporal changes in MRI appearances of the prostate in patients who underwent focal therapy with MRI follow up.

METHOD AND MATERIALS

The Institutional Review Board approved this retrospective study and waived the requirement for informed consent. Forty-two patients (median age 61; 48-76 years) with low-to-intermediate-risk, clinically organ-confined prostate cancer underwent focal ablation therapy from 2009 through 2014. Two radiologists reviewed post-treatment MRIs (n=88) and categorized imaging features blinded to the time interval between the focal therapy and the follow-up MRI. Inter-reader agreement was assessed (kappa) and generalized linear regression was used to examine associations between imaging feature being present/absent and days between ablation and MRI.

RESULTS

Inter-reader agreement on MRI features ranged from fair to substantial. The presence of edema on MRI was found at the shortest median time interval after ablation (15-22d; $p<0.001$), followed by rim enhancement of the ablation zone (18-23d), a hypointense rim around the ablation zone on T2-weighted images (49-54d) and the presence of an appreciable ablation cavity (49-55d; all $p<0.05$). The formation of a T2-hypointense scar (446-461d) and enhancement of the ablation zone/scar (216-610d) were found to be present on later MRI scans for one reader.

CONCLUSION

The MRI appearance of the prostate after focal ablation changes substantially over time. Identification of temporal patterns in the appearance of imaging features should help radiologists distinguish normal MRI findings from possible recurrence and reduce image interpretation variability and errors when assessing post-therapeutic scans.

CLINICAL RELEVANCE/APPLICATION

The identification of distinct imaging features on prostate MRI after ablation with distinct temporal patterns allows for a more consistent language among radiologists and could reduce variability and errors when assessing post-therapeutic scans.

SSK09-05 Multiplexed Sensitivity-Encoding (MUSE) Reconstructed Multi-Shot Diffusion Weighted Imaging in Patients with Prostate Cancer: Preliminary Study on Image Quality and Apparent Diffusion Coefficient

Wednesday, Nov. 29 11:10AM - 11:20AM Room: E450B

Participants
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PURPOSE

Multiplexed Sensitivity-Encoding (MUSE) is a new reconstruction algorithm for multi-shot diffusion weighted image (msDWI) without using navigator echo to correct motion-induced phase error. The purpose of this study was to prospectively evaluate the image quality and apparent diffusion coefficient (ADC) of high-spatial resolution msDWI reconstructed with MUSE in patients suspected with prostate cancer.

METHOD AND MATERIALS

Fifteen consecutive patients clinically suspected with prostatic cancer (median 72 years old, range 55 - 80) underwent 3-T MR imaging using T2 weighted image, single-shot DWI (ssDWI; matrix, 96 x 96) and MUSE-reconstructed msDWI (matrix, 192 x 192) acquired with 4-shot interleaved echo-planar imaging. Both DWI were acquired with FOV of 22 cm, thickness of 4 mm, and b-value of 50 and 800 mm2/s. ADC maps were constructed for both DWI. Two radiologists blindly and independently assessed the image quality of DWI (b = 50, 800) and ADC map by comparing ssDWI and msDWI on image noise, anatomic delineation, distortion, artifact, and overall image quality with a 5-point scale. ADC values were measured in transitional and peripheral zone (TZ and PZ). Wilcoxon rank-sum test, kappa coefficient and paired t test was used to compare the score, inter-observer concordances and ADC value.

RESULTS

The scores of anatomic delineation of msDWI (b = 50, 800) and msADC map were significantly better than a single-shot image, and the scores of image noise were significantly worse for multi-shot image by 2 radiologists ($p < .05$, respectively). The score of overall image quality of msDWI (b = 50) was significantly better than ssDWI by 2 radiologists ($p = .001$, for both), but there were no significant differences for DWI (b = 800) and ADC map. Distortion and artifact were not significantly different between msDWI and ssDWI. The inter-observer concordances were poor to good (k = .074 - .770). ADC values of msDWI and ssDWI were not significantly different for TZ and PZ ($p = 0.47$ and 0.70).

CONCLUSION

The msDWI reconstructed with MUSE and its ADC map significantly improved anatomical delineation of the prostate, although the technique increased image noise. ADC values were not significantly different between ssDWI and msDWI.

CLINICAL RELEVANCE/APPLICATION

Evaluation of the prostate can be improved with high-spatial resolution msDWI reconstructed with MUSE, which is a promising technique for the detection and diagnosis of prostate cancer.

SSK09-06 Radiomics on Contrast-Free Bi-Parametric MRI Achieves Improves Prediction of Significant Prostate Cancer Compared to Clinical PI-RADS Version 2 Interpretation

Wednesday, Nov. 29 11:20AM - 11:30AM Room: E450B

Participants
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PURPOSE

To apply radiomics and machine learning (ML) to PI-RADS version 2 lesions and assess whether radiomics alone or the addition of radiomics improves predictive performance.

METHOD AND MATERIALS

In 194 consecutive patients examined on a 3T MRI system 253 PIRADSv2 lesions were identified and manually segmented on ADC/b-value of 1500 s/mm2 and T2-weighted images (segP). Patient were subsequently undergoing MRI-TRUS fusion biopsy with median 23 systematic cores and 4 targeted cores per lesion. In addition, on the basis of the biopsy results, retrospective PI-RADS assessment (PIRADSv2R) and manual lesions segmentation of the MR index lesion was performed manually by an experienced radiologist (segR). A total of 1073 quantitative radiomics features [including first-order, volume shape features, and texture features] were automatically extracted. The prediction of clinically significant Cancer (csPC) (GS 3+4 and 4+3 or higher) by PIRADSv2 assessment was compared to different ML approaches to integrate radiomics data (random forest, parameter normalization, training on segP/segR). Performance was assessed using bootstrap. The number of biopsies spared was assessed on a lesion and patient level.

RESULTS

A cut-off >=3 for PIRADSv2 was used. Radiomics Models were evaluated at the PIRADSv2 sensitivity, which was 96-97% in all cases. On a per-lesion basis PIRADSv2 achieved a specificity of 20% compared to 39% for the best ML model (RF trained using segR at PIRADSv2R cut-off of 4 including normalization, for GS4+3 prediction), which would have saved 42.3 biopsies. On a per-patient basis the model increased specificity from 23% to 37% which would have saved 23 patients a biopsy. Excluding the transitional zone, specificity increased from 41% to 52% for lesions, saving 11.2 biopsies and from 48% to 59% for patients saving

14.2 biopsies for GS3+4 prediction. Figure 1 demonstrates improved performance of the best ML model over PI-RADSv2, especially in the important high sensitivity range.

CONCLUSION

Radiomics and ML improve predictive performance compared to PI-RADS version 2 when applied to clinically selected lesions. The potential of radiomics to support clinical decision making is shown. Our results motivate the evaluation of this approach in larger and prospective cohorts.

CLINICAL RELEVANCE/APPLICATION

The potential application of the addition of radiomics to the clinical evaluation of PI-RADS lesions should be evaluated in a prospective setting.

SSK09-07 Towards Improved Gleason Score Prediction Using 18F-FACBC (Fluciclovine) PET and MRI: Evaluation of Advanced Post-Processing Methods Using Machine Learning

Wednesday, Nov. 29 11:30AM - 11:40AM Room: E450B

Awards
Trainee Research Prize - Resident

Participants
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PURPOSE

To evaluate the potential of advanced post-processing methods for 18F-FACBC (Fluciclovine) PET and MRI in the characterization of prostate cancer.

METHOD AND MATERIALS

Twenty one patients with histologically confirmed prostate cancer (PCa) scheduled for robotic-assisted prostatectomy underwent PET/CT immediately after injection of 369 ±10 MBq 18F-FACBC followed by PET/MRI (ClinicalTrials.gov Identifier: NCT02002455). MRI of PET/MRI consisted of T2-weighted imaging (T2w), two separate diffusion weighted imaging (DWI) acquisitions, second order rotating frame (RAFF) imaging, and T2 mapping. A separate 3T mpMRI consisting of T2w, three DWI acquisitions, proton magnetic resonance spectroscopy (1H-MRS) and dynamic contrast enhanced (DCE) imaging was acquired within a week of the PET scans. DWI was post-processed using kurtosis (ADCk, K), mono- (ADCm), and biexponential functions (f, Dp, Df) while Logan plots were used to calculate volume of distribution (VT). Logistic Regression with l2 normalization and leave-pair out cross validation (LPOCV) based area under the curve (AUC) values were used to estimate the potential of the quantitative parameters and their combination to predict Gleason score group (3+3 vs >3+3). Recursive feature elimination technique in the cross-validation loop was applied to exclude the bias of the model performance. In total, 16 unique PET (Vt, SUV) and MRI derived quantitative parameters were evaluated. Whole mount prostatectomy sections were used as "ground true".

RESULTS

The RAFF, monoexponential and kurtosis derived parameters had LPOCV AUC in the range of 0.72 to 0.82 while the corresponding value for VT was 0.85. T2 mapping, 1H-MRS ((choline+creatine)/citrate)) and DCE-MRI (Ktrans, Ve) derived parameters had the lowest LPOCV AUC in the range of 0.33 to 0.60. Most frequently selected parameters in each round of the cross-validation were VT, ADCk (0-2000 s/mm2, 12 b values), ADCm (0-1500 s/mm2, 2 b values), ADCm (0-500 s/mm2, 5 values), and K (0-2000 s/mm2, 12 b values) which demonstrated LPOCV AUC of 0.91.

CONCLUSION

Quantitative models using DWI and RAFF derived parameters led to improved PCa characterization. The added value of 18F-FACBC PET appears to be limited.

CLINICAL RELEVANCE/APPLICATION

18F-FACBC (Fluciclovine) PET has a power to predict Gleason score but adds little value to DWI and RAFF derived parameters.

SSK09-08 Computer-Aided Diagnosis for Prostate Cancer Detection in Multiparametric MRI: Influence on Reader Performance

Wednesday, Nov. 29 11:40AM - 11:50AM Room: E450B

Participants
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PURPOSE

To determine the interaction between computer-aided diagnosis (CAD) and readers with varying levels of experience in the interpretation of multiparametric prostate MR imaging with PIRADS v2.

METHOD AND MATERIALS

The institutional review board waived the need for informed consent. 64 patients (PCa=35; nonPCa=29) who were suspected of PCa and underwent mpMRI with subsequent biopsy or prostatectomy within 3 months were involved in this retrospective study. 6 readers were divided into 3 groups according to their experience in prostate imaging. Unknown the pathologic diagnosis, readers were asked to detect up to 3 lesions and graded 1-5 score according to PI-RADS v2 separately first without CAD and subsequently with CAD. Interreader agreement was assessed. According to histologic-radiologic correlation, the effect of CAD was evaluated by using ROC curve and Z test on patients and lesions basis. Wilcoxon signed ranks test were used to compare the diagnostic time and confidence with and without CAD. Furthermore, the requirement for CAD was also evaluated.

RESULTS

the AUC of stand-alone CAD was 0.918±0.036, and the spearman correlation coefficient between predictive values and PI-RADS scores was 0.706(P<0.01). Based on lesions, the AUCs of 6 readers were improved from 0.697-0.868 to 0.778-0.921 and the improvements were better than patient basis analysis. While the difference wasn't significant(P>0.05). Among 3 groups, the difference of AUCs between less experienced and experienced readers was significant without CAD, while with CAD, the difference was not significant. Besides, the interreader agreement and diagnostic confidence was improved significantly with CAD assisted. The rates of requirement for CAD were rising with reader's experience reduce. The average interpretation time of each case required an additional 0.8 minutes.

CONCLUSION

Integrating CAD into PCa mpMRI diagnostic process as a second reader, the performance of less experienced readers could be improved and similar with experienced readers. Additionally, with the reducing of experience, the requirement for CAD was rising.

CLINICAL RELEVANCE/APPLICATION

The CAD assisted can significantly improve the performance of less experienced readers in prostate mpMRI interpretation, and much better in lesion detection and evaluation than it in patient, which indicate that CAD could be a promising method for detecting a target lesions for prostate biopsy.

SSK09-09 Detection of MRI "Index Lesion" with mpMRI-TRUS Fusion-Targeted Prostate Biopsy: Does it Correspond to Histopathology?

Wednesday, Nov. 29 11:50AM - 12:00PM Room: E450B

Participants
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PURPOSE

To determine the histopathological correspondence of MRI "index lesion" between multiparametric magnetic resonance imaging (mpMRI)/Transrectal ultrasonography (TRUS) fusion biopsy and radical prostatectomy.

METHOD AND MATERIALS

Institutional review board approval; Informed consent was obtained from all individual participants included in the study. This prospective study has been performed on a cohort of 142 biopsy naive patients aged 45-76 years, with elevated PSA level, recruited from October 2015. Diagnostic 3T MRI was performed and the index lesion is identified as being the one with the highest PI-RADS v.2 score and 1-3 additional "potential lesion" with a lower PI-RADS (v.2) and/or smaller volume are defined as 'Non Index lesion'. A maximum of 2-3 biopsies per lesion have been carried out and pathologic results acquired. Patients found to be positive undergo radical prostatectomy.

RESULTS

Prostate cancer was detected in 142/142 patients with a cancer detection rate being 100%. MR index lesion and the pathology report show a 100% correspondence concerning the lesion dimensions. MR/TRUS guided biopsy and the pathology report show a 86% correspondence with a relative risk of 0.94 and a p value <0.01, concerning Gleason Score Determination; and a 72% correspondence with a relative risk of 0.69 a p value <0.01, concerning the highest Gleason Score. Missed lesions on MRI proved to be low risk , Gleason Score 6 area, with a volume < 0.5 cc, which can be defined as «Insignificant» disease, with a negative predictive value (NPV) equal to 95-98%.

CONCLUSION

MRI/TRUS fusion biopsy shows a good correlation between "MRI index lesion" and definitive histopathological diagnosis on radical prostatectomy, in terms of dimensions, histological aggressiveness and highest Gleason Score of the pathology report.

CLINICAL RELEVANCE/APPLICATION

Among the new approaches to prostate biopsy, MR Imaging-Transrectal US Fusion has the potential to significantly increase the detection of csPCA.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

SSK12

Molecular Imaging (Infection and Inflammation)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: S504CD

CT MR MI NM

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

FDA Discussions may include off-label uses.

Participants
Kathryn A. Morton, MD, Salt Lake City, UT (*Moderator*) Nothing to Disclose
Vikas Kundra, MD, PhD, Houston, TX (*Moderator*) Institutional license agreement, Introgen Therapeutics, Inc; Research Grant, General Electric Company

Sub-Events

SSK12-01 Fluorescence Molecular Imaging of Cathepsin Activity as a Novel Biomarker for Giant Cell Arteritis

Participants
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PURPOSE

The aim of this study was to investigate whether cathepsin activity can be utilized as a novel biomarker for presence and inflammatory status of giant cell arteritis (GCA).

METHOD AND MATERIALS

Biopsy specimen of the temporal artery from patients (n=91, average age: 74 years) with a suspected giant cell arteritis were partially subjected to immunohistological analyses of the expression of Cathepsin K, L and B. The enzymatic activity of the specimen was assessed in n=61 cases with a fluorometric essay sensitive to cathepsin K. Ex vivo fluorescence imaging using a pan-cathepsin activatable fluorescent imaging agent was performed in n=45 temporal artery biopsy specimen and in n=13 segments of the internal thoracic artery from non-vasculitis patients (control group) undergoing cardiac bypass surgery. Cathepsin-based methods were compared to standard clinical diagnostics, serology, presurgical MRI and routine histology.

RESULTS

The clinical reference diagnosis revealed n=18 negative cases, n=45 positive cases and n=28 cases with inconclusive results. Immunohistochemistry (Figure) showed significantly increased ($p<0.001$) expression of cathepsins B, K and L in patients diagnosed with GCA versus negative diagnoses. GCA positive biopsy specimen also had significantly increased cathepsin activity compared to negative biopsy specimen ($p<0.01$) and compared to control arteries from bypass surgery ($p<0.05$) as determined by ex vivo fluorescent imaging. Supporting a pathogenic role for cathepsin K, tissue lysates showed increased Cathepsin K enzymatic activity ($p<0.001$). The ex vivo fluorescent signal moderately but significantly correlated with cathepsin K activity ($R^2=0.63$, $p<0.001$), and strongly with the histological scores of all cathepsin stainings (Cathepsin B: $R^2=0.74$; Cathepsin K: $R^2=0.72$; Cathepsin L: $R^2=0.76$; $p<0.001$).

CONCLUSION

These in vitro findings demonstrate that cathepsins can be utilized as an immunohistological and imaging biomarker for the diagnosis of GCA.

CLINICAL RELEVANCE/APPLICATION

Cathepsins possibly offer a translational approach towards in vivo fluorescent imaging for the non-surgical diagnosis of GCA.

SSK12-02 Comparison of Different Semi-quantitative Approaches for the Diagnosis of Graft Infection after Thoracic or Abdominal Aortic Repair Using [F-18]-FDG PET/CT

Wednesday, Nov. 29 10:40AM - 10:50AM Room: S504CD

Participants
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Heiko Wendorff, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
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Mona Mustafa, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim of this study was the evaluation and comparison of different semiquantitative parameters for the diagnosis of graft infection after thoracic or abdominal aortic repair applying [18F]fluorodeoxyglucose (FDG) positron emission tomography (PET)/computed tomography (CT).

METHOD AND MATERIALS

50 patients who underwent [18F]-FDG PET/CT for suspected aortic graft infection were retrospectively analysed. Besides, 13 oncological patients with aortic repair but without graft infection were included in the analysis. Maximum standardized uptake values (SUVmax) were obtained for all patients and different graft to background ratios were calculated. The diagnostic accuracy of SUVmax and different target-to-background ratios (TBRs) was assessed by receiver-operating-characteristic (ROC) analysis. Overall, 8 different background regions were defined and analysed (blood pool activity within the left cardiac ventricle, 4 different aortic segments, the vena cava and the pulmonary trunk as well as FDG wall uptake in non inflammatory aortic segments). A combination of clinical follow-up, imaging (including PET/CT) and/or microbiological/histopathological results, if available, served as the standard of reference for the final diagnosis.

RESULTS

28 infected and 35 uninfected grafts were identified. SUVmax was the most powerful predictor for the diagnosis of graft infection according to the ROC analysis (area under the curve: 0.978, CI: 0.904-0.999). ROC analysis suggested an SUVmax cut off value of >4.48 to differentiate between infected and non-infected grafts ($p<0.0001$). Notably, there was no substantial difference between SUVmax and other semiquantitative approaches (TBR) according to the area under the curve.

CONCLUSION

Semiquantitative approaches and in particular SUVmax provide a good reference to assess graft infection after thoracic or abdominal aortic repair and may increase the diagnostic accuracy of [18F]-FDG-PET/CT in the setting of suspected graft infection.

CLINICAL RELEVANCE/APPLICATION

[18F]-FDG-PET/CT is increasingly used in the setting of suspected aortic graft infection. However, data is limited with respect to different semiquantitative approaches for the diagnosis of graft infection. According to our results, SUV max showed the best performance to differentiate between infected and non-infected grafts and may increase the diagnostic accuracy of [18F]-FDG-PET/CT.

SSK12-03 Ultrasound-detectable O2 Microbubbles Generated from Catalase-Containing Silica Nanoshells (CSNs) in Determining Infected from Non-infected Fluid Collections in Humans

Wednesday, Nov. 29 10:50AM - 11:00AM Room: S504CD

Participants
Christopher D. Malone, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
David T. Fetzer, MD, Dallas, TX (*Presenter*) Nothing to Disclose
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PURPOSE

Elevated levels of hydrogen peroxide (H2O2) play a key role in neutrophil oxidative defense against infection. Catalase-containing silica nanoshells (CSNs) are novel nanoparticles that generate oxygen microbubbles (O2 MBs) in the presence of elevated levels of H2O2. We aim to determine whether ultrasound detectable O2 MBs produced by CSNs can distinguish infected from non-infected fluid collections drained from patients.

METHOD AND MATERIALS

During this HIPAA-compliant, IRB-approved study, 52 human fluid samples were collected from clinically-required, image-guided percutaneous drainage procedures. Each sample was placed in a 3 mL transfer pipette imbedded in a tissue mimicking agarose/corn starch holder. Both the holder and the face of a Siemens Sequoia 512; 15L8-S linear transducer were submerged and mechanically held in a 37 °C water bath. CSNs were added to the fluid samples while imaging in real-time using the CPS microbubble-only imaging technique. Production of detectable MBs was graded subjectively as negative (not infected), or mild, moderate, or marked (infected) by a single observer blinded to all clinical data. The truth standard was culture results performed by the Microbiology laboratory. Performance characteristics including ROC curves were calculated.

RESULTS

Presence of MB formation to distinguish infected from non-infected fluids was 84% sensitive and 72% specific, and offered positive and negative predictive values of 64% and 89%, respectively. The area under the ROC curve (AUC) was 0.79. All nine false positive cases were peritoneal fluid collections, which could be indicative oxidative stress rather than infection.

CONCLUSION

The presence of elevated H2O2 recognized by MB formation in the presence of CSNs is sensitive in distinguishing infected from non-infected fluids with a relatively high negative predictive value. CSNs may offer a novel point of care method at the time of

percutaneous drainage, potentially obviating placement of drains in otherwise sterile collections to minimize risk of colonization and secondary infection.

CLINICAL RELEVANCE/APPLICATION

CSN technology can be administered through a needle or potentially incorporated on existing needles/catheters, functioning as a point of care device during percutaneous drainage or aspiration.

SSK12-04 Utility of F18 FDG PET/CT in Evaluation of Pyrexia of Unknown Origin

Wednesday, Nov. 29 11:00AM - 11:10AM Room: S504CD

Participants
Rasika Kabnurkar, MBBS,MD, Thane, India (*Presenter*) Nothing to Disclose
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M.l Rokade, MD, Thane, India (*Abstract Co-Author*) Nothing to Disclose
Nikhil Kamat, MD, Thane, India (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Pyrexia of Unknown Origin (PUO) often poses diagnostic challenge. Timely diagnosis helps in guiding appropriate treatment. The aim of this retrospective study was to asses the contribution of Fluorine-18 Fluorodeoxyglucose (18F-FDG) Positron Emission Tomography /Computed Tomography (PET/CT) in the diagnostic evaluation of PUO.

METHOD AND MATERIALS

46 consecutive patients of PUO (23 men and 23 females, Age Range: 5 to 75 years) referred for 18F-FDG PET/CT between December 2015 to March 2017 were evaluated. Biopsy confirmation was available in 12 patients. Remaining patients underwent biochemical, microbiological, clinical and imaging follow up.

RESULTS

FDG PET/CT identified hypermetabolic foci in 42 patients (91.30%). Out of these, 14/42 patients revealed non-specific FDG uptake which did not contribute to final diagnosis. No abnormal focal FDG uptake was seen in 4 patients. No pathological disease was diagnosed in these 18 patients on subsequent work-up and were afebrile on follow up. Among the definite positive scans in 66.67% patients(28/42), various etiologies identified were as follows: A) Infectious etiology (n=15) including tuberculous lymphadenitis(7/15),septic arthritis (1/15), otitis media (1/15), acute hepatitis (1/15), infected prosthesis (2/15), spondylodiskitis (2/15), gluteal pyogenic abscess(1/15); B) Inflammatory etiology (n=10) such as Interstitial lung disease (2/10), Inflammatory mesenteric lymphadenopathy (2/10), Synovitis (2/10), Polymyositis and Dermatomyositis (2/10)Vasculitis (2/10); C) Malignancy (n=3) in colon carcinoma, adrenocortical carcinoma of lung, liver metastases from unknown primary.

CONCLUSION

18F-FDG PET/CT has a useful role in identification of pathological focus in PUO. Negative FDG PET/CT scan reliably rules out focal etiologies for PUO. Further prospective studies are warranted for confirmation.

CLINICAL RELEVANCE/APPLICATION

18F-FDG PET/CT has higher sensitivity to identify occult pathologies in PUO.

SSK12-05 Ultra-small Superparamagnetic Iron Oxide Nanoparticle as a Surrogate Marker of Aortic Wall Inflammation Following Radiation Therapy for Pancreatic Cancer

Wednesday, Nov. 29 11:10AM - 11:20AM Room: S504CD

Participants
Sandeep S. Hedgire, MD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

Radiation therapy for cancer can lead to atherosclerosis by inducing inflammatory changes in the vascular wall. Though atherosclerotic changes can be seen with CT and MRI techniques, it is difficult to quantitatively measure inflammation on CT and MR imaging studies. The purpose of this study was to assess the use of ferumoxytol- an ultrasmall superparamagnetic iron oxide nanoparticle, as a surrogate marker of vessel wall inflammation secondary to radiation therapy in pancreatic cancer patients in comparison with healthy volunteers.

METHOD AND MATERIALS

MRI of upper abdomen (T1, T2, multi-echo T2*-weighted imaging) was performed on 3T magnet before and 48 hours after intravenous administration of ferumoxytol in pancreatic cancer patients who underwent radiation therapy (n=8) and healthy volunteers (n=8). R2* value was obtained by drawing regions of interest (ROIs) outlining the aortic wall directly on the T2* medic image and subsequently transposed to the R2* image using Amira software (Version 5.3.2, FEI, Bordeaux, France). The change in R2* values was analyzed by student's t-test.

RESULTS

The average change in R2* value of the pancreatic cancer patients was determined to be 216.18 1/ms. The average change R2*

value of the control patients was determined to be 54.67 1/ms. This indicates that the pancreatic cancer patients following radiation therapy had a greater uptake of ferumoxytol (p=0.0082) in their aortic wall.

CONCLUSION

Ferumoxytol can offer a non invasive, quantitative assessment of vascular inflammation following radiation therapy in cancer patients.

CLINICAL RELEVANCE/APPLICATION

Radiation therapy induced atherosclerosis could potentially be diagnosed earlier on due to its inflammatory nature. Ferumoxytol enhanced MRI offers a novel, radiation-free imaging marker of inflammation, would augment risk stratification, inform therapeutic decisions, and allow safe, robust, and quantitative monitoring of therapy-mediated changes.

SSK12-06 Anti-Inflammatory Therapeutic Effects in Swine Acute Ileitis: Longitudinal Monitoring with Ultrasound Molecular Imaging

Wednesday, Nov. 29 11:20AM - 11:30AM Room: S504CD

Participants
Huaijun Wang, MD, PhD, Stanford, CA (*Presenter*) Nothing to Disclose
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PURPOSE

Ultrasound molecular imaging (USMI) using P- and E-selectin targeted microbubbles (MBselectin) has been shown to accurately quantify inflammation at molecular level in rodent and swine models of inflammatory bowel disease (IBD). This study aimed to assess whether USMI allows longitudinal monitoring of anti-inflammatory treatments in a swine model of IBD.

METHOD AND MATERIALS

Fourteen female swine with acute terminal ileitis induced by TNBS/ethanol solution at day 0 were randomized into 1) an anti-inflammatory treatment group (n=8 with meloxicam at 0.25mg/kg and prednisone at 0.5mg/kg; oral or intravenous, twice daily) and 2) a control group (n=6 without treatment). USMI was performed with a clinical machine (Acuson Sequoia 512; 15L8W, 7MHz; Siemens) after intravenous injection of MBselectin (5x108/kg). Three bowel segments per swine were imaged each at baseline, day 1, 3 and 6 after inflammation induction. Imaging signal was quantified as the difference between pre- and post-destructive signal intensity with VueBox software (Bracco) and normalized to day 1. At day 6 after imaging, scanned ileal segments were analyzed ex vivo for expression level of P-selectin using immunofluorescence staining.

RESULTS

Background USMI signals at baseline day 0 were not significantly different (P=0.09) between the two groups. At day 1, USMI signals significantly (P<0.05) increased in both groups and were not significantly different (P=0.9) between both groups. At day 3, signals significantly (P=0.02 vs. day 1) decreased in the treatment group, while it remained high in controls (P=0.25) and was significantly higher (P=0.001) compared to the treatment group. At day 6, signals further decreased in the treatment group; signals also dropped in controls due to known spontaneous decrease of inflammation in this model, but it remained significantly higher (P=0.046) compared to the treatment group. Immunofluorescence staining demonstrated significantly (P=0.004) higher P-selectin expression level in control versus treated ileum.

CONCLUSION

Dual-selectin targeted USMI allows longitudinal monitoring of anti-inflammatory treatment effects in a swine model of acute ileitis.

CLINICAL RELEVANCE/APPLICATION

This study paves the way for clinical translation of this radiation-free technique for monitoring IBD in patients.

SSK12-07 Sepsis of Unknown Origin: A Role of 18F-FDG-PET/MRI in Immunocompromised Patients

Wednesday, Nov. 29 11:30AM - 11:40AM Room: S504CD

Participants
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Jan Baxa, MD, PhD, Plzen, Czech Republic (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate a diagnostic value of the PET/MRI in detection of cause of the septic state in patients with immunodeficiency

METHOD AND MATERIALS

There were performed 20 18F-FDG-PET/MRI examinations in patients including two children (the age 7-69 year, 13 females, 8

males) who suffered from signs of sepsis, and the cause was remained unclear after routine examinations. The procedures were performed using integrated PET/MRI system after application of the 18F-FDG with the dose of 2.5 MBq/kg. The examinations had to be performed under general anesthesia in 5 patients. The imaging protocol contained gradient echo T1 (VIBE) and T2 STIR sequences before application of the gadolinium contrast. The application of macrocyclic gadolinium containing contrast agent was used with the dose of 0.1 mmol/kg in those patients in whom the renal impairment was not present. PET data acquisition took 4 minutes in each position. When the suspected inflammation of the brain or spine was suspicious, the targeted imaging was performed. The imaging findings were compared with microbiology investigations or histological assessments

RESULTS

There were eleven patients immunocompromised after therapy of the hemato-oncological disease, four patients with advanced diabetes, three patients on long-term dialysis and two patients with congenital impairment of cellular immunity. The cause of the septic state was found in 90% of all cases. There were found seven cases of musculoskeletal infections caused by Staphylococcus (5), Enterococcus sp. (1), and Pseudomonas (1) infections. In four patients were found central nervous system infections including one patient with granulomatous inflammation of unknown agens and one patient with Toxoplasma meningitis. Other single causes included lung aspergillosis, abdominal Salmonella abscess, mycobacterial lymphadenitis. In three patients, the recurrent hematological malignancy was found, the disseminated renal cell carcinoma was found in one patient. The cause of septic state remained undetected in two patients. The results of imaging trigger therapy in 16 patients.

CONCLUSION

18F-FDG-PET/MRI could play an important role in detection of the cause of septic state in immunocompromised patients and in the therapy decisions.

CLINICAL RELEVANCE/APPLICATION

The advantage of the combination of PET and MRI lies especially in the detection of central nervous system and musculoskeletal infections.

SSK12-08 MRI Detection of Brain Abscesses and Monitoring of Antibiotic Treatment Using Endogenous Bacterial CEST Contrast

Wednesday, Nov. 29 11:40AM - 11:50AM Room: S504CD

Participants
Jing Liu, Baltimore, MD (*Presenter*) Nothing to Disclose
Peter C. Van Zijl, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To develop an endogenous CEST MR imaging strategy to detect bacterial infections and to monitor their antibiotic treatment in deep organs, and to evaluate it in a preclinical animal model.

METHOD AND MATERIALS

Brain abscesses were developed by stereotactically injecting 6x106 *S. aureus* in the brains of F344 rats (3 mm left, 2 mm anterior of Bregma). After well circumscribed lesions were formed on ~ 9 days [1], rats received the ampicillin treatment at a daily dose of 30 mg/kg (*i.p.*) twice a day for 10 days. A F98 brain tumor model was established by injecting 5x104 F98-luc cells (3 mm right, 2 mm anterior of Bregma). MRI assessments were conducted before, 4 days and 10 days after the treatment. CEST MRI weighted images were acquired using a 3-sec CW pulse (B1= 1 and 3 μT) according to previously published methods [2].

RESULTS

As shown in Fig.1A, endogenous CEST contrast at 2.6 ppm allowed the *in vitro* MRI detection of three types of gram positive bacteria (*C. novyi-NT* [2], *S. aureus* and *S. epidermidis*) with slightly differing CEST patterns, as well as the *in vivo* visualization of brain abscesses formed by *S. aureus* (Fig.1C). Currently, differentiation of bacterial infection and brain tumors remains a formidable clinical challenge. In CEST MRI, while both type lesions showed higher CEST contrast than brain parenchyma, bacteria and tumors cells showed different CEST-dependence on the B1 strengths used for RF irradiation in CEST, likely attributed to the difference in cell composition and metabolism, which was utilized to differentiate them successfully (Figs. E-H). Finally, we investigated the longitudinal CEST signal changes during antibiotic treatment. As shown in Figs. I&J, CEST signal decreased markedly in the animals receiving amoxicillin treatment and, in contrast, remained constantly in the control group.

CONCLUSION

The endogenous CEST contrast of bacteria cells enables the direct and specific MRI assessment of bacterial infections of *S. aureus* in animal models. Moreover, this method allows non-invasive monitoring of bacteria responses to antibiotic treatments. References (1) Flaris, N. A.; Hickey, W. F. Am J Pathol 1992, 141, 1299-307. (2) Liu, G., et al. Magn. Reson. Med. 2013, 70, 1690-8.

CLINICAL RELEVANCE/APPLICATION

Endogenous CEST MRI contrast of bacterial cells provides a new clinically compatible imaging strategy for the diagnosis and treatment monitoring of bacterial infections in deep-seated organs.

SSK12-09 Developing a Novel Paramagnetic Fluorinated Nanoemulsion for Sensitive Imaging of Inflammation by Fluorine-19 Magnetic Resonance Imaging

Wednesday, Nov. 29 11:50AM - 12:00PM Room: S504CD

Awards
Trainee Research Prize - Resident

Participants
Amin Haghighat Jahromi, MD, PhD, San Diego, CA (*Presenter*) Nothing to Disclose
Stephen R. Adams, PhD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose
Kazim Narsinh, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Imaging of macrophages holds tremendous promise to address a variety of unmet diagnostic needs, such as imaging of cancer, cardiovascular disease, inflammatory disease, or tracking cells in vivo. 19F MRI of inflammation has emerged as an approach to locate macrophages using exogenous 19F probes in a highly specific and quantitative manner. We propose a novel nanoemulsion (NE) imaging probe for sensitive imaging of inflammation in vivo.

METHOD AND MATERIALS

We designed and synthesized a highly stable hexadentate chelating agent for iron (III). The structure of this complex was confirmed by NMR and x-ray crystallography. We added the iron (III) complex to perfluorooctyl bromide (PFOB) to form paramagnetic PFOB (P-PFOB) NE. (PFOB has been used previously in the clinic as a 19F tracer.) The NE was formed using high shear microfluidization to yield a monodispersed oil-in-water NE. Relaxation time 19F NMR measurements (9.4 T and 3 T) and in vitro cell apoptosis assays where used to characterize the nanoemulsion. Inflammation was induced in a murine model via a subcutaneous plug of Matrigel mixed with lipopolysaccharide in the neck. NE was subsequently injected intravenously and 11.7 T MRI data were acquired 24 h later using 2D chemical shift imaging (CSI).

RESULTS

Addition of Fe3+ chelate to PFOB dramatically enhanced 19F MRI detection sensitivity by reducing the 19F T1 by an order of magnitude. T1 values at 3 T are reduced from 1266 ms (PFOB) to 199 ms (P-PFOB, [Fe3+]= 3.5 mM) with minimal T2 line broadening; the effect diminishes at higher fields. In vitro cell assays confirmed viability of NE-labeled macrophages. Upon intravenous injection of P-PFOB NE, accumulation of the agent in the Matrigel plug was observed by 19F MRI, corresponding to the inflammation site. A linear [Fe3+]-dependent chemical shift was also observed in the PFOB fluorine peaks, which enables simultaneous tracking of various subtypes of cells via CSI.

CONCLUSION

We developed P-PFOB, capable of forming NE, with enhanced 19F MRI detection sensitivity over PFOB. By shortening T1, more signal averaging in a given scan time is possible. P-PFOB can also serve as a chemical shift agent for tracking various subtypes of immune cells.

CLINICAL RELEVANCE/APPLICATION

P-PFOB NE is a novel 19F MRI probe with greatly enhanced sensitivity for imaging inflammation and can be used to track various subtypes of immune cells in vivo.

SSK13

Musculoskeletal (Intervention)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: E353C

IR MR MK US

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

FDA Discussions may include off-label uses.

Participants
Luca Maria Sconfienza, MD, PhD, Milano, Italy (*Moderator*) Travel support, Bracco Group; Travel support, Esaote SpA; Travel support, ABIOGEN PHARMA SpA
Daria Motamedi, MD, Washington, DC (*Moderator*) Nothing to Disclose

Sub-Events

SSK13-01 CT Guided Pulsed Radiofrequency Treatment of the Lumbar Dorsal Root Ganglion in Patients with Acute Radicular Lower Back Pain

Participants
Alessandro Napoli, MD, Rome, Italy (*Presenter*) Nothing to Disclose
Roberto Scipione, MD , Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Hans Peter Erasmus, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Cristina Marrocchio, 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 patients with acute or sub-acute neuro-radicular pain from lumbar disc herniation, refractory to usual therapeutic strategies.

METHOD AND MATERIALS

Patients were eligible for this single-center prospective study if they presented acute or sub-acute neuro-radicular low back pain (EMG confirmed), refractory to usual treatments (drugs and injections), and if they could safely undergo Pulsed Radiofrequency procedure. Treatment was performed using a 22-20 G needle-electrode with probe tip directed to the symptomatic DRG under CT guidance; E-pulsed radiofrequency (Cosman G4) was administered for 10 min at 45V with constant local temperature of 42°C. Clinical evaluation was conducted with Visual Analogue Scale (VAS), Owestry Disability Index (ODI) and Roland-Morris (RM) score for quality of life assessment; all questionnaires were obtained at baseline and at 1-week, 1-month and 3-month follow-up. Analyses were performed on a per-protocol basis.

RESULTS

Over a 3-year period, 80 patients were treated with Pulsed RadiofrequencyMedian VAS scores decreased from 7.8 at baseline to 3.5 at 1week after treatment, to 2.6 at 1 month and 1.3 at 3 months; median ODI scores decreased from 78.0 at baseline to 12.5 at 1 week, to 6.0 at 1 month and 5.5 at 3 months; RM score decreased from 16 at baseline to 3 at 1 month and 1.5 at 3 months ($p<0.001$). Overall, 90.0% of patients reached a 0 VAS score within the first month after treatment; 97.5% of patients had a decrease of at least 20 points in ODI score in the same interval. There were 6 patients considered partial responders that required a second PRF session.

CONCLUSION

CT-guided Pulsed Radiofrequency has shown to be a minimally invasive, 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 compression.

SSK13-02 Effects of Allogeneic Human Chondrocytes Expressing TGF-ß1 (TG-C) On Structural Progression of MRI Features Of Knee Osteoarthritis: A Randomized Clinical Trial

Wednesday, Nov. 29 10:40AM - 10:50AM Room: E353C

Participants
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Frank W. Roemer, MD, Erlangen, Germany (*Abstract Co-Author*) Chief Medical Officer, Boston Imaging Core Lab LLC; Director of Research, Boston Imaging Core Lab LLC; Shareholder, Boston Imaging Core Lab LLC; ;

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PURPOSE

To determine effects of allogeneic human chondrocytes expressing TGF-ß1 (TG-C) on structural progression of MRI features of knee osteoarthritis over a 1 year period.

METHOD AND MATERIALS

This phase II randomized controlled trial of TG-C included patients with moderate to advanced osteoarthritis. Patients were randomized to receive an intraarticular 3:1 mixture of non-transduced allogeneic human chondrocytes and TG-C or placebo. 3T MRI was acquired for all patients at baseline and follow-up (3, 6 and 12 months). MRIs were assessed using the WORMS system including cartilage damage, bone marrow lesions (BMLs), meniscal damage/extrusion, Hoffa-, effusion-synovitis, and osteophytes. Analyses were performed on a whole knee level, compartmental level, and subregional level. Binary logistic regression with Generalized Estimating Equation was used to compare risks of progression, adjusting for baseline age and gender. Mann-Whitney-Wilcoxon tests were used to assess differences for continuous variables.

RESULTS

57 Patients were included in the TG-C group and 29 in the placebo group. At 12 months, knees in the TG-C group showed less progression of cartilage damage compared to placebo on a whole knee level (34.6% vs. 47.9%; adjusted RR 0.7, 95%CI [0.5-1.1], p=0.077). Less progression of Hoffa-synovitis and effusion-synovitis was observed in the TG-C group compared to placebo (9.6% vs. 21.1%, adjusted RR 0.5, 95%CI [0.2,1.2], p=0.115). No statistically significant differences were seen for BMLs, meniscal damage and osteophytes.

CONCLUSION

Intraarticular treatment with TG-C showed fewer patients in the treated group with progression in structural OA features and other MRI-defined inflammatory markers such as Hoffa-synovitis and effusion-synovitis. However, no differences were observed in regard to progression of BMLs and meniscal damage, or hypertrophic osteophyte formation.

CLINICAL RELEVANCE/APPLICATION

Intraarticular treatment with TG-C may potentially show benefits on delayed progression of cartilage damage and MRI markers of inflammation in osteoarthritis.

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/ Ali Guermazi, MD, PhD - 2012 Honored Educator

SSK13-03 MR Guided High Intensity Focused Ultrasound (MRgFUS) for the Treatment of Oligometastatic Prostate Cancer Bone Metastasis: Can Soundwaves Downstage Cancer Spread?

Wednesday, Nov. 29 10:50AM - 11:00AM Room: E353C

Participants
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Cristina Marrocchio, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Lorenzo Chiurchioni, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Fabrizio Andrani, MD , Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

With improvements in diagnostic modalities such as functional imaging, oligometastatic prostate cancer is being diagnosed with greater frequency than ever before. Our aim was to determine MRgFUS ability to downstage patients with oligometastatic bone disease with single session of non-invasive metastasis-directed therapy.

METHOD AND MATERIALS

The study was designed with intention-to-treat metastatic bone lesions. Patients were enrolled if they had accessible bone metastasis and could safely undergo MRgFUS (InSightec, Israel). Baseline measurable characteristics included dynamic contrast enhanced MRI study (Gd-BOPTA, Bracco; GE 750 3T magnet) with semiquantitative perfusion analysis, PSA level (ng/ml) and choline PET (SUV). Measurable variables were obtained at treatment time, 3 months, 12 months and 24 months follow-up.

RESULTS

18 patients fulfilled the inclusion criteria and safely underwent MRgFUS procedure of metastatic bone ablations. Lesions were located in the pelvis (11), scapula (3) and long bones (4). At baseline all lesions showed a significant DCE perfusion (highly vascular) with mean perfusion reduction of 88% at 3 months follow-up (CI: 100-50; p<0.001) stable at subsequent follow-up scans. Similarly PSA levels decreased from a mean baseline of 19 (ng/ml) to 7.1, 2.9 and 2.1, at 3-12 and 24 moths respectively. SUV values showed similar trend with reduction from baseline (mean 8.9 to 3.0, 2.3 and 1.7: p<0.001). In all patients single MRgFUS session was appropriate without any major or minor adverse events reported.

CONCLUSION

MRgFUS is a totally non-invasive procedure that can obtain nearly complete bone ablation in patients with oligometastatic prostate disease. The technique features a radiation-free approach that can be of incremental value in long-survivor subset on oncological patients, significantly reducing risk of toxic effects.

CLINICAL RELEVANCE/APPLICATION

MRgFUS could be routinely introduced as a treatment option for oligometastatic bone disease non responding to conventional treatment.

SSK13-04 Image-guided Spine Injections: Paradoxical Particle Formation of Ropivacaine and Non-Particulate Dexamethasone Poses a Risk for Spinal Cord Infarction Events

Wednesday, Nov. 29 11:00AM - 11:10AM Room: E353C

Participants
Brandon Childers, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Il Minn, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Jace Jones, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Maureen Kane, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Jan Fritz, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG; Scientific Advisor, Siemens AG; Scientific Advisor, Alexion Pharmaceuticals, Inc; Speaker, Siemens AG

PURPOSE

Image-guided epidural steroid injections are frequently performed radiologic procedures using local anesthetics and steroids. Because particulate steroids can embolize into the arterial system and cause rare cord infarction events, non-particulate steroids are now recommended. However, we have observed paradoxical particulation when mixing the non-particulate steroid dexamethasone and the local anesthetic ropivacaine, posing a risk for cord infarction events despite using recommended non-particulate injectables. Therefore, we investigated the occurrence of particulation between different local anesthetics and non-particulate dexamethasone formulations, as well as the mechanism of action.

METHOD AND MATERIALS

We evaluated clinically relevant dilution series (1:1 - 1:10) of commercially available ropivacaine (2), lidocaine (2) and bupivacaine (1) formulations mixed with three different commercially available dexamethasone formulations. The outcome variables were the pH of the native drugs and mixtures as well as the presence of precipitation using macroscopic inspection and microscopic photography. Mass spectroscopy was used to analyze the composition of ropivacaine-dexamethasone precipitate.

RESULTS

The pH of the native formulations and mixtures were acidic for ropivacaine, and near neutral for bupivacaine, lidocaine, and dexamethasone. All mixtures were pH neutral. Both ropivacaine formulations demonstrated particulation at all concentrations when combined with two dexamethasone formulations, whereas only minimal particulation occurred at concentrations of 1:1-2 of ropivacaine and the third dexamethasone formulation. Bupivacaine showed minimal, wall-adherent crystal formation with only one dexamethasone formulation at concentrations of 1:1-2. Lidocaine did not form any particles. Mass spectroscopy identified the particles as pure ropivacaine precipitate.

CONCLUSION

Ropivicaine precipitates out of solution and forms particles when combined with dexamethasone, owing to a change from acidic to neutral pH. However, the degree of particulation varies based upon the commercially-available formulations, suggesting that other factors may also play a role.

CLINICAL RELEVANCE/APPLICATION

The combination of non-particulate ropivacaine and non-particulate dexamethasone formulations should be avoided when performing epidural steroid injections to prevent particle formation and minimize the risk of embolic cord infarction events.

SSK13-05 Greater Occipital Nerve Infiltration under MR Guidance: Feasibility Study and Preliminary Results

Wednesday, Nov. 29 11:10AM - 11:20AM Room: E353C

Participants
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PURPOSE

To assess the feasibility of greater occipital nerve (GON) intermediate site infiltration with MRI guidance

METHOD AND MATERIALS

Eleven consecutive patients suffering from chronic refractory cranio-facial pain who underwent 16 GON infiltrations between November 2016 and January 2017 were included in this prospective study. All of the procedures were performed on an outpatient basis in the research facility of our institution, equipped with a widebore 1.5T scanner. The fatty space between inferior obliquus and semispinalis muscles at C1-C2 level was defined as the infiltration target. Technical success was defined as the ability to accurately inject the products in the pre-defined target, assessed by post procedure axial and sagittal proton density weigthed sequences. Clinical success was defined as a 50% pain decrease at one month follow up.

RESULTS

Technical success as defined above was 100%. GON was depicted in 6 of 11 cases on planning MRI sequences. Mean duration of procedure was 22.5 minutes (range-16-41). Clinical success as previously defined was obtained in 7 of 11 included patients (63.6%) with a mean self reported improvement of 78%.

CONCLUSION

Interventional MR guidance for GON infiltration is a feasible technique offering similar results to an already established effective procedure. It may appear as a useful tool in specific populations, such as young patients and repeat infiltrations, and should be considered in these settings.

CLINICAL RELEVANCE/APPLICATION

• MR guidance for GON infiltration is a feasible technique • Preliminary results are in agreement with other guidance modalities • MR guidance may be seen as a useful tool in specific populations

SSK13-06 Cementoplasty of Pelvic Bone Metastases: Lesion Filling and Other Factors Influencing the Therapeutic Response

Wednesday, Nov. 29 11:20AM - 11:30AM Room: E353C

Participants
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PURPOSE

To determine the parameters likely to influence the therapeutic response in cementoplasty of pelvic metastases.

METHOD AND MATERIALS

We retrospectively reviewed a series of pelvic bone cementoplasties performed for symptomatic metastatic involvement in the last 7 years. In addition to demographics, primary tumor and associated treatments, we collected information on the lesion treated: localization, dimensions, cortical destruction graded 0-6, soft tissue mass and pathological fracture; and procedural information: number of needles, cement volume, filling percentage and extra-osseous leakage. The pain scores were evaluated on a visual analog scale before treatment and at the 1 month follow-up visit.

RESULTS

We included 44 procedures in 40 patients (21 females and 19 males, mean age 63 years). The primary tumor was lung (n = 15), breast (n = 9), kidney (n = 7), thyroid (n = 2) or other (n = 7). There were 38 osteolytic and 6 mixed lesions. Localization was acetabular (n = 30), iliac (n = 11) or sacral (n = 3). The maximal lesion diameter was on average 43 mm. The cortical destruction was on average 2.4 / 6 with soft tissue extension in 7/35 and pathological fracture in 7/35. The number of needles was one in 32/44, two in 10/44 and three in 2/44. The volume of cement injected was on average 10 ml with an average filling of 55%. A cement leak was minimal in 11/44, moderate in 9/44. Pain relief was observed in 74% of patients with an average score of 84/100 before the procedure and 46/100 after. The pain relief did not appear correlated to lesion volume (p = 0.2), presence of pathological fracture (p = 0.3), soft tissue extension (p = 0.21), filling percentage (p =0,42), cement leak (p = 0,26), or previous radiation therapy (p = 0,8).

CONCLUSION

Cementoplasty of pelvic bone metastases provides pain relief in a majority of patients. The lesion filling can be optimized by injection through multiple needles but this parameter does not appear correlated with the therapeutic response.

CLINICAL RELEVANCE/APPLICATION

Cementoplasty is a valuable adjunct in the management of symptomatic pelvic bone metastases.

SSK13-07 Hip Steroid/Anesthetic Injections: Is there an Increased Incidence of Hip Osteoarthritis Progression, Femoral Head Osteonecrosis and Collapse?

Wednesday, Nov. 29 11:30AM - 11:40AM Room: E353C

Participants
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PURPOSE

To evaluate incidence of osteoarthritis progression, femoral head osteonecrosis and articular surface collapse in hip steroid/anesthetic injection patients.

METHOD AND MATERIALS

Our study was IRB-approved and HIPAA compliant. A total of 123 hip steroid/anesthetic(40 mg triamcinolone, 4 mL 0.5%

preservative free ropivicaine) injections were performed from 01/2014 to 07/2015. Inclusion criterion was follow-up radiography of the native hip 3-9 months after the injection. Two musculoskeletal radiologists performed retrospective, blinded reviews of the pre- and post-injection radiography of hip injection patients (HIPs) and 2 demographic and follow-up duration matched control groups: 1, patients undergoing hip x-rays without injection; 2, glenohumeral joint injection patients. Groups were compared with Fisher exact test.

RESULTS

There were 102 HIPs (age 65 ± 13 (range 19-92) years; 62 F, 40 M; 41 L, 61 R), who were followed for 26 ± 10 (12-66) weeks. For Reader 1, 38/102 (37%) of HIPs had increased osteoarthritis after steroid injection, compared with 27/102 (26%) of hip controls and 14/44 (32%) of shoulder injection patients. For Reader 2, 42/102 (41%) of HIPs had increased osteoarthritis after steroid injection, compared with 20/102 (20%) of hip controls and 10/44 (23%) of shoulder injection patients. There was no significant difference between these groups (P>0.05). For Reader 1, 24/102 (24%) of HIPs had new osteonecrosis and 15/102 (15%) had new collapse after the steroid injection, compared with 9/102 (9%) and 4/102 (4%) of hip controls and 2/44 (5%) and 1/44 (2%) of shoulder injection patients. There was significantly more osteonecrosis and collapse in HIPs, compared with hip controls (P=0.001 and 0.01) and shoulder injection patients (P = 0.005 and 0.04). For Reader 2, 22/102 (22%) of HIPs had new osteonecrosis and 17/102 (17%) had new collapse after the steroid injection, compared with 9/102 (9%) and 4/102 (4%) of hip controls and 2/44 (5%) and 1/44 (2%) of shoulder injection patients. There was significantly more osteonecrosis and collapse in HIPs, compared with hip controls (P=0.01 and 0.01) and shoulder injection patients (P = 0.03 and 0.005).

CONCLUSION

Hip injection patients have a greater incidence of osteonecrosis and collapse compared with hip controls and shoulder injection patients.

CLINICAL RELEVANCE/APPLICATION

Further evaluation of hip injectates and the injection population is warranted, given these findings.

SSK13-08 MRI-Guided High Intensity Focused Ultrasound: A New First-Line Technique in the Treatment of Osteoid Osteoma?

Wednesday, Nov. 29 11:40AM - 11:50AM Room: E353C

Awards
Trainee Research Prize - Resident

Participants
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PURPOSE

to demonstrate that completely non-invasive radiation-free ablation of osteoid osteoma with MRI-guided high intensity focused ultrasound (MRgFUS) is a safe, effective and durable treatment option.

METHOD AND MATERIALS

Patients with typical clinical and radiological diagnostic findings of osteoid osteoma (non-vertebral), suitable for MRgFUS and anaesthesia, were enrolled in this dual-centre prospective observational study. Vertebral locations were excluded as considered inaccessible. MrgFUS was performed using InSightec ExAblate 2100 system. Safety (rate of complications), clinical effectiveness (Visual Analogue Scale [VAS] pain score reduction) and durability (stability of results over time) of MRgFUS were evaluated as primary outcomes; tumour control (nidus ablation) at dynamic contrast enhanced MR imaging (Discovery 750, GE; Gd-BOPTA, Bracco) was considered as secondary outcome. All patients underwent a minimum follow-up period of 4 years.

RESULTS

Out of 50 subjects screened for recruitment, 45 were enrolled and submitted to MRgFUS. No treatment-related complications were observed. A complete and durable response was achieved in 80% of cases. Median VAS pain score dropped from 8 (IQR 7-9) to 0 at 1-week, and at all subsequent follow-up check points (1 month, 6, 12, 24, 36 and 48 months). Scores evaluating interference of pain with sleep, physical and daily activities showed similar improvement after treatment. Among subjects with partial response (20%), 4 received a second treatment (3 with CT-guided Radiofrequency Ablation, 1 with MRgFUS), and 5 did not need any other treatment. All re-treated patients achieved 0 VAS score. Overall, 87% of patients after MRgFUS treatment reached and maintained a stable 0 VAS score during follow-up. At 3-year MRI osteoid osteoma showed no vascularization in 32/42 patients (76%) treated with MRgFUS alone.

CONCLUSION

MRgFUS is a safe, effective and durable option in the treatment of non-spinal osteoid osteoma.

CLINICAL RELEVANCE/APPLICATION

This technique provides relevant advantages in the treatment of this impairing disease affecting mostly young population: no ionizing radiation, no incisions or needles, and, so far, no complications. Our results support the role of MRgFUS as first-line treatment option for accessible osteoid osteoma.

SSK13-09 Imaging and Clinical Risk Factor Correlation with Rate of Conversion to Surgery Following Fluoroscopically Guided Facet Cyst Rupture

Wednesday, Nov. 29 11:50AM - 12:00PM Room: E353C

Participants
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PURPOSE

Facet cysts may be encountered at magnetic resonance imaging (MRI) in patients with back pain and radicular symptoms. The purpose of this study was to evaluate the conversion rate to surgery following cyst rupture, and to assess associated clinical, imaging and procedural variables.

METHOD AND MATERIALS

A retrospective review was completed of all patients who underwent fluoroscopically guided facet cyst rupture through access of the inferior facet recess from 2000-2016. Primary outcome was conversion to surgery. Secondary outcomes included clinical, MRI, and procedural variables possibly associated with conversion. Clinical variables included sex, age, # of comorbidities, symptoms (pain, motor, sensory), pain laterality, and if pain involved the leg, back or both. MRI variables included cyst size, shape, internal signal, rim signal, spine level, laterality, spondylolisthesis, canal or lateral recess stenosis, presence of facet fluid +/- unilateral vs. bilateral, bone edema and erosion. Procedural variables included cyst opacification, successful epidural rupture and pre vs. post procedure pain.

RESULTS

49 patients met the inclusion criteria. 4 were excluded because they had either no clinical notes or no MRI available for review. 13/45 (29%) of patients converted to surgery. Successful epidural rupture was observed fluoroscopically in 33/45 (73%), of whom 7/33 (21%) converted to surgery. No epidural rupture was seen in 12/45 (27%), of whom 6/12 (50%) converted to surgery. The average interval to surgery was 95 days and average follow up was 889 days after cyst rupture. Of the clinical, imaging and procedural variables evaluated, only the number of comorbidities was significantly associated with conversion to surgery ($p = 0.03$).

CONCLUSION

Facet cysts have been recognized as a cause of spinal stenosis. Fluoroscopically guided facet cyst rupture may be attempted prior to surgery, though 29% our patients eventually required surgery. No significant correlation was found between facet cyst features at MRI and conversion rate to surgery to aid in determining which patients may be benefit from intervention.

CLINICAL RELEVANCE/APPLICATION

Fluoroscopic guided facet cyst rupture is a minimally invasive procedure worth attempting in symptomatic patients as it has a high rate of technical success, with most patients avoiding surgery.

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SSK14

Nuclear Medicine (Breast and Gynecologic Imaging)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: S505AB

BR CT MR NM

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

FDA Discussions may include off-label uses.

Participants
Gary A. Ulaner, MD, PhD, New York, NY (*Moderator*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd
Don C. Yoo, MD, E Greenwich, RI (*Moderator*) Consultant, Endocyte, Inc

Sub-Events

SSK14-01 Bridging the Gap between Digital Mammography and Molecular Breast Imaging

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To develop image processing algorithms and visualization tools to assist with the interpretation of molecular breast imaging (MBI).

METHOD AND MATERIALS

MBI images were first denoised using a state-of-the-art denoising pipeline. The pipeline consists of a variance stabilization step, followed by noise suppression using the block-matching 3D (BM3D) filter. Optimal denoising parameters were defined based on a subset of cases; a graphical user interface allows for dynamic adjustment of the sharpness and noise by the reader. The visualization software includes a computer-aided diagnosis (CAD) feature, which searches for bright regions on the denoised image and automatically highlights their positions for further investigation. To assist the translation between MBI and digital mammography (DM), a registration algorithm is used to determine an affine algebraic transformation that maps coordinates from the MBI images into coordinates on the DM images. The transformation can be used to highlight a region on the DM image based on a user selected location on an MBI image. Alternatively, the MBI may be fused with the corresponding DM images and displayed similar to PET CT images. A software prototype was implemented using MATLAB and evaluated using 18 patient cases.

RESULTS

The denoising algorithm improved the visualization of lesions with subtle uptake by suppressing noise with minimal signal smoothing. The CAD was capable of identifying areas of increased uptake in faint lesions. In this small test set, all lesions were marked; false-positive marks at the chest wall were noted in a minority of cases. The MBI registration resulted in good matches between MBI and DM images, based upon visual inspection of anatomic landmarks.

CONCLUSION

We have developed image processing algorithms and visualization tools for improving the interpretation of MBI images. It is important that MBI is combined with current technologies, such as DM and tomosynthesis, to improve the detection and characterization of lesions.

CLINICAL RELEVANCE/APPLICATION

Denoising may offer the potential to reduce MBI radiation dose and imaging time and increase tumor detectability. By co-registering MBI and DM images, ambiguities between the modalities are reduced, offering the potential to reduce false positive findings.

SSK14-02 Supine Breast PET-MR Imaging in a Whole-Body Approach: How Good is it Compared to Dedicated Breast PET MR Imaging

Wednesday, Nov. 29 10:40AM - 10:50AM Room: S505AB

Participants
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PURPOSE

To evaluate the detection rate of breast tumor in supine breast MRI and supine breast 18F-FDG PET/MRI compared to diagnostic breast MRI and diagnostic breast 18F-FDG PET/MRI.

METHOD AND MATERIALS

A total of 32 patients (31 women, 1 man, mean age 38 years) with histopathologically confirmed breast cancer were included in this study. Each patient underwent a whole-body 18F-FDG PET/MR examination including dedicated diagnostic breast imaging in prone position and subsequently a whole-body MRI in supine position. We analysed the diagnostic performance of (1) dedicated prone breast MRI, (2) dedicated prone breast 18F-FDG PET/MRI (3) supine breast MRI and (4) supine breast 18F-FDG PET/MRI derived from a whole-body staging examination, on a per-patient and per-lesion basis.

RESULTS

Dedicated prone breast MRI and dedicated prone breast 18F-FDG PET/MRI correctly identified all 32 patients with breast cancer (100%). Supine breast MRI correctly identified 28/32 patients (87.5%), while supine breast 18F-FDG PET/MRI correctly identified 29/32 patients (90%). Based on the reference standard a total of 51 lesions were included for analysis. In both dedicated breast imaging examinations all lesions (100%) were identified with 2 additional false-positive findings. Supine breast MR imaging identified 36/51 lesions (70%) with 5 additional false-positive findings and supine breast 18F-FDG PET/MRI identified 40/51 lesions (78%) with 6 additional false-positive findings. The mean SUVmax for lesions in prone 18F-FDG PET/MRI was 3.4 and 4.2 in supine 18F-FDG PET/MRI.

CONCLUSION

Dedicated breast imaging in prone positioning with or without 18F-FDG information is superior to examinations in supine position. While 18F-FDG information did not improve the diagnostic value of dedicated prone breast MRI, adding 18F-FDG information to supine breast examination led to an increase of tumor detection but also of false positive findings.

CLINICAL RELEVANCE/APPLICATION

Dedicated prone breast (PET)MRI is superior to supine breast imaging, as supine breast (PET)MR imaging identifies less tumor lesions and elicits an increase of false-positive findings leading to potentially harmful biopsies.

SSK14-03 Correlation of Bone Marrow Fat Fraction Content using T1 Dixon and Changes in FDG with PET/MR in Breast Cancer Patients with Bone Metastases

Wednesday, Nov. 29 10:50AM - 11:00AM Room: S505AB

Participants
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PURPOSE

Bone metastases replace the normal fat of bone marrow which can easily be imaged with Dixon sequence. However, there is a lack of quantitative evaluation in the literature. We utilized Dixon sequence with FDG PET/MR to determine if change in fat content correlated with change in metabolic activity and if it could be used to assess treatment response.

METHOD AND MATERIALS

We retrospectively identified 7 females with osseous metastases from breast cancer who had pre- and post-treatment FDG PET/MR scans. Regions of interest were drawn around metastases on coronal T1 Dixon fat only images. Fat fraction of each lesion was measured using the ratio of signal intensity of metastases to signal intensity of the patient's normal psoas muscle as well as normal vertebral body. Change in fat fraction was then compared with change in PET SUV of each lesion.

RESULTS

32 bone metastases were identified on PET/MR scans in 7 females with breast cancer. 63% (n=20) of the lesions were in the spine, 22% (n=7) in the pelvis, and 15% (n=5) in the extremities. The average time between studies was 6 months. From pre-treatment

to post-treatment study, 25 lesions increased in FDG activity and 7 lesions decreased in FDG activity. 89% (22/25) of lesions with increasing metabolic activity demonstrated a decrease in fat fraction, with an overall average change in fat fraction of -56%. To the contrary, lesions with decreasing metabolic activity had an average change of +153% in fat fraction. A Wilcoxon rank-sum test revealed a significant difference in the change of fat fraction between the two groups with a p-value of 0.01. A Pearson correlation test between the percent change in SUV and change in fat fraction of each lesion revealed an r-value of -0.3. More specifically, 100% (7/7) of pelvic and 85% (11/13) of vertebral lesions with increased metabolic activity demonstrated a decrease in fat fraction.

CONCLUSION

Quantitative analysis of bone metastases in breast cancer patients reveals that fat fraction of lesions increases with significance as metastases improve and vice versa. However, a strong negative linear correlation did not exist between changes in metabolism and changes in fat fraction.

CLINICAL RELEVANCE/APPLICATION

Many breast cancer patients present in the late stages with osseous metastases. Measuring quantitative fat fraction changes in lesions can help follow up treatment response in bone metastases, especially when PET imaging is not available.

SSK14-04 Quantitative Evaluation of Metabolic Tumor Burden in Molecular Subtypes of Primary Breast Cancer with FDG PET/CT

Wednesday, Nov. 29 11:00AM - 11:10AM Room: S505AB

Participants
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PURPOSE

To quantitatively evaluate volume-based metabolic tumor burden including metabolic tumor volume and total lesion glycolysis in different molecular subtypes of breast cancer and to compare the total lesion glycolysis before and after normalizing for lean body mass on 18F-FDG PET/CT.

METHOD AND MATERIALS

This study involved 99 female patients who were pathologically diagnosed with primary breast cancer and 18F-FDG PET/CT were performed before any therapy. The patients were divided into 4 subtypes including Luminal A, Luminal B, ERBB2+ and Basal-like according to the immunohistochemistry results. Metabolic tumor volume (MTV) and total lesion glycolysis (TLG) before and after correction for lean body mass (LBM) were achieved and compared. Correlations between metabolic tumor burden and the expression level of Ki-67 and p53 were analyzed. Diagnostic performance of volume-based metabolic parameters was evaluated using the receiver operating characteristic curve.

RESULTS

Group differences of the total lesion glycolysis were found between each molecular subtype of breast cancer, with the highest value in the subtype of Basal-like but there was no significant difference in metabolic tumor volume in subtypes of breast cancer. Values of total lesion glycolysis before and after correction for LBM were highly associated and significant reduction was found after correction of LBM for all subtypes of breast cancer. TLG after correction for LBM showed more close correlations with the expression level of Ki-67 and it presented higher diagnostic ability in identifying patients of Basal-like from those of non-Basal-like than that before correction.

CONCLUSION

Metabolic tumor burden could reflect the metabolic differences and predict prognosis of different molecular subtypes of breast cancer, especially total lesion glycolysis after correction for LBM. It could be used to help with differentiating patients in the subtype of Basal-like.

CLINICAL RELEVANCE/APPLICATION

Metabolic tumor burden is superior to daily used SUV and could comprehensively reflect the metabolic differences and predict prognosis of different molecular subtypes of breast cancer,

SSK14-05 Relationship between SUV Max and Gene Expression in FDG-PET/CT in Invasive Ductal Breast Cancer

Wednesday, Nov. 29 11:10AM - 11:20AM Room: S505AB

Participants
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PURPOSE

To compare 18FDG uptake within invasive ductal breast carcinoma (IDC) with estrogen and progesterone receptor status, as well as epidermal growth factor (HER-2) gene expression.

METHOD AND MATERIALS

Over a 5-year interval, a total of 142 women with IDC, 1 cm or larger, underwent PET/CT imaging for staging purposes. From histopathology reports, all estrogen receptor (ER) and progesterone receptor (PR) status results were collected, as well as results of the human epidermal growth receptor 2 (HER-2) gene expression status. Four patient subgroups were formed. Group A (N=43) were ER negative/PR negative/HER-2 negative (i.e. 'triple negative'), group B (N=50) were ER positive/PR positive/HER-2 negative, group C (N=45) were ER positive/PR positive/HER-2 positive, group D (N=9) consisted of any other combination.

RESULTS

The triple-negative tumors had the highest SUV Max, ranging from 2.24 to 26.7, with a mean of 14.69. The ER positive/PR positive/HER-2 positive had the lowest SUV Max, ranging from 0.85-6.86, with a mean of 3.85.

CONCLUSION

As expected, triple negative IDC, as the most aggressive, demonstrated the highest glucose comsumption rate. By contrast, those tumors with combined estrogen, progesterone and HER-2 receptor activity demonstrates the lowest glucose consumption.

CLINICAL RELEVANCE/APPLICATION

There is a direct correlation between hormone and HER-2 receptor status and 18FDG uptake in invasive ductal breast cancers.

SSK14-06 A Patient-Centered Quality Initiative: Stepwise Modification of Departmental Protocol Culminating in a Single Periareolar Radiotracer Injection with Equally Effective Sentinel Node Detection While Reducing Procedural Pain

Wednesday, Nov. 29 11:20AM - 11:30AM Room: S505AB

Awards
Student Travel Stipend Award

Participants
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Arnold Brenner, DO, Staten Island, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the effectiveness of multiple technical modifications of technique in performing preoperative axillary sentinel lymph node (SLN) mapping in breast cancer patients, with the endpoints of nodal detection sensitivity and perceived procedural pain.

METHOD AND MATERIALS

A superficial injection of radiotracer 99Tc- ultra-filtered sulfur colloid was used. Stepwise optimization of this technique resulted in a standardized injection protocol with a tracer dose of 1 mCi, administered through a single periareolar intradermal injection of 0.1 mL using a TB syringe and a 26G needle. Additional modification included the use of benzocaine topical anesthetic spray. Over a 6 year period (2011 - 2017), the number of periareolar injections performed was reduced stepwise from 4 injection sites to 1 injection site and this final refinement was analyzed for SLN detection sensitivity and perceived pain, using our institutional pain scale ranging from 0-10.

RESULTS

682 women with invasive breast cancer who underwent consecutive preoperative axillary SLN mapping were included (mean age 63, range 31-90). Laterality of breast injection site included 263 in the right breast, 287 in the left breast and 132 in bilateral breasts. Axillary SLN was visualized with detection sensitivity of 100%. In women who had 4 injection sites in a unilateral breast or 8 injections in bilateral breasts (n= 180), the mean reported pain score was 4.6 (range 0-10). Women with 3 injection sites in a unilateral breast or 6 injections in bilateral breasts (n= 214) and 2 injection sites in a unilateral breast or 4 injections in bilateral breasts (n= 196) have a mean reported pain score of 3.7 and 3.2, respectively (range 0-10). Women who had only 1 injection in a unilateral breast or 2 injections in bilateral breasts (n= 92) reported a mean pain score of 2.4 (range 0-8). A decrease in the number of injection sites from 4 to 1 reduced the mean pain score by 48% (p-value < 0.0001).

CONCLUSION

Multiple sequential technical modifications culminating in a single periareolar injection technique for axillary SLN mapping reduces periprocedural pain while maintaining 100% SLN detection sensitivity.

CLINICAL RELEVANCE/APPLICATION

A stepwise modification of technique resulting in a single periareolar intradermal injection reduces periprocedural pain while maintaining 100% axillary sentinel lymph node detection sensitivity.

SSK14-07 Value of Intratumoral Metabolic Heterogeneity and Quantitative 18F-FDG PET/CT Parameters to Predict Prognosis in Patients with Cervical Cancer

Wednesday, Nov. 29 11:30AM - 11:40AM Room: S505AB

Participants
Daniella F. Pinho, MD, Dallas, TX (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the impact of intratumoral metabolic heterogeneity and quantitative FDG PET/CT parameters for predicting patient outcomes in cervical cancer.

METHOD AND MATERIALS

This ongoing IRB and HIPPA complaint retrospective study included a total of 120 patients with biopsy proven squamous cell carcinoma of the cervix who had a FDG PET/CT for initial staging. Automated gradient-based segmentation method was used to assess the primary tumor standardized uptake value maximum and peak (SUV max and SUV peak), metabolic tumor volume (MTV) and metabolic intratumoral heterogeneity index, calculated as the area under cumulative SUV-volume histograms (AUC-CSH), with lower AUC-CSH indexes corresponding to higher degrees of tumor heterogeneity. Patient's demographics and tumor staging were also collected. Median follow up time was 27.5 months. Overall survival (OS) and progression free survival (PFS) were calculated using multivariate cox proportion hazard regression model and log-rank (Mantel-Cox) test to generate Kaplan-Meier survival plots.

RESULTS

The patients' mean age was 54.4 ± 13.1 years and there were 27 patients with stage I, 53 with stage II, 23 with stage III and 17 with stage IV disease. Median survival was 74.9 months. Thirty three patients died and 82 were alive (for 5 patient no information on survival available). Higher MTV was significantly associated with reduced OS in the multivariate analysis for every 10 mL increase in volume (HR=1.084, 95% CI=1.036-1.134, p=0.0005). Higher AUC-CSH (lower tumor heterogeneity) was significantly associated with increased PFS in the multivariate analysis for every 1000 increase in the area under the curve (HR=0.679, 95% CI=0.468-0.968, p=0.042). Kaplan-Meier survival analysis using the median value for MTV (74.7 mL) significantly predicted OS (HR = 2.839; 95% CI =1.33-6.02; p=0.0045) and using median value for AUC-CSH of 5602 significantly predicted PFS (HR = 0.469; 95% CI =0.226-0.973; p=0.03).

CONCLUSION

MTV segmented by gradient method is significantly associated with overall survival and tumor heterogeneity is associated with progression free survival for patients with cervical cancer.

CLINICAL RELEVANCE/APPLICATION

FDG PET/CT quantitative parameters can provide prognostic information on initial staging scan, potentially leading to a more personalized approach for patient's treatment.

SSK14-08 18F-FDG PET/MRI vs MRI Alone in Whole-Body Staging of Seventy-One Patients with Suspected Recurrent Gynecologic Pelvic Cancers

Wednesday, Nov. 29 11:40AM - 11:50AM Room: S505AB

Participants
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PURPOSE

To evaluate the diagnostic performance of whole-body 18F-fluordesoxyglucose positron emission tomography/magnetic resonance imaging (18F-FDG PET/MRI) for whole-body staging of suspected recurrent gynecologic pelvic cancer in comparison with whole-body MRI alone.

METHOD AND MATERIALS

Seventy-one consecutive female patients (54 ± 13 years) with suspected recurrence of cervical (32), ovarian (26), endometrial (7), vulvar (4), and vaginal (2) cancer prospectively underwent whole-body PET/MRI including a diagnostic contrast-enhanced MRI protocol. PET/MRI and MRI datasets were separately evaluated regarding lesion count, localization, categorization (benign/malignant), and diagnostic confidence (4-point scale; 0 - 3) by two radiologists. The reference standard was based on histopathological results and follow-up imaging. Proportions of lesions rated correctly were compared on a per-patient and per-lesion basis using McNemar's chi2 test. Differences in diagnostic confidence were assessed by Wilcoxon test.

RESULTS

Fifty-five patients had cancer recurrence. PET/MRI and MRI alone correctly identified 55/55 (100 %) and 46/55 (83.6 %) patients with cancer recurrence, respectively. A total of 241 lesions were described on the reference standard, including 181 malignant and 60 benign lesions. PET/MRI detected all 241 lesions, whereas only 186/241 lesions (77.2 %) were detectable on MRI alone. PET/MRI provided correct identification of all 181 malignant lesions. Instead, MRI alone correctly identified only 126/181 (69.6 %) malignant lesions, which was significantly less compared with PET/MRI ($p < 0.001$). PET/MRI offered significantly higher diagnostic confidence in the categorization of malignant lesions compared with MRI alone ($p < 0.001$).

CONCLUSION

PET/MRI demonstrates excellent diagnostic performance and outperforms MRI alone in staging of patients with suspected recurrent gynecologic pelvic cancers.

CLINICAL RELEVANCE/APPLICATION

PET/MRI enables exact assessment of recurrence of female pelvic malignancies and should be considered a valuable alternative for whole-body staging of patients with suspected recurrent disease.

SSK14-09 First-in-Human Biodistribution and Dosimetry of In-111/Y-90-FF-21101: A Radioimmunotherapeutic Agent Targeting P-cadherin

Wednesday, Nov. 29 11:50AM - 12:00PM Room: S505AB

Participants
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PURPOSE

To assess the human biodistribution and dosimetry of 111In/90Y-FF-21101, a human-mouse chimeric monoclonal antibody directed against P-cadherin, encoded by CDH3 gene-overexpressing solid tumors.

METHOD AND MATERIALS

Ten patients (4 male, 6 female) in a first-in-human dose-escalation (5, 10, 15, 20, 25 mCi/m2 <= 60 mCi) 90Y-FF-21101 clinical trial, underwent a 5 mCi 111In-FF-21101 pre-treatment dosimetry study. Whole-body planar (WB) scans were acquired at 0.25, 4, 24, 72 and 144 h on a Siemens Symbia S camera. A two-bed SPECT scan was acquired at 24-h, calibrated with a 10 ml vial containing 50 µCi of 111In, to compute organ absolute activity. (A CT scan was acquired on a General Electric 750 HD scanner for SPECT attenuation correction and fusion.) Blood samples were collected at 0.5, 1, 2, 4, 24, 72 and 144 h, for estimating marrow dose. Time-activity curves (TACs) were generated from two-dimensional regions of interest drawn on the WB images around the heart contents, lungs, liver, spleen, kidneys, testes and total body. Three-dimensional volumes of interest for the lungs, liver, spleen and kidneys were defined on the SPECT/CT images, to activity-correct planar TACs and estimate organ masses for the dosimetric analysis. Source organ and marrow 111In and 90Y residence times derived from TAC exponential fits were entered into OLINDA/EXM v1.1 for dose calculation (mSv/MBq), with mass correction for liver, kidneys, spleen and lungs. Tumor uptake was assessed qualitatively.

RESULTS

The five highest mSv/MBq for 111In were: spleen (M:2.55,F:2.66); kidneys (M:0.77,F:0.76); testes (M:0.62) and liver (F:0.64); liver (M:0.62) and lungs (F:0.52); and pancreas (M:0.57,F:0.47); and for 90Y were: spleen (M:23.4,F:28.5); testes (M:8.56) and kidneys (F:6.42); kidneys (M:6.48) and lungs (F:5.09); liver (M:4.34,F:4.66); and lungs (M:4.12) and heart wall (F:2.66). Tumor uptake was visualized in 6 of 10 patients; with the highest uptake seen in tumors of epithelial origin, including metastatic vaginal, ovarian and colon carcinomas, and liposarcoma, consistent with anti-P-cadherin targeting.

CONCLUSION

FF-21101 exhibits favorable biodistribution and dosimetry, enhancing its attractiveness as an imaging and therapeutic agent targeting P-cadherin overexpression.

CLINICAL RELEVANCE/APPLICATION

FF-21101 demonstrates P-cadherin targeting and favorable biodistribution, and thus may be a viable radioimmunotherapeutic agent for P-cadherin-overexpressing cancers.

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SSK15

Neuroradiology (Striking at the Heart of Stroke)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: N226

ER MR NR

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

FDA Discussions may include off-label uses.

Participants

Bharathidasan Jagadeesan, MD, Minneapolis, MN (*Moderator*) Research Consultant. MicroVention Inc; Research Consultant, Medtronic plc; Research Consultant, CVRx
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Sub-Events

SSK15-01 Prediction of Malignant Cerebellar Edema Occurrence and Clinical Outcome after Ischemic Cerebellar Stroke Using Multiparametric CT

Participants
Wolfgang G. Kunz, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
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Wieland H. Sommer, MD, Munich, Germany (*Abstract Co-Author*) Founder, Smart Reporting GmbH
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PURPOSE

Malignant cerebellar edema (MCE) is a life-threatening complication after acute cerebellar stroke. The aim of this study was to identify imaging predictors for the occurrence of MCE using multiparametric CT including whole-brain CT perfusion (WB-CTP).

METHOD AND MATERIALS

We selected all subjects with cerebellar WB-CTP perfusion deficit and follow-up-confirmed infarction from a cohort of 3,254 consecutive patients who underwent multiparametric CT. Follow-up imaging was assessed for the presence (MCE+) or absence (MCE-) of MCE, measured using an established 10-point scale by Jauss et al., of which scores >=4 are considered malignant. Posterior-circulation-Acute-Stroke-Prognosis-Early-CT-Score (pc-ASPECTS) was determined to assess ischemic changes on non-contrast CT (NCCT), CT angiography (CTA), and on parametric WB-CTP maps (cerebral blood flow, CBF; cerebral blood volume, CBV; mean transit time, MTT; time to drain, TTD). The volumes of CBF, CBV, MTT, and TTD deficits were quantified. Chi-square, Mann-Whitney-U tests and receiver operating characteristics (ROC) analyses were performed.

RESULTS

Fifty-one patients were included. 42 patients (82.4%) were categorized as MCE- and 9 (17.6%) as MCE+. MCE+ patients had larger CBF, CBV, MTT and TTD deficit volumes (each with $p<0.001$) and showed significantly lower median pc-ASPECTS assessed using WB-CTP (CBF: 5 vs. 8; CBV: 8 vs. 9; MTT: 5 vs. 8; TTD: 5 vs. 8; each with $p<0.001$) compared to MCE- patients, while median pc-ASPECTS on NCCT was not significantly different (9 vs. 10, $p=0.097$). ROC analyses for MCE yielded the largest area-under-the-curve (AUC) values for CBF (0.984), followed by CBV deficit volumes (0.972) and pc-ASPECTS on CBF (0.949), whereas pc-ASPECTS on NCCT (0.664) and CTA (0.699) provided less diagnostic value. Regarding mortality, ROC analyses revealed the highest AUC values for pc-ASPECTS CBV (0.853) and CBV deficit volume (0.837), and the lowest AUC values for pc-ASPECTS on NCCT (0.610) and CTA (0.643).

CONCLUSION

WB-CTP provides added diagnostic value regarding the prognosis of MCE occurrence and clinical outcome after cerebellar stroke compared to NCCT and CTA.

CLINICAL RELEVANCE/APPLICATION

WB-CTP performed in acute cerebellar stroke has the potential to impact clinical decision making based on an early identification of patients that are at high risk of developing MCE.

SSK15-02 Utility of Serial and Ancillary Neuroimaging in Assessment of Suspected Hypertensive Hemorrhage

Wednesday, Nov. 29 10:40AM - 10:50AM Room: N226

Participants
Edward Kuoy, MD, Orange, CA (*Presenter*) Nothing to Disclose

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Daniel S. Chow, MD, Orange, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess the utility of serial and ancillary neuroimaging in the work-up of primary intracerebral hemorrhage involving characteristic hypertensive regions, including basal ganglia, thalamic, pontine and cerebellar hemorrhages. Lobar hemorrhages were included in the study, although these are more classically seen with cerebral amyloid angiopathy in non-hypertensive patients.

METHOD AND MATERIALS

This IRB-approved study retrospectively reviewed hypertensive patients presenting to the emergency room or transferred from an outside facility with imaging findings of primary intracerebral hemorrhage from October 2013 - October 2015. Patients were excluded if they had known CNS malignancy. Age, admitting systolic blood pressure, the location of bleed, and findings from follow-up imaging were recorded.

RESULTS

A total of 135 patients were identified, of which 73.6% (98/135) and 51.9% (70/135) had follow-up CTA/MRA or MRI, respectively. Sites of involvement included basal ganglia (42.9%, 56), thalamic (24.4%, 36), lobar (20%, 27), and the remaining within the brainstem or cerebellum. Of patients who underwent ancillary imaging, CTA/MRA revealed a vascular abnormality in a single patient, an arteriovenous malformation within the cerebellum. MRI also revealed a vascular abnormality in a single patient, vasculitis resulting in lobar hemorrhage. All remaining follow-up imaging reviewed was negative for additional pathology. With regards to location, all cases of basal ganglia and thalamic hemorrhages were consistent with hypertensive hemorrhage only.

CONCLUSION

In the setting of hypertension, ancillary imaging for basal ganglia and thalamic hemorrhages did not reveal alternative etiologies. In the absence of initial findings to warrant operative management, serial CT imaging in otherwise clinically stable patients did not result in findings warranting a change in management.

CLINICAL RELEVANCE/APPLICATION

In the absence of clinical concerns and findings on initial imaging, there is low utility in ancillary and serial neuroimaging for primary intracerebral hemorrhage involving the basal ganglia and thalamus in patients presenting with hypertension.

SSK15-03 The Ischemic Penumbra Assessment Using 3D ASL at Different Post Labeling Delays in Patients with Unilateral Middle Cerebral Artery Severe Stenosis or Occlusion

Wednesday, Nov. 29 10:50AM - 11:00AM Room: N226

Participants
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PURPOSE

To evaluate ischemic penumbra (IP) using three-dimensional pseudo continuous arterial spin labeling (3D pCASL) at PLD of 1.5 s and 2.5 s in patients with ischemic cerebrovascular disease.

METHOD AND MATERIALS

Twenty-six patients (mean age, 60±12 years; 16 men and 10 females) with unilateral middle cerebral artery (MCA) severe stenosis or occlusion were enrolled into the present study, underwent MRI scan especially 3D pCASL with PLDs of 1.5s and 2.5s and DWI. The IP was first observed according to mismatched CBF-DWI region. The mean CBF (CBF1.5 vs. CBF2.5, mL/100g per minute) values and the mean area (mm2) of IP were measured at PLDs of 1.5s and 2.5s. Comparisons of the mean CBF values and the mean IP area between the two PLDs were analyzed using paired T test. Compared with the positive detection rate of IP by Chi-square test.

RESULTS

The detection rate of IP increased at the PLD of 1.5s (21/26, 80.77%) than 2.5s (6/26, 23.08%) (P=0.000). The mean CBF1.5 and CBF2.5 values of IP were 12.32±1.66 vs.18.84±1.44 (P=0.002). The mean IP area was also significantly widened at the PLD of 1.5s (4273.17±611.17) than 2.5s (1074.50±955.32, P=0.01).

CONCLUSION

IP detection and areas result from different PLD using 3D ASL and DWI in patients with ischemic cerebrovascular disease. The higher detection, decreased CBF and wider region of IP are present at the PLD of 1.5s.

CLINICAL RELEVANCE/APPLICATION

It is necessary to consider the different PLDs to assess IP by 3D pCASL in ischemic cerebrovascular disease.

SSK15-04 Early Identification of Tissue at Risk of Infarction after Acute Ischemic Stroke Using Convolutional Neural Networks

Wednesday, Nov. 29 11:00AM - 11:10AM Room: N226

Awards
Trainee Research Prize - Resident

Participants
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Ona Wu, PhD, Charlestown, MA (*Abstract Co-Author*) Royalties, General Electric Company; Royalties, Toshiba Medical Systems Corporation; License agreement, General Electric Company; License agreement, Toshiba Medical Systems Corporation; Research Consultant, Penumbra, Inc

PURPOSE

Early identification of potentially salvageable tissue after acute ischemic stroke (AIS) is increasingly being used to guide treatment decisions. Deep learning algorithms, e.g. convolutional neural networks (CNN), have been employed for chronic stroke lesion segmentation. We investigated the utility of CNN algorithms for predicting tissue infarction on follow-up MRI based on acute DWI and PWI MRI.

METHOD AND MATERIALS

The study included 50 AIS patients not treated with reperfusion therapy with DWI and PWI acquired <12h from the time when patients were last known to be well. Patients were also required to have follow-up (F/U) imaging performed >= 4 days after stroke. Apparent diffusion coefficient maps, T2WI, isotropic DWI, MTT, and Tmax were used as covariates to train a CNN (5-fold cross validation). The CNN was trained via the open source framework DeepMedic using the default architecture. The CNN segmentation maps were evaluated for each patient individually. Performance metrics were based on Dice score, sensitivity, and precision.

RESULTS

The CNN prediction of F/U lesions resulted in a mean±SD Dice score of 42%±26%, sensitivity 39%±27% and precision 60%±30%. The CNN resulted in fair results for lesion volumes >= 10ml, however it underperformed for smaller lesions <10 mL (Dice score 24%±20%, Sensitivity 25%±25%, Precision 38%±30%). Visual inspection showed compelling results for large lesions (Figure). The lesion size group analysis and the correlations of lesion volumes revealed that performance was dependent on lesion extent.

CONCLUSION

Our results showed that CNN can be used to combine acute multiparametric MRI for predicting tissue infarction on F/U, which hold especially true for large lesions. Although the CNN performed best for large lesion volumes, the focus of many early decision-making for AIS patients is whether or not the patient is at high risk of infarct growth. Therefore, CNN algorithms that can identify which patients will experience large infarct volumes without intervention hold promise for guiding AIS treatment decision strategies on an individual patient basis.

CLINICAL RELEVANCE/APPLICATION

Convolutional neural networks can be used to combine acute multiparametric MRI to predict follow-up tissue infarction with high accuracy, and therefore has potential for guiding treatment decisions on an individual patient basis.

SSK15-05 Regional Detection of Hemorrhagic Transformation using Kernel Spectral Regression and a Neural Network on Multi-modal MRI for Acute Ischemic Stroke

Wednesday, Nov. 29 11:10AM - 11:20AM Room: N226

Participants
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PURPOSE

Hyperperfusion detected on arterial spin labeling (ASL) cerebral blood flow (CBF) images acquired after acute ischemic stroke (AIS) onset has been shown to be significantly associated with development of intracerebral hemorrhage. The purpose of this study was to develop a machine model for the voxel-based detection of tissue at risk for hemorrhagic transformation (HT) given multiple MRI modalities as input.

METHOD AND MATERIALS

The present study utilized routine clinical MRI and ASL image data acquired from 67 AIS patients shortly after endovascular therapy or clot retrieval. A novel regional cuboid sampling framework was developed for machine learning training, in which local cuboids were extracted from the CBF map, DWI, FLAIR, and T2 TSE before being matched with GRE-based manually drawn bleed groundtruth delineations. Kernel spectral regression (KSR) uses the information in the eigenvectors of the graph representation to reveal low dimensional structure in high dimensional data. After determining optimal kernel input parameters with KSR, we built a two-layer feed-forward neural network with 10 neurons in the sigmoid hidden layer and trained with scaled conjugate gradient backpropagation to classify cuboid inputs into likelihood of HT.

RESULTS

The proposed multimodal regional framework reached an accuracy of 80.59 ± 3% in detecting hemorrhage with KSR on our dataset (better than any single image modality alone); while a simple voxel-based prediction was 72.80 ± 5% accurate. Using the neural network training, the framework reached an improved accuracy of 95.1% ± 0.6%. Figure 1 shows a few predictive images based on the probabilities determined by the neural network. One can appreciate how the regions with high likelihood of hemorrhage determined by machine learning match well with the manually drawn regions in the reference GRE map.

CONCLUSION

Machine learning using kernel spectral regression or neural networks in particular can provide more accurate detection of tissues at risk for HT. Although CBF can inform AIS patient clinical outcome, the addition of multi-modal MRI data into the regional cuboid framework substantially improves the voxel-based HT detection accuracy.

CLINICAL RELEVANCE/APPLICATION

The proposed multi-modal regional framework for HT detection can improve stroke physicians' utilization of perfusion data in AIS treatment planning and monitoring.

SSK15-06 The Detectability of Forward Projected Model-Based Iterative Reconstruction for Low Contrast Lesions: Acute Cerebral Infarction-Phantom Study

Wednesday, Nov. 29 11:20AM - 11:30AM Room: N226

Participants
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PURPOSE

Low-contrast areas in acute cerebral infarction are often difficult to be detected by computed tomography (CT) despite use of hybrid iterative reconstruction techniques such as adaptive iterative dose reduction 3D (AIDR 3D, Toshiba Medical Systems). Forward projected model-based Iterative Reconstruction SoluTion (FIRST, Toshiba Medical Systems), a novel iterative reconstruction technique, can strongly reduce noise and beam hardening artifact and improve spatial resolution. We compared the detectability of low contrast lesions on AIDR 3D- and FIRST images using a head phantom including simulated acute cerebral infarction.

METHOD AND MATERIALS

We developed dedicated head phantoms including simulated acute cerebral infarction using a 3D printer (Agilista 3200, Keyence). This study included 36 images of various models of acute cerebral infarction and 24 images of normal brain model. Half of these images were reconstructed with AIDR 3D and the rest were reconstructed with FIRST. Two radiologists separately specified the location of the low-contrast lesions in which subtle contrast between the gray and white matter diappeared. They rated the probability of the presence using an analog confidence scale. For the evaluation ROC analysis was performed. Statistical difference between AIDR 3D and FIRST was tested by DeLong's method.

RESULTS

ROC analysis showed that the difference between AIDR 3D (reader1: Az- value 0.773, reader2: Az- value 0.706) and FIRST (reader1: Az- value 0.935, reader2: Az- value 0.880) was significant in favour of FIRST (p = 0.037, 0.041, respectively).

CONCLUSION

Our study demonstrates a significant advantage of FIRST in the detection of low contrast lesions compared with AIDR 3D, one of the conventional iterative reconstruction techniques.

CLINICAL RELEVANCE/APPLICATION

FIRST may improve detectability of low contrast lesions in acute cerebral infarction.

SSK15-07 Intra-Arterial Thrombectomy in Patients with Cervical Dissections in the MR CLEAN Trial: A Descriptive Analysis

Wednesday, Nov. 29 11:30AM - 11:40AM Room: N226

Participants
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Ad Van Es, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Aad Van Der Lugt, MD, PhD, Rotterdam, Netherlands (*Abstract Co-Author*) Research Grant, Stryker Corporation; Research Grant, General Electric Company
Bart J. Emmer, MD, Leiden, Netherlands (*Presenter*) Nothing to Disclose

PURPOSE

Several treatment strategies have been proposed in patients presenting with acute stroke and an extracranial dissection of the internal carotid artery (ICA). The aim of this study is to describe the outcome and variation of treatment strategies in intra-arterial thrombectomy (IAT) in patients with dissection of extracranial ICA and a proximal intracranial occlusion.

METHOD AND MATERIALS

Data (n=500) of the randomized controlled MR CLEAN trial on the effectiveness of IAT were analyzed. Carotid dissection was identified on CTA scans at baseline. Primary outcome was a favorable functional outcome defined as an modified Rankin Scale (mRS) score of <=2. Secondary outcomes were mRS <=3 and serious adverse events (SAE).

RESULTS

Carotid dissection was identified in 24 patients (21 male; median age 50.5)of which 15 in IAT group and 9 in non-IAT group. No differences at baseline NIHSS (p 0.74) and collateral score (p 0.29) was observed. In two patients stent placement was performed during IAT. A good functional outcome was observed at 7 (47%) in the IAT group versus 1 patient (11%) but was not statistically different (p 0.18). With respect to secondary outcomes, mRS <=3 and SAE were significantly different in favor of IAT (resp. p 0.03 and 0.04).

CONCLUSION

IAT is feasible in patients with extracranial dissections of the ICA and good outcomes have also been observed without carotid stenting.

CLINICAL RELEVANCE/APPLICATION

Carotid dissection is not a reason the withhold IAT in acute stroke patients.

SSK15-08 Diagnostic Accuracy of 3D black blood MRI with High Resolution T1 SPACE in the Evaluation of Intracranial Arterial Thrombosis

Wednesday, Nov. 29 11:40AM - 11:50AM Room: N226

Participants
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PURPOSE

3D black blood (BB) MRI using a T1 sampling perfection with application-optimized contrast using different flip angle evolutions (SPACE) sequence allows high resolution, vessel wall imaging to evaluate the intracranial arterial wall and its associated pathologies. We investigated the diagnostic features and accuracy of 3D BB MRI in the detection of arterial thrombosis.

METHOD AND MATERIALS

We retrospectively identified fifteen patients with intracranial arterial thrombosis that underwent 3D BBMRI with non-enhanced and contrast enhanced high resolution T1 SPACE sequences. 3D BBMRI findings were evaluated by 2 independent neuro-radiologists blinded to all other angiographic studies, conventional MRI sequences, and clinical indications for imaging. Nineteen total intracranial vessel segments per patient were evaluated and graded on a three-point scale (grade 0-2) [Table] for intraluminal TI SPACE hyperintensity and contrast enhancement. Images were considered positive for arterial thrombosis when focal intraluminal T1 SPACE hyper-intense signal and/or enhancement on 3D BBMRI was graded as 1 or 2. Arterial occlusion was confirmed by digital subtraction angiography (DSA) or computed tomographic angiography (CTA). In limited cases (n=4) without DSA/CTA availability, susceptibility weighted imaging (SWI) in combination with time of flight (TOF) MR angiography (MRA) confirmed the diagnosis of complete vessel occlusion.

RESULTS

Fifteen patients with 18 intracranial arterial occlusions were studied. Fair inter-observer agreement for intraluminal T1 SPACE hyperintensity (Kappa = 0.50) and excellent inter-observer agreement for contrast enhancement (Kappa = 0.84) was noted. The sensitivity and specificity for intracranial arterial thrombosis of intraluminal T1 hyperintensity was 88.89% and 100% respectively and that of contrast enhancement was 94.45% and 100% respectively, taking Observer 1 as gold standard and Observer 2 as test when both partial and clear visualization (combined grades 1 and 2) suggested vessel thrombosis/occlusion.

CONCLUSION

3D BBMRI with T1 SPACE imaging is a valuable sensitive and specific technique for the evaluation of intracranial arterial thrombosis.

CLINICAL RELEVANCE/APPLICATION

This technique provides an adjunctive mechanism to confidently diagnose complete arterial occlusions in the setting of low resolution conventional MRI findings and absent flow enhancement on TOF-MRA imaging prone to overestimation.

SSK15-09 Actionable Vascular and Other Incidental Findings on CTA in Patients Undergoing Acute Stroke Intervention: Findings in 225 Patients

Wednesday, Nov. 29 11:50AM - 12:00PM Room: N226

Participants
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PURPOSE

The detection and appropriate management of incidental findings is an important part of any clinical radiology practice. The intricate anatomy covered by CTAs of the head and neck coupled with the time pressures of acute stroke diagnosis creates an environment for missing important unrelated findings. The purpose of our study was to document incidental findings on CTA in 225 patients undergoing acute stroke intervention.

METHOD AND MATERIALS

Under IRB approval and HIPAA compliance, 225 CTAs of the head and neck in patients undergoing acute stroke intervention from 2011-2016 were reviewed for important incidental findings. Average patient age was 65 (range 16-95 years). Findings were separated into vascular (mainly aneurysms) and non-vascular entities (such as tumor and infection), with results tabulated.

RESULTS

There were 19 vascular and 31 non-vascular important incidental findings. Intracranial aneurysms were the most common vascular finding, with 18 aneurysms present in 16 patients (7% of patients). All aneurysms were unknown prior to imaging, with average size of 5mm(range of 2-10mm). 5 malignancies, most of which were unknown, included 2 lung cancers and an erosive nasopharyngeal skull base tumor. 2 patients with malignancy had pathologic cervical spine fractures. Critical pulmonary findings included 3 malpositioned endotracheal tubes in their right main stem bronchus, and 1 moderate pneumothorax. 6 patients had pulmonary edema, and 3 had pneumonia.

CONCLUSION

Providing fast and accurate diagnosis of acute large vessel occlusion on CTA is essential for good stroke outcomes. However, important and even urgent findings are surprisingly frequent in this patient population, and should be looked for with equal fervor.

CLINICAL RELEVANCE/APPLICATION

CTAs of the head and neck in patients undergoing acute stroke intervention harbor important and urgent findings with surprising frequency, and should not be overlooked even in this time-sensitive clinical scenario.

SSK16

Neuroradiology (Epilepsy Imaging: Finding the Spark)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: N229

MR NR

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

FDA Discussions may include off-label uses.

Participants
Girish M. Fatterpekar, MBBS, New York, NY (*Moderator*) Nothing to Disclose
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Sub-Events

SSK16-01 Comparison of Arterial Spin Labeling MRI With EEG and Structural MRI in Patients With Epilepsy

Awards
Student Travel Stipend Award

Participants
Shankhneel Singh, MBBS,MD, Chandigarh, India (*Presenter*) Nothing to Disclose
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PURPOSE

The purpose of our study was to compare the results of interictal EEG and structural MRI with ASL-MRI findings in patients with epilepsy in the peri-ictal period and inter-ictal period and try to localize the epileptogenic zone.

METHOD AND MATERIALS

Two groups of patients were selected. The first group consisted of 21 patients having seizure episode in the hospital premises (selected randomly as per availability of MRI machine at time of seizure) who underwent structural MRI with an additional ASL sequence in the peri-ictal period (arbitrarily fixed at 2 hours from seizure onset). The patients also underwent an inter-ictal scalp EEG. The second group included 30 patients with refractory seizures who underwent inter-ictal structural MRI with additional ASL sequence (selected randomly from out-patient referrals for MRI from a dedicated seizure clinic). Inter-ictal scalp EEG was also performed for these patients. Hyperperfusion or hypoperfusion was recorded and localized to the hemisphere and if possible the anatomical lobe.

RESULTS

In the 'peri-ictal' group, 'structural MRI positive' patients had 87.5% concordance of ASL findings with the structural MRI abnormalities (50% showed localization to ipsilateral hemisphere -partial concordance, and an additional 37.5% to ipsilateral lobe and the hemisphere -complete concordance) whereas the 'structural MRI negative' patients had 71.3% concordance between ASL and structural MRI findings (57% having complete concordance and an additional 14.3% showing partial concordance). In the 'inter-ictal' group, 'structural MRI positive' patients showed 75% concordance between ASL and structural MRI findings (50% complete concordance and 25% partial concordance) and 'structural MRI negative' patients had a 78.5% concordance between ASL and structural MRI findings (71.4% complete concordance and additional 7.1% partial concordance).

CONCLUSION

Perfusion abnormalities are intricately linked with seizures in both inter-ictal and peri-ictal phase with localized hyperperfusion being the most frequent pattern in peri-ictal and hypoperfusion predominating in the inter-ictal phase.

CLINICAL RELEVANCE/APPLICATION

ASL imaging can be a promising complementary imaging tool and can be contributory to the clinical scenario irrespective of the time of imaging, including in follow-up imaging and in increasing confidence in lesion localization for possible surgical work-up.

SSK16-02 Multi-Regional Volumetric Patterns are Associated with Post-Surgical Outcomes in Patients with Medically Refractory Temporal Lobe Epilepsy

Wednesday, Nov. 29 10:40AM - 10:50AM Room: N229

Participants
Anil K. Vasireddi, BS,MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
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PURPOSE

To investigate patterns of regional pre-operative volumetric differences that may be associated with post-operative outcome using lasso regression analysis (LRA) in patients with medically refractory temporal lobe epilepsy (TLE) who underwent anterior temporal lobectomy (ATL).

METHOD AND MATERIALS

69 subjects with TLE treated with ATL are classified as either seizure-free (ILAE 1-2) or as having continued seizures (ILAE 3-6) postoperatively. Preoperative T1-weighted MRI were analyzed for volumetric measurements. LRA was performed to identify groups of regions associated with postoperative outcomes and results were cross-validated to quantify the selected model's ability to predict outcome classification. A sub-group of patients with pathology proven mesial temporal sclerosis (MTS) was analyzed in a similar manner (n=26).

RESULTS

LRA identified smaller volumes in the contralateral occipital lobe as being associated with the seizure-free group ($p = 0.0179$); cross-validation revealed sensitivity of 0.27 and specificity of 0.77 in correctly identifying patients with continued postoperative seizures. In the sub-group of patients with MTS, LRA selected the contralateral occipital lobe, ipsilateral hippocampus, ipsilateral caudate, contralateral cerebellum, and contralateral frontal lobe in the model associated with postoperative outcomes ($p<0.001$). Cross-validation yielded better results in the more focused sub-group (sensitivity = 0.7, specificity=0.81). Hippocampal volumes alone were not significantly different between the seizure-free and continued seizures groups in either analysis.

CONCLUSION

LRA identified temporal and extra-temporal regions associated with postoperative seizure outcome. The model selected by LRA was more descriptive and more robust in cross-validation when limited to subjects identified by a single pathology such as MTS indicating that the underlying pathology should be accounted for in such analyses. Involvement of extra-temporal regions may be related to extra-temporal seizure activity, chronic sequela of anti-epileptic drug usage and/or history of frequency/severity and generalization of seizures.

CLINICAL RELEVANCE/APPLICATION

Approximately 40% of patients who undergo temporal lobectomy for TLE may continue to experience seizures postoperatively. Thus, further stratification of potential surgical candidates using pre-operative data may improve outcomes.

SSK16-03 The Clinical Impact of Emergency CT Brain Scan in Seizure

Wednesday, Nov. 29 10:50AM - 11:00AM Room: N229

Participants
Bodo P. Kress, MD, Frankfurt, Germany (*Presenter*) Research Grant, Guerbet SA; Research Grant, Bayer AG
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PURPOSE

Does emergency CT brain in patients with seizures have an immediate clinical impact?

METHOD AND MATERIALS

In a retrospective analysis we evaluated 1785 CT brain scans performed between 2006 and 2013 in patients after seizures. The indication for this exam has been to exclude pathological lesions being focus of seizures or being caused by seizures. Study design and protocol has been approved by our local ethic comitee (S071/2017).

RESULTS

1088 male, 697 female, average age 58 years. In 173 (9,6%) patients the CT scan revealed a significant pathological finding. In 104 (5%) patients a either tumorous or metastatic lesion was found, in 62 (3,5%) hemorrhages (subdural, epidural, parenchymal or subarachnoidal) and in 14 (0,7%) signs of a subacute infarct. 1 patient revealed signs of a acute hydrocephalus. All patients with infarcts were outside the lysis time window or time window for thrombectomy. No patient with tumorous or metastatic lesion needed immediate treatment. 6 (0,3%) of 62 patient with hemorrhage were transfered for immediate treatment. All 6 patients had clinical symptoms additionally to seizures such as clinical history of acute headache, midface fracture, hypertension (>220mmHg). No patient with isolated clinical symptom of seizure needed emergency treatment.

CONCLUSION

In this study no CT scan revealed pathological findings with immediate clinical impact if patient had only clinical history of seizure. It should be discussed whether patient with additional clinical symptoms such as acute headache, severe head trauma or hypertension need CT scan in the acute setting and whether the other patients -taken to the ward for surveillance- are evaluated only by MR scan in between 24 hours.

CLINICAL RELEVANCE/APPLICATION

Retrospective design is ia limitation, however all other studies published in the literature evaluated less than 200 exams (while we evaluated 1785), therefore this is the study with by far the biggest number of cases.

SSK16-04 Abnormality of Cerebral White Matter Microstructure in Children with New-Onset, Untreated Idiopathic Generalized Epilepsy

Wednesday, Nov. 29 11:00AM - 11:10AM Room: N229

Participants
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PURPOSE

Epilepsy, as one of the most prevalent, noncommunicable neurologic conditions and a significant cause of disability and mortality, affects approximately 70 million people worldwide. Microstructural change of idiopathic generalized epilepsies (IGE) has been widely reported in children and adult patients. However, previous studies were focused on the chronic patients with antiepileptic drugs. This study aims at using the diffusion tensor imaging (DTI) technique to investigate the microstructural abnormalities of white matter in children with new-onset, untreated IGE.

METHOD AND MATERIALS

A total of 45 IGE patients (age range: 5-18 years, males: females=26:19) and 32 healthy controls (age range: 5-18 years, males: females=21:11) were included in our present study. Voxel-based analysis was used to compare the differences of DTI metrics including fractional anisotropy (FA) and mean diffusivity (MD) between patients and controls. Pearson correlation analysis was used to investigate the relationships between altered DTI metrics and clinical parameters.

RESULTS

After multiple comparison correction using family-wise error method, only the parameter of mean diffusivity (MD) showed significant decrease in the left paracentral lobule, right precuneus and right superior parietal lobule (SPL) in IGE patients compared to healthy controls. Increased factional anisotropy (FA) was found in the deep white matter of bilateral prefrontal lobe in IGE patients at a less conservative level using AlphaSim correction. There was no correlation between the altered diffusion parameters and the clinical measures.

CONCLUSION

Our study demonstrated microstructural impairments in children with new-onset, untreated IGE and that the MD might be more sensitive to detect the microstructural changes in the early stage of IGE than FA. Furthermore, the increased FA and decreased MD in the IGE group might suggest an initiating or compensatory mechanism prior to cognitive decline in IGE patients. Longitudinal studies are needed to clarify the maturational and seizure-related nature of these alterations of brain anatomy, their potential progression over the course of illness in IGE patients, and the potential impact of therapeutic intervention on these processes.

CLINICAL RELEVANCE/APPLICATION

Microstructural abnormalities exist from the very beginning of IGE and MD may be more affected than FA in the initial stage of children with IGE.

SSK16-05 Utility of MRI Brain Epilepsy Protocol in New Onset Seizures: How is it Different in Developing Countries?

Wednesday, Nov. 29 11:10AM - 11:20AM Room: N229

Participants
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PURPOSE

1. To evaluate the diagnostic efficacy of a standard MRI of the brain in patients with first onset seizures. 2. To identify whether there is an increase in the diagnostic yield with the addition of high-resolution sequences with a dedicated seizure protocol. 3. To compare the diagnostic yields of MRI and EEG individually and in combination.

METHOD AND MATERIALS

Patients presenting with a history of first onset seizures who underwent MRI of the brain and EEG. Totally 129 cases were studied for a period of 18 months. Chi square test of significance ($p<0.005$) was used to test for the difference in proportion. The correlation between MRI brain and EEG was studied using McNemer test. All the patients underwent both standard protocol and dedicated epilepsy protocol MRI brain scanning on 1.5T within seven days from the onset of seizures. A routine electroencephalogram is recorded from the scalp electrodes obtained three days before or after the MRI and as soon as practical after presentation with the index seizure, preferably within 48 hours.

RESULTS

The diagnostic yield of MRI in detecting epileptogenic lesion was 47% in our study. Among the potentially epileptogenic lesion, infection and inflammation was most common 17 (28%). Of the 59 patients with potential epileptogenic lesions in our study, 37 (63%) epileptogenic lesions were detected using "standard protocol" MRI and remaining 22 (37%) lesions were detected using "dedicated epilepsy protocol" MRI. Of the epileptogenic lesions, all 11 patients (100%) with hippocampal sclerosis were detected by using "epilepsy protocol" MRI which would have been missed if only "standard protocol" MRI was done. Patients who presented with focal-onset seizures (27) had a higher proportion of potentially epileptogenic lesions 22 (81%) compared with the patients with generalized clonic tonic seizures. There were 22 patients (18%) with an abnormality on both MRI and EEG. So, abnormal MRI and

EEG were concordant in18% of patients in our study.

CONCLUSION

A dedicated epilepsy protocol MRI should be done in all patients who presents with first-onset seizures. MRI in first-onset seizure patients allows the identification of a lesion and earlier consideration of epilepsy surgery especially in patients presenting with focal-onset seizures.

CLINICAL RELEVANCE/APPLICATION

A dedicated epilepsy protocol MRI should be done in all patients who presents with first-onset seizures.

SSK16-06 PET-MRI Value in Detecting 'Occult' Anterior-Inferior Temporal Lobe Encephaloceles in Medically Refractory Focal Temporal Lobe Epilepsy

Wednesday, Nov. 29 11:20AM - 11:30AM Room: N229

Participants
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Robert E. Watson JR, MD, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Temporal lobe anterior-inferior encephaloceles are increasingly recognized as a surgically amenable cause of adult medically-refractory temporal lobe epilepsy. The anatomic defect on MRI exam can be quite subtle and these lesions are frequently overlooked for multiple years and exams. Two such cases led to a review of our PET-MRI experience in imaging-occult medically refractory focal epilepsy.

METHOD AND MATERIALS

PET-MRI has been part of our epilepsy imaging armament since December 2015. A PET-MRI database was created that included patients with refractory focal epilepsy that were considered non-lesional, based on prior MRI exams. The PET-MRI exams were reviewed without knowledge of the specific clinical history or signs and symptoms with a goal of identifying additional cases of anterior inferior temporal lobe encephalocele. Separately, we collected demographic and clinical data from the medical record including age of seizure onset, semiology, EEG and interpretation of prior imaging exams.

RESULTS

Sixty-eight patients were catalogued in our epilepsy PET-MRI database including examinations through March 31, 2017. Four patients were identified with anterior-inferior temporal lobe encepahlocele. Two patients had been identified through clinical evaluation for epilepsy surgery and two additional patients were identified though this retrospective review. The key PET-MRI findings were 1. Decreased FDG uptake in anterior temporal lobe, ipsilateral to the clinical region of concern, 2. FDG activity extending beyond the expected confines of the middle cranial fossa and sphenoid wing, 3. MRI findings of CSF or brain extending into a defect in sphenoid wing, unrecognized on prior exams. Demographic items include: 3 female patients (75%), age: mn= 28 (15-43 range), age from seizure onset mn=9 years (3-18 range). The three female patients demonstrated MRI findings of incranial hypertension or dural ectasia.

CONCLUSION

PET-MRI can be useful as a next-step in evaluation of medically refractory focal temporal lobe epilepsy, particularly in the surgical candidate. Anterior-inferior temporal lobe encephalocele, as a cause of refractory epilepsy, is unusual but a combination of co-localizable findings can identify patients who may benefit from a focal resection.

CLINICAL RELEVANCE/APPLICATION

Temporal lobe encephalocele is emerging as an important, surgically amenable cause of epilepsy. PET-MRI can help with detection.

SSK16-07 Hippocampal Sclerosis with Negative MR Findings: Diagnostic Usefulness of Subfield Volumetric Analysis

Wednesday, Nov. 29 11:30AM - 11:40AM Room: N229

Participants
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PURPOSE

In previous studies, up to 15% of the patients with diagnosis of hippocampal sclerosis (HS) showed normal findings on conventional MRI (neg-MR). Recently, subfield volumetry of hippocampus (SVH) using the open-source automatic segmentation software has been utilized. Our aims were; (a) to study the volume changes of the hippocampal subfields in HS patients using SVH, and (b) to determine the diagnostic accuracy of the SVH for the HS patients with neg-MR.

METHOD AND MATERIALS

We assessed 46 unilateral HS patients and 54 controls; all HS cases had histopathologic confirmation by surgery. Two neuroradiologists divided the HS patients into two groups based on the presence (pos-MR, n=26) or absence (neg-MR, n=20) of following MR findings at the affected hippocampus; reduced volume or increased T2 signal. For SVH analysis, 3D-volume T1-weighted images were processed with FreeSurfer (ver.5.3, ver.6.0) in all patients and controls. The ratio to total intracranial volume were calculated for each subfield and compared among the two groups. The diagnostic accuracy (AUC) were calculated using cutoff values for the hippocampal subfield volumes that were obtained in a ROC analysis.

RESULTS

In the pos-MR group, 8 of 9 subfields at the affected side (CA1, CA3, CA4-DG, fimbria, hippocampal-amygdala transitional area, presubiculum, hippocampal tail, and subiculum) were significantly smaller than in the controls. In the neg-MR group, however, only 2 of 9 subfields (CA3 and CA4-DG) were significantly smaller than in the controls. The diagnostic accuracy of the discrimination of the HS patients with neg-MR was better for the SVH based on the volumes of CA3 and CA4-DG (AUC: 0.719) than for the volume of the whole hippocampus (AUC: 0.614).

CONCLUSION

In the MR-negative HS patients, the subfield volumetry detected the localized atrophy within CA3 and CA4-DG, and showed better diagnostic performance than the whole hippocampal volume.

CLINICAL RELEVANCE/APPLICATION

In the mesial temporal epilepsy patients with normal findings on conventional MRI, SVH may be used not only for the diagnosis of HS but also for the assessment of its histopathologic subtypes.

SSK16-08 Longitudinal Functional Connectivity of Language Networks in Surgical Epilepsy Patients: Preliminary Results

Wednesday, Nov. 29 11:40AM - 11:50AM Room: N229

Participants
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PURPOSE

Investigating the reorganization of language networks in temporal lobe epilepsy (TLE) patients with task-based functional MRI (fMRI) before and after selective amygdalohippocampectomy or anterior temporal lobectomy (ATLR).

METHOD AND MATERIALS

Eighteen TLE patients (8 left TLE, 10 right TLE) performed task-based fMRI using a verb generation and a semantic paradigm before and after neurosurgery (9 ATLR; mean age at surgery: 38y, range: 26-53y). Mean time between surgery and postoperative scan was 14.9 months (range: 3-44m). Neuropathology revealed hippocampal sclerosis in 13 patients, focal cortical dysplasia in 4 patients and ganglioglioma in one patient. Ten healthy right-handed subjects underwent the same fMRI protocol on the same 3T scanner (mean age: 38y, range: 31-49y). FMRI activation maps and functional connectivity (FC) were analyzed on SPM12 for intra- and intergroup comparisons ($p<0.005$ uncorr.).

RESULTS

Compared to controls, patients showed decreased FC ipsilateral to their epileptogenic focus before and after surgery. In comparison to scans before surgery, postoperative left TLE patients had markedly decreased FC involving the left TL with particularly less connections to the right frontal lobe, stronger connections were visible including the residual left posterior TL and the right TL. In postsurgical right TLE, inter- and intrahemispheric FC to the right TL was decreased with only few stronger postsurgical connections exclusively found in the left hemisphere.

CONCLUSION

Task-based fMRI functional connectivity analysis visualizes extensive language related reorganization processes in TLE patients following surgery. Patterns of reorganization in language FC differ between left- and right-sided TLE with more extensive changes in left TLE patients.

CLINICAL RELEVANCE/APPLICATION

Temporal lobe epilepsy (TLE) surgery triggers widespread changes of language-related functional connectivity (FC). FC analysis allows us to link specific clinical deficits with certain neuroanatomical and imaging substrates. This will help to optimize surgical approaches and minimize postoperative language deficits in individual TLE patients.

SSK16-09 DTI-Derived Textural Features Can Improve Detectability of Epileptogenic Tubers in Tuberous Sclerosis Complex

Wednesday, Nov. 29 11:50AM - 12:00PM Room: N229

Participants
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Iren Orosz, MD,PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Noriko Salamon, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Diffusion tensor imaging (DTI)-derived quantitative values such as maximum apparent diffusion coefficient (ADC) were reported as predictors of epileptogenic tubers in tuberous sclerosis complex (TSC). Texture of tubers, volume and location were also known predictors of epileptogenicity. The purpose of this study was to document detectability of texture analysis for DTI, which can combine the information of DTI and textural heterogeneity.

METHOD AND MATERIALS

Twenty-five consecutive studies involving 23 patients were involved in this study. Epileptogenic tubers were characterized using video-encephalographyEEG, structural MRI, FDG-PET, magnetoencephalography, magnetic source imaging (MSI) and intraoperative electro-corticography. A total of 558 tubers, 32 epileptogenic and 526 nonepileptogenic, were identified. The volume of interest (VOI) of tubers was drawn on an ADC map based using T2-weighted and FLAIR images. The original VOI was inflated to include 4-mm-thick ring-shaped tissues surrounding the tuber. Histogram- and 3-dimentional 13-direction gray-level co-occurrence matrix (GLCM)-based textural features were extracted from the VOIs using ADC, fractional anisotropy, axial diffusivity and radial diffusivity maps. Mann-Whitney U-test with false discovery rate control was used to compare the features. The diagnostic model was constructed with an elastic net model to avoid overfitting. The model was compared with known predictors using receiver operating characteristic analysis and DeLong test.

RESULTS

A total of 122 features was derived from each VOI. There were no significant difference in features derived from the original VOI between epileptogenic vs non epileptogenic tubers. By contrast, 32 of 122 features showed significant differences on the inflated VOI. The diagnostic model was significantly better than the ROC curves of maximum ADC, volume and location (area under curve = 0.75 vs. 0.67 and 0.55; P = 0.042 and 0.001). The model did not significantly surpass tuber volume (0.75 vs. 0.71, P = 0.119).

CONCLUSION

Texture analysis using inflated VOI showed improved diagnostic performance to differentiate between epileptogenic and nonepileptogenic tubers. The VOI within the tuber was not useful for DTI-based texture analysis.

CLINICAL RELEVANCE/APPLICATION

DTI-derived texture analysis with VOI including perituber tissue can improve detectability of epileptogenic tubers in tuberous sclerosis complex.

SSK17

Physics (MR: New Techniques, System Evaluation)

Wednesday, Nov. 29 10:30AM - 12:00PM Room: S404AB

MR PH SQ

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

Participants
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Sub-Events

SSK17-01 Blipped Radial CAIPIRINHA for Simultaneous Multislice pseudo-SSFP Magnetic Resonance Fingerprinting

Participants
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PURPOSE

The purpose of the present work is to accelerate pseudo steady-state free-precession magnetic resonance fingerprinting (pSSFP-MRF) T1 and T2 mapping sequences with simultaneous multislice (SMS) imaging methods.

METHOD AND MATERIALS

Controlled aliasing (CAIPI) techniques are useful for improving the image quality from SMS acquisitions. For multi-shot non-Cartesian k-space trajectories, as is the case for most MRF acquisitions, CAIPI takes the form of modulating the phase of one or more SMS slices relative to the others from readout-to-readout. This is usually accomplished by means of RF phase cycling. An underlying assumption of the pSSFP-MRF method, however, is that all slices experience a sign change of RF phase in consecutive excitations, thus prohibiting the use of RF phase cycled CAIPI. Gradient blips along the slice-selection axis allow similar CAIPI phase modulation without the use of RF phase patterns. This work employs a blipped-CAIPI acquisition with a radial trajectory for pSSFP-MRF. The SMS pSSFP-MRF sequence was implemented on a Siemens 3T scanner. The gradient blips were applied to induce a phase difference of pi/2 between two simultaneously excited slices. The sign of the gradient blip changed in each subsequent spoke which rotates with the golden angle of ~111.246 degrees. A total of 881 spokes were acquired in approximately 5 seconds. To reconstruct images of each slice, the conjugate of the blip-induced phase of the slice-of-interest was added to each spoke. A dictionary was simulated, and T1 and T2 maps were reconstructed using the low rank (R=5) alternating direction method of multipliers (ADMM) technique. The brain of a glioblastoma patient who consented to be a part of an institutional review board approved study was scanned.

RESULTS

The T1 and T2 maps of two simultaneously excited slices are shown in the figure. Total acquisition time was 5 seconds. No slice-leakage is apparent. The relaxation times outside of the tumor agree with literature values for healthy brain tissue. Lengthened T1 and T2 values can be seen within the lesion.

CONCLUSION

A blipped radial CAIPI pSSFP-MRF sequence permits rapid T1 and T2 mapping for use in disease diagnosis, treatment planning, and response assessment.

CLINICAL RELEVANCE/APPLICATION

This work aims to further push the acceleration of pSSFP magnetic resonance fingerprinting scans to aid in the clinical adoption of fully quantitative imaging protocols.

SSK17-02 First Clinical Assessment of kT-Points Dynamic RF Shimming on Abdominal DCE-MRI in a Commercial 3T MRI Scanner

Wednesday, Nov. 29 10:40AM - 10:50AM Room: S404AB

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PURPOSE

The 'B1 artefact' is an important challenge for abdominal MRI at 3T. Our aim was to assess excitation homogeneity and image quality achieved in the liver by kT-points pulses, compared to patient-tailored static RF-shimming.

METHOD AND MATERIALS

The prototypical non-selective kT-points pulse design was compared with patient-tailored static RF shimming for 3D breath-hold liver DCE-MRI on a product dual-transmit MAGNETOM Skyra MRI (Siemens Healthcare). 50 consecutive patients referred for liver MRI at a single institute were included in this IRB-approved study. Quantitative analysis was carried out via simulation to estimate flip angle homogeneity. Signal homogeneity, T1 contrast, enhancement quality, structure details and global degree of trust provided by each technique were qualitatively assessed on a 4-level scale (0 to 3) by 2 radiologists on in vivo pre-injection and late-phase images from 20 acquisitions selected from the pool. An exact matched-pairs one-tailed Wilcoxon signed-rank test was used to compare the methods.

RESULTS

Average excitation inhomogeneity was significantly reduced with kT-points compared to static RF-shimming (mean flip angle error ± standard deviation: 8.5±1.5% vs 20.4±9.8% respectively; $p<0.0001$). The worst case (heavy ascites) was 13.0% (kT-points) vs 54.9% (RF-shim). KT-points qualitative grades were higher for all criteria. Global image quality was significantly higher for kT-points than for RF-shimming (mean grade ± standard deviation: 2.3±0.5 vs 1.9±0.6; $p=0.008$). One subject's examination was judged unusable (0/3 for all criteria) with RF-shim by one reader and none with kT-points. 85% of kT-points acquisitions were graded at least 2/3, compared to only 55% in the static RF-shim case.

CONCLUSION

KT-points significantly reduce excitation inhomogeneity both quantitatively and qualitatively, especially in patients with ascites and prone to 'B1 artefact'.

CLINICAL RELEVANCE/APPLICATION

Proper excitation homogeneity is crucial to take advantage of the high signal-to-noise ratio available at 3T. KT-points improve 3T MRI for abdominal imaging of all patients.

SSK17-03 Multi-Compartmental Analysis Using a Fast Multi-Echo TSE Sequence for Prostate Cancer Diagnosis

Wednesday, Nov. 29 10:50AM - 11:00AM Room: S404AB

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PURPOSE

Prostate tissue has three major histological components: stroma, glandular lumen and epithelial cells. These volume fractions change when cancer is present. This study evaluates the feasibility of measuring the volume fractions of these compartments quantitatively in normal prostate and prostate cancer (PCa) using multi-compartment T2 decay modeling. A fast multi-echo TSE T2 MRI (k-t-T2) was applied to obtain high resolution T2 maps in clinically feasible scan time. Signal contributions from the three compartments were compared with pathological slices as a gold standard.

METHOD AND MATERIALS

k-t-T2 data were acquired on 17 patients on Philips 3T Achieva scanner; this method uses k-space under sampling for image acquisition to accelerate the scan. TR=3.1-10s; 32 echoes; ΔTE=12ms (TE=24-396ms); 1.0x1.0x3 mm3 in-plane resolution, scan time=4.5-9.6min. Regions of-interest (ROIs) including PCa (n=28) and normal prostate (n=43) were identified through histologic and MRI consensus review. Voxel-based three compartment analysis was used to extract the epithelial, lumen and stromal volume fractions, and T2 value of each compartment, in each ROI. Kruskall-Wallis test and Welch two sample t-test were used to evaluated the statistical significance between ROI groups. Spearman correlation coefficient was calculated between the image features and ROI-specific Gleason scores (GS).

RESULTS

ROI based analysis results showed the volume fraction of epithelium (50±12% vs. 37±10%) and lumen (11±6% vs. 21±7%) are

significantly different between PCa and normal prostate (p<0.01). There is no significant difference in stromal volume fraction (39±9% vs. 41±8%) between PCa and normal prostate (p>0.5). The volume fractions measured by MRI are close to those reported in previous histological studies. The volume fractions of epithelial cells and lumen are strongly correlated with GS (ρ =0.53; -0.41, p<0.05). Epithelial volume fraction in PCa correlates better with GS compared to T2 values (ρ=-0.41, p=0.02).

CONCLUSION

Multi-echo k-t-T2 sequence is feasible in clinical setting. Volume fractions obtained from three compartment model fitting of spin echo signal decay sampled at multiple TE's may help to characterize prostate lesions and may be sensitive to Gleason grade.

CLINICAL RELEVANCE/APPLICATION

New features extracted from multi-echo TSE images are more sensitive to prostate cancer and Gleason score than T2 values alone which may improve prostate cancer 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/ Aytekin Oto, MD - 2013 Honored EducatorAytekin Oto, MD - 2017 Honored Educator

SSK17-04 Comparison between Readout Segmented Diffusion Weighted Imaging and Single Shot Echo Planar Imaging in Image Quality

Wednesday, Nov. 29 11:00AM - 11:10AM Room: S404AB

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PURPOSE

To compare difference of readout segmented diffusion weighted imaging (RS-EPI) and single shot echo planar imaging (SS-EPI) on image quality with ultra-high b value for prostate cancer detection.

METHOD AND MATERIALS

37 patients with prostate disease who underwent both RS-EPI and SS-EPI were enrolled in this study. All data were collected on a MAGNETOM Skyra 3T MR scanner (Siemens AG, Erlangen, Germany) with the b value of 0,1000,2000,3000s/mm2. The image quality including lesions clarity, anatomical distortion, image sharpness, detail display based on diffusion weighted imaging (DWI) were classified according to Likert score into 1 to 5 grade.(Grade 1 : cannot be used for diagnosis; Grade 2: poor; Grade 3: acceptable; Grade 4: good; Grade 5: very good.) All the images were analyzed by two experienced radiologists blinded to any clinical information as well as MR sequence information. The classification was provided from two radiologists separately. The signal-to-noise ratio (SNR), and contrast ratio, and contrast to noise ratio (CNR) were also measured on workstations by the radiologist.

RESULTS

The scores concluded by the two radiologists have good consistency, Kappa value>0.80. The image quality including lesions clarity, anatomical distortion, image sharpness, detail display obtained from RS-EPI sequences were higher than those obtained from SS-EPI regardless of 1000,2000,3000s/mm2 (P<0.001). The signal-to-noise ratio (SNR), and contrast ratio, and contrast to noise ratio (CNR) measured on RS-EPI sequences were also higher than those measured on SS-EPI (P<0.001) (table1).

CONCLUSION

Compared with the SS-EPI sequence, ultra high b value RS-EPI sequence significantly improves the image quality, which is more conducive to the detection of prostate lesions.

CLINICAL RELEVANCE/APPLICATION

Compared with the SS-EPI sequence, ultra high b value RS-EPI sequence significantly improves the image quality, which is more conducive to the detection of prostate lesions.

SSK17-05 Magnetic Resonance Water-Fat Separation using Deep Machine Learning

Wednesday, Nov. 29 11:10AM - 11:20AM Room: S404AB

Participants
James W. Goldfarb, PhD, Roslyn, NY (*Presenter*) Nothing to Disclose

PURPOSE

The goal of this study was to develop, train and evaluate a convolutional neural network for decomposition of cardiovascular MR images into separate water and fat images with additional calculation of R2* and off-resonance.

METHOD AND MATERIALS

1204 cardiac images in multiple anatomical orientations from 90 imaging sessions acquired at 1.5T using a dark blood double inversion recovery multiple spoiled gradient-echo sequence (TR=20ms; 12 TEs=2.4-15.5ms (1.2ms spacing), bipolar gradient acquisition) were included in this study. This included 15 acute myocardial infarction (MI), 24 sub-acute MI, 34 chronic MI subjects and 17 normal subjects. Water-fat separation was initially performed with a conventional model based technique providing water, fat, R2* and off-resonance images for deep learning training. A U-Net convolutional neural network (CNN) was used for deep learning. The input to the CNN was 24 real and imaginary images from 12 TEs. The output of the CNN was four images (water, fat, R2* and off-resonance). The implementation was done using open source software written in Python v2.7 with the TensorFlow v1.1 and Keras v2.0 machine learning libraries. Training on 900 (x12 echo-times) complex images with 50 epochs was performed using the Adam optimizer with Nestrov momentum. Water and fat images from the data not used for training (n=304) were predicted using the trained CNN. Water-fat fraction images were constructed for both the conventional and deep learning approaches.

RESULTS

Water-fat separation performed well across all image slice orientations. Signal-to-noise was better in the deep learning images when compared to conventional images, $p<0.001$. Fine details were preserved in the deep learning images when compared to conventional images. There was an excellent correlation ($R2=0.97$, $p<0.001$) between the conventional and deep learning fat fraction measurements. Multiple pathologies were visualized with deep learning, including fatty metaplasia (Fig 1a) and intramyocardial hemorrhage (IMH) Fig 1b.

CONCLUSION

Deep learning is a robust, efficient, feasible method for water-fat separation. After the learning phase, utilization is computationally efficient and can make use of echoes with bipolar gradients.

CLINICAL RELEVANCE/APPLICATION

Deep machine learning can provide fat suppressed images and quantitative fat fraction maps with R2* and off-resonance corrections in challenging situations such as cardiovascular imaging.

SSK17-06 Analysis of Different Image Registration Algorithms for Fourier Decomposition MRI in Functional Lung Imaging

Wednesday, Nov. 29 11:20AM - 11:30AM Room: S404AB

Participants
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PURPOSE

To evaluate different image registration algorithms for Fourier decomposition MRI (FD-MRI) in functional lung imaging in healthy subjects.

METHOD AND MATERIALS

Fifteen healthy volunteers (mean age 33.0±10.1 years) were examined on a 1.5 T whole-body MR-scanner (Magnetom Avanto, Siemens AG) with a non-contrast enhanced 2D-TrueFISP pulse sequence in coronal view (TR/TE 2.06/0.89 ms, acquisition time 180 ms/image, 250 images). No ECG or respiratory triggering was used. Three different image registration algorithms (fMRLung 3.0, Siemens Corporate Research; diffeomorphism based ANTs by Avants et al. NeuroImage 2011; Elastix by Staring et al. Medical Physics 2007) were used to compensate the spatial variation of the lung structure. Quality control for the image registration was performed by quotient images (ΔQ) and dice similarity coefficient (ΔD). The impact of the used registration algorithms on the calculated perfusion and ventilation values by Fourier decomposition method was evaluated.

RESULTS

The average time for motion correction by the different image registration algorithms were for fMRILung 1.0±1.6 min, ANTs 38±13.5 min and Elastix 5.9±1.3 h, respectively. No significant ($p>0.05$) difference in the quality of the motion correction provided by different image registration algorithms (ΔQ fMRILung 0.12, ANTs 0.11, Elastix 0.11; ΔD fMRILung 0.06, ANTs 0.07, Elastix 0.06) occurred. Further no significant difference of the calculated ventilation and perfusion values between the different registration algorithms ($p>0.05$) were determined. The calculated ventilation values were 119±12 for fMRILung, 110±14 for ANTs and 118±12 ml/min/100 ml for Elastix, respectively. The perfusion values for fMRILung, ANTs and Elastix were 156±41, 166±46 and 185±66 ml/min/100 ml, respectively.

CONCLUSION

The mandatory motion correction for the calculation of perfusion and ventilation images by FD-MRI is possible with different image registration algorithms without significant influence on the quality of the motion correction or changes of the calculated functional lung values. fMRILung 3.0 (Siemens Corporate Research) provides the fastest way of motion correction.

CLINICAL RELEVANCE/APPLICATION

Motion correction for FD-MRI is possible with different image registration algorithms without loss of accuracy of perfusion and ventilation results.

SSK17-07 MRI Quantitative Quality Control and Calibrated Measurement with DTI and Reference Fluid Phantom Novel Phantom for Quantitate Assessment of DTI Inters Canner Variability

Wednesday, Nov. 29 11:30AM - 11:40AM Room: S404AB

Participants
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CONCLUSION

Current DTI scanning has substantial systematic error, distorting measurement and impairing clinical diagnostic stability. Phantom calibration can quantify such errors and may provide a means for a correction factor to reduce variability across scanners.

Background

We used a novel DTI and isotropic fluid phantom funded by the Chronic Effects of Neurotrauma Consortium, VA, DoD & NIH QIBA programs to provide "ground truth" reference measurement and quality assurance metrics.

Evaluation

The phantom contains anisotropic diffusion components of hollow textiles termed Taxons (axon-shaped tubes, 12-µm inner diameter diffusion chambers) arranged in water-filled bundles of > 100,000. To quantify loss of tract integrity and size, we created tracts with densities of 12.5%- 100% and tract cross-sections of 4-100 mm2. The phantom includes 32 NIST reference fluids (T1, T2, PD, ADC) for isotropic reference metric correction. We imaged on 11 scanners (1.5T and 3T, Siemens, GE & Phillips) with head coils 12-64 channels. Scans detected tracts with high spatial detail at all sizes (average correlation of FA to tract density r=0.992). We found tight repeat measurements, with small changes between scans on the same magnet within a few weeks. However, substantial (35%) inter-scanner systematic error/biases in measurements of FA were seen, greatly exceeding presumed effect size of TBI-induced FA change and 2.85 times the variance within scanner. We applied a reference measurement correction by estimating scanner-specific systematic error on one scan and applying that correction to a second scan weeks later to calculate calibrated FA relative to the mean cross-scanner FA to reference density metrics. The correction reduced the across-scanner spread error by 94%.

Discussion

The phantom provides a reliable and reproducible method to determine degree to which DTI scans on a MR scanner differ from a reference standard that simulates the microstructure of brain white matter. The phantom also allows a means to determine the degree to which DTI scans from multiple scanners differ from one another and, potentially, a method to correct for inter-scanner differences.

SSK17-08 A Quality Improvement (QI) Initiative to Evaluate MR QA Training Strategies for MR Technologists to Enable Them to Undertake Quality Assurance (QA) Testing in MRI

Wednesday, Nov. 29 11:40AM - 11:50AM Room: S404AB

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PURPOSE

The American College of Radiology (ACR) standard recommends that quality assurance (QA) testing of MR systems is the responsibility of both technologists and medical physicists to ensure efficient scanner performance. However, in the Kingdom of Saudi Arabia (KSA), meeting this standard is challenging due to a shortage of medical physicists, variable MR-specific education amongst technologists, and difficulties in achieving standardisation across centres providing MR imaging services. These factors have contributed to low compliance with recommendations for the performance of MR QA tests. This study explored the development of an education-based Quality Improvement (QI) initiative to enable MR technologists across multiple clinical sites to consistently perform MR system QA testing. The authors aimed to develop an educational tool to provide MR QA training to technologists enabling them to undertake this activity in their departments.

RESULTS

There was 95% agreement between the expert-determined and technologist-determined MR QA test results. Interview findings revealed that all technologists reported that the test methods presented in the training video were clear and logical, and enabled them to perform practical QA testing of their scanner. 12% of technologist participants (n=1) acknowledged some difficulty positioning the QA phantom, and 50% (n=4) indicated challenges interpreting the test pattern appearances due to the inherent subjectivity of the low contrast detectability QA test. All participants indicated that their experience of MR QA training was positive, using expressions such as "I enjoyed it", "It was a positive experience", and "very good experience", "It showed me what I can do with the right training". Technologists indicated they had learned a new skill to help them improve the quality of the MR imaging service they provide, and were willing to continue undertaking QA testing, seeing this as one way to expand their professional role.

CONCLUSION

With the ongoing shortage of medical physicists in KSA and other countries, the training video introduced as a QI initiative

With the ongoing shortage of medical physicists in KSA and other countries, the training video introduced as a QI initiative demonstrated the effectiveness of an appropriately designed educational resource combining both technical information and practical skills demonstration. The ease of access and display means that this educational tool can readily be made available to MR technologists across multiple centres in KSA, as a strategy to prevent a shortage in expert personnel limiting the implementation of practices to optimise MR service quality. The broader application of the methods applied during this education-based QI is apparent.

METHODS

Educational Tool Design: A training video was designed to demonstrate MR QA test methods and provide background explanatory information. sing a focus group discussion framework, the research team, comprising two medical physicists and four MR technologists, reached consensus regarding the essential content and presentation format, drawing on ACR MR QA guidelines and the expertise of group members. Based on ACR recommendations, the method for the following QA tests was planned: central frequency, geometric accuracy, high-contrast spatial resolution, low-contrast detectability, image intensity uniformity and signal-to-noise ratio (SNR). Each test was broken down into logical steps which included: MR QA phantom design features, set-up and positioning, pulse sequence and parameters and use of MR images to provide numerical indicators of MR system performance. The performance of these steps by the research team members for each QA test was videoed in sequential order to make it easy for the MR technologists to follow the test method. Editing of the video footage and overlay of audio content was performed by a videographer in consultation with the research team. Educational Tool Evaluation: MR technologists (n=8) in one public (n=4) and one semi-public (n=4) hospital in KSA evaluated the QA training video. Technologists were given supervised access to this resource for two 30-minute sessions per day over one week. A supporting booklet outlining the test methods was also provided. On completion of the educational intervention, each technologist was asked to implement the QA test process in their MRI department for a three-month period by individually conducting weekly QA testing on the MR scanner and documenting the images and numerical results for each test. These findings were compared to images and values independently determined for the same QA tests on each MR scanner as performed by an expert in MR QA following the methodology outlined in the training video. Face-to-face semi-structured interviews were conducted with each technologist to ascertain their opinion regarding the effectiveness of the QA training video and their experiences undertaking the QA tests.

PDF UPLOAD

https://abstract.rsna.org/uploads/2017/17016601/17016601_ox5k.pdf

SSK17-09 A Microwave Imaging System and Real-Time Image Reconstruction Algorithm for Intraoperative 3D Monitoring of Thermal Ablation Therapies

Wednesday, Nov. 29 11:50AM - 12:00PM Room: S404AB

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CONCLUSION

We proposed a 3D real-time microwave monitoring method and synthetically validated it for interstitial thermal therapy monitoring. We will further validate on animal models before moving to clinical trials. With this intraoperative temperature monitoring, radiologists will be able to more selectively target tumors, extend the application of thermal ablation to new therapeutic areas, and reduce surgery time.

Background

Thermal ablation is a minimally invasive surgery that is gaining increasing popularity as first-line therapy for soft-tissue tumors. However, its application has been limited by inadequate thermal image guidance. Fiber optic sensors measure temperature only at their tips. B-mode ultrasound is limited to 2D. MRI is not available within the operating room and adds 30-40 minutes to surgery time. To address these challenges, we have developed a microwave monitoring system that can intraoperatively provide a 3D real-time temperature map. The system consists of a multi-antenna imaging cavity, where microwave measurements are collected with a network-analyzer-based measurement system. The data is processed with a differential inverse scattering algorithm, which generates real-time 3D temperature images through a mapping between tissue dielectric change and temperature. In our prior work, the system has been experimentally validated using laboratory phantoms heated with an ablation probe.

Evaluation

To synthetically test the monitoring of the ablation process in the case of brain tumor treated with thermal therapy, we derived a 3D dielectric brain phantom from MRI and simulated the heating of the target region with a multi-physics model of an interstitial ablation probe. In the test, the target region is heated from 37 °C to 70 °C, and 3D temperature maps are generated throughout the procedure.

Discussion

Sample validation results are shown in the figure attached. The 3D temperature maps can be generated as fast as 1 frame/second, provide a resolution of 1 cm, and can track temperature change as small as 1 °C. To further improve temperature accuracy, the mapping model between dielectric and temperature change is currently being refined with empirical studies using *in vitro* tissue samples.

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MSRT43

ASRT@RSNA 2017: Rapid Screening Breast MRI - Protocol, Benefits and Financial Impact

Wednesday, Nov. 29 10:40AM - 11:40AM Room: N230B

BR MR

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

Participants
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LEARNING OBJECTIVES

1) Learn the Rapid MRI protocol sequences, the developed reading criteria, and how they give the 'average' MRI radiologist the ability to significantly reduce interpretation time and cut biopsy rates nearly in half. 2) Understand how screening breasts with MRI shifts time of cancer detection up to 6 years earlier than other screening modalities. 3) Identify the three basic steps for evaluating suspicious lesions and six reasons why kinetic evaluation is important to retain in an abbreviated protocol. 4) Discuss the impact a national MRI screening program could have on reducing costs and saving lives. Identify eight financial advantages for insurance carriers who pay for annual screening breast MRIs. 5) Learn how benign lesions as well as malignancy lesions played a critical role in developing the protocol.

ABSTRACT

Several key 'firsts' not published by any other authors... *Recording of all mammographically missed lesions, benign as well as malignant, and the surprising discovery of 452 missed lesions in 234 of 671 women who had a recent negative screening mammogram. *Development of a unique method to correctly identify the proper abbreviated MRI protocol...by letting each acquisition, in and of themselves, define which would work and which would not work in a breast screening environment. *First time initial baseline reading criteria was developed usable by all radiologists, not just 'expert radiologists' allowing biopsy rates to be cut nearly in half compared to any other screening modality. *Requirement to retain important kinetic information in the breast MRI protocol. *The realization of the importance of kinetic activity over morphology in evaluating small lesions - those lesions that would be expected in a MRI breast screening environment. *The time difference between a 3-minute protocol and a 6-minute protocol has no impact on overall patient throughput. *By establishing baseline reading criteria and using our shortened protocol, recall rates are near zero. *Discovering screening with mammograms are viable for women with fatty breasts (half the female population) and, therefore, MRI is not necessarily needed in this subgroup. *The important role benign lesions play in defining the correct acquisitions. *The first time a 4- to 6 year earlier pick up was realized, based on 16.3 new cancers per 1000 women. Breast MRI essentially shifts time of detection up to 6 years earlier than screening the same group of women with mammography. *We identified substantial dollars saved by insurance companies (and patients as well) in 10 major categories. The estimated total dollar savings are high enough (2,000%+ ROI) to absorb the cost of both mammograms and MRI and still yield a significant net savings. *The realization that 715 women in our modest-size county, who have had a negative mammogram within the last 12 months, have breast cancer and their identities are unknown to anyone...except for the women who have had a Rapid Screening Breast MRI.

Active Handout:David A. Strahle

http://abstract.rsna.org/uploads/2017/17001469/Active MSRT43 11.20.17.pdf

MSSR43

RSNA/ESR Hybrid Imaging Symposium: Hybrid Imaging in the Male (An Interactive Session)

Wednesday, Nov. 29 1:30PM - 3:00PM Room: S402AB

GU MR NM

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

Participants
Alexander Drzezga, MD, Cologne, Germany (*Moderator*) Consultant, Siemens AG; Consultant, Bayer AG; Consultant, General Electric Company; Consultant, Eli Lilly and Company; Consultant, The Piramal Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company; Speakers Bureau, Eli Lilly and Company; Speakers Bureau, The Piramal Group
Katrine Riklund, MD, PhD, Umea, Sweden (*Moderator*) Nothing to Disclose

Sub-Events

MSSR43A Prostate Cancer: PET, MR or Both?

Participants
Frederik L. Giesel, MD, MBA, Heidelberg, Germany (*Presenter*) Patent application for F18-PSMA-1007

LEARNING OBJECTIVES

1) Learn about pathophysiology in prostate cancer. 2) Understand how to interpret hybrid imaging of prostate cancer. 3) Learn about the role of hybrid imaging in staging, treatment evaluation and follow-up.

MSSR43B Prostate Cancer: Novel Tracers

Participants
Steven P. Rowe, MD, PhD , Parkville, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn about novel tracer and their biochemical properties. 2) Understand the differences of information given by the use of different tracers. 3) Understand how to interpret examinations with different tracers.

MSSR43C Interactive Case Discussion

Participants
Frederik L. Giesel, MD, MBA, Heidelberg, Germany (*Presenter*) Patent application for F18-PSMA-1007
Steven P. Rowe, MD, PhD , Parkville, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how to interpret hybrid imaging of prostate cancer. 2) Understand the pathophysiology in relation to imaging.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

SSM03

Cardiac (Congenital Cardiovascular Disease)

Wednesday, Nov. 29 3:00PM - 4:00PM Room: S502AB

CA CT MR

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

FDA Discussions may include off-label uses.

Participants
Randolph K. Otto, MD, Seattle, WA (*Moderator*) Nothing to Disclose
Evan J. Zucker, MD, Stanford, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSM03-01 Self-Navigated Free-Breathing Radial Whole-Heart MR Angiography for the Assessment of Coronary Artery Anatomy in Congenital Heart Disease

Wednesday, Nov. 29 3:00PM - 3:10PM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Domenico Mastrodicasa, MD, Charleston, SC (*Presenter*) Nothing to Disclose
Moritz H. Albrecht, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Georg Apfaltrer, MD, Thal, Austria (*Abstract Co-Author*) Nothing to Disclose
Taylor M. Duguay, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; ; ;
Matthias Stuber, PhD, Lausanne, Switzerland (*Abstract Co-Author*) Founder, Diagnosoft, Inc Stockholder, Diagnosoft, Inc
Davide Piccini, Lausanne, Switzerland (*Abstract Co-Author*) Employee, Siemens AG
Arni C. Nutting, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Anthony M. Hlavacek, MD, Charleston, SC (*Abstract Co-Author*) Investigator, Siemens AG Research Grant, Siemens AG
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Philipp L. von Knebel Doeberitz, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Megha Penmetsa, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
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Antonio R. Cotroneo, MD, Chieti, Italy (*Abstract Co-Author*) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

To assess a free-breathing self-navigated three-dimensional (SN3D) radial whole-heart MR angiography (MRA) pulse sequence for the evaluation of coronary artery (CA) anatomy in patients with congenital heart disease (CHD).

METHOD AND MATERIALS

SN3D datasets were previously acquired in 109 patients (20.1±11.8 years) as part of a prospective clinical trial for the assessment of CHD anatomy using a 1.5T scanner. SN3D datasets, retrospectively evaluated by three radiologists, were scored based on the appearance of CA segments and reader confidence in determining CA dominance using a two-point scale. A three-point scale was used to rate overall image quality along with the ability to freeze cardiac and respiratory motion. Vessel sharpness of the internal thoracic artery (ITA, representing respiratory motion), the left anterior descending (LAD) and right CA (RCA, representing a combination of respiratory and cardiac motion) were quantitatively measured using a dedicated prototype application (SoapBubble). Wilcoxon statistics, Pearson correlation, and Intra-Class Correlation (ICC) were used to evaluate the data.

RESULTS

The average duration of the SN3D acquisition was 9.1±2.4 minutes. The mean score for overall image quality was 2.35, with excellent agreement (ICC 0.95). A diagnostic study was obtained in 83.7% of scans with excellent image quality in 51.7% of them. The SN3D technique was able to successfully visualize the individual CAs in the following percentage of cases: left main 92.6% (ICC 0.66), LAD 88.3% (ICC 0.59), RCA 87.8% (ICC 0.55), left circumflex 82.8% (ICC 0.74), posterior descending 50.2% (ICC 0.46), and first diagonal 39.8% (ICC 0.64). Diagnostic confidence for the assessment of CA dominance was scored at 1.56. Image quality was affected more by cardiac motion freezing (mean score, 2.18; Pearson's r=0.73, P<0.029) than respiratory motion freezing (mean score, 2.20; r=0.58, P<0.029). The ITA, RCA, and LAD vessel sharpness scores were 53.1, 52.5, and 48.7%, respectively.

CONCLUSION

In the majority of young CHD patients, SN3D MRA allows for the visualization of the proximal CAs with excellent quality. However,

the quality of cardiac motion freezing still has a strong impact on image quality.

CLINICAL RELEVANCE/APPLICATION

SN3D MRA is a promising technique in CHD patients especially when impaired breath-holding capacity limits the visualization of CA anatomy due to motion artifacts.

SSM03-02 Evaluation of 3D Magnetic Resonance Imaging of Autopsied Human Heart Specimens for Computational Modeling of Congenital Heart Diseases

Wednesday, Nov. 29 3:10PM - 3:20PM Room: S502AB

Participants
Wataru Ueki, RT, Suita, Japan (*Presenter*) Nothing to Disclose
Yoshiaki Morita, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Masaru Shiotani, RT, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Ryo Haraguchi, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Taka-Aki Matsuyama, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Yukishige Tanida, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuto Harumoto, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Atsushi K. Kono, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose
Tetsuya Fukuda, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Autopsied human heart specimens of congenital heart disease are valuable for medical education and surgical simulation in understanding complex anatomical structure. Because of the decreasing number of autopsies and the deterioration of human heart specimens over time, digitalization, such as computational modeling using 3D image data, is an effective approach to capture these valuable specimens. This study aimed to compare the visibility of formalin-fixed heart among various 3D MRI sequences and to clarify the optimal sequence for the computational modeling of congenital heart disease.

METHOD AND MATERIALS

Five human hearts with various types of congenital heart diseases obtained during autopsy and preserved with formalin fixation underwent ex vivo MRI with a 3T clinical machine. The different types of 3D MRI sequences were performed in the same spatial resolution (1.0*1.0*1.0mm): T2-SPACE (3D with a constant flip angle to acquire bright blood imaging), True-FISP (SSFP imaging), MPRAGE (inversion-recovery-based T1WI), and FLASH (basic GRE sequence). The autopsied heart was scanned in a plastic container filled with normal saline. Among the four 3D sequences, we compared the contrast ratio between the myocardium and the ventricular lumen and between the vascular wall and the lumen. In addition, we visually assessed the cardiovascular structure using MPR and 3D images.

RESULTS

The average contrast ratios between the myocardium and the ventricular lumen in MPRAGE, T2SPACE, FLASH, and True FISP were 0.80, 0.31, 0.26, and 0.28, respectively. The average contrast ratios between the vascular wall and the lumen were 0.78, 0.43, 0.32, and 0.20, respectively. MPRAGE showed the best contrast for the imaging of both the myocardium and the vascular structure. By visual assessment, MPRAGE also provided more detailed information on morphology and cardiovascular continuity.

CONCLUSION

MPRAGE is the optimal sequence for the computational modeling of human autopsied heart specimens fixed by formalin, which replaces water in cardiac tissue, with congenital heart diseases.

CLINICAL RELEVANCE/APPLICATION

MPRAGE showed the best contrast for imaging a formalin-fixed heart. The computational cardiac modeling of autopsied heart using MPRAGE plays a critical role in surgical simulation and education.

SSM03-03 Right Ventricle Native T1 Mapping and Pulmonary Regurgitation in Patients with Congenital Heart Diseases: Preliminary Data

Wednesday, Nov. 29 3:20PM - 3:30PM Room: S502AB

Participants
Francesco Secchi, MD,PhD, Milano, Italy (*Presenter*) Nothing to Disclose
Paola Maria Cannao, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Marco Ali, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesca Romana Pluchinotta, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Massimo Lombardi, MD, Trondheim, Norway (*Abstract Co-Author*) Nothing to Disclose
Francesco Sardanelli, MD, San Donato Milanese, Italy (*Abstract Co-Author*) Speakers Bureau, Bracco Group; Research Grant, Bracco Group; Advisory Board, Bracco Group; Speakers Bureau, Bayer AG; Research Grant, Bayer AG; Advisory Board, General Electric Company
Marcello Petrini, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To correlate native T1 mapping (nT1) of the right ventricle (RV) with biventricular functional parameters and pulmonary regurgitation.

METHOD AND MATERIALS

We prospectively evaluated 27 patients (24±10y, mean ± standard deviation) who underwent a cardiac magnetic resonance exam at1.5T. Six patients were treated with percutaneous pulmonary valve. For each patient left (LV) and right ventricle (RV) functional evaluation was performed. Pulmonary flow analysis with phase-contrast sequences was performed and regurgitation fraction (RF) was calculated. A native modified look-locker inversion recovery (MOLLI) prototype sequence was acquired at basal, mid and apical-ventricular level in short-axis view in systole, by starting the data acquisition at the individually adopted trigger time. The MOLLI sequence included motion correction and subsequent automatic generation of T1 maps. Spearman and Mann Whitney U test were used for statistical analysis.

RESULTS

LV functional parameters were: end-diastolic volume (EDVi) 77±20 (mean±standard deviation), LV end-systolic volume (ESVi) 29±16, LV stroke volume (SV) 82±16 and ejection fraction (EF) 63±8. RV functional parameters were: RVEDVi 101±27, RVESVi 47±17, RVSV 96±30 and EF 55±10. Mean RF was 26±18 % and mean nT1 was 1025±38 ms. A negative significant correlation between RVEF and nT1 (r=-333, P=.045) and between RF and nT1 (r=-234, P=.047) was found. nT1 was 1006±95 ms in patients before pulmonary valve treatment and 1087±87 ms in patients after percutaneous implantation (P = .057).

CONCLUSION

Native RV T1 mapping was negatively correlated with PR and RVEF, reflecting an adaptation of RV muscle to the pulmonary conduit dysfunction. A borderline significant increase of nT1 in patients after pulmonary percutaneous treatment was found.

CLINICAL RELEVANCE/APPLICATION

RV T1 value should be used as an early indicator of RV dysfunction in patients with congenital heart diseases.

SSM03-04 Anatomy of Retroesophageal Major Aortopulmonary Collateral Arteries in Pulmonary Atresia with Ventricular Septal Defect: Results from Preoperative CTA

Wednesday, Nov. 29 3:30PM - 3:40PM Room: S502AB

Participants
Qianjun Jia, MD, Guangzhou, China (*Presenter*) Nothing to Disclose
Jinglei Li, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Changhong Liang, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

There is little information in the literature available on major aortopulmonary collateral arteries (MAPCAs) anatomy, especially about the retroesophageal MAPCAs (REM). This study aimed to assess the anatomy of REM in pulmonary atresia with ventricular septal defect and major aortopulmonary collateral arteries (PA-VSDMAPCAs) patients.

METHOD AND MATERIALS

We retrospectively analysed 130 consecutive PA-VSD-MAPCA patients with preoperative CTA who underwent cardiac surgery. A detailed analysis of the MAPCAs anatomy was made using CT imaging, including the total number, origin and stenosis of MAPCAs, the presence or absence of a retroesophageal course for MAPCAs, relationship between MAPCAs and tracheal at the pulmonary hilum. MAPCAs were divided into two groups on the basis of REM diagnosis by CT: REM group (REM diagnosed by CT, n=94) and Not REM group (no REM diagnosed by CT, n=183).

RESULTS

A REM was identified in 82 of the 130 patients (63%), all of which were located on the side opposite the arch. REM group originate higher level of thoracic vertebrae (level 6), compared with Not REM group (level 5) (P<0.01), and REM group have a higher probability to originate from the lateral side of the aorta median degree of 144, contrast to median degree of 90 for Not REM group (P<0.01). There was a difference in the occurrence of stenosis comparing REM group to Not REM group (89% vs 78%), ($\chi 2$=9.79, P< 0.01). A midsegment stenosis was present more often in REM group compared with Not REM group (31% vs 21%), ($\chi 2$=6.27, P= 0.01). Relative to trachea, there was a difference in the anterior-posterior position comparing REM to Not REM group at the pulmonary hilum (91% MAPCAs posterior to tracheal vs 51% MAPCAs posterior to tracheal), ($\chi 2$=50.81, P<0.01).

CONCLUSION

Sixty-three percent of patients with PA-VSD-MAPCAs have a retroesophageal MAPCA, and a left aortic arch was associated with a higher prevalence of the retroesophageal MAPCAs. Compared with not retroesophageal MAPCAs, the retroesophageal MAPCAs associated with higher level, more lateral origin, more stenosis, particularly a midsegment stenosis, and were prone to course posterior to tracheal at the pulmonary hilum.

CLINICAL RELEVANCE/APPLICATION

The anatomy of retroesophageal MAPCAs is highly relevant and useful for surgeons in identifying the retroesophageal MAPCAs to perform unifocalization procedures for PA-VSD-MAPCAs patients

SSM03-05 Common Atrium and the Associated Malformations: Evaluation by Low-Dose Dual-Source Computed Tomography

Wednesday, Nov. 29 3:40PM - 3:50PM Room: S502AB

Participants
Yi Zhang, MS, Chengdu, China (*Presenter*) Nothing to Disclose
Zhigang Yang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Mengxi Yang, MS, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

Ke Shi, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Rui Li, Nanchong, China (*Abstract Co-Author*) Nothing to Disclose
Kaiyue Diao, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Ying-Kun Guo, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine CA characteristics and diagnostic accuracy in assessing associated malformations in these patients with low-dose DSCT.

METHOD AND MATERIALS

This study was approved by the Institutional Review Board, and informed consent was obtained from all patients. Twenty-one pediatric and adolescent CA patients underwent low-dose DSCT. Different ventricular types and associated malformations were assessed. The diagnostic accuracy of DSCT and transthoracic echocardiography (TTE) in evaluating associated malformations were assessed by reference to surgical results. The effective doses of low-dose DSCT were calculated.

RESULTS

Seven CA patients and 14 CA with single ventricle (SV) were finally included. In the CA with SV, three types of SV morphology were distinguished: single left ventricle (n = 4), single right ventricle (n = 5) and undifferentiated ventricle (n = 5). Seventy-eight associated malformations were observed, among which 22 were seen in CA and 56 in CA with SV. DSCT was superior to TTE for detection of intracardiac anomalies (sensitivity: DSCT, 92.31% vs. TTE, 76.92%), anomalies of great vessels (sensitivity: DSCT, 100.00% vs. TTE, 77.50%), and of collateral vessels (sensitivity: DSCT, 100% vs. TTE, 20.00%). The estimated mean effective dose was 0.95 ± 0.44 mSv (<1 mSv).

CONCLUSION

Low-dose DSCT is an excellent alternative for pediatric and adolescent patients with CA, providing morphological details of CA and associated malformations with high accuracy.

CLINICAL RELEVANCE/APPLICATION

Common atrium (CA) is a rare complex congenital heart disease. Those with associated malformations who do not receive surgical treatment usually have a poor prognosis. Low-dose DSCT is an excellent alternative for pediatric and adolescent patients with CA, providing morphological details of CA and associated malformations with the high accuracy needed to conduct treatment effectively.

SSM03-06 Anomalous Right Coronary Artery from the Left (ARCA-L): Dual-Source Computed Tomography Angiography (DSCT) Findings in Southwest China

Wednesday, Nov. 29 3:50PM - 4:00PM Room: S502AB

Participants
Kaiyue Diao, Chengdu, China (*Presenter*) Nothing to Disclose
Zhigang Yang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Qin Zhao, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Yue Gao, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Yingkun Guo, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

We sought to provide the anatomic particularities of anomalous right coronary artery from the opposite (ARCA-L) in Southwest China on a relatively large scale under the postulation that some anatomy features on DSCT could help predict adverse clinical events.

METHOD AND MATERIALS

Over 18000 patients' coronary computed tomography angiography (CCTA) data was screened from Jan 2012 to Aug 2015. The prevalence of ARCA-L was computed and the subtype was decided by the spatial relationship between the right coronary artery with the pulmonic valve. CCTA was used to evaluated the proximal stenosis, observe the high-risk anatomy features including the take-off angle, proximal length as well as the ostium type and analyze the accompany anomalies. Follow-up was done by telephone and the major adverse clinical event (MACE) was recorded. Wilcox test and Chi-square test were used for testing the difference between groups. Cox hazard analysis was performed to identify prognosis predictive factors. P<0.05 was considered significant and Bonferroni correction of P value was used when necessary.

RESULTS

A prevalence of 0.70% (127/18226) was observed in our population and younger people tend to have higher degree of vessel stenosis (the age among the mild vs the middle vs the severe: 64.7 vs 59.6 vs 56.9, p=0.04). RCA origins from below the pulmonary valve was the most common type in our population. The take-off angle and the proximal stenosis length were found to have significant difference between mild (<30%) and severe stenosis (>=60%) group. An average of 15.3 ± 9.2 months' follow-up was conducted on 65 non-CAD patients. Stenosis severity was the most predictive factor among the anatomy features with a RR of 5.23 (95% CI: 2.34 to 8.47, P<0.001).

CONCLUSION

ARCA-L found on CCTA in the Southwest China has a comparable prevalence with other regions with certain variations in high-risk anatomy features. Stenosis severity was the most reliable prognosis predictive factor for patients with conservative therapy.

CLINICAL RELEVANCE/APPLICATION

Our study proved some potentially malignant anatomic features on CCTA for evaluating patients with ARCA-L. Avoiding overloading exercise might be necessary for such patients.

SSM05

Chest (Thoracic Malignancy/Thymic and Esophageal)

Wednesday, Nov. 29 3:00PM - 4:00PM Room: S404AB

CH CT MR OI

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

Participants
Jin Mo Goo, MD, PhD, Seoul, Korea, Republic Of (*Moderator*) Research Grant, Samsung Electronics Co, Ltd; Research Grant, DRTECH Co, Ltd
Carol C. Wu, MD, Houston, TX (*Moderator*) Author, Reed Elsevier

Sub-Events

SSM05-01 Whole-Tumor Histogram Analysis of Apparent Diffusion Coefficient Maps for the Differentiation of Thymic Carcinoma from Lymphoma

Wednesday, Nov. 29 3:00PM - 3:10PM Room: S404AB

Participants
wei zhang, nan jing, China (*Presenter*) Nothing to Disclose

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PURPOSE

To assess the performance of whole-tumor histogram analysis of apparent diffusion coefficient (ADC) maps in differentiating thymic carcinoma from lymphoma, and compare with that of commonly used hot-spot region of interest (ROI) based ADC measurement.

METHOD AND MATERIALS

Diffusion weighed imaging (DWI) data of 15 patients with thymic carcinoma and 13 patients with lymphoma were retrospectively collected and processed with mono-exponential model. The measurement of ADCs were performed by using histogram-based and hot-spot ROI based approach. In histogram-based approach, following parameters were generated, including mean ADC (ADCmean), median ADC (ADCmedian), 10 and 90 percentile of ADC (ADC10 and ADC90), kurtosis and skewness. The difference of ADCs between thymic carcinoma and lymphoma was compared using t test. Receiver operating characteristic analyses were conducted to determine and compare the differentiating performance of ADCs.

RESULTS

Lymphoma demonstrated significantly lower ADCmean, ADCmedian, ADC10, ADC90 and hot-spot ROI based (mean) ADCs than thymic carcinoma (all p values < 0.001), while no differences were found on kurtosis (P=0.412) and skewness (P=0.273). ADC10 demonstrated optimal differentiating performance [cut-off value, 0.403×10-3 mm2/s; area under curve (AUC), 0.977; sensitivity, 92.31%; specificity, 93.33%], followed by ADCmean, ADCmedian, ADC90 and hot-spot ROI based ADC. The AUC of the ROC curve of ADC10 was significantly higher than that of hot-spot ROI based ADC (0.977 vs 0.797, P=0.036).

CONCLUSION

Compared with commonly used hot-spot ROI based ADC measurement, histogram analysis of ADC maps holds the promise in improving the differentiating performance between thymic carcinoma and lymphoma.

CLINICAL RELEVANCE/APPLICATION

our preliminary study results indicated that histogram analysis of ADC maps could be a promising approach to improve the differentiating performance between thymic carcinoma and lymphoma.

SSM05-02 Can CT Textural Analysis Predict the World Health Organization (WHO) Classification of Thymic Epithelial Neoplasms?

Wednesday, Nov. 29 3:10PM - 3:20PM Room: S404AB

Participants
Shaunagh McDermott, FFR(RCSI), Boston, MA (*Presenter*) Nothing to Disclose
Florian J. Fintelmann, MD, Boston, MA (*Abstract Co-Author*) Consultant, McKesson Corporation; Royalties, Reed Elsevier
Valentina Nardi, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Michael Lanuti, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Azadeh Tabari, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate if CT textural analysis (CTTA) can differentiate between low-risk and high-risk thymic epithelial neoplasms (TENs) on routine CT images.

METHOD AND MATERIALS

The preoperative CT scans of 48 patients diagnosed with a TEN over a 10-year period were reviewed with respect to contour, enhancement pattern, degree of enhancement (relative to skeletal muscle), calcification, pleural effusion, pleural seeding, pericardial effusion, and invasion of local structures. CTTA was performed with commercially available software (TexRAD) that applies a filtration-histogram technique for characterizing tumor heterogeneity. TENs were divided into two groups based on the WHO classification (low-risk = types A, AB and B1; high-risk = types B2, B3 and C). Student t-test was used to compare the mean value of each texture parameter between the two groups. Receiver operating characteristics (ROC) analysis was performed and area under the curve (AUC) was calculated for texture parameters that differed significantly. Sensitivity and specificity were calculated using the cut-off value with the highest AUC.

RESULTS

28 low-risk TENs (3 type A, 18 type AB, 7 type B1) and 20 high-risk TENs (11 type B2, 6 type B3, 3 type C) were included. The degree of enhancement differed significantly between the two groups (p=0.021). No significant difference was identified with respect to contour, enhancement pattern, calcification, pleural effusion or seeding, pericardial effusion, or invasion of local structures. Histogram analysis of CT values showed statistically significant differences in average Mean (SSF0, p=0.03) standard deviation (SD)(SSF0,p=0.006), entrophy (SSF0, p=0.04), mean positive pixels (MPP)(SFF6, p=0.008) and kurtosis (SSF3, p=0.02) values between the low-risk group (Mean 67.1 +/- 20.2/SD 21.2 +/- 6.5/entropy 4.3 +/- 0.3/MPP 32.8 +/- 21.1/kurtosis 0.23 + 0.75) and high-risk group (Mean 55.4 +/- 12.6/SD 16.6 +/- 3.6 /entrophy 4.1 +/- 0.2/MPP 21.1 +/- 6.4/kurtosis 1.14 +/- 1.83). Using an MPP threshold of 26.5, the sensitivity and specificity for differentiating low-risk from high-risk lesions was 90% and 54%, respectively (AUC 0.72).

CONCLUSION

CTTA may be able to separate TENs into low- and high-grade WHO histologic subtypes.

CLINICAL RELEVANCE/APPLICATION

The ability to preoperatively predict the WHO subtype of thymic epithelial neoplasms may help determine the need for preoperative adjuvant treatment.

SSM05-03 A Comparison between 3T MR and Endoscopic Ultrasound for Preoperative T Staging of Potentially Resectable Esophageal Cancer with Histopathological Correlation

Wednesday, Nov. 29 3:20PM - 3:30PM Room: S404AB

Participants
Jia Guo, Zhengzhou, China (*Presenter*) Nothing to Disclose
Hongkai Zhang, Zhengzhou, China (*Abstract Co-Author*) Nothing to Disclose
Zhaoqi Wang, Zhengzhou, China (*Abstract Co-Author*) Nothing to Disclose
Hui Liu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Xu Yan, Shanghai, China (*Abstract Co-Author*) Employee, Siemens AG
Dominik Nickel, Erlangen, Germany (*Abstract Co-Author*) Employee Siemens AG
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Jinrong Qu, Zhengzhou, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare the value of 3T magnetic resonance imaging (MRI) and endoscopic ultrasonography (EUS) in the preoperative T staging of potentially resectable esophageal cancer.

METHOD AND MATERIALS

Patients with resectable EC diagnosed by clinical and pathological biopsy were prospectively collected. All patients underwent MRI (including T2-TSE-BLADE, DWI and a radial-VIBE sequence prototype) and EUS within one week before surgery. T staging was assigned on MR and EUS by two independent radiologists and one endoscopist in accordance with the 7th edition of AJCC TNM Classification for EC. Two readers separately determined the EC segment and evaluated the MR image quality using a 5-point score. The consistency of image quality score between two MRI readers and the correlation coefficient between image quality and EC segment were calculated using SPSS 20.0. Considering postoperative pathological T staging results as the gold standard, the performance of MRI (T2-TSE-BLADE + DWI + radial-VIBE) and EUS was evaluated based on the calculation of sensitivity, specificity, positive predictive value and negative predictive value.

RESULTS

A total of 70 patients were enrolled in the study, 16 cases were stage T1, 18 cases were stage T2, 30 cases were stage T3, and 6 cases were stage T4a. The evaluation of the image quality by two readers was almost identical (Kappa=0.825, P <0.001). The correlation coefficients between image quality score and EC segment by two readers were (r = -0.665, P <0.01)and (r = -0.619, P <0.01). The sensitivity values obtained by the two MRI readers for T1-T4a staging were 93.75%, 100%, 90%, 100% and 81.25%, 94.44%, 93.33%, 100%, and the specificity values were 100%, 94.23%, 100%, 98.44% and 100%, 90.38%, 97.50%, 100%; using EUS, the sensitivity and specificity values for T1-T4a staging were 81.25%, 83.33%, 53.33%, 50% and 96.3%, 67.31%, 92.50%, 98.44%.

CONCLUSION

MRI was comparable to EUS in the staging of T1 and T2, and showed advantage over EUS for T3 and T4a staging. MRI can accurately assess the depth of invasion of EC, which can be used as a routine examination for preoperative staging of EC and provide the basis for the formulation of a clinical treatment plan.

CLINICAL RELEVANCE/APPLICATION

(dealing with preoperative T staging of esophageal cancer)"MRI was comparable to EUS in the staging of T1 and T2, and showed

advantage over EUS for T3 and T4a staging."

SSM05-04 Accuracy of a Machine Learning Algorithm for Anterior Mediastinal Mass Diagnosis

Wednesday, Nov. 29 3:30PM - 3:40PM Room: S404AB

Awards
Student Travel Stipend Award

Participants
Nityanand Miskin, MD, Boston, MA (*Presenter*) Nothing to Disclose
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PURPOSE

The purpose of this study is to evaluate the accuracy of a machine learning algorithm as a diagnostic aid for anterior mediastinal masses (AMM), and to compare the accuracy to expert clinical assessment.

METHOD AND MATERIALS

Cases were identified by searching our medical record for patients with an AMM evaluated with CTs, from 2012-2015. 223 cases were found: 103 thymomas, 40 lymphomas, 12 germ cell tumors, 65 benign lesions (cyst, thymic hyperplasia), and 3 fibrosing mediastinitis. The latter group was excluded as there were too few for reliable diagnosis. We divided the remaining 220 cases into 122 training and 98 test cases. One thoracic radiologist reviewed the training cases for the following: size, attenuation in Hounsfield Units, attenuation homogeneity, shape, midline location, intralesional fat, calcification, vascularity, cystic spaces, preservation of fatty septum, supraclavicular, mediastinal, or internal mammary lymphadenopathy (LAD), chest wall invasion, lung invasion, pulmonary metastases, pleural metastases, and pleural effusion. We evaluated the predictive efficacy of each parameter, as well as age and sex, using the Weka machine learning software. Parameters most predictive of diagnosis were then used to generate a ruleset-based classifier using the JRip algorithm. A thoracic radiologist then blindly reviewed the 98 test cases for the presence of each parameter, to be fed into the classifier, and provided a best-guess diagnosis. A related-samples McNemar test was performed to assess differences in accuracy.

RESULTS

Using the machine learning software, the most predictive parameters for the diagnosis of an AMM were: age, sex, size, attenuation, shape, midline location, internal mammary LAD, mediastinal invasion, and pleural effusion. For the training set, the ruleset classifier correctly diagnosed 103/122 cases (84%). For the test set, the radiologist's best-guess diagnosis achieved an accuracy of 72/98 (74%). The ruleset classifier achieved an accuracy of 79/98 (81%). No significant difference in accuracy was seen (p=0.23). A ruleset-based classifier was constructed from the data.

CONCLUSION

A ruleset-based classifier can achieve accuracy comparable to a thoracic radiologist when evaluating the diagnosis of an anterior mediastinal mass.

CLINICAL RELEVANCE/APPLICATION

This algorithm is a potential semi-automated tool for accurate anterior mediastinal mass diagnosis in resource poor areas.

SSM05-05 Combination of DCE-MRI and DWI in Predicting the Treatment Effect of Concurrent Chemoradiotherapy in Esophageal Carcinoma

Wednesday, Nov. 29 3:40PM - 3:50PM Room: S404AB

Participants
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PURPOSE

To study the value of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) combined with diffusion-weighted imaging (DWI) in evaluating the effect of concurrent chemoradiotherapy (CCRT) in patients with esophageal carcinoma.

METHOD AND MATERIALS

A total of 76 patients with newly diagnosed esophageal carcinoma were enrolled in this study. All the participants were examined with DCE-MRI and DWI at baseline (pre-treatment) and during the third week after the start of CCRT (post-treatment). The volume transfer constant (Krans), rate contrast (Kep), the contrast agent percentage in the extracel¬lular fluid space (Ve), and the apparent diffusion coefficient (ADC) were measured by two radiologists with greater than 10 years' individual experience. The changes in lesion volume on CT were measured at the completion of radiotherapy and was used as an endpoint to evaluate the predictive ability of DCE-MRI and DWI. All the quantitative parameters were analyzed with the paired t-test and a p-value of less than 0.05 indicated statistical significance.

RESULTS

A total of 76 and 56 DCE-MRI and DWI scans were available for analysis at baseline and at the third week, respectively. Pre-treatment Krans, pre-treatment Kep, pre-treatment ADC ($P < 0.05$), and post-treatment Krans ($P < 0.05$) and ΔKrans, ΔADC ($P < 0.05$) were significantly different after CCRT. Based on the binary logistic model, the ROC analysis demonstrated that the combined predictors demonstrated a high diagnostic performance with a threshold of 0.211 and an AUC of 0.939. The sensitivity and specificity were 98.6% and 73.8%, respectively.

CONCLUSION

The combination of DCE-MRI and DWI, as a noninvasive method, allows for the visualization of esophageal carcinoma lesions and can be used as an early biomarker in the prediction of the effect of CCRT three weeks after treatment initiation.

CLINICAL RELEVANCE/APPLICATION

DCE-MR can detect the effects of radio- and chemotherapy at early time points and is recommended as part of a MR study prior to esophageal carcinoma.

SSM05-06 CT Features of Thymic Epithelial Tumors: Correlation with the Clinical Stage Classification Using the Recently Proposed TNM Staging System

Wednesday, Nov. 29 3:50PM - 4:00PM Room: S404AB

Participants
Akiko Sumi, MD, Kurume, Japan (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the CT features of thymic epithelial tumors with recently proposed TNM staging system and to determine the CT features helpful in predicting patient outcome.

METHOD AND MATERIALS

This retrospective study included 116 patients with thymic epithelial tumor surgically treated. Two radiologists interpreted independently the 21 categories of CT findings and finally classified each category into two groups. Correlation of these categories with new TNM staging system and with prognosis were assessed.

RESULTS

The patients were 68 women and 48 men (median age, 59 years; range, 27-82 years). WHO histologic classification included Type A in 10, Type AB in 22, Type B1 in 28, Type B2 in 24, Type B3 in 10, and Carcinoma in 22 patients. The clinical stage using by TNM staging system were stage I in 92, stage II in 3, stage IIIa in 10, stage IIIb in 2, stage IVa in 3, and stage IVb in 6 patients. In the present study, stage II and greater (stage II-IV) tumors were considered an invasive tumor. There was statistically significant relationship between WHO histologic classification and tumor invasiveness (Fisher, $P < .001$). In multivariable analysis, there were statistically significant differences in tumor contour, adjacent chest wall change, pericardial thickness, and vascular invasion between stage I and stage II-IV (all, $P < .05$). Multivariate analysis using a stepwise forward Cox proportional hazards regression model showed that tumors with lobulated and irregular contour, lobulated and irregular contour with mediastinal fat, presence of hemorrhage/cyst/necrosis, and presence of band-like opacity in the lung were significantly associated with disease progression (all, $P < .05$). Patients with three or four of these factors had a significantly shorter cause-specific survival than the other patients ($P < .001$).

CONCLUSION

CT characteristics of thymic epithelial tumors may be helpful in the classification of the new TNM staging system and the prediction of the worse prognosis.

CLINICAL RELEVANCE/APPLICATION

CT features suggestive of invasiveness in thymic epithelial tumor were irregular contour, absence of chest wall's fat layer, presence of pericardial thickness or vascular invasion. Patients with these factors had the worse prognosis.

SSM09

Gastrointestinal (Esophagus and Stomach)

Wednesday, Nov. 29 3:00PM - 4:00PM Room: E353B

CT GI MR

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

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

Sub-Events

SSM09-01 The Application Value of Spectral CT Low Dose Scanning Protocol Preoperatively Optimized for T Stage on Esophageal Cancer

Wednesday, Nov. 29 3:00PM - 3:10PM Room: E353B

Participants
Yue Zhou, Zhengzhou, China (*Presenter*) Nothing to Disclose
Jianbo Gao, MD, Zhengzhou, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the T stage for esophageal cancer using low dose spectral CT technique, and to discuss the diagnosed accuracy of T stage based on low dose scanning.

METHOD AND MATERIALS

Fifty-two patients with esophageal cancer confirmed by surgery or esophagoscopy randomly divided into two groups were enrolled in our study. Dual-phase chest CT enhancement was performed by using GE HD750 CT. Spectral CT were performed in study group with 350mgI/kg contrast medium injection, while control group underwent conventional 120KVp CT with 450mgI/kg contrast medium injection. Patients were divided into two sub-groups with A/C (FBP reconstruction) and B/D (ASIR). The SNRs, CNRs and subjective image quality score were calculated in four groups. Radiation dose were measured automatically in study group and control group. T stages were evaluated by a radiologist with 10 years experience of CT diagnosis.

RESULTS

The CNR and SNR in four groups showed significant difference ($P<0.05$). The SNR in group B was the highest, followed by group A, group C was the lowest. The overall image quality score and anatomy detailed score among four groups exhibited significant difference ($P<0.05$). Group B was the highest while group C was the lowest. The sensitivity and accuracy in study group (A and B) in terms of T1/2 stage were higher than control group (C and D). With regard to T3, the sensitivity and specificity in study group (A and B) were higher than control group (C and D). The accuracy in diagnosis of T4 between study group and control group were similar.

CONCLUSION

Low dose spectral CT scanning optimized the image quality for chest CT enhancement and reduced the radiation and contrast medium dose. Compared to conventional CT, low dose spectral scanning promoted the differential diagnosis between T1/2 and T3, and improved the sensitivity and specificity in differential diagnosis between T1/2 and T3.

CLINICAL RELEVANCE/APPLICATION

Low dose spectral CT scanning reduced the contrast medium and radiation dose, and improved the sensitivity and specificity in differential diagnosis between T1/2 and T3 for esophageal cancer.

SSM09-03 Fractal Dimension Analysis of Glucose Metabolism in Esophageal Cancer by FDG-PET: Correlation between the Quantitative Evaluation of Tumor Heterogeneity and Malignancy

Wednesday, Nov. 29 3:20PM - 3:30PM Room: E353B

Participants
Toru Tochigi, MD, Chiba, Japan (*Presenter*) Nothing to Disclose
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PURPOSE

Intratumoral heterogeneity is a well-recognized characteristics of cancer. The purpose of this study is to assess the heterogeneity

of the intratumoral glucose metabolism using fractal analysis, and evaluate its prognostic value in patients with esophageal squamous cell carcinoma (ESCC).

METHOD AND MATERIALS

18F-fluorodeoxyglucose positron emission tomography (FDG-PET) was performed in 125 consecutive patients with ESCC. FDG-PET images were analyzed using a fractal analysis software, where differential box-counting method was employed to calculate the fractal dimension (FD) of the tumor lesion. Maximum standardized uptake value (SUVmax) and FD were compared with overall survival (OS).

RESULTS

The median FD was 1.97 (range, 1.7941 -2.0359). The survival curve was analyzed using the median FD as the cutoff value. The survival rate in the high-FD group was significantly better than that in the low-FD group as determined by the Kaplan-Meier method (P = 0.0029). In the multivariate survival analysis, the FD was identified as an independent prognostic factor for the overall survival (<0.0001). Furthermore, we analyzed the overall survival rate in the patients who were treated with surgery alone and with neoadjuvant chemotherapy. The Kaplan-Meier analysis of this data also showed that the high-FD group had a significantly better survival than did the low-FD group (P = 0.0011, P = 0.0177)

CONCLUSION

Metabolic heterogeneity measured by fractal analysis can be a novel imaging biomarker for survival in patients with ESCC.

CLINICAL RELEVANCE/APPLICATION

The preoperative tumor metabolic heterogeneity was a useful biomarker for OS of patients with ESCC, and was independent of clinical markers such as TNM-staging.

SSM09-05 MRI of the Gastric Antrum for the Quantification of Gastric Motility: Comparison between Obese and Normal Weight Patients

Wednesday, Nov. 29 3:40PM - 3:50PM Room: E353B

Participants
Simona Picchia, MD, Rome, Italy (*Presenter*) Nothing to Disclose
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Damiano Caruso, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To compare differences in gastric motility between obese and normal weight patients with MRI.

METHOD AND MATERIALS

Motility antral scans were obtained by Magnetic Resonance Imaging (MRI) after a liquid meal: patients drunk 650-ml standardized liquid meal over 10 min (Nutridrink) plus two egg yolks and one albumen and 150 ml of water. This 525-kcal meal was composed of 25% fat, 25% protein, and 50% carbohydrate. Imaging was performed on a 1.5-Tesla system. CineMRI for motility analysis was performed using a coronal and axial 2DtrueFISP. Images have been acquired before (T0), immediately after the end of the meal assumption (T1) and every 20 minutes (T2-T5), for a total exam time of 100 minutes. Each gastric motility scan lasted 60 seconds, with 100 images acquired in free breathing. Images have been evaluated on a dedicated software. Two measurements were evaluated. The distal antral contraction waves (ACWs) and the antral diameter. The ACWs were measured as the distance between the proximal and distal border of a segmental contraction of the distal antrum. The antral diameter was measured at the level of the measured ACWs. The measurement lines have been propagated into the next image of the MRI sequence, and the newly detected distance registered. This process has been repeated for every single image of the cine sequence. The temporal changes of the antrum diameter and ACWs over time have been plotted on a graph thus displaying gastric motility frequencies and magnitude. Results obtained in obese and normal weight patints were compared.

RESULTS

Twenty patients were included in the study (10 obese and 10 normal weight). Motility antral scans in obese antrum showed that, during fasting and in the late-postprandial period of a liquid meal, the length of the antrum was significantly shorter with lower maximal contraction amplitude and frequency.

CONCLUSION

MRI is able to identify differences in antral motility between obese and normal weight patients.

CLINICAL RELEVANCE/APPLICATION

This study confirmed the presence of antral motility disfunction in obese patients. These results can be correlated with the previously published in vitro evidence that in antral smooth muscle of obese patients the alteration in VIP pathway occurs, suggesting that smooth muscle might represent a new therapeutical targets in gastrointestinal motility disorders.

SSM09-06 Imaging Assessment of Lauren Classification for Gastric Cancer Using a Non-Gaussian Fractional Order Calculus Diffusion Model

Wednesday, Nov. 29 3:50PM - 4:00PM Room: E353B

Participants
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Yi Sui, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the performance of a new set of parameters (*D*, *ß*, and *μ*) from a fractional order calculus (FROC) diffusion model for imaging assessment of Lauren classification in gastric cancer.

METHOD AND MATERIALS

With IRB approval, 41 patients (12 females and 29 males) with gastric cancer underwent MRI scans at 1.5T. Surgical specimens were obtained for pathology analysis to determine the cancer type according to Lauren classification, resulting in 10 patients with diffuse type, 23 with intestinal type, and 8 with mix type. For the statistical analysis, the diffuse and mix types were combined as mixed-and-diffuse type (MDT) to be differentiated from the intestinal type (IT). The MRI protocol included T1-weighted (VIBE), T2-weighted (turbo spin echo with respiratory-trigger), and diffusion-weighted imaging with 11 *b*-values (0 to 2000 s/mm2). Three parameters of the FROC model, diffusion coefficient *D*, fractional order parameter *ß* (which correlates with intra-voxel tissue heterogeneity), and a microstructural quantity *μ* were estimated from the diffusion data. The mean values of FROC parameters over the tumor regions of interest were computed. Receiver operating characteristic (ROC) analysis was then performed to assess the performance of FROC model for gastric cancer type differentiation. The combination of FROC parameters (*D*, *ß*, *μ*) were compared to using only *D*, which is equivalent to apparent diffusion coefficient.

RESULTS

A significant difference between MDT and IT were observed in the combination of *D*, *ß*, and *μ* with a p-value < 0.05. The combination of FROC parameters also produced a better accuracy (74.3% vs. 69%), specificity (73.9% vs. 56%), and area under the curve (78.5% vs. 65.2%) than using *D* alone, while providing a comparable sensitivity (75% vs. 78.2%).

CONCLUSION

The combined FROC parameters (*D*, *ß*, *μ*) outperformed *D* in non-invasive imaging assessment of Lauren classification for gastric cancer.

CLINICAL RELEVANCE/APPLICATION

The combined FROC parameters (*D*, *ß*, *μ*) perform better than using diffusion coefficient alone for imaging assessment of Lauren classification in patients with gastric cancer.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
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McCormick Place, Chicago
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SSM14

Musculoskeletal (Ultrasound)

Wednesday, Nov. 29 3:00PM - 4:00PM Room: E353C

MR MK US

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

FDA Discussions may include off-label uses.

Participants
Mary M. Chiavaras, MD, PhD, Ancaster, ON (*Moderator*) Nothing to Disclose
Kenneth S. Lee, MD, Madison, WI (*Moderator*) Grant, General Electric Company; Research support, SuperSonic Imagine; Research support, Johnson & Johnson; Consultant, Echometrix, LLC; Royalties, Reed Elsevier

Sub-Events

SSM14-01 Ultrasound-Guided Treatment of Calcific Tendinitis of the Rotator Cuff: Efficacy of Percutaneous Lavage Using Sodium Hexametaphosphate (SHMP) in Comparison with Simple Saline

Wednesday, Nov. 29 3:00PM - 3:10PM Room: E353C

Participants
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PURPOSE

To determine the efficacy of percutaneous US-guided needle lavage of symptomatic rotator cuff calcifications using a sodium hexametaphosphate (SHMP) solution (0.5%), in comparison with the same technique using simple saline

METHOD AND MATERIALS

We evaluated 24 calcifications (4 type A, 11 type B, 9 type C according to Gartner classification, mean size 24.7mm, range 9-31mm) in 24 patients (13 males, 11 females, mean age 34.8 years). Patients were divided into 2 groups and treated by percutaneous fragmentation and lavage using SHMP (Group 1, 12 patients) or simple saline (Group 2, 12 patients). Pre- and post-procedure (at 2 and 4 weeks follow-up) imaging evaluation was performed in all patients, including conventional radiography (RX) and ultrasound (US) examination to assess location, size and type of calcifications. Imaging findings after treatment were evaluated by two independent raters and defined as "partial" or "subtotal" dissolution. Pre- and post-procedure clinical evaluation (at 2 and 4 weeks follow-up) was assessed using the Constant Shoulder Score for functionality and the VAS Score for pain

RESULTS

The two study groups were homogeneous in terms of patient demographics, size and type of calcifications. 2 weeks after treatment in Group 1 we found subtotal dissolution of calcifications in 8 patients (66.7%) and partial dissolution in 4 (33.3%); of these, 2 (50%) showed subtotal dissolution at the 4 weeks follow-up. In Group 2 we found subtotal dissolution in 58.3% and partial in 41.7% ($p<=0.05$). 1 patient (20%) showed subtotal dissolution at the 4 weeks follow-up. Clinical evaluation showed significant improvement in VAS and Constant scores in 91.7% of patients of Group 1 and in 83.3% of Group 2 ($p<=0.05$). No major complications were reported in both groups.

CONCLUSION

The use of SHMP showed superior results in terms of imagingfindings and clinical improvement compared to the treatment with simple saline

CLINICAL RELEVANCE/APPLICATION

With its chemical action of calcium chelation and dissolution, besides the mechanical action, percutaneous lavage with SHMP is an effective procedure, suitable for different types of calcifications, providing a safe, valid and cost-effective alternative treatment management for calcific tendinitis

SSM14-02 Effect of Compression Stockings on the Development of Delayed-Onset Muscle Soreness: A Quantitative Assessment with 3T MRI, Contrast-Enhanced Ultrasound (CEUS) and Acoustic Radiation Force Impulse (ARFI) Elastography

Wednesday, Nov. 29 3:10PM - 3:20PM Room: E353C

Participants
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Thilo Hotfiel, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the influence of commercially available sport compression garments on changes in muscle perfusion, muscle stiffness and the development of exercise induced intramuscular edema in the context of DOMS.

METHOD AND MATERIALS

DOMS was induced in fifteen healthy participants. They had to perform a standardized eccentric exercise of the calf muscles. After exercise a conventional sports compression sock (class I, 18-21 mmHg) was placed accordingly manufacturer's instructions at one randomized calf for 60h. MRI (normalized T2 signal intensity and T2-time), CEUS (Peak enhancement (PE) and Wash-in Area Under Curve (WIAUC)) and ARFI (shear wave velocities (SWV)) of the gastrocnemius muscle (GM), as well as creatine kinase activity, extension range of the ankle joint, calf circumference and muscle soreness were assessed at baseline and 60 h after exercise at both calves.

RESULTS

After exercise the normalized T2 signal intensity (1.0±0.30 vs. 1.94±1.05, p=0.008), the T2-time (37.52±9.67 vs. 55.64±12.72 ms, p=0.015) was significantly higher in the GM in the compressed calf; but no change for WIAUC (4322±521 vs. 11730±3536, p=0.88), PE (474±54 vs. 1185±345, p=0.51) and ARFI SWV (2.16±0.31 vs. 2.13±0.32, p=0.60) were observed. In the non-compressed calf all assessed parameters changed significantly: T2: 1.0±0.16 vs. 2.20±1.16, p=0.001; T2-time: 37.75±9.28 vs. 55.67±14.78 ms, p=0.005, WIAUC: 2461±660 vs. 5297±743, p=0.01, PE: 328±45 vs. 753±31, p=0.005, ARFI SWV: 2.2±0.26 vs. 1.78±0.24m/s, p=0.008. No significant difference was observed in normalized T2 signal intensity (p=0.397), T2-time value (p=0.953), WIAUC (p=0.93) and PE (p=0.730) in the GM comparing the compressed and non-compressed lower leg after exercise. Only ARFI SWV values in the same comparison revealed a statistically significant difference (p=0.001).

CONCLUSION

Our results indicate that wearing conventional sports compression socks after inducing DOMS may shorten the normalization of muscle stiffness, but have no significant effect on the degree of intramuscular edema or perfusion of the MGM. Furthermore, no effects on occurring muscle soreness or reduced range of motion were noticed.

CLINICAL RELEVANCE/APPLICATION

Muscle injuries are common sports injuries. Delayed onset muscle soreness (DOMS), an entity of ultrastructural muscle injury is one of the most common reasons for impaired muscle performance in professional and recreational athletes.

SSM14-03 Repeated Ultrasound-Guided Core Needle Biopsy of Musculoskeletal Lesions: Clinical Utility According to the Types of the Lesions

Wednesday, Nov. 29 3:20PM - 3:30PM Room: E353C

Participants
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Min Hee Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Myung Jin Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the clinical utility of repeated ultrasound-guided core needle biopsy(US-CNB) of musculoskeletal lesions according to the types of the lesions.

METHOD AND MATERIALS

We retrospectively reviewed 1996 consecutive US-CNBs performed for bone or soft-tissue lesions in 1914 patients during 10 years at a single institution. Repeated biopsy cases for the same lesion were enrolled in this study. The reasons for repeat biopsies were nondiagnostic results, different from clinical expectations, or negative culture results. The reference standard was culture result for infection and pathological diagnosis at excisional biopsy for others. Concordance rate of initial and repeat biopsies were compared according to the types of the lesions by tumors, infection, or others. McNemar's test were used for their statistical significance ($p < .05$).

RESULTS

Of the 30 cases of repeat biopsy, final pathologies were bone and soft tissue tumor, 18(60%); infection, 8(27%); and others, 4(13%). Among the 18 tumors, 16(89%) cases were soft tissue tumors and 14(78%) were malignancy. The overall concordance rate of initial biopsy was 23%(7/30) and that for repeat biopsy was 60%(18/30), which revealed significantly higher concordance for repeated biopsy (p=0.001). The initial and repeated concordance rates of bone and soft tissue tumor were 22%(4/18) and 72%(13/18), respectively. Repeated US-CNB for bone and soft tissue tumor increased diagnostic rate significantly compared to the initial biopsy (p=0.008). The pathogen concordance rates between the initial and repeated US-CNB for infectious cases were 0%(0/8) and 13%(1/8), which showed no significant difference (p=1.000).

CONCLUSION

Repeated US-CNB of musculoskeletal bone and soft tissue tumors can be useful for accurate diagnoses. However, in cases of

Repeated US-CNB of musculoskeletal bone and soft tissue tumors can be useful for accurate diagnoses. However, in cases of infection, repeated US-CNB may have limited clinical utility for pathogen determination.

CLINICAL RELEVANCE/APPLICATION

Repeated US-CNB can be useful for accurate diagnoses of musculoskeletal bone and soft tissue lesions. However, we should consider the types of the lesions. Although repeated CNB increased diagnostic rate for bone and soft tissue tumors, but did not increase the pathogen determination for infection.

SSM14-04 Adhesive Capsulitis of the Shoulder: Evaluation with US-Arthrography Using a Sonographic Contrast Agent

Wednesday, Nov. 29 3:30PM - 3:40PM Room: E353C

Participants
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CONCLUSION

Consequently, US-arthrography was more effective method than US for assessment of AC. Filling defects of joint cavity and synovitis-like abnormality in the joint are characteristic US-arthrography findings for diagnosing AC.

Background

Adhesive capsulitis (AC) is a painful and disabling disorder, which caused restricted motion and chronic pain of shoulder. Intracavitary contrast-enhanced ultrasound has recently applied to assess obstructive bile duct diseases, tubal patency, vesicoureteric reflux and so on.

Evaluation

The aim of this study was to detect the value of US-arthrography by injecting the contrast agent SonoVue into glenohumeral joint compared with US in diagnosing AC.

Discussion

US and US-arthrography images of 45 patients with AC were compared with that of 45 control subjects without AC with MRI as a gold standard.Patients with AC had a significantly thickened CHL (3.1 mm) and inferior capsule (3.5 mm) on US, and a decreased volume of axillary recess (1.14 ml) on US-arthrography compared with the control subjects. Filling defect (91.1%) and synovitis-like abnormality (75.6%) in the joint on US-arthrography were more sensitive than that of rotator interval abnormality (71.1%), thickened CHL more than 3 mm (64.4%), thickened inferior capsule more than 3.5 mm (66.7%) on US respectively for diagnosis of AC.

SSM14-05 Contrast-Enhanced Ultrasound (CEUS) as a New Method in Diagnostic Imaging of Muscle Injuries: Systematic Comparison of Conventional Ultrasound, CEUS and Findings in MRI

Wednesday, Nov. 29 3:40PM - 3:50PM Room: E353C

Participants
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Michael Uder, MD, Erlangen, Germany (*Abstract Co-Author*) Speakers Bureau, Bracco Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Research Grant, Siemens AG;
Thilo Hotfiel, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To emphasize the diagnostic value of contrast-enhanced ultrasound (CEUS) in imaging of muscle injuries with different degrees of severity by comparing findings to the established imaging modalities as conventional ultrasound and magnet resonance imaging (MRI).

METHOD AND MATERIALS

A total of 15 patients were examined after indirect muscular injuries on the lower extremity. Within 24 - 48 hours after injury, a conventional sonography and a CEUS were performed. Direct after the sonography, an MRI was performed as a 'gold standard' in order to graduate the lesion and to determine the spatial extent of the lesion as a reference variable. The classification was carried out according to the modified, four-stage Peetron classification described by Ekstrand et al..

RESULTS

All 15 injuries were identified on MRI and CEUS, whereas 10 injuries showed abnormalities in conventional ultrasound. The determination and measurement revealed significant differences between conventional ultrasound and CEUS depending on the injuries' severity. CEUS revealed an impairment of microcirculation in grade I lesions (corresponding to intramuscular edema observed in MRI), which were not detectable in conventional ultrasound.

CONCLUSION

Our results indicate that performing CEUS seems to be a sensitive additional diagnostic modality in the assessment of muscle injuries in the acute phase after injury. Our results provide advantages of CEUS in imaging of low grade lesions compared to

conventional ultrasound, as they show its superiority in the identifiability of intramuscular edema.

CLINICAL RELEVANCE/APPLICATION

Muscle injuries are frequently observed during recreational and professional sports and have been reported as one of the most common sports injuries. Diagnostic imaging is essential to provide a correct assessment of the injury's severity. So far MRI has shown its superiority over ultrasound examination and has been reported as the preferred modality providing detailed image analysis and characterization of an intramuscular lesion. In clinical practice, however, MRI is often reserved for high-level athletes or serious injuries in which a pronounced structural damage is expected. In conventional ultrasound diagnostic of low grade lesions (ultrastructural lesions and muscle strains), the concerned muscle tissue often appears normal. In this context CEUS may be a new investigative tool in the diagnostic imaging of low grade muscle lesions.

SSM14-06 Quantitative Assessment of Skin Stiffness in Localized Scleroderma Using Ultrasound Shear-Wave Elastography

Wednesday, Nov. 29 3:50PM - 4:00PM Room: E353C

Participants
Liyun Wang, Chengdu, China (*Presenter*) Nothing to Disclose
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PURPOSE

The purpose of this study was to evaluate the usefulness of ultrasound shear-wave elastography (US-SWE) in characterization of localized scleroderma (LS), as well as in the disease staging.

METHOD AND MATERIALS

21 patients with 37 LS lesions were enrolled in this study. The pathological stage (edema, sclerosis or atrophy) of the lesions was characterized by pathological examination. The skin elastic modulus (E-values, including Emean, Emin, Emax and Esd) and thickness (h) was evaluated both in LS lesions and site-matched unaffected skins (normal controls) using US-SWE. The relative difference (ERD) of E-values was calculated between each pair of lesion and its normal control for comparison among different pathological stages.

RESULTS

Of the 37 LS lesions, 2 were in edema, 22 in sclerosis and 13 in atrophy. US-SWE results showed a significant increase of skin elastic modulus and thickness in all lesions ($p<0.001$ in sclerosis and $p< 0.05$ in atrophy) compared to the normal controls. The measured skin elastic modulus and thickness were greater in sclerosis than in atrophy. However, once normalized by skin thickness, the atrophic lesions, which were on average thinner, appeared significantly stiffer than those of the sclerosis (normalized ERD: an increase of 316.3% in atrophy vs. 50.6% in sclerosis compared to the controls, $p = 0.007$).

CONCLUSION

These findings suggest that US-SWE allows to quantitatively evaluate the skin stiffness of LS lesions in different stages; however, the E-values directly provided by US-SWE system alone do not distinguish between the stages, and the normalization by skin thickness is necessary. This non- invasive, real-time imaging technique is an ideal tool for assessing and monitoring LS disease severity and progression.

CLINICAL RELEVANCE/APPLICATION

Ultrasound shear-wave elastography can measure skin stiffness in LS patients which can be used to assesse and monitor LS disease severity and progression.

SSM15

Nuclear Medicine (Head and Neck Imaging)

Wednesday, Nov. 29 3:00PM - 4:00PM Room: S505AB

CT HN MR NR NM

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

Participants
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Sub-Events

SSM15-01 Integrated 11C-MET PET/MRI for Detection of Recurrent Glioma

Wednesday, Nov. 29 3:00PM - 3:10PM Room: S505AB

Participants
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PURPOSE

The objective of this study was to evaluate hybrid 11C-MET PET/MRI for detection of recurrent glioma.

METHOD AND MATERIALS

Fifty consecutive patients with histopathological proven glioma (9 Low Grade Glioma (LGG), 33 High Grade Glioma (HGG), 8 Oligodendroglioma (OGG)) were prospectively enrolled for a hybrid 11C-MET PET/MRI to differentiate recurrent glioma from treatment induced changes. Sole MRI data were analyzed based on RANO. Sole PET data and in a second session hybrid 11C-PET/MRI data were assessed for metabolic respectively metabolic and morphologic glioma recurrence. Reference standard was either histopathological report (n = 22) or follow-up imaging (n=28), whereas only patients of at least 6 months with follow up imaging were included. Based on the reference standard 35 patients were classified with recurrent glioma, whereas 15 patients with treatment induced changes.

RESULTS

Hybrid 11C-MET PET/MRI was performed in 50 patients for differentiation between recurrent glioma and treatment induced changes.Sensitivity, specificity, positive predictive value and negative predictive was calculated 86,11%, 71,43%, 88,57%, 66,67 for 11C-MET PET alone; 96,77%, 73,68%, 85,71%, 93,33% for MRI alone and 97,14%, 93,33%, 97,14%, 93,33% for hybrid 11C-PET/MRI, respectively. In all 50 patients diagnoses based on the reference standard were correct in 82% for 11C-MET PET, 88% for MRI alone and 96% for hybrid 11C-PET/MRI. A significant difference was found among hybrid 11C-MET PET/MRI and 11C-MET PET (p=0,016), whereas no significant difference was found among hybrid 11C-PET/MRI and MRI alone or MRI alone and 11C-MET PET alone. Furthermore, significant ($P < 0.05$) higher scores were found for diagnostic confidence when comparing 11C-MET PET/MRI (4,26 ± 0,777) to 11C-MET PET alone (3,44 ± 0.705) or to MRI alone (3,56 ± 0.733).

CONCLUSION

Hybrid 11C-MET PET/MRI offers metabolic and morphological information for the assessment of glioma recurrence. The hybrid imaging concept increases accuracy and showed significant higher scores for diagnostic confidence when compared to MRI or PET.

CLINICAL RELEVANCE/APPLICATION

Hybrid 11C-MET PET/MRI might have the potential to strengthen RANO classification by adding the metabolic information. This should be evaluated in larger study cohorts.

SSM15-02 Does 18F-FDG PET/MR Increase the Diagnostic Performance for Recurrence Diagnostics in Comparison to MRI in Patients Suffering From Adenoid Cystic Carcinoma of the Head and Neck?

Wednesday, Nov. 29 3:10PM - 3:20PM Room: S505AB

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PURPOSE

To compare the diagnostic performance between 18F-fluorodeoxyglucose positron emission tomography / magnetic resonance (18F-FDG PET/MR) and MR imaging for the detection of recurrent adenoid cystic carcinoma (ACC) of the head and neck and locoregional metastases.

METHOD AND MATERIALS

In this retrospective analysis, a total of 31 dedicated 18F-FDG PET/MR examinations of the head and neck performed for recurrence diagnostics and locoregional metastases detection in patients after primary therapy of ACC were included (12 patients, mean age 59 years). In separate sessions, MRI and 18F-FDG PET/MR images were analyzed by two individual readers. Tumor recurrence or metastatic disease was confirmed by clinical and radiological follow-up examinations. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated on a per lesion basis and diagnostic accuracy between both modalities was compared using McNemar's test. $p<0.05$ was considered as statistically significant.

RESULTS

Tumor recurrence and / or locoregional metastases were detected in 20 examinations. 18F-FDG PET/MR correctly identified all 20 suspicious examinations, while MRI detected 19 of 20 examinations. On a per lesion basis, sensitivity, specificity, PPV and NPV were 77%, 94%, 95% and 73% for MRI and 96%, 84%, 90% and 93% for 18F-FDG PET/MR, respectively. On a per lesion basis, the diagnostic accuracy of 18F-FDG PET/MR (91%) was significantly higher in comparison to MRI (84%, $p<0.05$).

CONCLUSION

In patients suffering from ACC of the head and neck, 18F-FDG PET/MR is superior to MRI in detection tumor recurrence and locoregional metastases. Especially the superior NPV of 18F-FDG PET/MR is advantageous in regular follow-up examinations after primary tumor treatment in patients suffering from ACC.

CLINICAL RELEVANCE/APPLICATION

In comparison to MRI, 18F-FDG PET/MR provides a superior diagnostic performance in follow-up examinations after primary treatment of adenoid cystic carcinoma of the head and neck.

SSM15-03 4'-[Methyl-11C]-Thiothymidine PET/CT for Early Assessment of Disease Control Of Chemoradiotherapy for Head and Neck Squamous Cell Carcinoma: Comparison with FDG PET/CT

Wednesday, Nov. 29 3:20PM - 3:30PM Room: S505AB

Participants
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PURPOSE

A new radiopharmaceutical, 4'-[methyl-11C]-thiothymidine (4DST), has been developed as an in vivo cell proliferation marker based on the DNA incorporation method. The purpose of this study was to evaluate the usefulness of 4DST PET/CT for early assessment of disease control of chemoradiotherapy for head and neck squamous cell carcinoma (HNSCC), in comparison with 2-deoxy-2-18F-fluoro-D-glucose (FDG) PET/CT.

METHOD AND MATERIALS

A total of 28 patients with HNSCC underwent 4DST and FDG PET/CT studies before, during, and after therapy. Uptake of 4DST and FDG was examined visually and semiquantitatively using standardized uptake value (SUV) for before, during and after therapy (SUVbefore, SUVduring and SUVafter, respectively). Percent change (during) was calculated from SUVbefore and SUVduring and percent change (after) was calculated from SUVbefore and SUVafter. Based on histopathological verification or radiologic follow-up, patients were divided into relapse-free and relapse groups. Relapse-free group was defined as those having no local recurrence or distant metastasis.

RESULTS

In all 28 patients, focally increased 4DST and FDG uptake in primary lesion was visible. On both 4DST PET/CT scans during and after therapy, 23 patients showed no increased uptake in primary lesion. On FDG PET/CT scans during and after therapy, 16 and 18 patients showed no increased uptake in primary lesion, respectively. Twenty-two patients were found to be relapse-free group and 6 to be relapse group. SUVduring and SUVafter values from 4DST PET/CT in relapse-free group were significantly lower than those in relapse group ($p<0.001$, respectively). The percent change (during) and percent change (after) values from 4DST PET/CT in relapse-free group were significantly higher than those in relapse group ($p<0.001$, respectively). Using FDG PET/CT, SUVduring, SUVafter, percent change (during) and percent change (after) were not significant differences between relapse-free and relapse groups.

CONCLUSION

The results of this preliminary study suggest that, compared with FDG PET/CT, 4DST PET/CT may be useful for early assessment of disease control of chemoradiotherapy in patients with HNSCC.

CLINICAL RELEVANCE/APPLICATION

4DST PET/CT may be useful for early assessment of disease control of chemoradiotherapy in patients with HNSCC.

SSM15-04 The Value 18F-FDG PET/CT in Early Stage Squamous Cell Carcinoma of the Oral Cavity

Wednesday, Nov. 29 3:30PM - 3:40PM Room: S505AB

Participants
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PURPOSE

The purpose of this study is to evaluate the value of 18-F fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) for staging of early stage squamous cell carcinoma (SCC) of the oral cavity. Nodal staging on 18F-FDG PET/CT was compared with magnetic resonance imaging (MRI) of the neck and correlated with pathological staging on neck dissections.

METHOD AND MATERIALS

A retrospective review of all patients with clinically T1 and T2, biopsy-proven, squamous cell carcinoma of the oral cavity, and a clinically node-negative neck, between 2012 and 2017 was carried out. All patients that underwent both 18F-FDG PET/CT and MRI neck prior to surgical resection were included. The N and M stages on PET/CT were recorded, according to the AJCC/UICC TNM staging system, along with any incidental findings requiring further investigation. N stage on MRI was also recorded. Pathology reports were reviewed for pathological staging of the primary tumour and nodal status.

RESULTS

Sixty-four patients have been reviewed to date. Fifty-seven (89%) patients proceeded to neck dissection. Of these patients, 47 (82.5%) were histologically-proven node negative and 10 (17.5%) had histologically-proven nodal metastases. Of those patients with nodal metastases, 4 patients were staged N1 on PET/CT and 6 were staged N0. There were 2 patients with nodal metastases staged N1 on PET/CT but N0 on MRI. Of the node negative patients, 44 were staged N0 on PET/CT and 3 were staged N1. This yields a sensitivity of 40%, specificity of 93.6%, positive predictive value of 57.1% and negative predictive value of 88%. All patients were staged as M0 on PET/CT. Incidental findings requiring further clinical and radiological investigation were detected on PET/CT in 23 (35.9%).

CONCLUSION

Occult cervical nodal metastases are relatively infrequent in early stage SCC of the oral cavity with a clinically node negative neck. The relatively high specificity and negative predictive value of PET/CT in this study is due to the low prevalence of nodal metastases in this patient cohort. This study demonstrates that PET/CT is of limited value in conjunction with MRI for the detection of nodal metastases in these patients.

CLINICAL RELEVANCE/APPLICATION

The clinically node negative neck in early stage SCC of the oral cavity poses a potential treatment dilemma. PET/CT is of limited value in the detection of nodal metastases in these patients.

SSM15-05 Clinical Value of Three-Dimensional SPECT/CT Imaging For Assessment of Jaw Bone Invasion in Oral Cancers

Wednesday, Nov. 29 3:40PM - 3:50PM Room: S505AB

Participants
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PURPOSE

Imaging diagnosis of jaw bone invasion in oral cancers is still challenging due to dental artifacts as well as difficulty in detecting morphological change of early invasion. We have recently developed three-dimensional (3D) single-photon emission computed

tomography-computed tomography (SPECT/CT) imaging. We aimed to investigate the diagnostic performance of 3D SPECT/CT imaging for jaw bone invasion in comparison with other imaging modalities.

METHOD AND MATERIALS

Preoperative 3D SPECT/CT, contrast-enhanced CT (ceCT), and MRI images in 14 oral cancer patients were retrospectively evaluated by an oral surgeon. Each of the 3 image sets was independently reviewed with the knowledge of the tumor locations as to the likelihood of jaw bone invasion. When reviewing 3D SPECT/CT images, 3D volume-rendered SPECT/CT images with and without clip-plane editing were generated in order to grasp 2D and 3D bone anatomy and metabolism. The likelihood was classified using a 5-point diagnostic confidence scale. A jaw bone without cancer invasion that was scored as 1, 2 or 3 was considered true negative. A jaw bone with cancer invasion that was scored as 4 or 5 was considered true positive. Imaging results were compared with postsurgical results.

RESULTS

Seven of the 14 patients had jaw bone invasion of cancer cells and the other 7 did not. The sensitivity, specificity, positive and negative predictive values in the diagnosis of jaw bone invasion were 100% (7/7), 71% (5/7), 78% (7/9) and 100% (5/5) in 3D SPECT/CT, 43% (3/7), 86% (6/7), 75% (3/4), 60% (6/10) in ceCT, and 57% (4/7), 86% (6/7), 80% (4/5) and 67% (6/9) in MRI, respectively. Receiver operating characteristic analysis showed that 3D SPECT, ceCT and MRI had an area under the curve of 0.837, 0.786 and 0.704, respectively (not statistically different). Two cases with false-positive findings in 3D SPECT/CT had destruction of both periosteal and alveolar bones with severe inflammatory cell infiltration around the tumor sites.

CONCLUSION

3D SPECT/CT may be more sensitive than ceCT or MRI in the detection of jaw bone invasion.

CLINICAL RELEVANCE/APPLICATION

3D SPECT/CT appears more sensitive than ceCT or MRI in detecting jaw bone invasion in oral cancers and may be useful when jaw bone invasion is unclear with ceCT or MRI.

SSM15-06 The Usefulness of Initial Treatment Effects Based On PERSIST Criteria in Predicting the Three Years Disease Free Survival of Head and Neck Cancer

Wednesday, Nov. 29 3:50PM - 4:00PM Room: S505AB

Participants
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PURPOSE

The study was done to evaluate the usefulness of the initial treatment effects based on PERSIST criteria in predicting the disease free survival (DFS) 3 years after the initial therapy of head and neck cancer (HNC).

METHOD AND MATERIALS

We analyzed retrospectively fifty-one cases of HNC, 35 male and 16 female, 18 hypo-pharynx cancer, 9 gingival cancer, 9 tongue cancer, 7 laryngeal cancer, 4 maximal cancer and 4 oropharynx cancer. All cases were performed FDG-PET/CT on both before and after the initial therapy. Chemo-radiotherapies were done in 35 patients and radiotherapies were done in 16 patients. We divided all patients into 2 groups, the responders (CMR+PMR) and the non-responders (SMD+PMD), based on the result of RECIST criteria. Then we compared the diagnostic ability of predicting DFS 3 years after the initial therapy among the result of initial therapeutic effect by PERCIST criteria and three kinds of FDG uptake parameters. The FDG uptake parameters were SUL max (< 16.0) ,SUL peak (< 12.0) and TLG(< 180g) obtained before the initial therapy respectively.

RESULTS

Among 36 responders, 25 cases (69.0%) reached 3 years DFS. In contrast, only 5 of 15 cases non-responders (33.0%) could reach 3 years DFS. The diagnostic accuracy of initial treatment effects based on PERSIST criteria for predicting 3 years DFS was 68.6%. Regarding FDG uptake indices before the initial therapy, TLG (<180g) was the most powerful predictor among three kinds of indexes (TLG 68.6%, SUL max 51.0%, SUL peak 52.9 %, in accuracy).

CONCLUSION

We could predict 3 years DFS with high probability based on the result of PERCIST criteria after the initial therapy in patients of HNC. Similarly, TLG (<180g) before the initial therapy was also good predictor of 3 years DFS.

CLINICAL RELEVANCE/APPLICATION

The result of the initial therapy based on PERCIST is useful not only for diagnosing therapeutic effect but also for predicting DFS 3 years after the initial therapy in HNC patients.

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SSM16

Neuroradiology (Gadolinium Deposition)

Wednesday, Nov. 29 3:00PM - 4:00PM Room: N226

MR NR

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

Participants
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Sub-Events

SSM16-01 Assessment of the Neurologic Effects of Intracranial Gadolinium Deposition Using a Large Population Based Cohort

Wednesday, Nov. 29 3:00PM - 3:10PM Room: N226

Participants
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PURPOSE

The neurotoxic potential of intracranial gadolinium (Gd) deposition following intravenous administration of gadolinium based contrast agents (GBCAs) is undefined. In the current study, we used the world's largest prospective population-based cohort on aging to study the effects of Gd exposure on neurologic and neurocognitive function.

METHOD AND MATERIALS

The Mayo Clinic Study of Aging (MCSA) cohort was enumerated from the Rochester Epidemiology Project in 2004 to study the incidence and natural history of cognitive impairment and dementia. All participants underwent extensive longitudinal clinical (neurologic evaluation, neuropsychological testing) assessment at baseline and 15-month follow-up intervals. Neurologic and neurocognitive scores were compared using standard multivariate methods between MCSA patients with no history of prior Gd exposure and those who underwent prior Gd-enhanced MRI. Progression from normal cognitive status to mild-cognitive impairment and dementia was assessed using multistate Markov model analysis.

RESULTS

Among 4261 cognitively normal study participants aged 50-90 (mean age (SD): 71.9 yrs (10.7), mean study participation (SD): 3.7 yrs (3.0)), 1092 (25.6%) received one or more GBCA doses (median: 2 doses, range: 1-28 doses) unrelated to their participation in the MCSA. Median time since first Gd exposure was 5.6 years (IQR=2.2-9.3 years). After adjusting for age, sex, education level, baseline neurocognitive performance, Charlson comorbidity index, and ApoE4 status, GBCA exposure was not a significant predictor of cognitive decline (changes in clinical dementia rating (p=.48), Blessed dementia scale (p=.68), or mental status exam score (p=.55)), diminished neuropsychological performance (p=.13), or diminished motor performance (Unified Parkinson's Disease Rating Scale (p=.43)). No dose-related effects were observed among these metrics (p=.89-.20). Finally, Gd exposure was not an independent risk factor in the rate of cognitive decline from normal cognitive status to dementia in this cohort (p=.91).

CONCLUSION

GBCA administration was not associated with worse overall neurologic or neurocognitive performance nor does it significantly affect the natural progression of cognitive decline in a large population-based cohort.

CLINICAL RELEVANCE/APPLICATION

Despite evidence of Gd accumulation following intravenous GBCA administration, Gd exposure is not associated with adverse neurologic outcomes.

SSM16-02 Differences in Gadolinium Retention after Repeated Injections of Macrocyclic MR Contrast Agents to

Rats

Wednesday, Nov. 29 3:10PM - 3:20PM Room: N226

Participants
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PURPOSE

To investigate whether significant differences exist among macrocyclic MR contrast agents with respect to their retention in cerebellum, brain, kidneys and other organs.

METHOD AND MATERIALS

Gadobutrol (Gadovist®; Bayer), gadoterate meglumine (Gd-DOTA, Dotarem®; Guerbet), gadoteridol (ProHance®; Bracco) or Saline solution (0.9% w/v NaCl) were administered at 0.6 mmol/kg (1.2 mL/kg for saline) four times a week for five weeks to healthy male Wistar Han rats, randomly assigned to each of the four groups (n=15/group). After the end of the treatment, a recovery period of 4 weeks (28 d) was allowed before sacrifice. Organs (blood, cerebrum, cerebellum, liver, femur, kidneys and skin) were then collected for ICP-MS determination of gadolinium. Based on available amounts of samples, the LOQ (Limit of Quantitation) for Gd was 0.1 nmol/mL for blood, 0.1 nmol/g for cerebrum/cerebellum, 0.5 nmol/g for femur, 1 nmol/g for liver and skin. 1.7 nmol/g for kidneys. Statistical analysis was carried out by an independent expert.

RESULTS

Both in cerebellum and in cerebrum ProHance resulted in significantly ($p < 0.001$) lower levels of gadolinium compared both to Dotarem and to Gadovist. Also in the kidneys ProHance showed a residue that was significantly lower than both Dotarem (6 times higher; $p < 0.01$) and Gadovist (8 times higher; $p < 0.001$). In the femur, the differences were less pronounced, with only gadoterate meglumine showing a lower accumulation than gadobutrol ($p < 0.001$) and gadoteridol ($p < 0.05$). Gd concentration in blood, liver and skin samples was < LOQ.

CONCLUSION

After repeated injections of the 3 macrocyclic GBCAs and a 4-week off-dose period, ProHance resulted in significantly lower gadolinium concentrations than either Dotarem or Gadovist in cerebellum, cerebrum and kidneys. The observed differences, in the absence of dechelation, point to differences in wash-out rates, with gadoteridol being the GBCA that is most efficiently removed from both CNS and renal tissues.

CLINICAL RELEVANCE/APPLICATION

This non-clinical study shows that also macrocyclic MR contrast agents differ in the extent of retention in CNS and renal tissues, with ProHance giving less retention than Gadovist or Dotarem.

SSM16-03 Absence of Toxicity in Extended Duration Study of Gadolinium in Rodent Brains after Repeat Dosing of Gadodiamide: Investigation of Concentration, Location and Cell Ultrastructure

Wednesday, Nov. 29 3:20PM - 3:30PM Room: N226

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PURPOSE

Recent studies report low levels of gadolinium based contrast agents in the brain following repeat exposure. The purpose of this study was to evaluate the levels of Omniscan in the rat brain up to one year post-dosing, to evaluate the location of retained gadolinium, and to determine if there were any neurohistopathological sequelae.

METHOD AND MATERIALS

This study reports on a 50-week experimental endpoint from a previously published study (Smith et al. Radiology, 282:3, March 2017) together with additional analyses at the 1, 20 and 50 week timepoints. Gadolinium concentrations were quantified in blood and brains of rats 50 weeks after the cessation of dosing (cumulative dose 12 mmol/kg over 5 weeks) using inductively coupled plasma mass spectrometry (ICP-MS). Brain sections at standard toxicological levels were evaluated by standard toxicological

assessment. A portion of the Deep Cerebellar Nucleus (DCN) was reserved and processed for transmission electron microscopic (TEM) cell ultrastructure analysis and TEM with electron dispersive spectroscopy (TEM-EDS).

RESULTS

Gadolinium levels at 50 weeks were comparable to those observed at 20 weeks. Toxicologic histopathology analysis revealed no findings, and cell ultrastructural TEM analysis similarly revealed no findings, indicating that this extended period of gadolinium exposure for up to 1 year did not result in any tissue injury. A TEM-EDS analysis of gadolinium localization in the DCN showed approximately 100 nanometer foci located in the basal lamina, abluminal to the endothelium.

CONCLUSION

We conclude that whilst a small portion of gadolinium in the brain after repeat doses of GBCA is subject to long term retention (approximately 1/1,000,000 of the injected dose), this does not result in any observable tissue injury. We further propose that this gadolinium is in perivascular foci, and we have not found foci in the brain parenchyma.

CLINICAL RELEVANCE/APPLICATION

These observations are consistent with clinical observations of brain Gd in the human brain but without histopathological changes or a corresponding clinical syndrome.

SSM16-04 Long Term Deposition with Slow Clearance of Gadolinium in Cerebellum After Repeated Injections of Gadodiamide as compared to Gadoterate Meglumine in Rats

Wednesday, Nov. 29 3:30PM - 3:40PM Room: N226

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PURPOSE

The objective of this study is to compare the long-term kinetics of Gd deposition in the cerebellum for gadodiamide (Omniscan®, linear contrast agent) and gadoterate meglumine (Dotarem®, macrocyclic contrast agent).

METHOD AND MATERIALS

Injection protocol: N=120 healthy rats received 5 intravenous injections of 2.4 mmol/kg of gadodiamide or gadoterate meglumine (N=60/agent) over a period of 5 weeks (1 injection per week) according to a published protocol (Robert 2016). Rats were divided in 6 groups with 0, 1, 2, 3, 4 and 5 months of washout period (N=10/agent, groups M0, M1, M2, M3, M4 and M5 respectively). Gd dosing: At each delay, animals were sacrificed. Blood and cerebellum were sampled and total Gd concentrations were dosed by the ICP-MS technic. Pharmaco-kinetics analysis: tissue Gd elimination kinetics in the cerebellum were fitted to estimate the tissue elimination half-lives in days along the 5 months of washout.

RESULTS

At all time-points, a significantly higher concentration of total Gd was found in cerebellum for gadodiamide groups as compared to gadoterate groups. Five months after the last injection, 30-fold more Gd was measured in the cerebellum in the gadodiamide group (2.29±0.30nmol/g) versus gadoterate (0.075±0.037nmol/g, $p<0.0001$). At this time-point, no remaining Gd was detected in the blood for both products. For gadodiamide, mean half-life of elimination (T1/2) of Gd accumulated in the cerebellum was 410 days. For comparison, more than 87% of Gd was cleared from the cerebellum with a T1/2 of 15 days for gadoterate meglumine.

CONCLUSION

A 30-fold higher total Gd concentration in the cerebellum was found 5 months after gadodiamide treatment as compared to gadoterate. Elimination of Gd from the cerebellum was 28-fold slower after injection of gadodiamide as compared to gadoterate meglumine. Recent studies have shown that a large amount of Gd is present under dechelated form one month after repeated injections of linear Gd contrast agents (Frenzel 2017) in contrary to macrocyclic Gd contrast agents which are excreted in chelated form. Such speciation analysis are ongoing on these long term data.

CLINICAL RELEVANCE/APPLICATION

After injection of linear Gd-based contrast agent gadodiamide, long term total Gd concentration in the cerebellum is 30-fold higher and elimination rate is 28-fold slower as compared to the macrocyclic gadoterate meglumine.

SSM16-05 Penetration and Distribution of Gadolinium-Based Contrast Agents into Cerebrospinal Fluid in Humans

Wednesday, Nov. 29 3:40PM - 3:50PM Room: N226

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PURPOSE

Signal hyperintensity on unenhanced T1-weighted magnetic resonance (MR) images correlating with gadolinium deposition has been reported after multiple administrations of gadolinium-based contrast agents (GBCAs). This increase seems to be primarily associated with the repeated use of linear GBCAs. Recent studies on healthy rats have furthermore demonstrated that the blood-cerebrospinal fluid (CSF) barrier is permeable to not only linear but also macrocylcic GBCAs. The aim of our clinical study was to evaluate whether gadolinium (Gd) can be detected in CSF, to the best of our knowledge, for the first time in humans.

METHOD AND MATERIALS

This study was approved by the local Ethics committee with patient's consent authorizing use of tissue samples in research studies. For inclusion, all patients with a lumbar puncture between January and August 2016 were screened for at least one previous MR examination with GBCA administration (gadoterate meglumine at a dose of 0.1 mmol/kg bodyweight) within a time frame of 60 days prior to CSF extraction. A total of 39 consecutive samples fullfilling these criteria were identified. These patients were enrolled and their CSF was analyzed for the presence of Gd. The control group consisted of 10 patients without any prior intravenous GBCA administration according to medical files. Gd measurements in the CSF were performed using inductively coupled plasma mass spectrometry by monitoring the response of the 158Gd isotope.

RESULTS

In all cases with prior GBCA administration, Gd could be detected in the CSF. Gd concentration in the CSF showed a steady increase over 6 hours following the intravenous injection of the contrast agent. A significant decrease of Gd concentration compared to the peak values could be detected 24 hours after injection. Less amounts but still measurable concentrations of Gd could be detected several days/weeks after contrast enhanced MR examination. Control groups were all negative for Gd presence as expected.

CONCLUSION

Gadoterate meglumine, a macrocyclic GBCA, crosses the blood-brain barrier in humans and penetrates the CSF, in accordance with previous preclinical studies on healthy rats. Traces of GBCA can be detected in the CSF days/weeks after iv administration.

CLINICAL RELEVANCE/APPLICATION

It seems that the glio-vascular pathway via the CSF is a potential entrance way for GBCA into the brain.

SSM16-06 Cerebrospinal Fluid (CSF) Gadolinium Accumulation after Intravenous Gadobutrol-Enhanced MRI

Wednesday, Nov. 29 3:50PM - 4:00PM Room: N226

Awards
Student Travel Stipend Award

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PURPOSE

Recent studies in the setting of an intact blood brain barrier (BBB) have demonstrated intracranial gadolinium deposition following MRI with gadolinium-based contrast agents (GBCAs). While the mechanism of gadolinium distribution from bloodstream to neuronal tissue remains unclear, a proposed mechanism is through the blood-cerebrospinal fluid (CSF) barrier. This study evaluates gadolinium accumulation in the CSF after intravenous Gadobutrol administration.

METHOD AND MATERIALS

Patients who underwent a Gadobutrol-enhanced MRI and subsequent lumbar puncture (LP) within a period of 30 days (Gadobutrol group) were included versus a control group who had an LP without prior history of receiving gadolinium-enhanced MRI. Serum samples were also obtained following MRI exam. Gadolinium in CSF and serum samples was quantified using inductively coupled plasma mass spectrometry. Intact BBB was defined as total CSF protein less than or equal to 35 mg/dL. The relationship between gadolinium clearance and patient characteristics (ie. age, gender, CSF protein), and between serum and CSF gadolinium concentration were examined using regression models.

RESULTS

Eighty two (n=82) pediatric and adult patients (68 Gadobutrol, 14 control) were included. Time between Gadobutrol exposure and CSF collection ranged from 1.1 and 594 hours. Gadolinium was detected in the CSF of all Gadobutrol group patients (range 0.2 to 1494 ng/mL); alternatively the median gadolinium concentration in the control group patients was 0 ng/mL (IQR 0 - 0 ng/mL). Pediatric patients (<18 years) and those with an intact BBB had significantly faster clearance of gadolinium compared to adult patients and those with compromised BBB (CSF protein >35 mg/dL) (p=0.046 and <0.001, respectively). Furthermore there was significant correlation between gadolinium concentrations in the serum (range 2.2 - 277.8 ng/mL) and CSF samples (p<.0001).

CONCLUSION

Intravenous administration of Gadobutrol results in gadolinium accumulation within the CSF, even in the setting of normal renal function and no BBB dysfunction. Further research is required to determine the mechanism and clinical significance of gadolinium accumulation in CSF.

CLINICAL RELEVANCE/APPLICATION

Gadolinium accumulates in the CSF following intravenous administration of Gadobutrol in the absence of neurologic pathology and normal renal function, suggesting a route for intracranial deposition.

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SSM17

Neuroradiology (Intracranial Vascular Imaging: Pipe Dream or Reality?)

Wednesday, Nov. 29 3:00PM - 4:00PM Room: N227B

MR NR VA

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

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Sub-Events

SSM17-01 Reduced Intravoxel Incoherent Motion Microvascular Perfusion Predicts Delayed Cerebral Ischemia and Vasospasm After Cerebral Aneurysm Rupture

Wednesday, Nov. 29 3:00PM - 3:10PM Room: N227B

Participants
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PURPOSE

Cerebral arterial vasospasm and clinical delayed cerebral ischemia (DCI) following aneurysmal subarachnoid hemorrhage (aSAH) accounts for up to 30% of the morbidity and mortality in these patients. Neurologic examinations, daily transcranial Doppler ultrasound (TCD), and screening CT/CT Angiography/CT Perfusion studies have limited sensitivity and specificity in identifying DCI. Intravoxel incoherent motion (IVIM) MRI extracts microvascular perfusion information from a multi-b value diffusion-weighted sequence. We determined whether decreased IVIM perfusion on brain MRI may identify patients with DCI and cerebral vasospasm.

METHOD AND MATERIALS

We performed a retrospective cohort study of patients with aneurysmal SAH rupture at our neurovascular center. Consecutive patients who underwent a brain MRI after ruptured aneurysm treatment with neurologic deterioration and possible DCI were included. Intravoxel incoherent motion was included in all MRI examinations during the study period. Patient demographic, DCI development, aneurysm and vasospasm treatment, and outcome data were determined by electronic medical record review. Statistical analysis was performed using Excel and SPSS.

RESULTS

16 patients (11 female; 5 male; p=0.9) were included. 10 patients (63%) developed DCI and vasospasm requiring endovascular treatment (DCI+ group) and 6 (37%) did not (DCI- group). DCI+ patients were younger (mean 59 years versus 70 years in the DCI- group; p=0.03); there were no differences in medical co-morbidities between these groups. Presentation Glasgow Coma Scale, Hunt and Hess Scale, and Fisher Grade were also similar between these groups. 20 MRI studies (14 in DCI+ and 6 in DCI-) were performed. All MRIs were performed prior to endovascular vasospasm treatment in DCI+ patients. Whole brain microvascular blood volume on IVIM was significantly reduced in DCI+ patients (mean±sd 0.13±0.02 mm2/s) compared to DCI- patients (0.9±0.03 mm2/s; p=0.03). There was no significant difference in arterial spin labeling or perfusion weighted imaging measures of cerebral perfusion between DCI+ and DCI- patients.

CONCLUSION

Decreased microvascular blood volume on IVIM correlates with DCI development following cerebral aneurysm rupture.

CLINICAL RELEVANCE/APPLICATION

IVIM perfusion may be a useful biomarker for DCI and a triage tool for endovascular vasospasm treatment. Prospective studies should validate this hypothesis.

SSM17-02 Assessment of Steal Phenomenon in MMD Patients with Combination of T-ASL and MRA

Wednesday, Nov. 29 3:10PM - 3:20PM Room: N227B

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PURPOSE

Steal phenomenon is an independent risk factor for future stroke. We aimed to generalize the steal phenomenon conducted by the first and the second collaterals separately using t-ASL combining with MRA in MMD patients, and to explore the relationship between pre-operation hemorrhage and the steal phenomenon.

METHOD AND MATERIALS

Forty-three patients with bilateral moyamoya disease underwent t-ASL, MRA and DSA. Clinical factors including sex, age, hypertension, diabetes metabolic, hyperlipidemia, current smoking, history of taking Aspirin were gathered. Correlation analysis was used to compare the relationship between the amount of steal phenomenon and Suzuki staging. Univariate logistic regression analyses were performed to examine the relationship between pre-operation hemorrhage and each of the factors separately. Forward stepwise multivariate logistic regression analyses were performed to determine the crucial risk factor.

RESULTS

In every MMD patient steal phenomenon was positive (total amount 136). SP could be divided into five types on t-ASL images (ICA-contralateral ACA, ICA-contralateral MCA, anterior circulation-ipsilateral posterior circulation, posterior circulation-ipsilateral anterior circulation, external carotid circulation) and three groups according to MRA and t-ASL. The amount of SP was not associated with SUZUKI stage (P=0.122, 0.689). Out of all the clinical and imaging factors, high SUZUKI stage (P=0.038) and the existence of the steal phenomenon completely conducted by the second collateral (P=0.002) showed great power for predicting pre-operation hemorrhage. Forward stepwise multivariate logistic regression analyses revealed steal phenomenon completely conducted by the second collateral (OR: 29.499, 95% CI: 3.629-239.780; P =0.002) was more powerful than high SUZUKI stage (OR: 0.265, 95% CI: 0.098-0.718; P =0.009).

CONCLUSION

Steal phenomenon in MMD can be divided into five types by t-ASL and three groups according to MRA and t-ASL. Comparing with high SUZUKI stage, the existence of the steal phenomenon completely conducted by the second collateral is a stronger risk factor for pre-operation hemorrhage in MMD patients.

CLINICAL RELEVANCE/APPLICATION

Comparing with high SUZUKI stage, the existence of the steal phenomenon completely conducted by the second collateral is a stronger risk factor for pre-operation hemorrhage in MMD patients.

SSM17-03 High Resolution Time-of-Flight Magnetic Resonance Angiography with Volume Rendering Algorithm for Detection of Cerebral Aneurysms: Correlation with Standard Digital Subtraction Angiography (DSA)

Wednesday, Nov. 29 3:20PM - 3:30PM Room: N227B

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PURPOSE

We investigated the diagnostic performance and increased discriminative value of the biomarkers of high-resolution MRA(HR-MRA) with volume rendering(VR) post-processing techniques for the detection of cerebral aneurysms compared with conventional MRA(C-MRA), using digital subtraction angiography(DSA) as the gold standard.

METHOD AND MATERIALS

HR-MRA was performed for 38 patients with 51 possible aneurysms on C-MRA. For each possible aneurysm, two readers recorded their level of confidence on a 5-point scale. All patients were performed DSA, which was used as the standard of reference. ROC analysis was conducted to determine the effectiveness of C-MRA and HR-MRA in detecting aneurysm with and without VR. The sensitivity, specificity, PPV, and NPV for each category was calculated. AUC and the 95% CI of the area were computed to evaluate the detective ability. The increased discriminative value of the biomarkers was examined by calculation of NRI and IDI indices.

RESULTS

DSA revealed 37 aneurysms in 26 patients. Both in aneurysm-based and patient-based analyses, HR-MRA showed higher diagnostic accuracy than C-MRA, and when a VR algorithm was added, increased diagnostic accuracy was revealed(C-MRA vs. HR-MRA $p<0.01$; in addition of VR, $p<0.01$, respectively). Although the addition of VR to the HR-MRA did not improve the AUC(0.8031 vs. 0.8658, $p=0.16$), the IDI(19.38%, $Z=3.18$, $p<0.01$) and NRI(46.3%, $Z=6.32$, $p<0.01$) were statistically significant. When using the 5-point scale of MRA finding, C-MRA showed better performance than that of categorized MRA finding, without statistically significant difference of AUC ($p=0.27$). And the addition of VR to the HR-MRA did not improve the AUC(0.9228 vs. 0.9188, $p=0.14$), but the IDI(29.5%, $Z=4.3$, $p<0.01$) and NRI(73%, $Z=15.39$, $p<0.01$) were statistically significant. For aneurysms less than 3 mm, when HR-MRA with VR was applied, the detection rate was further increased than that of aneurysms greater than or equal to 3 mm.

CONCLUSION

The application of HR-MRA with a VR algorithm improved diagnostic performance for the detection of intracranial aneurysms, especially when the aneurysm was less than 3 mm.

CLINICAL RELEVANCE/APPLICATION

The application of HR-MRA with a VR algorithm has high accuracy, sensitivity and specificity for the detection of intracranial aneurysms, which is recommended to improve diagnostic performance for the detection of intracranial aneurysms.

SSM17-04 Comparative Study of 4D CTA and DSA for Vascular Assessment in Moyamoya Disease

Wednesday, Nov. 29 3:30PM - 3:40PM Room: N227B

Participants
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PURPOSE

We use 4D CTA to evaluate the vascular changes in moyamoya disease, including the vascular stenosis (modified Suzuki score, Houkin score) and collateral circulation (basicranial moyamoya vessels, posterior circulation collaterals and ECA collaterals). DSA was used as the gold standard to determine the value of noninvasive angiography in moyamoya disease.

METHOD AND MATERIALS

101 patients with confirmed moyamoya disease were underwent 4D CTA and DSA with an interval of <1 week. Two neuroradiologists evaluated the 4D CTA (VR and MIP) and DSA images independently or jointly in the case of disagreement. The performance of 4D CTA relative to DSA was determined using consistency checks (kappa values, 95% CI) and correlation analysis.

RESULTS

We obtained the following kappa values for consistency between 4D CTA and DSA: modified Suzuki score, 0.714 (0.649-0.778); Houkin score, 0.846 (0.780-0.911); the basicranial moyamoya vessels, 0.594 (0.525-0.663); posterior circulation collaterals, 0.435 (0.325-0.544); and ECA collaterals, 0.591 (0.483-0.699). The corresponding correlation coefficients (P values) were 0.843 (<0.001), 0.872 (<0.001), 0.792 (<0.001), 0.635 (<0.001) and 0.797 (<0.001).

CONCLUSION

In the evaluation of the vascular changes of moyamoya disease, 4D CTA (VR and MIP) showed strong consistency and correlation with DSA in terms of the vascular stenosis score, but was insufficient in collateral circulation evaluation.

CLINICAL RELEVANCE/APPLICATION

We adopted the modified Suzuki score and Houkin score to evaluate intracranial vascular stenosis in MMD, and also evaluated collateral circulation (the basicranial moyamoya vessels, and collaterals from the posterior circulation and ECA). Here, we discuss the value of 4D CTA for vascular assessments in adult MMD patients as compared with the gold standard, DSA. Upon analyzing the 4D CTA and DSA images of 101 adult patients with confirmed MMD, we concluded the following: (1) 4D CTA has high consistency and correlation with DSA in terms of the Suzuki and Houkin scores; and (2) 4D CTA has fair correlation and moderate consistency with DSA for the assessment of collateral circulation, specifically, the basicranial moyamoya vessels, and collaterals from the posterior circulation and ECA.

SSM17-05 4D Flow MRI Analysis of Cerebral Blood Flow Before and After High-Flow EC-IC Bypass Surgery

Wednesday, Nov. 29 3:40PM - 3:50PM Room: N227B

Awards
Trainee Research Prize - Fellow

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PURPOSE

One of the treatment options for complex ICA aneurysm is the ligation of the ICA with the high-flow extracranial-intracranial (EC-IC) bypass surgery. Though the cerebral hemodynamics is thought to be changed drastically after the surgery, there has been no published papers performing quantitative evaluation. The purpose of this study was to clarify the change of the hemodynamics after the high-flow EC-IC bypass surgery by using time-resolved 3D-phase contrast (4D Flow) MRI.

METHOD AND MATERIALS

We enrolled 11 patients (2 men; mean age 62.8) who underwent ICA ligation and high-flow EC-IC bypass surgery with radial artery graft for treatment of a complex ICA aneurysm. They underwent 4D Flow MRI preoperatively and 3 weeks after the bypass surgery. The imaging parameters; 3.0-T MRI (Aheiva, Philips), TR/TE=8.4/5.4, VENC=100cm/sec, voxel size=0.82X0.82X1.4mm, heart phase= 15, scan time= approx. 6 min. We measured blood flow volume (BFV) of bilateral ICAs, BA, and bypass artery by using GT Flow (Gyro Tools). The BFV of each vessel and total brain BFV (t-BFV = bilateral ICAs + BA + bypass) were compared between before

and after surgery by using paired t-test. We evaluated post-operative hyperperfusion based on CT perfusion and clinical symptoms within 3 weeks after the surgery.

RESULTS

In all patients, the patency of the bypass artery was confirmed by 4D Flow MRI. The BFV of contralateral ICA and BA were statistically increased after the surgery (ICA: 5.89±2.08 vs. 7.22±1.88 ml/sec (p=.0018), BA: 3.06±0.17 vs. 4.12±0.14 ml/sec (p<.001)). T-BFV was statistically increased after surgery (12.99±8.65 vs. 15.18±3.14 ml/sec (p=.0067)). While, there was no evidence of hyperperfusion in any cases based on CT perfusion or clinical symtoms.

CONCLUSION

In the current study, we could prove that the drop of BFV from sacrificed ICA is compensated by both native arteries (contralateral ICA and BA) and the bypass. Though the CT perfusion and clinical symtoms confirmed there is no hyperperfusion, the t-BFV increased 16.8%. It may indicate 4D Flow MRI could reveal the subtle hyperperfusion. In conclusion, 4D Flow MRI could quantify the change of hemodynamics after the high-flow bypass surgery. It provides insight to the autoregulation system in the cerebral blood flow.

CLINICAL RELEVANCE/APPLICATION

4D Flow MRI is one of the optimized imaging modalities for the quantitative assessment of the cerebral hemodynamic change after high-flow EC-IC bypass surgery.

SSM17-06 Angiogram-negative Non-perimesencephalic Subarachnoid Hemorrhage: A Meta-Analysis of Follow up Strategies

Wednesday, Nov. 29 3:50PM - 4:00PM Room: N227B

Participants
Long Tu, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Yiyuan Fang, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Xiao Wu, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Ajay Malhotra, MD, Stamford, CT (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study is to synthesize the current literature into recommendations regarding the follow up of non-perimesencephalic subarachnoid hemorrhage. Specifically, we will investigate the utility of various imaging modalities (CTA, DSA, MRA) of repeat imaging after an initially negative angiographic study (usually CTA or DSA).

METHOD AND MATERIALS

PUBMED, EMBASE, SCOPUS and research meeting abstracts were searched up to March 2017 for studies of patients with spontaneous subarachnoid hemorrhage (SAH) and an initially negative angiographic study (DSA, CTA, or MRA). Title/abstract and then full text screening was performed by two independent reviewers. Study quality was assessed via the Cochrane Risk of Bias Tool (CRBT). Where appropriate, meta-analysis was conducted using random effects models.

RESULTS

A total of 1917 studies were identified, of which 178 underwent full text review; 95 studies were included. Diagnostic methods for initial angiographic as well as follow up studies were variable. Preliminary assessment of study quality by CRBT also showed variability; however, most studies had a low risk of bias. Preliminary data suggest superiority of DSA and CTA to MRA for follow up of angiogram-negative NPSAH.

CONCLUSION

Spontaneous SAH may be categorized as perimesencephalic, diffuse aneurysmal , peripheral (convexity, sulcal), or CT-negative (detected only on lumbar puncture) based on the distribution of acute hemorrhage. Follow up imaging for patients with perimesencephalic patterns of hemorrhage has been shown to be unlikely to find an underlying structural lesion or to change outcome for this relatively benign entity. The optimal management strategies for non-perimesencephalic SAH however are not clear. Preliminary data from our meta-analysis suggest superiority of DSA (including rotational 3D angiogram) and CTA over MRA for NPSAH with an initially negative angiographic study.

CLINICAL RELEVANCE/APPLICATION

Our study will make recommendations on the optimal management of the more concerning (non-perimesencephalic) subtypes of spontaneous SAH based on existing literature.

SSM20

Physics (MR: New Techniques)

Wednesday, Nov. 29 3:00PM - 4:00PM Room: S403A

MR PH

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

FDA Discussions may include off-label uses.

Participants
Timothy J. Carroll, PhD, Chicago, IL (*Moderator*) Nothing to Disclose
Geoffrey D. Clarke, PhD, San Antonio, TX (*Moderator*) Nothing to Disclose

Sub-Events

SSM20-01 Hyperpolarized Water as an Alternative MRI Contrast Agent

Wednesday, Nov. 29 3:00PM - 3:10PM Room: S403A

Participants
Sebastian Fischer, MD, Frankfurt, Germany (*Presenter*) Nothing to Disclose
Richard D. Maeder, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Maxim Terekhov, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Stefan Zangos, MD, Frankfurt Am Main, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Prisner, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Vasyl Denysenkov, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

sebastian.fischer@kgu.de

CONCLUSION

Hyperpolarized water might be a promising future alternative to Gadolinium based contrast agents in MR angiography or even further diagnostics without risking the potential adverse effects or intracorporal remnants of Gadolinium based contrast agents.

Background

The administration of Gadolinium based contrast agents is associated with the risk of allergic reactions and the development of a systemic nephrogenic fibrosis (NSF). Current research showed remnants of some types of Gadolinium based MR contrast agents in the brain - with unknown long-term effects. Purpose of our work is the development of an alternative method to create MRI contrast by using dynamic nuclear polarization (DNP). The tested liquid-state Overhauser DNP is a technique to achieve hyperpolarization by microwave irradiation of electron spins in TEMPOL radicals, which are coupled with the nuclear spins of water molecules.

Evaluation

Our setup comprises a 42 GHz microwave source and an in-bore DNP polarizer, equipped with a multimode resonator inside a standard clinical 1.5 T scanner, which allows a continuous hyperpolarization of water molecules with a flow rate about 1.2 ml/min. In this work we characterized the performance of the DNP setup for MR imaging in various vascular models by comparing it to standard Gadolinium-based contrast media. We used 2D and 3D scan protocols with GRE- and VIBE-sequences for measurements, which feature up to a 30-fold signal enhancement of the hyperpolarized aqueous solution. A comparison to Gadolinium enhanced signals of physiologic intravascular conditions shows 12-fold enhancement rates and an increased absolute sensitivity.

Discussion

The used liquid state in-bore DNP setup creates hyperpolarized water, which features high T1 MR signal enhancements and a short relaxation time. SNR and CNR values were substantially improved by DNP and capillary diameters down to 75µm could be visualized. In our comparing experiments the hyperpolarized water showed an enhancement higher than gadolinium, which allows imaging down to small vascular structures in a standard clinical 1.5 T scanner.

SSM20-02 Intravoxel Incoherent Motion Diffusion-weighted Imaging of Bone Marrow Microstructure in Patients with Acute Leukemia

Wednesday, Nov. 29 3:10PM - 3:20PM Room: S403A

Participants
Jinliang Niu, MD, PhD, Taiyuan, China (*Presenter*) Nothing to Disclose
Hong Zhu, Taiyuan, China (*Abstract Co-Author*) Nothing to Disclose
Wenqi Wu, Taiyuan, China (*Abstract Co-Author*) Nothing to Disclose
Yang Wang, Taiyuan, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Intravoxel Incoherent Motion Diffusion-weighted Imaging of Bone Marrow Microstructure in Patients with Acute Leukemia

METHOD AND MATERIALS

28 patients with AL underwent MRI scans at 1.5T using conventional diffusion weighted imaging (DWI) and IVIM (b= 0, 10, 25, 50, 100, 200, 400, 600, 800, 1000, 1200s/mm2) in the sagittal plane covering the lumbar bone marrow before standard chemotherapy. The IVIM parameters (perfusion fraction [f], molecular diffusion coefficient [D], and perfusion-related D [D*] and apparent diffusion coefficient (ADC) were extracted from the bone marrow images. The microvessel density (MVD) and vascular endothelial growth factor(VEGF) was confirmed by bone marrow biopsy of the iliac crests, whichwere used to evaluate bone marrow microstructure. All patients were divided into complete remission (CR) and non-remission (NR) group according to the treatment response.

RESULTS

All patients underwent the first remission induction chemotherapy, with 19 patients achieved CR and 9 patients achieved NR.The ADC and D* values were not significant different between the two groups. However, D value of CR group was significantly higher (p=0.003), and f value of CR group was significantly lower (p=0.039) than those of NR group. Using receiver operator characteristic (ROC) analysis, the area under the curve (AUC) of D and f were 0.848 and 0.746 respectively in evaluating prognosis of AL before treatment. The fshowed significantly statistical correlations with MVD (r= 0.384) and VEGF (r= 0.439).

CONCLUSION

The D , f value ofbone marrow could play a potential role in prognosticating patients with AL. The f value could be used as noninvasive biomarkers to evaluate the microstructure bone marrow.

CLINICAL RELEVANCE/APPLICATION

Evaluation of bone marrow microstructure and prognosis of leukemia patients

SSM20-03 Auto-Calibrated Correlation Time Diffusion Brain qMRI and the Principle of Diffusional Homeostasis

Wednesday, Nov. 29 3:20PM - 3:30PM Room: S403A

Participants
Hernan Jara, PhD, Boston, MA (*Presenter*) Patent holder, qMRI algorithms; Royalties, World Scientific Publishing Co; ; ;
Stephan W. Anderson, MD, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Osamu Sakai, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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CONCLUSION

A fully automated and auto-calibrating DCT mapping algorithm has been developed and could be useful for aiding in the diagnosis of pathologic entities that disrupt diffusional homeostasis such as acute ischemic stroke.

Background

Standard diffusion MRI is based on the pulsed field gradient (PFG) experiment and probes molecular water motions at the 10-100millisecond time scale depending on experimental conditions. Despite the very different water micro-environment in gray matter (GM) and white matter (WM), one of the most remarkable findings of DPFG MRI is the near equality of the mean diffusivities of water in both tissues at diffusion times reported in the literature. Correlation time diffusion (DCT) MRI is based on T1 relaxometry and therefore probes water diffusion at the very short time scale of the correlation time: approximately 20ps for brain tissue. We hypothesize that the herein termed "*principle of diffusional homeostasis*" is valid at such short time scales and apply it to develop a self-calibrating DCT mapping algorithm whereby the one external model parameter -specifically, the magnetization transfer coupling constant (kappa in Fig. 1)-- is auto-determined by minimizing the WM-to-GM diffusional differences to within one half the standard deviation.

Evaluation

This is a HIPAA compliant prospective study approved by the local IRB that included ten patients without major abnormalities ranging in age from 2 to 87years. MR images acquired with the mixed turbo spin echo pulse (mixed-TSE) sequence were qMRI processed generating maps of T1, T2, and PD. These maps were used to generate DCT maps using an algorithm which calculates the pure correlation time without magnetization transfer effects. In all ten cases, the DCT maps were in quantitative agreement (<5%) with the DPFG maps for GM, WM, and cerebrospinal fluid.

Discussion

The developed fully auto-calibrating DCT mapping algorithm is based on the assumption of diffusional homeostasis, which is supported by a wealth of DPFG evidence in the healthy brain. Differences between DCT and DPFG may arise in pathologic conditions whereby the long time scale diffusion tissue properties may be abnormal via restricted diffusion.

SSM20-04 Metal Artifact Reduction for Myocardial Scar Assessment in Patients with Cardiac Implanted Electronic Devices Using Cardiac Magnetic Resonance

Wednesday, Nov. 29 3:30PM - 3:40PM Room: S403A

Participants
Jadranka Stojanovska, MD, MS, Ann Arbor, MI (*Presenter*) Consultant, Guerbet SA
El-Sayed H. Ibrahim, PhD, MSc, Ann Arbor, MI (*Abstract Co-Author*) Employee, General Electric Company
Yuxi Pang, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Maryam Ghadimi Mahani, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

Anil K. Attili, MD, Saline, MI (*Abstract Co-Author*) Nothing to Disclose
Thomas L. Chenevert, PhD, Ann Arbor, MI (*Abstract Co-Author*) Consultant, Koninklijke Philips NV

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jstoanov@umich.edu

CONCLUSION

The developed wideband IR technique minimizes the CIED-generated hyperintensity artifacts without increasing scan time, and allows for accurate identification of arrhythmogenic substrate in VT patients.

Background

An important application of late gadolinium enhancement (LGE) cardiac magnetic resoncance (CMR) is assessment of myocardial scar in patients with ventricular tachycardia (VT) before ablation. LGE imaging in patients with cardiac implanted electronic devices (CIEDs) is challenging because of device-generated metal artifacts that compromise the effect of the inversion recovery (IR) pulse and obscure the region of interest. In 2016 we have performed 180 CMRs in patients with CIED at our institution. In this abstract we will discuss the use of modified IR technique to alleviate metal artifacts and improve diagnostic image quality.

Evaluation

The modified sequence includes a wideband IR pulse with adjustable frequency offset and bandwidth, which allows for optimal myocardial signal nulling in the presence of off-resonance effects. A phantom experiment was conducted on a 1.5T scanner using conventional and wideband IR sequences with different frequency offset and bandwidth (BW) values. Then, 20 patients (18 males, age=62±17) with CIEDs (8 Boston Scientific, 10 Medtronic, and 2 St Jude) were imaged on the same scanner using the conventional and optimized wideband LGE techniques prior to ablation. The imaging parameters were optimized for each patient. Conventional IR sequence resulted in severe artifacts that obscured ventricular segments in 15 out of 20 patients. The wideband IR sequence significantly minimized the artifacts. Optimal BW was in the range of 2000-3000Hz with optimal frequency shift up to 1000Hz.

Discussion

Increasing the IR frequency BW results in better artifact reduction, although this comes at the cost of incomplete myocardial nulling. So, BW should be set to the minimum value that eliminates the artifact, which is affected by the device type and location. Similarly, the frequency offset of the IR pulse affects the artifact appearance, so proper setting of the frequency offset could allow for removing the artifact without the need to increase the frequency BW.

SSM20-05 TSE-Based DWI of the Prostate as an Alternative to SS-SE-EPI DWI

Wednesday, Nov. 29 3:40PM - 3:50PM Room: S403A

Participants
Antonio Luna, MD, Jaen, Spain (*Presenter*) Consultant, Bracco Group; Speaker, General Electric Company; Speaker, Toshiba Medical Systems Corporation
Paula Montesinos de la Vega, Madrid, Spain (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Lidia Alcala Mata, MD, Jaen, Spain (*Abstract Co-Author*) Nothing to Disclose
Teodoro Martin, MD, Jaen, Spain (*Abstract Co-Author*) Nothing to Disclose
Jordi Broncano, MD, Cordoba, Spain (*Abstract Co-Author*) Nothing to Disclose
Javier Sanchez, MD, PhD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

DWI TSE has a potential role as an alternative to SS-SE-EPI DWI in MR protocols for prostate cancer detection.

Background

DWI is a key MR imaging contrast for prostate cancer detection. In clinical practice, a SS-SE-EPI sequence is used. EPI readout is prone to geometrical distortion and susceptibility artifact due to the presence of air content within the rectum or metallic implants. These limitations make more difficult the proper spatial localization of the lesions. Also, the use of DWI to localize suspicious areas in targeted MR/ultrasound fusion guided biopsy is limited. Turbo Spin Echo-based DWI is proposed as a potential alternative to eliminate geometric distortion and local susceptibility artefacts. In this presentation, its geometric validation is performed to demonstrate spatial accuracy of DWI-TSE images compared with conventional DWI-SE-EPI sequence.

Evaluation

All images were acquired in a 3.0 T Achieva scanner (Philips Healthcare, The Netherlands) with a 16ch body coil on 15 patients with prostate cancer in targeted MR/ultrasound guided biopsy. On these patient, two DWI sequence were performed with equal b values (0, 1000 and 1500 s/mm2) wit DWI-SE-EPI (TR/TE=4500/90ms) and DWI-TSE (TR/TE=11173/131ms) sequences. DWI images were acquired in the same orientation of conventional TSE T2-weighted sequence. Both acquisitions shared equivalent spatial resolution (2.6x2.8x4.5 mm3) with no gap between slices. Total scan time was 118s and 290s for SS-SE-EPI and TSE respectively. ADC maps were calculated using b0 and b 1000 s/mm2 for both sequences. SNR and CNR were compared for all b values and ADC maps. Also, the presence of geometric distortion and susceptibility artifacts was recorded. Both sequences were also compared to target prostate biopsy using an specific MR/ultrasound fusion device.

Discussion

TSE-based DWI presented free geometric distorted images in all cases with similar CNR, although with a moderate increase in acquisition time. Also, this approach permits to delineate lesions for targeted biopsy with advantage over SS-SE-EPI DW-sequence due to good geometrical performance.

SSM20-06 Measuring Frequency Drift in MR Spectroscopy on a 3 T MRI

Wednesday, Nov. 29 3:50PM - 4:00PM Room: S403A

Participants

Gregory A. Book, MS, Hartford, CT (*Presenter*) Nothing to Disclose
Alecia D. Dager, PhD, Hartford, CT (*Abstract Co-Author*) Nothing to Disclose
Malgorzata Marjanska, PhD, Minneapolis, MN (*Abstract Co-Author*) Nothing to Disclose
Godfrey Pearlson, MD, Hartford, CT (*Abstract Co-Author*) Consultant, Astellas Group

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CONCLUSION

Change in gradient temperature from heavy usage negatively impacts scanning quality for MRS sequences. Methods exist to compensate for frequency drift, but significant drift can still negatively impact quantification of the metabolite concentrations due to the poor water suppression. Quantifying the time required for gradients to stabilize after intense use, in this example of a Siemens Skyra 3 T, can inform scheduling of MRS studies to maximize their stability, and reduce the need for drift correction tools.

Background

MR spectroscopy (MRS) is susceptible to frequency drift caused by gradient warming, more so than other MR imaging modalities. Frequent switching of gradients in fMRI and DTI causes heating and the frequency of the magnet to change in an unpredictable way. Frequency drift in functional brain imaging can cause spatial drift over time, especially in the z direction, but is easily corrected by realignment. Frequency drift in MRS degrades the water suppression and quality of the spectrum through increased linewidth. We examine the effects of gradient heating on frequency drift and map the time required for gradients to stabilize on a specific magnet.

Evaluation

Drift was tested on a Siemens 3 T Skyra MRI, with a 32-channel receive-only head-coil, standard gradients, and an MRS phantom. Using a PRESS sequence, transmitter voltage and water suppression flip angle were adjusted to produce optimal water suppression. At 10 minute intervals over a period of 3 hours, magnet frequency was adjusted to convergence and the new frequency recorded. Two 9 min fMRI sequences (TR = 700ms) were run starting 20 minutes after initial frequency measurement.

Discussion

Frequency drift was negligible prior to perturbation of gradients from fMRI, but increased 5.6Hz/min to a peak of 70 Hz above baseline after the second fMRI sequence. Frequency returned to baseline 120 minutes after completion fMRI at a rate of 0.83 Hz/min for the first 60 minutes. Spectra collected using LASER sequence after perturbation showed significant drift, and spectra collected before perturbation showed no drift.

MSSR44

RSNA/ESR Hybrid Imaging Symposium: Hybrid Imaging of the Brain (An Interactive Session)

Wednesday, Nov. 29 3:30PM - 5:00PM Room: S402AB

NR MR NM

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

Participants
Alexander Drzezga, MD, Cologne, Germany (*Moderator*) Consultant, Siemens AG; Consultant, Bayer AG; Consultant, General Electric Company; Consultant, Eli Lilly and Company; Consultant, The Piramal Group; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company; Speakers Bureau, Eli Lilly and Company; Speakers Bureau, The Piramal Group
Katrine Riklund, MD, PhD, Umea, Sweden (*Moderator*) Nothing to Disclose

Sub-Events

MSSR44A Neurodegenerative Disorders

Participants
Henryk Barthel, Leipzig, Germany (*Presenter*) Research support, The Piramal Group; Consultant, The Piramal Group; Travel support, The Piramal Group

LEARNING OBJECTIVES

1) To learn about pathophysiology in neurodegenerative disorders. 2) To learn about different tracers and how to interpret the findings. 3) To understand the role of hybrid imaging in neurodegenerative disorders.

MSSR44B Brain Tumors

Participants
Gagandeep Choudhary, MD, MBBS, Birmingham, AL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To get an overview of brain tumours and tracers used. 2) To learn how to interpret the examinations. 3) To understand the role of hybrid imaging of brain tumours.

Active Handout:Gagandeep Choudhary

http://abstract.rsna.org/uploads/2017/16003680/Active MSSR44B.pdf

MSSR44C Interactive Case Discussion

Participants
Henryk Barthel, Leipzig, Germany (*Presenter*) Research support, The Piramal Group; Consultant, The Piramal Group; Travel support, The Piramal Group
Gagandeep Choudhary, MD, MBBS, Birmingham, AL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about evaluation of hybrid imaging in neurodegenerative disorders. 2) To learn about evaluation of hybrid imaging of brain tumours.

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RCA45

Rectal MRI (Hands-on)

Wednesday, Nov. 29 4:30PM - 6:00PM Room: S401AB

GI IN MR

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

Participants
David H. Kim, MD, Middleton, WI (*Presenter*) Co-founder, VirtuoCTC, LLC; Shareholder, Cellectar Biosciences, Inc; Shareholder, Elucent Medical;
Mukesh G. Harisinghani, MD, Boston, MA (*Presenter*) Nothing to Disclose
Marc J. Gollub, MD, New York, NY (*Presenter*) Nothing to Disclose
Courtney C. Moreno, MD, Suwanee, GA (*Presenter*) Nothing to Disclose
Raj M. Paspulati, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Gaiane M. Rauch, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose
Zahra Kassam, MD, London, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Critically evaluate the primary tumor to accurately place in the appropriate T category. 2) 2. Apply specific criteria to determine regional lymph node status. 3) Recognize relevant anatomic landmarks used in Rectal MRI cancer staging to help determine management.

ABSTRACT

This workshop will be led by members of the Society of Abdominal Radiology Rectal Cancer Disease Focused Panel. This group helps set the interpretation standards for rectal cancer MRI in the United States. In this 1.5 hour Hands-on Workshop, the participants will have the opportunity to review a number of rectal staging MRI cases on stand-alone computers or on a personal mobile device. The selected cases are intended to give a broad overview of the common issues encountered in rectal cancer staging, including appropriately categorizing the correct T category of the tumor as well as determining regional lymph node status. The relevant anatomic relationships of the tumor with adjacent structures for surgical and potential neoadjuvant options will be emphasized. An interactive platform will allow participants to see overall class performance for questions posed by the expert reviewer. Each case will be reviewed after a short interval to allow a participant to form an opinion prior to the expert review. This workshop is intended to give a practical, hands-on approach to rectal cancer staging by MRI.

SPSC43

Controversy Session: MR Imaging Enhancers (Muscle Relaxants, Rectal Gel, Vaginal Gel): Are They Really Necessary?

Wednesday, Nov. 29 4:30PM - 6:00PM Room: E353B

GI GU MR

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

FDA Discussions may include off-label uses.

Participants
Hero K. Hussain, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) To determine the advantages and disadvantages of imaging enhancers on image quality and diagnostic capability. 2) To assess the effect of imaging enhancers on MRI workflow. 3) To examine the financial effects of imaging enhancers on the patient and the imaging department. 4) To evaluate the impact of potential side effects of imaging enhancers on the patient and the imaging department.

Sub-Events

SPSC43A The Case FOR the Use of Imaging Enhancers for MRI of Prostate and Rectal Cancer

Participants
Caroline Reinhold, MD, MSc, Montreal, QC (*Presenter*) Consultant, GlaxoSmithKline plc

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

The Case FOR the Use of Imaging Enhancers for MRI of Prostate and Rectal Cancer will be made.1) To determine the advantages of antispasmodic agents and rectal contrast on the image quality and diagnosis for MR examinations of the prostate and rectum. 2) To propose an efficient work flow for administering imaging enhancers. 3) To propose screening guidelines to minimize potential side effects of imaging enhancers on the patient and the imaging department.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Caroline Reinhold, MD, MSc - 2013 Honored EducatorCaroline Reinhold, MD, MSc - 2014 Honored EducatorCaroline Reinhold, MD, MSc - 2017 Honored Educator

SPSC43B The Case AGAINST the Use of Imaging Enhancers for MRI of Prostate and Rectal Cancer

Participants
Donald G. Mitchell, MD, Philadelphia, PA (*Presenter*) Consultant, CMC Contrast AB

For information about this presentation, contact:

dgm101@jefferson.edu

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSC43C The Case FOR the Use of Imaging Enhancers for MRI of the Female Pelvis

Participants
Andrea G. Rockall, MRCP, FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

The case to support the use of image enhancers in female pelvic MRI will be made.

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/ Andrea G. Rockall, MRCP, FRCR - 2017 Honored Educator

SPSC43D The Case AGAINST the Use of Imaging Enhancers for MRI of the Female Pelvis

Participants
Evan S. Siegelman, MD, Philadelphia, PA (*Presenter*) Consultant, BioClinica, Inc; Consultant, ICON plc;

For information about this presentation, contact:

Evan.Siegelman@uphs.upenn.edu

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

Upon completion of this presentation, participants should be able to: 1. Apply principles of MR imaging to optimize female pelvic imaging protocols without the use of imaging enhancers and perform MR studies that are not inferior to MR studies performed with MR enhancers. 2. Assess the cost savings and improvement in workflow when muscle relaxants, vaginal gel and rectal gel are not administered.

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/ Evan S. Siegelman, MD - 2013 Honored Educator

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SPDL50

Diagnostic Challenges in MSK, Body and Neuroimaging (Case-based Competition)

Thursday, Nov. 30 7:15AM - 8:15AM Room: E451B

ER MR MK NR

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

Participants
Petra J. Lewis, MD, Lebanon, NH (*Moderator*) Nothing to Disclose
Jenna N. Le, MD, Lebanon, NH (*Presenter*) Nothing to Disclose
David A. Pastel, MD, Lebanon, NH (*Presenter*) Nothing to Disclose
John J. McIntyre IV, MD, Lebanon, NH (*Presenter*) Nothing to Disclose
Michael J. Tsapakos, MD, PhD, Lebanon, NH (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Identify a variety of common sports injuries utilizing MRI. 2) Review clinical presentations of sports injuries that present to orthopedic clinics and how these presentations can assist in the diagnosis when correlated with imaging. 3) Review a variety of typical and atypical musculoskeletal injuries that present to the Emergency Department. *This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.*

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SPSH50

Hot Topic Session: Abbreviated MRI Exam - Breast MRI in 5 Minutes

Thursday, Nov. 30 7:15AM - 8:15AM Room: E450A

BQ BR MR

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

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

LEARNING OBJECTIVES

1) Discuss the concept of an abbreviated breast MRI (AB-MR) examination. 2) Discuss the role of an AB-MR examination as a screening tool. 3) Discuss the role and applications of ultrafast imaging in an AB-MR examination. .

ABSTRACT

MRI is a highly sensitive imaging tool to detect occult malignancy. However the long scan time and high costs has limited its wide availability. There is increasing interest in the role of a shorter MRI exam and the amount of information that can be obtained in a short time window. This hot topic session will discuss the concept of an abbreviated MR (AB-MR) exam of the breast. The talks will focus on both technical and clinical aspects of a comprehensive AB-MR exam. The speakers will discuss their approaches to an AB-MR of the breast. Also, we will discuss the incorporation of ultrafast imaging into an AB-MR exam.

Sub-Events

SPSH50A Abbreviated Breast MRI: A Game Changer for Screening of Breast Cancer

Participants
Christiane K. Kuhl, MD, Bonn, Germany (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To identify the cancer yield of breast cancer screening with MRI compared to digital breast tomosynthesis or breast ultrasound. 2) To list results of research on abbreviated breast MRI. 3) To define advantages and disadvantages of MR technology used for abbreviated breast MRI.

ABSTRACT

Breast-MRI screening is associated with high direct and indirect costs. This, together with the lack of sites that offer high level breast-MRI, limits the clinical access to screening MRI. One reason for the high cost is the fact that current breast-MRI protocols are time consuming to acquire and to read. A typical MRI study occupies the MR system for up to 40 minutes and generates several hundred images. Although MRI pulse-sequence protocols of the different MRI-screening trials conducted so far vary widely, they all have in common that for screening, the same MRI acquisition-protocol had been used that was also used for diagnostic purposes in the respective institutions. To make breast MRI a real screening tool, we proposed to use an abbreviated, short MRI-protocol that is limited to one acquisition before and after contrast injection, then to use standard image reconstruction tools (maximum intensity projection, MIP) to allow a very fast overview of the imaging volume, and finally to have expert radiologists interpret this limited protocol. Aim was to substantially reduce image acquisition and reading time of screening-MRI. Long term goal is to increase the access to screening breast-MRI. We prospectively investigated this approach in women at mildly increased risk.MRI was offered for screening in addition to digital mammography, plus ultrasound in women with dense breast. We found that the diagnostic utility of the abbreviated breast-MRI screening protocol was comparable or even identical to that of the routine breast-MRI screening protocol. The abbreviated protocol, however, allowed a substantial reduction of image acquisition time down to 3 minutes, and also a fast interpretation (radiologist reading-time of 3 seconds for MIP, and under 30 seconds for the first post contrast subtracted images). Reading the MIP-image helped exclude presence of breast-cancer with a negative predictive value of close to 100 %. Reading FAST images helped correctly characterise positive MIP findings. With the abbreviated protocol, the same added cancer yield (18 per 1000) was achieved as with the regular screening breast-MRI protocol. Most importantly, the interval cancer rate was zero. if combined with dedicated breast MR systems, it is conceivable to offer abbreviated breast MRI on a population wide level for breast cancer screening.

SPSH50B Ultrafast Imaging: Improving Screening Results with a 2 Minute Protocol

Participants
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research agreement, Siemens AG; Research agreement, Seno Medical Instruments, Inc; Research agreement, Identification Solutions Inc; Research agreement, Micrima Limited; Scientific Advisor, ScreenPoint Medical BV

LEARNING OBJECTIVES

1) Discuss the available techniques for ultrafast breast MRI. 2) Evaluate the ultrafast images in a concise manner. 3) Understand the value of ultrafast breast MRI for screening.

ABSTRACT

This session will focus on the use of ultrafast breast MRI as a tool for screening women for breast cancer. Different approaches to ultrafast imaging will be discussed and pro's and con's of the various techniques described. The clinical use of ultrafast imaging including useful lesion classification techniques will be presented and the value of the technique as a tool for breast cancer screening will be shown. All in, ultrafast breast MRI allows breast screening with MRI in under 2 minutes acquisition time, while being just as accurate as a full length diagnostic protocol.

SPSH50C New Biomarkers for Breast Cancer from Abbreviated Ultrafast DCE-MRI

Participants
Gregory S. Karczmar, PhD, Chicago, IL (*Presenter*) Nothing to Disclose

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

RCB51

Prostate MRI (Hands-on) Course will be repeated Monday, Tuesday, Wednesday and Thursday from 8am-10am

Thursday, Nov. 30 8:00AM - 10:00AM Room: S401CD

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
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Siemens AG
Roel D. Mus, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Geert M. Villeirs, MD, PhD, Ghent, Belgium (*Presenter*) Nothing to Disclose
Marloes van der Leest, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Renske L. van Delft, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Rianne R. Engels, Cuijk, Netherlands (*Presenter*) Nothing to Disclose
Leonardo K. Bittencourt, MD, PhD, Rio De Janeiro, Brazil (*Presenter*) Investor, Healfies LLC
Joseph J. Busch, MD, Chattanooga, TN (*Presenter*) Nothing to Disclose
Baris Turkbey, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Daniel J. Margolis, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Antonio C. Westphalen, MD, Mill Valley, CA (*Presenter*) Scientific Advisory Board, 3DBiopsy LLC ; Research Grant, Verily Life Sciences LLC
Philippe A. Puech, MD, Lyon, France (*Presenter*) Nothing to Disclose

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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 be able to review up to 30 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. There will be 50 workstations available. PLEASE NOTICE: Based on last year's experience, we expect this course to be very popular. We only have 50 computers, and two spots per computer. Only the first 100 people will be acceted in the room. The front ows are reserved for beginners. In case you already are experienced in prostate MR: Please take a seat in the back of the room. We will not have space for any additional listeners this year. The coursebook can be found as handout to this course. Please dowload and take it with you on your tablet or other device.

Active Handout:Renske Lian van Delft

http://abstract.rsna.org/uploads/2017/16002006/Active RCB.pdf

MSES51

Essentials of Trauma Imaging

Thursday, Nov. 30 8:30AM - 10:00AM Room: S406B

ER MR MK

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

Sub-Events

MSES51A Radiographic Evaluation of Shoulder Trauma

Participants
Jonelle M. Petscavage-Thomas, MD, MPH, Hummelstown, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe normal radiographic anatomy of the shoulder. 2) Describe commonly missed injuries of the shoulder. 3) Describe appropriate radiologic management of suspected shoulder injuries.

ABSTRACT

Injuries of the shoulder are common but some are easily overlooked or mischaracterized. This presentation will be a case-based review of shoulder injuries that are frequntly missed including fractures, dislocations and clues to significant soft tissue injuries.

MSES51B MRI of Meniscal Tears

Participants
Tetyana A. Gorbachova, MD, Huntingdon Vy, PA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

GorbachT@einstein.edu

LEARNING OBJECTIVES

1) Recognize normal anatomy and MRI appearance of menisci. 2) Describe various types of meniscal tears and their clinical and treatment implications. 3) Be familiar with common pitfalls in diagnosis of meniscal tears on MRI.

ABSTRACT

Evaluation of menisci is one of the essential skills in interpreting MRI of the knee. MRI diagnosis of a meniscal tear relies on two main criteria: abnormal meniscal signal and abnormal morphology. Abnormal signal is defined as unequivocal intrameniscal signal extending to the articular surface of a meniscus, seen on two images which can be either two consecutive images or images in two orthogonal planes. Abnormal morphology is defined as abnormal meniscal contour, displaced or absent meniscal tissue or a menisco-capsular separation. Each basic meniscal tear can be described in two planes. One plane describes the orientation of the tear with respect to the meniscal circumference which can be either longitudinal or radial. The other plane defines a tear with respect to a blade of a "cutting tool" and can be vertical or horizontal. The combination of these two planes results in three basic types of meniscal tears. Basic patterns can produce displaced types of tears. Several MR imaging signs of meniscal tears as well as common pitfalls will be reviewed.

MSES51C Post-op MRI of Shoulder: Instability and Rotator Cuff

Participants
Luis S. Beltran, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the mechanisms of injury and associated pathologies in anterior shoulder instability and rotator cuff tears. 2) Be familiar with current treatment guidelines for management of anterior shoulder instability and rotator cuff disease. 3) Recognize the normal and abnormal appearances of postoperative MRI studies for anterior shoulder instability surgery and rotator cuff repairs.

ABSTRACT

The treatment of anterior glenohumeral instability varies substantially depending on patient age, level of activity, and severity of disease. The currently recommended treatment options include Bankart labral repair, Reimplissage, coracoid transfer, autograft, allograft, partial resurfacing prosthesis, and shoulder arthroplasty. Imaging plays a key role in determining the severity of disease, which is primarily determined by the degree of glenoid, humeral, or combined glenoid and humeral (bipolar) bone loss. Preoperative quantification of glenoid and humeral bone loss as well as labral pathology with MRI is one of the several key components that is necessary to determine appropriate therapy. It is also important to be familiar with normal and abnormal postoperative MRI appearance of these techniques to guide postoperative management. There are currently many surgical treatment options for rotator cuff tears including arthroscopic debridement, complete repair, partial repair, use of allograft patch to augment repair, superior capsular reconstruction, muscle tendon transfer, and reverse total shoulder arthroplasty. Appropriate therapy depends on patient age, level of activity, and severity of disease. Preoperative assessment of disease severity on MRI includes the severity of tendon tearing, retraction, and rotator cuff muscle atrophy. An understanding of the normal and abnormal postoperative MRI appearances of these techniques is also essential to assist in postoperative management.

MSES51D Injuries in the Young Athlete

Participants
Diego Jaramillo, MD, MPH, Miami, FL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

diego.jaramillo@mch.com

LEARNING OBJECTIVES

1) Understand the differences between the skeleton of the young athlete and that of the adult that predispose children and adolescents to specific injuries. 2) Recognize the imaging manifestations of the most common pediatric sports injuries. 3) Be familiar with the main contribution of the various imaging modalities for the diagnosis of these injuries.

ABSTRACT

The immature skeleton is susceptible to unique injuries. The physes at the ends of the long bones and at the apophyses where tendons insert are weak particularly during the growth spurt. Injury to the physes at the ends of long bones can result in growth arrest. The apophyseal physes are prone to avulsion. Repetitive injury to the physeal cartilage can disrupt endochondral ossification, and result in a wide, irregular physis with extensions of cartilage into the metaphysis. Once repetitive injuries are recognized, rest is recommended to avoid premature closure of the growth plate. The triplane and juvenile Tillaux fractures result from vulnerability of the partially closed distal tibial physis. The osteochondral junctions at the epiphyses and round bones are also vulnerable to sports related trauma. Acute injury can lead to avulsion of the cartilaginous lower pole of the patella, the patellar sleeve fracture and to osteochondral injuries in the patella and femoral condyles. Repetitive injury, and osteochondritis dissecans may develop in the distal femur, humeral capitellum and talar dome. The metaphyseal cortex becomes porous, also in response to increased hormone secretion during puberty, and is prone to buckling or disruption. Some tendinous and ligamentous insertions are also uniquely predisposed to avulsion, such as the tibial eminence and the lateral tibial epiphysis in the Segond fracture.In the knee, pivot shift injuries lead to tibial eminence avulsion in puberty, incomplete anterior cruciate ligament (ACL) tear in young adolescents, and complete tear in older adolescents. Meniscal tears are usually vertical, and when extensive result in flipped fragments. Patellar dislocations are common injuries in young adolescents. In the shoulder, most sport injuries affect the anterior or superior glenoid labrum. Many sports related injuries in skeletally immature athletes require imaging beyond radiographs: CT for injuries that are primarily osseous such as the triplane fracture, and MRI for injuries involving cartilage or ligaments. Ultrasound is playing a growing role in diagnosing ligamentous injuries and occult fractures.

Active Handout:Diego Jaramillo

http://abstract.rsna.org/uploads/2017/17000082/Active MSES51D.pdf

RC603

MRI of Cardiomyopathies

Thursday, Nov. 30 8:30AM - 10:00AM Room: S404AB

CA MR

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

FDA Discussions may include off-label uses.

Participants
Sachin S. Saboo, MD, FRCR, Dallas, TX (*Moderator*) Nothing to Disclose

Sub-Events

RC603A Evaluation of the Right Ventricular Cardiomyopathies and Other Disorders

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 the MR appearance of cardiomyopathies primarily involving the right ventricle.

RC603B Hypertrophic and Dilated Cardiomyopathies

Participants
Marco Francone, MD, Rome, Italy (*Presenter*) Speakers Bureau, Bracco Group

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marco.francone@uniroma1.it

LEARNING OBJECTIVES

1) To review importance of correct phenotypic recognition in dilated and hypertrophic cardiomyopathies understanding respective functional and morphological changes characterizing different stages of diseases. 2) To understand complexity and heterogeneity of genotypes underlying apparently similar phenotypic forms of disease correlating pathological changes with CMR imaging findings. 3) To recognize common and less common signal intensity abnormalities and late enhancement patterns to provide etiological differentiation of the various forms of cardiomyopathies. 4) To review prognostic implications of CMR-derived imaging biomarkers in dilated and hypertrophic cardiomyopathies.

RC603C Restrictive Cardiomyopathy and Amyloidosis

Participants
Daniel Vargas, MD, Denver, CO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

daniel.vargas@ucdenver.edu

LEARNING OBJECTIVES

1) Discuss the physiologic aspects of restrictive cardiomyopathy. 2) Familiarize the imaging specialist with patterns of delayed enhancement and other ancillary findings that aid in differentiating causes of restrictive cardiomyopathy. 3) Review newer imaging techniques in the assessment of restrictive cardiac physiology.

Honored Educators

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

RC603D MRI for Cardiac Chest Pain (ACS, TakoTsubo, Myocarditis)

Participants
Jens Bremerich, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To distinguish different clinical scenarios with chest pain and their suggested diagnostic algorithms. 2) To understand different diseases that might present with chest pain as leading symptom. 3) To oversee applications and limitations of MR in management of patients presenting with chest pain.

RC607

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

Thursday, Nov. 30 8:30AM - 12:00PM Room: E450B

GU BQ MR

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

Participants

Clare M. Tempany-Afdhal, MD, Boston, MA (*Coordinator*) Research Grant, InSightec Ltd Consultant, Profound Medical Inc Advisory Board, Profound Medical Inc Spouse, Employee, Spring Bank Pharmaceuticals, Inc Spouse, Consultant, AbbVie Inc Spouse, Consultant, Bristol-Myers Squibb Company Spouse, Consultant, Gilead Sciences, Inc Spouse, Consultant, Merck & Co, Inc Spouse, Consultant, Vertex Pharmaceuticals Incorporated Spouse, Consultant, Echosens SA Spouse, Consultant, GlaxoSmithKline plc Spouse, Consultant, Novartis AG Spouse, Consultant, Boehringer Ingelheim GmbH Spouse, Consultant, Ligand Pharmaceuticals, Inc Spouse, Consultant, Medgenics, Inc Spouse, Consultant, Kadmon Corporation, LLC Spouse, Consultant, Johnson & Johnson Spouse, Consultant, Achillion Pharmaceuticals, Inc Spouse, Stock options, Spring Bank Pharmaceuticals, Inc Spouse, Stock options, Medgenics, Inc Spouse, Editor, John Wiley & Sons, Inc
Clare M. Tempany-Afdhal, MD, Boston, MA (*Moderator*) Research Grant, InSightec Ltd Consultant, Profound Medical Inc Advisory Board, Profound Medical Inc Spouse, Employee, Spring Bank Pharmaceuticals, Inc Spouse, Consultant, AbbVie Inc Spouse, Consultant, Bristol-Myers Squibb Company Spouse, Consultant, Gilead Sciences, Inc Spouse, Consultant, Merck & Co, Inc Spouse, Consultant, Vertex Pharmaceuticals Incorporated Spouse, Consultant, Echosens SA Spouse, Consultant, GlaxoSmithKline plc Spouse, Consultant, Novartis AG Spouse, Consultant, Boehringer Ingelheim GmbH Spouse, Consultant, Ligand Pharmaceuticals, Inc Spouse, Consultant, Medgenics, Inc Spouse, Consultant, Kadmon Corporation, LLC Spouse, Consultant, Johnson & Johnson Spouse, Consultant, Achillion Pharmaceuticals, Inc Spouse, Stock options, Spring Bank Pharmaceuticals, Inc Spouse, Stock options, Medgenics, Inc Spouse, Editor, John Wiley & Sons, Inc

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LEARNING OBJECTIVES

1) Prostate MRI in the PI-RADS era: Detection, diagnosis and MRI guided/targeted interventions Overview- 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 MpMRI quantitative metrics- added value to PI-RADS? 2) To understand the complementary nature of quantitiative metrics MpMR and prostate biopsy: when to biopsy and how Cognitive, fusion and In bore approaches will be outlined Impact of PI-RADS on outcomes of prostate biopsy and treatment. Meta-analytic and other reviews of population studies will be presented.

Sub-Events

RC607-01 mpMRI in Clinical Practice: Changes in Urology Practice Patterns in US

Thursday, Nov. 30 8:30AM - 8:50AM Room: E450B

Participants
Scott Eggener, Chicago, IL (*Presenter*) Research Grant, Visualase, Inc Speakers Bureau, Johnson & Johnson

LEARNING OBJECTIVES

View learning objectives under main course title

RC607-02 Cost-Effectiveness of Multiparametric Magnetic Resonance Imaging and Targeted Biopsy in the Diagnosis of Prostate Cancer

Thursday, Nov. 30 8:50AM - 9:00AM Room: E450B

Participants
Ruth M. Dunne, MBBCh, Aclare, Ireland (*Presenter*) Nothing to Disclose
Wendy Ye Wang, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Steven Chang, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Clare M. Tempany-Afdhal, MD, Boston, MA (*Abstract Co-Author*) Research Grant, InSightec Ltd Consultant, Profound Medical Inc Advisory Board, Profound Medical Inc Spouse, Employee, Spring Bank Pharmaceuticals, Inc Spouse, Consultant, AbbVie Inc Spouse, Consultant, Bristol-Myers Squibb Company Spouse, Consultant, Gilead Sciences, Inc Spouse, Consultant, Merck & Co, Inc Spouse, Consultant, Vertex Pharmaceuticals Incorporated Spouse, Consultant, Echosens SA Spouse, Consultant, GlaxoSmithKline plc Spouse, Consultant, Novartis AG Spouse, Consultant, Boehringer Ingelheim GmbH Spouse, Consultant, Ligand Pharmaceuticals, Inc Spouse, Consultant, Medgenics, Inc Spouse, Consultant, Kadmon Corporation, LLC Spouse, Consultant, Johnson & Johnson Spouse, Consultant, Achillion Pharmaceuticals, Inc Spouse, Stock options, Spring Bank Pharmaceuticals, Inc Spouse, Stock options, Medgenics, Inc Spouse, Editor, John Wiley & Sons, Inc

PURPOSE

The purpose of our study is to evaluate the cost-effectiveness of multiparametric magnetic resonance imaging (mp-MRI) and

targeted biopsy (MRTB) in diagnosing prostate cancer (PCa) by comparing standard transrectal ultrasound guided biopsy (TRUSGB) pathway and MRTB pathway in diagnosis of PCa and assessing whether the assed inital costs related to MRI are balanced with the benefits of MRTB in a cost-utility model from a US perspective.

METHOD AND MATERIALS

A decision-analytic Markov model with a lifetime horizon of 10 years was developed to evaluate diagnostic accuracy, long-term health outcomes, costs, and quality-of-life of the two strategies (i.e., mp-MRI and MRTB versus TRUSGB) in men with elevated prostate-specific antigen ((>4 ng/ml). Probabilities of clinical events were obtained from published literature. Direct medical costs included diagnostic and treatment-related healthcare costs were derived from the Premier Hospital Database. Costs were inflated to 2015 US dollars and discounted at an annual rate of 3%. Health outcomes were measured in quality-adjusted life years (QALYs), which were determined based on published literature and expert opinion. We calculated the incremental cost-effectiveness ratio and performed sensitivity analyses to assess uncertainty.

RESULTS

The MRTB biopsy strategy yielded a lower average discounted cost ($5,358 versus $6,372) and higher total QALYs-gained (7.21 versus 7.19) than TRUS. The reduced expenditures associated with MRTB was primarily due to avoiding intervention for clinically insignificant prostate cancer. The results were robust with the sensitivity analyses.

CONCLUSION

The mp-MRI and MRTB strategy generated lower total costs but higher QALYs than the TRUSGB strategy. Therefore, mp-MRI and MRTB was the optimal choice that provided the greatest health benefits for the diagnosis of men with suspected PCa in the US population.

CLINICAL RELEVANCE/APPLICATION

For men in the United States with an elevated PSA, the use of MRTB in the evaluation for PCa represents a greater value than TRUSGB, the standard of care option. Widespread adoption of MRTB may serve to reduce the economic burden of PCa.

RC607-03 Addition of Standard Systematic Biopsies to Target Prostate Biopsies May Influence Treatment Choices for Patients and Clinicians

Thursday, Nov. 30 9:00AM - 9:10AM Room: E450B

Participants
Jinxing Yu, MD, Richmond, VA (*Presenter*) Nothing to Disclose
Ann S. Fulcher, MD, Midlothian, VA (*Abstract Co-Author*) Nothing to Disclose
William C. Behl, MS, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Sarah G. Winks, MD, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Mary A. Turner, MD, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Anna L. Ware, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Lance Hampton, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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PURPOSE

To determine detection rate of prostate cancer (PCa) Gleason score (GS) >= 7 in the other sectors of the prostate separated from the sector containing cancer suspicious region (CSR) and to determine the necessity of performing a standard systematic prostate biopsy in addition to a target biopsy for the CSR.

METHOD AND MATERIALS

Twelve sectors of prostate were generated by dividing the prostate base, midgland, and apex into four quadrants each. A total of 102 consecutive men with elevated PSA, at least one CSR detected on mp-MRI on a sector of the prostate and no TRUS-guided biopsy within the preceding 3 years underwent MRI/US fusion-guided biopsy of CSRs and standard systematic prostate biopsy (12 cores). Histopathology results, including GS, location of cancer and percentage of tumor involving positive cores were recorded. Two experienced GU radiologists retrospectively reviewed all mp-MRI studies blindly in consensus. The assessment included but was not limited to location and PI-RADS scores of CSRs. The findings from the imaging review were correlated with the histopathology results.

RESULTS

On confirmatory MRI/US fusion-guided target biopsy, 78 of 102 patients had biopsy-proven PCa (77%). By the standard systematic biopsy, 14 of 102 patients (14%) had PCa GS >= 7 (GS 7, n=8, GS 8, n=4 and GS 9 n=2) in the sectors of the prostate other than the sector containing target lesions. Among the 14 patients, the mean percentage of the positive core of PCa for GS 7 was 45, GS 8 was 25% and GS 9 was 20%. Three of 14 patients had higher GS PCa than that of the target lesions. Retrospective review of these 14 patients' mp-MRI studies detected 4 lesions with PI-RADS score 3 (positive for PCa GS >= 7 on TRUS biopsy) and the remaining 10 patients had corresponding normal findings.

CONCLUSION

Addition of standard systematic prostate biopsy to target biopsy detected PCa GS >= 7 in 14% of patients in the sectors of the prostate other than the sector containing target lesions. This result may influence treatment choices, particularly for those patients considering focal therapy for PCa.

CLINICAL RELEVANCE/APPLICATION

Addition of standard systematic prostate biopsy to target biopsy may be necessary in patients with no TRUS-guided biopsy within the preceding 3 years. That is because some significant prostate cancers (14%) may be sparsely distributed in the gland, resulting in negative mp-MRI.

RC607-04 Prostate cancer: Detection and Localization of Prostate Cancer on 3T Multiparametric MRI Based on

PI-RADS Version 2 and 39 Sector Segmentation: Correlation with Whole Mount Histopathology (WMHP)

Thursday, Nov. 30 9:10AM - 9:20AM Room: E450B

Participants
Pornphan Wibulpolprasert, MD, Bangkok, Thailand (*Presenter*) Nothing to Disclose
Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose
William Hsu, PhD, Los Angeles, CA (*Abstract Co-Author*) Research Consultant, Prosocial Applications, Inc; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Siemens AG
Daniel J. Margolis, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Nazanin H. Asvadi, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Pooria Khoshnoodi, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Amin Moshksar, MD, Reseda, CA (*Abstract Co-Author*) Nothing to Disclose
Nelly Tan, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Preeti Ahuja, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Cleo K. Maehara, MD, Brookline, MA (*Abstract Co-Author*) Nothing to Disclose
Jiaoti Huang, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
James W. Sayre, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
David S. Lu, MD, Los Angeles, CA (*Abstract Co-Author*) Consultant, Medtronic plc; Speaker, Medtronic plc; Consultant, Johnson & Johnson; Research Grant, Johnson & Johnson; Consultant, Bayer AG; Research Grant, Bayer AG ; Speaker, Bayer AG
Robert E. Reiter, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine performance of 3T mp-MRI for prostate cancer detection and localization by using PI-RADS v2 scoring and segmentation correlated to whole mount histopathology (WMHP)

METHOD AND MATERIALS

With IRB approval and HIPAA compliance, the 3T mp-MRI of 415 consecutive men were compared with thin section WMHP. Two GU radiologists blindly reviewed mp-MRI and assigned PI-RADS v2 scores and then manually mapped the suspicious lesion into the PIRADS v2 39 prostate sector model by consensus. Each detected focus on 3T mp-MRI was individually matched to WMHP by a GU radiologist and GU pathologist blinded to MR findings assigned as true or false positive and manually mapped into the same prostate model. Both a rigid sector and adjust sector matching model were utilized to account for surgical deformation, shrinkage, and non-uniform slicing factors in pathologic specimens.

RESULTS

Overall 863 prostate cancer lesions and 16,185 prostate sectors were analyzed. There was significantly greater detection of PCa for lesions >= 1 cm (61.6% all lesions and 81.6% index lesions), higher Gleason grade lesions (GS >= 7)(71.4% all lesions, 80.9% index lesions), and lesions with GS >= 7, >=1 cm (83.3%). Adjusted tumor localization sensitivity was significantly higher than rigid tumor localization for all lesions (56.0% vs 28.5%), index lesions 55.4% vs 34.3%), GS>= 7, (55.7% vs 36) and index tumors >= 1cm (56.1% vs 35%). 3Tmp-MRI had similarly high specificity (96-97.5%) for overall and index tumor localization when using both sector match approaches.

CONCLUSION

Using 3T mp-MRI and the PIRADS v2, we were able to achieve the highest sensitivity (83.3%) for detection of index tumor with GS >= 7 lesions >=1 cm with 97.5% specificity. Sectoral localization of PCa within the prostate was moderate and was best with the adjusted model compared to the rigid model.

CLINICAL RELEVANCE/APPLICATION

To date this is the largest study to evaluate the performance of 3T mpMRI with WMHP correlation. We have demonstrated excellent sensitivity and specificity for significant prostate cancer detection but moderate performance for intraprostatic sectoral localization of individual PCa foci, which may have implications for focal therapy.

RC607-05 Update on Prostate Cancer Care and Role of Imaging

Thursday, Nov. 30 9:20AM - 9:40AM Room: E450B

Participants
Clare M. Tempany-Afdhal, MD, Boston, MA (*Coordinator*) Research Grant, InSightec Ltd Consultant, Profound Medical Inc Advisory Board, Profound Medical Inc Spouse, Employee, Spring Bank Pharmaceuticals, Inc Spouse, Consultant, AbbVie Inc Spouse, Consultant, Bristol-Myers Squibb Company Spouse, Consultant, Gilead Sciences, Inc Spouse, Consultant, Merck & Co, Inc Spouse, Consultant, Vertex Pharmaceuticals Incorporated Spouse, Consultant, Echosens SA Spouse, Consultant, GlaxoSmithKline plc Spouse, Consultant, Novartis AG Spouse, Consultant, Boehringer Ingelheim GmbH Spouse, Consultant, Ligand Pharmaceuticals, Inc Spouse, Consultant, Medgenics, Inc Spouse, Consultant, Kadmon Corporation, LLC Spouse, Consultant, Johnson & Johnson Spouse, Consultant, Achillion Pharmaceuticals, Inc Spouse, Stock options, Spring Bank Pharmaceuticals, Inc Spouse, Stock options, Medgenics, Inc Spouse, Editor, John Wiley & Sons, Inc

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LEARNING OBJECTIVES

View learning objectives under main course title

RC607-06 Overview and Current Impact of PI-RADS v2 in Clinical Practice

Thursday, Nov. 30 9:40AM - 10:00AM Room: E450B

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

For information about this presentation, contact:

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LEARNING OBJECTIVES

View learning objectives under main course title

Honored Educators

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RC607-07 Standard and New Quantitative MR Techniques - Added Value to PI-RADS

Thursday, Nov. 30 10:20AM - 10:40AM Room: E450B

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

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LEARNING OBJECTIVES

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RC607-08 Imaging Facilities' Adherence to PIRADS v2 Minimum Technical Standards for the Performance of Prostate MRI

Thursday, Nov. 30 10:40AM - 10:50AM Room: E450B

Participants
Steven J. Esses, MD, New York, NY (*Presenter*) Nothing to Disclose
Samir S. Taneja, MD, New York, NY (*Abstract Co-Author*) Royalties, Reed Elsevie; Consultant, Reed Elsevier
Andrew B. Rosenkrantz, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

PIRADS v2 provides a comprehensive set of minimal technical standards for the performance of prostate MRI. We assess variability in imaging facilities' adherence to the PIRADS v2 technical standards.

METHOD AND MATERIALS

90 prostate MRI examinations performed at 90 separate imaging facilities that were referred to a tertiary care center for secondary interpretation were included. All exams were performed after the release of PI-RADS v2. The image sets, DICOM headers, and outside reports were reviewed to assess adherence to PI-RADS v2 minimum technical requirements. Comparisons were performed using Fisher's exact test.

RESULTS

The distribution of vendors was: 44% Siemens, 38% General Electric, 16% Phillips and 2% Toshiba. 25% were performed at 1.5T with a pelvic coil, 9.1% at 1.5T with an endorectal coil, 63% at 3T with a pelvic coil, and 3% at 3T with an endorectal coil. Adherence to PI-RADS v2 technical standards for T2WI: slice thickness (ST) <=3mm, 78%; no inter-slice gap, 53%; FOV 120-200mm, 82%; frequency resolution <=4mm, 0%; phase resolution <=0.7mm, 39%. Adherence for DWI (performed by 94% of facilities): TR>=3000ms, 91%; TE<=90ms, 73%, ST<=4mm, 91%; no inter-slice gap, 62%; FOV 120-220mm, 27%; frequency resolution <=2.5mm, 91%; phase resolution <=2.5mm, 77%. Among those performing DWI, 25% acquired two b-values, 58% three b-values, 12% four b-values, and 6% five or more b-values. 98% acquired a low b-value, 58% an intermediate b-value, 91% a high b-value, and 58% a very high b-value (e.g., >=1400; calculated in 15%); 99% calculated an ADC map. Adherence for DCE (performed by 91%): TR<=100ms, 100%; TE<=5ms, 100%, ST<=3mm, spatial resolution <=2mm, 98%, phase resolution <=2mm, 89%. Median DCE duration was 4.6 min (range, 1.3-11.2 min; >2min (minimum standard) in 93%.Temporal resolution was <10sec (minimum standard) in 21% and <7sec (preferred standard) in 11%. Studies performed at 3T were significantly more likely ($p<0.05$) to adhere to a number of minimal technical standards (e.g., T2WI phase resolution and DWI inter-slice gap).

CONCLUSION

Facilities' adherence to PI-RADS v2 minimum technical standards was variable, being particularly poor for various T2WI parameters and for DCE temporal resolution.

CLINICAL RELEVANCE/APPLICATION

Greater community education regarding the PI-RADS v2 minimum technical standards is warranted. In certain circumstances, the standards may be too stringent, and revisions should be considered.

RC607-09 MR-Guided Focused Ultrasound Treatment for Management of Organ-Confined Intermediate Risk Prostate Cancer: Evaluation of Safety and Effectiveness

Thursday, Nov. 30 10:50AM - 11:00AM Room: E450B

Participants
Andrea Leonardi, MD , Roma, Italy (*Presenter*) Nothing to Disclose
Fabrizio Andrani, MD , Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandro Napoli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Leonardo Costantino, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Valeria Panebianco, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the safety and effectiveness of Magnetic Resonance guided Focused Ultrasound (MRgFUS) ablation in patients with organ-confined intermediate risk prostate cancer in order to postpone or eliminate the need of definitive treatment (i.e. Radical Prostatectomy or Radiation therapy).

METHOD AND MATERIALS

This prospective single-arm study enrolled 16 patients, aged 50-74 years, with histologically proven organ-confined intermediate risk prostate cancer. Inclusion criteria for participation: Gleason score <= 7 (=3+4 or 4+3, no grade 5 pattern), T1-T2b, N0, M0 stage, PSA <= 20 ng/ml, lesion visible to dynamic contrast enhanced (DCE) MR imaging and no previous prostatic surgery, radiation therapy or androgen deprivation therapy. All patient underwent pre-treatment DCE (Gd-BOPTA, Bracco) MR examination (Discovery 750, GE) and MRgFUS treatment with ExAblate (InSightec). Safety of treatment was determined by evaluation of the incidence and severity of device related complications while clinical efficacy was evaluated monitoring MR imaging changes and PSA levels at 3, 6 and 12-months.

RESULTS

1 patient reported urinary incontinence while 2 patients referred erectile dysfunction after MRgFUS treatment. DCE MR imaging at 3, 6 and 12 months showed no recurrence/residual disease in treated patients. According to imaging, laboratory exams showed a progressive decrease of PSA level from an average value of 17,1 ng/ml before treatment to 2,2 ng/ml at 12 months follow-up. No one patient needed definitive treatment so far and can be considered free of clinically significant prostate cancer.

CONCLUSION

MR guided Focused Ultrasound appears as a safe and effective treatment for patients with organ-confined intermediate risk prostate cancer and can reduce the need of definitive treatment (i.e. Radical Prostatectomy or Radiation therapy)

CLINICAL RELEVANCE/APPLICATION

MRgFUS can reduce the need of surgery or radiation therapy in patient with intermediate risk prostate cancer representing a safe and effective treatment.

RC607-10 MR Guided Prostate Biopsy: The Approaches and New Guidelines

Thursday, Nov. 30 11:00AM - 11:20AM Room: E450B

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

LEARNING OBJECTIVES

View learning objectives under main course title

RC607-11 Value of 3T Multi-Parametric MRI in the Primary Detection of Significant Prostate Cancer in Men with an Elevated PSA: A Large Prospective Multicenter Clinical Study

Thursday, Nov. 30 11:20AM - 11:30AM Room: E450B

Participants
Marloes van der Leest, MD, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Martijn Hoogenboom, MSc, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Erik Cornel, MD, PhD, Hengelo, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Christina A. Hulsbergen-Van De Kaa, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Inge Van Oort, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Jeroen Veltman, MD, Hengelo, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Jelle O. Barentsz, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Advisor, SPL Medical BV
Hans v. Lelij, MD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the value of multi-parametric MRI prostate (mpMRI) compared to systematic transrectal ultrasound guided biopsy (TRUS-GB) in biopsy naive men with an elevated PSA. The aims are with the MRI strategy, to decrease the detection of insignificant prostate cancer (PCa), to reduce the number of biopsies, to have an equal or higher detection rate of clinically significant PCa.

METHOD AND MATERIALS

In this prospectively multicenter clinical study from February 2015 through February 2017 600 consecutive men with a PSA > 3 ng/ml were included. All subjects underwent mpMRI performed at 3T according to PI-RADS version 2 standards and routine 12 core TRUS-GB. Men with equivocal of suspicious lesions (PIRADS 3-5) on mpMRI also underwent MR guided target biopsy (MR-GB). mpMRI was scored using PI-RADS version 2 by three independent radiologists. In different outcomes a consensus assessment was used. TRUS-GB were performed blinded for the imaging results. Pathological findings were analyzed by two independent

pathologists. The detection rate of PCA (all grades) and clinically significant PCa (defined as Gleasonscore 7 and higher) compared to MR-GB and TRUS-GB were determined.

RESULTS

Of al participants 314 (52%) had Pca, and 178 (57%) of these were clinically significant PCa. MpMRI was positive (PIRADS 3-5) in 303 men (51%). With TRUS-GB 146 (24%) insignificant PCa's were detected, with the MRI strategy 80 (13%). TRUS-GB detected 134 (22%) clinically significant PCA's which about equal to MRI: 149 (25%).

CONCLUSION

This prospective multicenter powered trial shows that using mpMRI reduces the number of men who need biopsy with 49%, and only detects in 13% a clinically insignificant PCa, versus TRUS-GB in 24%. The detection of significant PCa is slightly better with mpMRI: 25% vs 22% with TRUS.

CLINICAL RELEVANCE/APPLICATION

The superior performance of MRI in this large study can alter the diagnostic workup of biopsy naive men with elevated PSA. Less will need biopsy and in only 13% insignificant cancers are detected

RC607-12 MRI-Guided Transurethral Ultrasound Ablation in Patients with Localized Prostate Cancer: State of the Art

Thursday, Nov. 30 11:30AM - 11:40AM Room: E450B

Participants
David Bonekamp, MD, PhD, Heidelberg, Germany (*Presenter*) Speaker, Profound Medical Inc
Sandeep S. Arora, MBBS, Nashville, TN (*Abstract Co-Author*) Speaker, Profound Medical Inc; Researcher, Profound Medical Inc
Masoom A. Haider, MD, Toronto, ON (*Abstract Co-Author*) Consultant, Bayer AG; Advisory Board, Siemens AG; ;
Zahra Kassam, MD, London, ON (*Abstract Co-Author*) Nothing to Disclose
Gary L. Brahm, BMedSc, MD, London, ON (*Abstract Co-Author*) Nothing to Disclose
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Research Grant, Siemens AG
Maya B. Mueller-Wolf, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Kiran R. Nandalur, MD, Bloomfield Hills , MI (*Abstract Co-Author*) Nothing to Disclose
Robert Staruch, Mississauga, ON (*Abstract Co-Author*) Employee, Profound Medical Inc
Mathieu Burtnyk, DIPLPHYS, Toronto, ON (*Abstract Co-Author*) Employee, Profound Medical Inc
Joseph Chin, MD, London, ON (*Abstract Co-Author*) Nothing to Disclose
Gencay Hatiboglu, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Markus Hohenfellner, MD, PhD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Heinz-Peter W. Schlemmer, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

MRI-guided transurethral ultrasound ablation (TULSA) is a novel minimally-invasive technology for ablation of malignant and benign prostate tissue, aiming to provide control of localized prostate cancer (PCa) with low morbidity. A prospective Phase I clinical study investigated safety and feasibility of TULSA; 12-month data have been published, and 30-month follow-up is presented here. Additionally, initial results are described from a larger Pivotal study (TACT) which is currently underway to evaluate the safety and efficacy of TULSA whole-gland ablation.

METHOD AND MATERIALS

Thirty PCa patients were enrolled in the Phase I trial: age>=65y, T1c/T2a, PSA<=10ng/ml, Gleason<=3+3 (3+4 in Canada only). Under general anaesthesia and 3T MRI guidance, the ultrasound device (TULSA-PRO, Profound Medical Inc.) was positioned in the prostatic urethra. Treatment planning was performed with 3mm margins at the gland periphery, and 10% residual viable prostate expected around the capsule. Treatment was delivered under continuous MRI thermometry feedback control. In the Pivotal trial, treatment planning has been adjusted to reduce residual viable prostate to <1%. To-date, 20 PCa patients have been enrolled in the TACT study: age 45-80y, <=T2b, PSA<=15ng/ml, Gleason<=3+4.

RESULTS

In Phase I, median (IQR) age was 69 (67-71) years and PSA 5.8 (3.8-8.0) ng/ml. Median PSA decreased 87% at 1 month, stable to 0.8 (0.6-1.1) ng/ml at 12 months (n=30), and to 0.7 (0.5-1.1) ng/ml at 30 months (n=15). MRI at 12 months shows diminutive prostates with median volume reduction of 88% (83-95%). In the first 16 TACT study patients, age was 64 (60-66) years and PSA 6.2 (5.4-7.1 ng/ml), with 53% low-risk and 47% intermediate-risk cancers (D'Amico). Spatial control of ablation was ±1.5mm on MRI thermometry, and correlated well with the non-perfused volume confirmed on CE-MRI immediately after treatment.

CONCLUSION

MRI-guidance enables accurate treatment planning, real-time dosimetry and control of the thermal ablation volume. Phase I data demonstrate safety and tissue ablation performance of TULSA. A larger TULSA trial with reduced safety margins is currently enrolling patients.

CLINICAL RELEVANCE/APPLICATION

Whole-gland ablation can be safely and accurately achieved using MRI-guided TULSA, which represents a minimally-invasive treatment option for organ-confined prostate cancer.

RC607-13 MR Guided Focal Therapy for Prostate Cancer: The Approaches and New Guidelines

Thursday, Nov. 30 11:40AM - 12:00PM Room: E450B

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

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[redacted]

LEARNING OBJECTIVES

View learning objectives under main course title

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

RC613

Pediatric Series: Pediatric Safety and Quality

Thursday, Nov. 30 8:30AM - 12:00PM Room: S102CD

CT MR PD SQ

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

FDA Discussions may include off-label uses.

Participants

Jonathan R. Dillman, MD, Cincinnati, IA (*Moderator*) Research Grant, Siemens AG; Research Grant, Guerbet SA; Travel support, Koninklijke Philips NV; Research Grant, Toshiba Medical Systems Corporation; Research Grant, Bracco Group
Donald P. Frush, MD, Durham, NC (*Moderator*) Nothing to Disclose
Michael S. Gee, MD, PhD, Jamaica Plain, MA (*Moderator*) Nothing to Disclose
Robert Orth, MD,PhD, Houston, TX (*Moderator*) Nothing to Disclose

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Sub-Events

RC613-01 Intravascular Contrast Material Use in Children: Safety Update

Thursday, Nov. 30 8:30AM - 8:50AM Room: S102CD

Participants
Jonathan R. Dillman, MD, Cincinnati, IA (*Presenter*) Research Grant, Siemens AG; Research Grant, Guerbet SA; Travel support, Koninklijke Philips NV; Research Grant, Toshiba Medical Systems Corporation; Research Grant, Bracco Group

LEARNING OBJECTIVES

1) Implement practices for safe use of intravascular contrast material in children with impaired renal function. 2) Understand the literature related to gadolinium tissue deposition in the pediatric population. 3) Comprehend the basic principles for treating allergic-like contrast reactions in children.

Honored Educators

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RC613-02 Effect of Iodinated Contrast Medium on Thyroid Function: An Observational Study on Children Undergoing Cardiac Computed Tomography

Thursday, Nov. 30 8:50AM - 9:00AM Room: S102CD

Participants
Elena Belloni, MD, Castel San Giovanni, Italy (*Presenter*) Nothing to Disclose
Dante Chiappino, MD, Massa, Italy (*Abstract Co-Author*) Nothing to Disclose
Stefania Tentoni, Pavia, Italy (*Abstract Co-Author*) Nothing to Disclose
Mariangela Puci, MSc, Pavia, Italy (*Abstract Co-Author*) Nothing to Disclose
Cristina Montomoli, MSc, Pavia, Italy (*Abstract Co-Author*) Nothing to Disclose
Daniele Della Latta, BEng,BSC, Massa, Italy (*Abstract Co-Author*) Nothing to Disclose
Alberto Clemente, Massa, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco Avogliero, MD, Massa, Italy (*Abstract Co-Author*) Nothing to Disclose
Carla Susini, Pisa, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the effects on children's thyroid function of iodinated contrast medium administered during cardiac Computed Tomography (CT).

METHOD AND MATERIALS

We retrospectively collected data of 64 children (21 neonates and 43 children above 30 days of age, range 1-1642 days) undergoing cardiac CT with endovenous administration of 1.14±0.17 ml/Kg of Iopromide (370 mg I/ml). In order to evaluated thyroid function, thyroid-stimulating hormone (TSH) was measured before CT, at 48 hours after CT and at discharge from hospital, which occurred 20.30±20.81 days after the exam.

RESULTS

At baseline, TSH was normal in 47, increased in 13 and reduced in 4 children; at 48 hours it was normal in 13, increased in 2 and reduced in 44 cases (not available in 5 cases); at discharge it was normal in 40, increased in 8 and reduced in 8 children (not available in 8 cases). Of the 13 patients with increased TSH at baseline, 7 experienced normalization, 5 retained high TSH values and 1 had reduced TSH at discharge. Of the 4 children with reduced TSH at baseline, 3 experienced normalization and 1 still had reduced TSH at discharge.

CONCLUSION

Our data suggest that the majority of children experienced hyperthyroidism (reduced TSH) at 48 hours after iodinated contrast medium endovenous administration, but this condition was transient, in fact TSH normalized in most patients at discharge from hospital. In subjects with already altered TSH at baseline, hormone response following iodinated contrast medium showed high variability. Thyroid function should be closely monitored in children which experience iodine overload due to diagnostic/interventional procedures.

CLINICAL RELEVANCE/APPLICATION

Administration of iodinated contrast can have a significant effect on children's thyroid function, thus the latter should be monitored due to its critical importance in neurological development.

RC613-03 Advanced Virtual Monochromatic Reconstruction in Pediatric Abdominal CT Using a Low Iodine Concentration Contrast Medium: Image Quality Comparison with Conventional CT

Thursday, Nov. 30 9:00AM - 9:10AM Room: S102CD

Participants
Seunghyun Lee, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Young Hun Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yeon Jin Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Young Ha, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung-Eun Cheon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Sun Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
In-One Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate advanced virtual monochromatic images reconstructed from dual-energy abdominal CT using low iodine concentration contrast media in children, in terms of image quality and radiation dose

METHOD AND MATERIALS

From December 2016 to April 2017, 20 children (13 boys and 7 girls; mean age 10.7; range 2-19 years) underwent both dual-energy abdominal CT using a low iodine concentration contrast agent of 300 mgI/ml (Group A) and conventional polychromatic abdominal CT using a standard iodine concentration contrast medium (a tube voltage of 80-100kVp, iodine concentration of contrast agent 350 mgI/ml, Group B) within 3 months comprised our study. Advanced virtual monochromatic images (Mono+) were reconstructed at 60 keV. For quantitative analysis, mean attenuation, noise, signal-to-noise ratio (SNR), and contrast-to-noise ratio (CNR) were compared. Overall image quality was subjectively scored on a 5-point scale. Radiation dose and total iodine load were compared between two examinations.

RESULTS

The mean attenuations of liver and aorta were higher in group B than in group A (131.6±16.4 vs. 120.5±10.1 and 221.2±22.2 vs. 202.1±23.1, $p = 0.02$ and 0.02, respectively). Group A showed higher noise than group B (22.5±6.0 vs. 14.1±5.6 at the subcutaneous fat of the anterior abdominal wall, $p < 0.001$). CNR and SNRs of liver, pancreas and aorta showed no significant difference between two groups. Overall image quality scores were similar between two groups (4.50±0.48 vs. 4.16±0.62, $p > 0.05$). Low-iodine-concentration dual energy CT revealed significantly diminished radiation dose and iodine load (28.9% and 38.6% reduction, respectively), compared with standard-iodine-concentration polychromatic CT.

CONCLUSION

The duel-energy abdominal CT using Mono+ reconstruction algorithm and low iodine-concentration contrast medium can reduce both radiation dose and iodine load, while maintaining image quality in children.

CLINICAL RELEVANCE/APPLICATION

When it comes to contrast-enhanced CT in children, it is desirable to reduce radiation dose and iodine load. In this regard, duel-energy abdominal CT using low iodine concentration contrast media would be a good way to achieve this goal.

RC613-04 Gadoterate Meglumine Pharmacokinetics, Safety and Efficacy in Pediatric Subjects Aged Less Than 2 Years

Thursday, Nov. 30 9:10AM - 9:20AM Room: S102CD

Participants
Mario Scala, MD, Linz, Austria (*Presenter*) Research Grant, Guerbet SA

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PURPOSE

To evaluate the pharmacokinetics profile in plasma of gadoterate meglumine (Dotarem®, Guerbet, France) in children aged <2 years.

METHOD AND MATERIALS

Subjects aged <2 years with normal estimated Glomerular Filtration Rate (eGFR) and scheduled to undergo a gadolinium-enhanced MRI of any body region (dose: 0.1 mmol/kg) were included in this multicenter and open label study. A population pharmacokinetics approach was used. For each subject, blood samples were collected at three time points allocated by randomization, from 10 min to 8 hours after injection. Adverse events were recorded. Efficacy was assessed in subjects who underwent MRI of the Central Nervous System (CNS).

RESULTS

A total of 45 children received gadoterate meglumine (male: 48.9%; mean age: 9.9 months). Five children were <1 month old, 9 were 1 to 3 months old and 31 were >3 to <24 months old. Mean (±SD) baseline eGFR was 129.7±41.5 mL/min/1.73 m². Median area under the curve was 1591 h.µmol/L and terminal half-life, 1.35 h. Median total clearance and volume of distribution at steady state, both body weight normalized, were 0.06 L/h per kg and 0.047 L/kg, respectively. Only one child (2.2%) experienced one adverse event related to gadoterate meglumine: a moderate rash. No serious adverse reactions were reported. Regarding efficacy evaluation in subjects with CNS indication (n=28), lesion visualization was improved after administration of gadoterate meglumine. Lesions were identified in 15 subjects with pre-contrast images and in 16 subjects with pre- and post-contrast images.

CONCLUSION

At the standard dose of 0.1 mmol/kg, pharmacokinetics, safety and efficacy of gadoterate meglumine in children <2 years old are similar to those observed in older children or adults.

CLINICAL RELEVANCE/APPLICATION

As of today, the pharmacokinetics profile in children aged less than 2 years is not known for gadoterate meglumine

RC613-05 In Vitro Evaluation of Sequential Contrast Media/Saline Injection Using Automatic Contrast Media CT Injector for Contrast Enhanced CT at Any Phase of Injection

Thursday, Nov. 30 9:20AM - 9:30AM Room: S102CD

Participants
Gabriel Bartal, MD, Kfar-Saba, Israel (*Presenter*) Nothing to Disclose
Luc Bouwman, Ulm, Germany (*Abstract Co-Author*) Employe, Ulrich GmbH & Co KG

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PURPOSE

There is a clear need to reduce both IV Iodine concentration per ml of contrast media (CM) and radiation exposure. The degree of CT contrast enhancement increases proportionally with iodine concentration and the level of x-ray energy (ie, tube voltage). X-ray output energy at low e.g. 80 kVp is closer to the iodine k edge of 33 keV, which helps to improve vascular and parenchymal enhancement while simultaneously reducing radiation absorption. Automatic CT Injectors that can reduce Iodine concentration by mixing saline and CM at any phase of injection without need to replace the contrast. Our aim was to evaluate in vitro the iodine concentration that can be reached during sequential injection of contrast and saline.

METHOD AND MATERIALS

Sequential injections of saline and CM (Omnipaque 350) at flow rates of 2, 5 and 8 ml/sec were performed using CT motion XD 8000 ulrich medical automatic CM injector and collected in volumes of 60 ml each in dilutions from 10 to 90% with 10% difference and undiluted CM. The acquired mixtures were analyzed using Agilent Technologies 1260 Infinity series HPLC chromatograph with Zorbax Eclipse Plus C18 column and UV detector with 5% acetonitrile solution in distilled water. 60ml mix output, 2ml smallest bolus size, pre-heated CM, 1,5m tube. Statistical analysis was performed.

RESULTS

The results of the chromatography were constant according with the desired level of iodine per ml of CM. For instance at the 30% dilution of Omnipaque 350 (desired level of iodine in children of 105 mg/ml) we achieved at 8, 5 and 2 ml/sec injection rates 106.3, 115.1 and 104.8 accordingly. Average relative deviation for all sequences was 8, 5 and 2 ml/sec was 6.8, 7.0 and 5.1% accordingly.

CONCLUSION

Automatic injectors with sequential injection of saline and CM can deliver the desired concentration of iodine per ml of CM. Clinical applications of this method, including pediatric, are under evaluation.

CLINICAL RELEVANCE/APPLICATION

Iodine content changes during the injection of CM improve the workflow in busy CT units.

RC613-06 Prediction of Aortic Enhancement for Pediatric CT Angiography Using Test-Bolus Technique with Diluted Contrast Material

Thursday, Nov. 30 9:30AM - 9:40AM Room: S102CD

Participants
Takanori Masuda, Hiroshima, Japan (*Presenter*) Nothing to Disclose
Yoshinori Funama, PhD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Takeshi Nakaura, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Masao Kiguchi, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Naoyuki Imada, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd; Research Grant, Bayer AG; Research Grant, Daiichi Sankyo, Ltd; Research Grant, Eisai, Ltd; Medical Adviser, GE Healthcare; Research Grant, Fujitsu Ltd; ; ; ; ; ;

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PURPOSE

One index for image quality in pediatric cardiac CTA(c-CTA) is a contrast noise ratio (CNR). Optimal CNR at actual c-CTA may be achievable by the selecting tube current second corresponding to a predicted contrast arterial enhancement. Therefore it is necessary to increase the prediction accuracy in advance. The purpose of our study was to compare the test-bolus technique with diluted and undiluted contrast material for predicting aortic enhancement on c-CTA and reveal the usefulness of the test-bolus technique with diluted contrast material on c-CTA.

METHOD AND MATERIALS

Between Feb 2015, and Nov 2016, patients were divided into two protocols; Group A, undiluted contrast material (40 patients) and Group B, diluted contrast material (50 patients) were performed test-scan and helical scan using 64-detector CT (GE VCT 80kVp, 50mA-300mA, 64x0.625mm, 0.35s/r, helical pitch 1.375). We calculated contrast enhancement (per gram of iodine: ΔHU/gI) of the ascending aorta. We compared the contrast enhancement for the test-bolus technique with undiluted and diluted contrast materials. In addition, we also compared the contrast enhancement for the c-CTA and for each test-bolus technique.

RESULTS

The mean contrast enhancement in the ascending aorta was significantly higher in group B than for group A (275.2 vs. 131.9 HU/gI , $p < 0.001$). There was a significant difference in the correlation between the contrast enhancement of the ascending aorta on c-CTA images and images acquired with the test bolus using undiluted- or diluted contrast material ($p < 0.001$). In group B the correlation had very strong positive linear relationship ($r = 0.92$, $p < 0.001$) than group A ($r = 0.78$).

CONCLUSION

We observed that the aortic enhancement obtained at the test-bolus technique with undiluted contrast material is closely correlated to the enhancement of c-CTA. The test-bolus technique with diluted contrast material is therefore useful for predicting the aortic enhancement before scanning c-CTA.

CLINICAL RELEVANCE/APPLICATION

Using diluted contrast material method at c-CTA, Controlling CNR may be a promising method to optimize image quality and radiation dose.

RC613-07 Image Gently Alliance Journey: Lessons Learned about Safety and Quality

Thursday, Nov. 30 9:40AM - 10:00AM Room: S102CD

Participants
Donald P. Frush, MD, Durham, NC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the fundamental strategies of the Image Gently Alliance. 2) Learn how the Image Gently model exemplifies a culture of safety. 3) Be able to discuss challenges of radiation awareness efforts.

RC613-08 Dose Reduction: Setting Up Size Specific Radiographic Techniques for Pediatric CT

Thursday, Nov. 30 10:20AM - 10:40AM Room: S102CD

Participants
Keith J. Strauss, MSC, Cincinnati, OH (*Presenter*) Consultant, Medical Physics Consultants, Inc; Consultant, Koninklijke Philips NV; Speakers Bureau, Koninklijke Philips NV;

LEARNING OBJECTIVES

1. To understand the limitations of the Computed Tomography Dose Index (CTDI) with respect to estimating pediatric radiation doses during CT scanning.2. To understand the purpose and strengths of the Size Specific Dose estimate (SSDE) with respect to estimating pediatric radiation doses during CT scanning.3. To understand how to develop accepted dose levels during CT scanning of patients of all sizes from the newborn infant to the bariatric patient for the variety of examinations performed in a given department.4. To understand how to estimate the projected patient dose prior to the scan on any available CT scanner within a given department and adjust the radiographic technique prior to the scan if the estimated projected dose is greater than the department's accepted dose levels.

Active Handout:Keith Jerel Strauss

http://abstract.rsna.org/uploads/2017/17000843/Active RC613-08.pdf

RC613-09 Survey of Pediatric Local Diagnostic Reference Levels Using Patient Weight Ranges During Interventional Cardiac Catheterizations

Thursday, Nov. 30 10:40AM - 10:50AM Room: S102CD

Participants
Francesca De Monte, Padua, Italy (*Abstract Co-Author*) Nothing to Disclose
Biagio Castaldi, Padua, Italy (*Abstract Co-Author*) Nothing to Disclose
Lucia Riccardi, Padova, Italy (*Abstract Co-Author*) Nothing to Disclose
Luca Baffoni, Padua, Italy (*Abstract Co-Author*) Nothing to Disclose
Ornella Milanesi, Padua, Italy (*Abstract Co-Author*) Nothing to Disclose

Marta Paiusco, Padua, Italy (*Presenter*) Nothing to Disclose

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PURPOSE

To present a rigorous and exhaustive analysis of dosimetric data to assess Diagnostic Reference Levels (DRLs) in paediatric Interventional Cardiology (IC) procedures, overcoming inconsistencies of previous studies. Our work represents the keystone of an incoming multi-center project to develop National DRLs, missing to date.

METHOD AND MATERIALS

IC procedures were divided in two groups (57 diagnostic, 103 therapeutic) and stratified into five standard body weight (BW) ranges (<5 kg, 5-15 kg, 15-30 kg, 30-50 kg, 50-80 kg). Four dose-related quantities (dose-area product DAP, air-kerma at the reference point Ka,r, fluoroscopy time FT and number of cine-frames Nf) were extracted from the DICOM Structured Dose Report. Mean, median, σ and 75th (used as DRL definition) values were calculated. Analysis of fluoroscopy and angiography contributions to the total dose was also performed. Correlations between DAP and BW was studied, focusing on specific types of interventions (Pearson's coefficients and linear regression equations calculated). Student's t test (95% c.i.) was used to compare quantities between the groups [diagnostic (D-) vs. therapeutic (T-)] and DAP/BW ratios for different procedure types.

RESULTS

Local DRLs found in this study are aligned to those published in literature: global DRLs for DAP were 19.3 Gy·cm2 for D- and 16.7 Gy·cm2 for T-cases. Comparison of D- and T-DRLs of DAP and Ka,r did not show statistically significant differences (fig.1). As expected, dose resulted to be proportional to BW, particularly for therapeutic group. FT markedely decreased with increasing weight; the longest FT was found for procedures performed on newborns (<5 kg), with T-FT 41% larger than D-FT on average ($p<0.05$). No significant difference in Nf was observed between D- and T-procedures. Relevant contribution of angiography to the total dose was observed, thus efforts for reduction are needed.

CONCLUSION

Dose to children for IC is largely variable due to differences in body size and procedures. Setting DRLs is recommended in order to optimize exposures and minimize risks. This work represents a pilot study which will be soon extended to the first multi-center National study, aiming to define DRLs for paediatric IC procedures.

CLINICAL RELEVANCE/APPLICATION

Interventional cardiology considerably contributes to expose children to ionizing radiation risks. A standardize methodology is crucial to assess consistent paediatric Diagnostic Reference Levels.

RC613-10 Dose Evaluation in Neonatal X-Ray Imaging Using a Digital Detector: Benchmarking Three Hospitals

Thursday, Nov. 30 10:50AM - 11:00AM Room: S102CD

Participants
Teun Minkels, MSc, Eindhoven, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Carola V. Pul, PhD, Veldhoven, Netherlands (*Presenter*) Institutional research collaboration, Koninklijke Philips NV
Peter Andriessen, Veldhoven, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Toine v. Linden, Veldhoven, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Lida Dam-Vervloet, MSc, Zwolle, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Irma Verstraaten, Zwolle, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Ward Cottaar, PhD,MSc, Eindhoven, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Cecile R. Jeukens, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

While x-rays have diagnostic benefit, detrimental effects of ionizing radiation can occur, particularly in preterm infants. Diagnostic Reference Levels (DRLs) expressed in dose-area product (DAP) for x-ray examinations have been published in the Netherlands, for newborns, one-year-old and five-year-old children. However, no DRLs are available for preterm infants. In addition, it is unknown what the achievable DRL would be if digital x-ray systems are used. In this benchmarking study we investigate the DAP for three Dutch Neonatal Intensive Care Units (NICUs) using digital flat panel detectors. Monte Carlo simulations are used to calculate effective dose.

METHOD AND MATERIALS

4461 thorax, thorax-abdomen and abdomen x-ray images from three Dutch NICUs over a two year period were analyzed retrospectively. For each image, DAP, kV and mAs was obtained from DICOM headers. Subsequently, effective dose was calculated per patient weight category using Monte Carlo software (PCXMC, Helsinki, Finland). Calculations of lung doses were experimentally validated with thermoluminescent dosimeter (TLD) measurements in a Gammex 610 Neonatal Chest Phantom on two different mobile x-ray systems.

RESULTS

The figure shows DAP-values (25th/75th percentile) for thorax AP examinations. Hospital A places detector in the incubator tray, B and C place it directly under the patient. Median DAP for thorax AP-exams ranged between 0.05µGym2-0.69µGym2 for different weight categories, resulting in mean effective doses between (4±4)µSv and (20±8)µSv per examination. Substantial differences in protocols were observed: positioning of the x-ray detector in the incubator tray instead of directly underneath the patient resulted in a transmission reduction of 13-41% depending on kV and incubator model. The TLD measurements show a lung dose on average 35% lower than the PCXMC calculations for most settings.

CONCLUSION

Although DAP values and effective doses are low compared to literature, this benchmarking study shows that standardization of protocols helps to further lower overall doses in vulnerable preterm infants. Strategies to lower doses (e.g. x-ray detector in the incubator) have to be evaluated in clinical practice and balanced against the disadvantages (hygiene; disturbing sleep).

CLINICAL RELEVANCE/APPLICATION

Digital X-rays result in low effective dose per image and standardization of protocols can help to further lower overall doses in vulnerable preterm infants

RC613-11 Determination of the Best ASIR-V Blending Level for Low Dose Pediatric Chest CT

Thursday, Nov. 30 11:00AM - 11:50AM Room: S102CD

Participants
Jie Ding, Yin Chuan, China (*Abstract Co-Author*) Nothing to Disclose
Lili Yang, Yinchuan, China (*Presenter*) Nothing to Disclose
Fang Wang, Yinchuan, China (*Abstract Co-Author*) Nothing to Disclose
Yanhong Zhao, MMed,MMed, Yinchuan, China (*Abstract Co-Author*) Nothing to Disclose
Xiao Bo Ni, Yingchuan, China (*Abstract Co-Author*) Nothing to Disclose
Yongbin Gao, Yinchuan, China (*Abstract Co-Author*) Nothing to Disclose
Ruoshui Ha, BA, Yinchuan, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To explore the optimal blending level of adaptive statistical iterative reconstruction V (ASIR-V) in low dose pediatric chest CT.

METHOD AND MATERIALS

20 pediatric patients aging from 1 to 5 years were enrolled and underwent chest scans on wide-coverage volumetric CT scanner (Revolution CT, GE healthcare). The tube voltage was 70kV. Images with six different ASIR-V blending levels (0%, 20%, 40%, 60%, 80% and 100%) were reconstructed. The image quality of lung and standard algorithms were evaluated by two radiologists using 5-point scores, when their scores were inconsistent, averaged score as a result. Image attenuation and noise were measured and signal-to-noise (SNR) was calculated. Data among different ASIR-V levels was compared with Friedman test.

RESULTS

With the increase of ASIR-V blending level, the noise decreased and increased gradually. The subjective scores of two readers had moderate consistency (kappa=0555, P=0.059). Images of ASiR-V60% and ASiR-V80% were rated higher than other levels ($P<0.05$), and images with lung were rated higher than standard algorithms ($X^2=7.00$, $P=0.008$). On images with ASiR-V60% and ASiR-V80%, there was no significant difference between lung and standard algorithms ($P>0.05$).

CONCLUSION

ASiR-V60% to 80% is optimal blending level for pediatric chest CT.

CLINICAL RELEVANCE/APPLICATION

Best ASIR-V blending level for low dose pediatric chest CT scan mode has comprehensive advantages in reducing radiation dose while ensuring high image quality, and is of great clinical application value in the pediatric chest CT scan, especially in the observation of fine structures, such as small airways, interstitial tissues, and so on .

RC613-12 Patient-based Image Quality Metrology Program for Pediatric Clinical Chest Projection Imaging

Thursday, Nov. 30 11:10AM - 11:20AM Room: S102CD

Participants
Ranish D. Khawaja, MBBS, Durham, NC (*Presenter*) Nothing to Disclose
Jered R. Wells, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Aiping Ding, PhD, DSc, Troy, NY (*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
Gary R. Schooler, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Many factors affect radiographic image quality (IQ), such as exposure and post processing. Assessment of quality is limited to one or a few physical measures (e.g., noise, contrast), or time consuming and subjective observer studies. We developed a tool for automated quality assessment in adults that includes 10 perceptual attributes of chest radiographs including: lung grey level, lung detail, lung noise, rib-lung contrast, mediastinum noise, and subdiaphragm-lung contrast. Attributes are characterized as a physical quantity using an automated process along (vertical) lung centerlines, highly dependent on region-of-interest (ROI). The purpose of this project is to expand the computer algorithm to pediatric patients, allowing quantification of measurable perceptual attributes in pediatric chest radiographs to objectively assess IQ.

METHOD AND MATERIALS

With unaltered application of the automated IQ algorithm on pediatric radiography, the results yielded poor registration of ROIs on the smaller patients [Fig 1A]. In this IRB-approved HIPAA compliant retrospective study, 184 consecutive clinical chest radiographs (PA/AP; age range 0-18 years) were collected from our clinical operation to first assess correlation coefficients between rib width,

rib interspace, and vertebral body width with patient age and chest width to properly adapt the size of ROIs for use in the IQ algorithm [Fig 1B].

RESULTS

Based on linear fitting to measured data, the coefficients of determination (R2) between 5th rib width, 5th rib interspace and 5th vertebral body width with chest width were 0.90, 0.78 and 0.83, respectively [Fig 1C]. The coefficients when age was used a reference parameter were as follows: 0.85, 0.79 and 0.75, respectively [Fig 1D]. Above data were used to program a size-specific ROI for measuring the physical quantity metrics of chest radiographs. Execution of the program was demonstrated on portable image with improved performance [Fig 1E].

CONCLUSION

Image-based IQ indices from our novel tool, now modified for children, can be readily applied for automated evaluation of perceptual image quality in clinical pediatric chest radiography (phase II).

CLINICAL RELEVANCE/APPLICATION

Our novel automated computer algorithm can quantify measurable perceptual attributes of chest radiographs in children, and ultimately be used for monitoring image quality, and protocol optimization.

RC613-13 Children Centered Care: The Development and Use of a Multi-Faceted Concept for MRI of Children Aged 4-10 with the Aim to Reduce the Need of Anesthesia and Increase Comfort for Children and Parents

Thursday, Nov. 30 11:20AM - 11:30AM Room: S102CD

Participants
Stine B. Runge, MD, Kolding, Denmark (*Abstract Co-Author*) Nothing to Disclose
Kim Jensen, Kolding, Denmark (*Abstract Co-Author*) Nothing to Disclose
Ib E. Jensen, MD, Odense S, Denmark (*Abstract Co-Author*) Nothing to Disclose
Nicolaj L. Christensen, MD,PhD, Vejle, Denmark (*Presenter*) Nothing to Disclose

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CONCLUSION

Four main interventions were used: An educative app, pediatric MRI Radiographers, a toy scanner and child-friendly environment with lights, graphics and in-bore solution. The CCC concept markedly reduces the need for anesthesia in children aged 4-6 and improves the quality experienced by children in all age groups and their parents.

Background

MRI of younger children often requires general anesthesia to achieve an acceptable image quality. Anesthesia can be unpleasant and anxiety provoking for children and parents. It may induce cognitive disturbances and ADHD. Rare complications include aspiration and death. For non-sedated children an MRI examination itself can be frightening. We developed and tested in a prospective set-up a multi-faceted concept to markedly reduce the need for anesthesia for children aged 4-6 and to increase comfort for children aged 4-10, and their parents: An interactive app for use at home in which the child is introduced to the experience in the scanner and the physical environment, creating comfort and recognizability Selection and communicative training of a dedicated pediatric team of MRI Radiographers Establishment of a children´s lounge with a toy-scanner The use of child-friendly environment with lights, graphics and in-bore solution to create positive distraction with movies and themes known from the app during the MRI examination

Evaluation

For children aged 4-6, the use of anesthesia was compared before establishment of the Children Centered Care (CCC) concept and after. For children all ages, patient-experienced quality and comfort was evaluated in a questionnaire including questions for the parents and a visual scale for the children to use.

Discussion

Preliminary data are available. 156 children were included before establishment of the CCC concept and 79 after. Of these, 20/40 (50%) children aged 4-6 had general anesthesia before CCC vs. 1/14 (7%) after. Among children aged 4-10, 103/133 (77%) reported to be comfortable during the examination before CCC vs. 60/71 (85%) after. The parental sense of security during their child´s MRI was measured as 'very high' in 104/133 (78%) before and 68/71 (96%) after.

RC613-14 The Value of Child-sized MRI Simulation in the General Anesthetic Pediatric Population: A Single Center Review

Thursday, Nov. 30 11:30AM - 11:40AM Room: S102CD

Participants
Elisabeth O Dwyer, MBBCh , Dublin, Ireland (*Presenter*) Nothing to Disclose
Rachel O'Connor, Dublin, Ireland (*Abstract Co-Author*) Nothing to Disclose
Ciara O Brien, MBBCh, Dublin, Ireland (*Abstract Co-Author*) Nothing to Disclose
Aisling Snow, MBBCh,MD, Dublin, Ireland (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

MRI is a mainstay of pediatric imaging but is frequently challenging due to the associated length of studies and noisy sequences. In patients aged between 4 and 7 years general anesthesia (GA) is often required to allow diagnostic, motion-free images to be

obtained. However, GA is a costly and timely procedure and carries a risk of patient morbidity. Child-sized MRI simulators allow play-based simulation of the MRI experience, including objective evaluation of the child's ability to remain still during life-like sequences. They can also act as a screening tool to identify children who likely able to undergo MRI without general anesthetic through familiarizing them with the environment, sounds, and equipment, while teaching them skills (such as breathing and relaxation) to cope with study.

METHOD AND MATERIALS

Patients between 4 and 7 years underwent MRI simulation using a Playful MRI (DOmed, Lyon, France) immediately prior to imaging when technologist staffing permitted and unless there was underlying patient developmental delay. We retrospectively reviewed all patients who underwent MRI simulation prior to imaging over the period January 2016 to December 2016 at a tertiary referral paediatric hospital. We reviewed whether the end point diagnostic study was diagnostic and whether patients had previously required MRI with general anesthetic. MRI waiting times over the study period were reviewed. MRI costs were estimated based on known departmental costings.

RESULTS

92 patients underwent MRI simulation with 82 patients having diagnostic MRI (88.1%). Increasing the number of walk in patients post-simulation was associated with a significant reduction in the 'routine' GA MRI waiting time from 29 months to 18 months. The cost of MRI without GA was approximately €250 and the cost of MRI with GA was approximately €950, with a GA-specific cost saving of €57,400 over 12 months.

CONCLUSION

MRI simulation was successful in the majority of developmentally normal pediatric patients between 4 and 7 years, who previously would have required general anesthetic. MRI simulation offers many benefits to radiology department through wait time, cost and time savings and also limits the number of general anesthetics performed in this population.

CLINICAL RELEVANCE/APPLICATION

MRI simulation is a cost and time saving measure in paediatric MRI department.

RC613-15 MR Imaging of the Non-Sedated Child

Thursday, Nov. 30 11:40AM - 12:00PM Room: S102CD

Participants
Michael S. Gee, MD, PhD, Jamaica Plain, MA (*Presenter*) Nothing to Disclose

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RC618

Tips, Tricks and Pitfalls in Body Oncological Imaging: Experts Tell All

Thursday, Nov. 30 8:30AM - 10:00AM Room: E353A

CT MR OI US

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

Participants
Dushyant V. Sahani, MD, Boston, MA (*Moderator*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

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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. 3) Develop biopsy strategies for indeterminate masses that need tissue sampling for diagnosis. 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.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Active Handout:Dushyant V. Sahani

http://abstract.rsna.org/uploads/2017/16000397/Active RC618.pdf

Sub-Events

RC618A 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. 3) Develop diagnosis and biopsy strategies for indeterminate masses. 4) Review 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.Emphasis is placed on the importance of knowing patient history and using good ultrasound technique in order to make accurate diagnoses with ultrasound alone. However, at times, further imaging and tissue sampling is necessary. The participant will be encouraged to "push the envelope" with ultrasound-guided diagnosis and biopsy for appropriate cases. In addition, we will review non-obstetrical diagnoses in pregnant patients with abdominal pathology (i.e. appendicitis, hydronephrosis, pyelonephritis, ovarian torsion, incidental masses found during pregnancy). 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/2017/16000398/Active RC618A.pdf

RC618B CT

Participants
Dushyant V. Sahani, MD, Boston, MA (*Presenter*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc

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LEARNING OBJECTIVES

1) To review the statistics and incidence of common cancers in USA. 2) To discuss the role of CT in oncology and value of optimal

oral and IV contrast media protocols for best results. 3) Offer perals and solutions to overcome the limitations of CT and review the potential role of new CT technology.

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

RC618C **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.

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RC629

Imaging Cancer in the Cirrhotic Liver: What We Need To Know (An Interactive Session)

Thursday, Nov. 30 8:30AM - 10:00AM Room: N228

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

RC629A Imaging Cancer in the Cirrhotic Liver: The Essentials

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

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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.

RC629B Imaging Cancer in the Cirrhotic Liver: The Atypical Scenario

Participants
An Tang, MD, Montreal, QC (*Presenter*) Research Consultant, Imagia Cybernetics Inc; Speaker, Siemens AG

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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.

RC629C 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, Guerbet SA

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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.

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MSRT53

ASRT@RSNA 2017: High-Field vs Low-Field MR Scanners: What Is the Best Use?

Thursday, Nov. 30 10:30AM - 11:30AM Room: N230B

MR

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

FDA Discussions may include off-label uses.

Participants

Subhendra N. Sarkar, PhD, Brookline, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To utilize the benefits of scanning in a high field MR scanner with desirable increase in signal and understand some of the unavoidable changes in tissue contrast at high fields. 2) To understand, for routine clinical applications, the usefulness of strong gradients, usually available at 3T, to obtain high quality MR diffusion, perfusion and 3D imaging. 3) To substitute Gadolinium contrast tumor perfusion imaging in body or brain imaging in compromised kidney function patients by perhaps non-contrast ASL perfusion at, e.g. 3T. 4) To utilize low field magnets if high field ones are not available or in departments with a combination of scanners, and select the best upgrade options to low field scanners to maximize clinical image quality. 5) To clearly distinguish for which indications low field scanners will produce lesser image quality than high field ones and when do low field ones may not alter the diagnosis. 6) To identify the risk of increased tissue heating, signal voids and electronic malfunctions at higher fields for active conditional implants even when those are turned off. 7) To appreciate the benefits of imaging within conservative/conditional guidelines when there exist implant related safety risks but alternative modalities are not adequate. 8) To appreciate that RF coil design and usable physics at high fields may not be the best at this time and hence the high field benefits may be limited. 9) To predict which MRI sequences will work almost equal at 3T and 1.5T while which sequences will work better at high fields. 10) To appreciate some of the advanced applications that clearly produce superior results just due to higher field strength, for example MR spectroscopy, DTI and fMRI.

Active Handout:Subhendra Nath Sarkar

http://abstract.rsna.org/uploads/2017/17001475/Active MSRT53.pdf

SSQ01

Breast Imaging (MRI Diagnostics)

Thursday, Nov. 30 10:30AM - 12:00PM Room: E450A

BR MR

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

FDA Discussions may include off-label uses.

Participants
Wendy B. Demartini, MD, Stanford, CA (*Moderator*) Nothing to Disclose
Bonnie N. Joe, MD, PhD, San Francisco, CA (*Moderator*) Nothing to Disclose

Sub-Events

SSQ01-01 Prospective and Randomized Intra-individual Comparison of Gadoterate Meglumine versus Gadobenate Dimeglumine at 3 Tesla: Evaluation with a Reduced Dose of Gadobenate Dimeglumine

Thursday, Nov. 30 10:30AM - 10:40AM Room: E450A

Participants
Paola Clauser, MD, Vienna, Austria (*Presenter*) Nothing to Disclose
Thomas H. Helbich, MD, Vienna, Austria (*Abstract Co-Author*) Research Grant, Medicor, Inc Research Grant, Siemens AG Research Grant, C. R. Bard, Inc
Claudio Spick, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Panagiotis Kapetas, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Maria Bernathova, MD, Wien, Austria (*Abstract Co-Author*) Nothing to Disclose
Pascal A. Baltzer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare a standard dose of Gadoterate Meglumine (Gd-DOTA 0.15 mmol/kg) to a half dose of a high relaxivity contrast agent (Gabobenate Dimeglumine, Gd-BOPTA 0.075 mmol/kg) for breast lesion detection and characterization at 3 Tesla.

METHOD AND MATERIALS

Eligible for this IRB-approved prospective, randomized, intra-individual comparison study were patients with suspicious findings (BI-RADS 4 or 5) on conventional breast imaging (i.e. mammography, tomosynthesis or ultrasound) undergoing additional 3T MR imaging of the breast including high spatiotemporal resolution DCE (TWIST), T2w-TSE and DWI according to international recommendations. Two repeated, identical examinations at least 24h apart from each other were performed with both contrast agents being administered in a randomized order. Histology was defined as standard of reference. Three blinded breast radiologists, not affiliated with the site of enrollment, evaluated the examinations off-site. Lesion detection rate, sensitivity, specificity and accuracy were calculated per-lesion and per-region, and compared using the McNemar test. Multivariate analysis was used to control for inter-reader performance.

RESULTS

109 patients were prospectively recruited. Excluded were 5 patients due to technical problems or lack of reference standard. Finally, 104 women with 142 histologically verified breast lesions (109 malignant and 33 benign) were enrolled. Detection rate with Gd-BOPTA (84.5-88.7%) was not inferior to Gd-DOTA (84.5%-90.8%), P>0.165. In the per-region analysis, Gd-BOPTA had a significantly higher specificity (96.4%-98.7% vs 92.6-97.3%) and accuracy (96.3-97.8% vs 93.6-96.1%) as compared to Gd-DOTA for all three readers. Multivariate analysis demonstrated a reader-independent superior accuracy with Gd-BOPTA.

CONCLUSION

A reduced dose of Gd-BOPTA 0.075 mmol/kg is not inferior to a standard dose of Gd-DOTA 0.15 mmol/kg in breast lesion detection, and superior in lesion characterization at 3T breast MRI.

CLINICAL RELEVANCE/APPLICATION

A reduced dose of Gd-BOPTA (0.075 mmol/kg) achieves breast MRI lesion detection comparable to a standard dose of Gd-DOTA, with a superior diagnostic performance. A reduced dose of Gd-BOPTA can be safely used in clinical practice at 3T breast MRI.

SSQ01-02 American College of Radiology Imaging Network (ACRIN) 6702 Diffusion-Weighted Breast MRI Trial: Image Quality and Factors Associated with Lesion Evaluability

Thursday, Nov. 30 10:40AM - 10:50AM Room: E450A

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PURPOSE

Diffusion-weighted imaging (DWI) has potential to improve conventional breast MRI specificity. Most DWI sequences use a single-shot echo planar imaging-based readout, which is prone to artifacts that may limit breast DWI reliability. The ACRIN 6702 multisite trial investigated DWI performance for diagnosing breast lesions. Here we describe DWI quality and factors affecting evaluability of apparent diffusion coefficient (ADC) values in breast lesions in the trial.

METHOD AND MATERIALS

The IRB-approved trial was performed at ten institutions on multiple 1.5T and 3T MRI platforms (Philips, GE, and Siemens). Women with MRI-detected BI-RADS 3, 4, or 5 lesions were enrolled in the study (from 3/2014 to 4/2015). Multi b-value (0, 100, 600, 800 s/mm2) DWI was performed in clinical breast MR exams. Each DWI scan was reviewed for image quality factors: fat suppression, signal-to-noise ratio (SNR), artifacts (magnetic susceptibility distortion, aliasing, chemical shift), and misregistration (from eddy-current-induced distortion). Lesions were considered not evaluable if significant image quality factors and/or lack of lesion visibility (due to partial volume averaging) prevented ADC measurement. Associations between image quality factors, field strength, lesion type (mass vs. non-mass), size, and evaluability were explored by Fisher's exact test.

RESULTS

ACRIN 6702 included 103 women with 142 lesions, of which 42 (41%) exams were performed at 1.5T and 61 (59%) at 3T. Poor or incomplete fat suppression affected 21% (22/103) of DWI scans, poor SNR 20% (21/103), artifacts 31% (32/103), and misregistration 20% (21/103). Exams at 1.5T were more prone to misregistration ($p=0.002$), while 3T exams exhibited more aliasing artifacts ($p=0.003$). ADC was evaluable for 100/142 (70%) lesions; factors associated with non-evaluability ($p<0.05$) included poor SNR, misregistration, and small lesion size <10mm (most common factor), but not lesion type or magnetic field strength.

CONCLUSION

This multisite breast DWI trial shows image quality remains a challenge, precluding measurement of 30% of lesions. Protocol optimization and technical advancements are needed to improve reliability and potential for widespread clinical implementation.

CLINICAL RELEVANCE/APPLICATION

Given strong data from this ACRIN 6702 trial that DWI can reduce false-positive breast MRIs, further research investment to improve image quality is warranted to facilitate clinical translation.

SSQ01-03 Contralateral Parenchymal Enhancement on Dynamic Contrast-Enhanced MRI is Complemented by Genomic ER-Pathway Data in Stratifying Outcome of ER+HER2 - Breast Cancer Patients

Thursday, Nov. 30 10:50AM - 11:00AM Room: E450A

Participants
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PURPOSE

High contralateral parenchymal enhancement (CPE) on dynamic contrast-enhanced MRI in the healthy breast of patients with ER+HER2- breast cancer receiving hormonal therapy has been associated with superior overall survival (OS). For patients with intermediate CPE, results have been inconclusive. The purpose of this retrospective study was to explore whether estrogen receptor (ER)-pathway activity derived from genomic data of the primary tumor is able to complement CPE in patient risk stratification.

METHOD AND MATERIALS

Between 2000 and 2008, 415 patients with ER+HER2- breast cancer eligible for breast-conserving therapy based on conventional imaging and physical examination received a preoperative MRI in study context. 181 Patients received hormonal therapy. Fresh-frozen tumor tissue of 104 patients was available for RNA sequencing. CPE was calculated using previously reported method. In short, parenchyma was automatically segmented, after which CPE was calculated as the mean of the top-10% relative signal increase. The ER-pathway activity of the tumor was assessed using unsupervised clustering of RNA, protein, and DNA copy number data from the TCGA database [Bismeijer et al.], and re-applied on the current dataset. The assay is strongly associated with activation of ESR1 targets. CPE and ER-pathway were each split in three groups (high, intermediate, low). OS was analyzed using Cox's models between CPE groups, ER-pathway groups, and combinations thereof.

RESULTS

The average patient age was 57 years (range: 32-84). The median follow-up was 87 months (range: 34-146). An event occurred in

11/104 (11%) patients. Patients with high CPE (n=38, 1 event) showed superior OS compared to those with low CPE (n=31, 7 event, P=.043), while for intermediate CPE (n=35, 33%) the test was inconclusive (P=.13). Differences in OS were observed between high and low ER-pathway, although not significant (P=0.12). When combined, patients with low CPE and low ER-pathway activity (n=52, 10 events) showed significantly worse survival than other patients (n=52, 1 event, P=.027).

CONCLUSION

CPE appears to be complemented by genomic-derived ER-pathway activity in stratifying patient survival.

CLINICAL RELEVANCE/APPLICATION

Combination of preoperative parenchymal enhancement on MRI of the healthy breast and ER-pathway axtivity in the primary tumor may predict therapy outcome more efficiently than either one alone.

SSQ01-04 Quantitative Measurement of Background Parenchymal Enhancement in Postmenopausal Women

Thursday, Nov. 30 11:00AM - 11:10AM Room: E450A

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To investigate MRI contrast material-enhancement kinetics of breast background parenchyma (BPE) in postmenopausal women with benign and malignant lesions using a semiautomatic method of segmenting fibroglandular tissue for quantitative measurement.

METHOD AND MATERIALS

The institutional review board approved this retrospective HIPAA-compliant study, and informed consent was waived. From January 1, 2013 to December 31, 2013, 83 postmenopausal women who had undergone contrast-enhanced MRI at 3T (90 s/frame) were identified. BPE in 53 malignant cases (age 61.57±8.39; range 50-83) and 30 benign cases (age 60.43±7.60; range 50-76) were analyzed. A method based on principal component analysis (PCA) was used to semi-automatically segment the fibroglandular tissues. The primary eigen component was used for quantitative analysis of signal enhancement in the breast parenchyma in terms of the percentage of enhancement (PE) for the initial (90 s) and delayed (360 s) post-contrast time points. Lesion-PE was measured using manually drawn regions of interest. Statistical analyses were performed using the Mann-Whitney U test.

RESULTS

53 malignant cases, of which 37 were invasive ductal carcinoma (IDC), 11 invasive lobular carcinoma (ILC), and 5 other invasive malignancies, were identified. 30 benign cases of which 11 were fibrocystic changes, 11 stable findings on imaging, and 8 others, were identified. There was no statistical difference in age and lesion size among these 3 groups. No statistical difference existed between initial and delayed BPE-PE in malignant cases compared to benign cases (p=0.051; p=0.09). In women with ILC, the initial and delayed BPE-PE values were significantly higher than in women with IDC (p=0.022 and p=0.02, respectively) and in women with benign lesions (p=0.006 and p=0.01, respectively). Lesion-PEs were not significantly different between IDC and ILC cases.

CONCLUSION

Higher BPE-PEs were seen in cases with malignant lesions compared to those with benign lesions. The sub-group analysis showed that cases with ILC have higher BPE-PE than those with IDC and with benign lesions.

CLINICAL RELEVANCE/APPLICATION

Significantly increased BPE in postmenopausal ILC cases, compared to IDC and benign cases, may be associated with ILC development in the absence of progesterone after menopause.

SSQ01-05 Impact of a Novel Abbreviated Breast MRI Protocol on Kinetic Analysis of Benign and Malignant Lesions

Thursday, Nov. 30 11:10AM - 11:20AM Room: E450A

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PURPOSE

To compare kinetic analyses and discrimination of benign and malignant lesions based on a novel abbreviated breast MRI (AB-MRI) versus a traditional extended dynamic contrast-enhanced MRI (DCE-MRI) protocol.

METHOD AND MATERIALS

This IRB-approved retrospective study included 162 patients with 177 lesions (84 imaged with AB-MRI and 93 imaged with DCE-MRI) assessed as BI-RADS category 4, 5, and 6 between 10/1/2015-8/31/2016. Traditional DCE-MRI included one pre and three post-

contrast phases: initial phase at 60-75 seconds and the third phase at 420-450 seconds post contrast (45 minutes total scan time). AB-MRI included one pre and two post-contrast phases: initial phase at 60-75 seconds and the second phase at 180-205 seconds post contrast (<10 minutes total scan time). Computer-aided kinetic analyses of lesions included delayed-phase volume percentages of washout, predominant curve type, and worst curve type, which were compared using Wilcoxon rank-sum test and Chi-Square test. Receiver operating curve (ROC) analyses for discrimination of benign and malignant lesions were performed.

RESULTS

The AB-MRI group consisted of 21 benign, 2 high risk, and 61 malignant lesions; the traditional DCE-MRI group consisted of 19 benign, 8 high risk, and 66 malignant lesions. Mean delayed-phase percentages of washout were 8% [range 0-45%] versus 9% [range 0-62%] (p=0.36) for benign lesions and 19% [range 0-92%] versus 17% [range 0-71%] (p=0.66) for malignancies in the AB-MRI and DCE-MRI groups respectively. No significant differences were found in the predominant and worst curve types for malignant and benign lesions between protocols (p>0.05). There were no significant differences between the AB-MRI and DCE-MRI in areas under the ROC curves (AUC) for delayed-phase percent washout (AUC 0.67 vs. 0.69, p=0.81), predominant curve type (AUC 0.62 vs. 0.55, p=0.45), or worst curve type (AUC 0.50 vs. 0.56, p=0.53).

CONCLUSION

Our study suggests that our novel AB-MRI protocol does not negatively impact the kinetic analyses and discrimination of benign and malignant lesions compared to traditional DCE-MRI, with malignant lesions demonstrating higher percentages of washout than benign lesions with both protocols.

CLINICAL RELEVANCE/APPLICATION

Abbreviated breast MRI protocol can improve patient comfort and workflow without the loss of diagnostic kinetic information.

SSQ01-06 Diagnostic Value of Electronic Property Tomography (EPT) For Differentiating Benign from Malignant Lesions: Comparison with Standard Dynamic Contrast-Enhanced MRI

Thursday, Nov. 30 11:20AM - 11:30AM Room: E450A

Participants
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PURPOSE

To compare diagnostic utility of EPT to standard DCE-MRI for differentiating benign from malignant lesions.

METHOD AND MATERIALS

Between January 2014 and December 2015, consecutive 67 patients with 83 breast lesions (33 benign and 50 malignant) underwent an IRB-approved 3T-MRI, including 3D turbo spin echo (TSE) sequence and standard dynamic contrast-enhanced (DCE)-MRI scans. Given the transceive phase Φ of a TSE image, EPT estimates tissue conductivity via $\sigma=(\Delta\Phi)/(2\mu o\omega)$ with Δ the Laplace operator, μo the magnetic permeability (assumed to be constant), and ω the Larmor frequency. The lesions were segmented semi-automatically using subtraction DCE-MR images (post-pre-contrast), and the segmented volume of the lesions was registered to the phase images. Conductivity reconstruction was performed only inside lesion volumes, and the mean conductivity of the lesion was obtained. From the standard DCE-MRI, a single voxel whithin each lesion that had the highest signal intensity on the early image was selected, and the initial enhancement rate and the signal enhancement ratio (SER) were caluculated as follows: the initial uptake = (SIearly-SIpre)/SIpre, SER = (SIearly-SIpre)/(SIdelayed-SIpre). The parameters from EPT and standard DCE-MRI were conpared between benign and malignant lesions. P<0.05 was considered significant. After Bonferroni correction of 4 multiple comparisons, the critical value became <0.0125(0.05/4).

RESULTS

The mean conductivity of malignant lesions (1.32±1.21S/m) was significantly higher than benign lesions (-0.09±1.77S/m) (p<0.0001). The SER of malignant lesions (1.19±0.27) was significantly higher than benign lesions (0.89±0.32S/m)(p<0.0001), whereas the initial uptake did not show significant difference between benign and malignant lesions (p=0.027). Receiver operating curve (ROC) analysis revealed that the are under the curve (AUC) of the mean conductivity and SER was 0.76 and 0.82, respectively. There was no significant difference in AUC between the mean conductivity and SER (p=0.41).

CONCLUSION

The mean conductivity might be comparable to standard DCE-MRI for differentiatiation between benign and malignant lesions.

CLINICAL RELEVANCE/APPLICATION

The mean conductivity measured by EPT might be comparable to standard DCE-MRI for differentiation between benign and malignant lesions.

SSQ01-07 Prediction of Low-Risk Ductal Carcinoma in Situ using Whole-Lesion Histogram Analysis of the Apparent Diffusion Coefficient

Thursday, Nov. 30 11:30AM - 11:40AM Room: E450A

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PURPOSE

To investigate the value of histogram-derived apparent diffusion coefficient (ADC) metrics obtained from whole-lesion assessment of diffusion-weighted imaging (DWI) for predicting a low-risk ductal carcinoma in situ (DCIS).

METHOD AND MATERIALS

The institutional review board approved this retrospective study, and waived informed consent. The authors identified 93 women (mean age, 51.9 years; range, 32-76 years) with pure DCIS, who had undergone preoperative MR imaging and DWI from 2013 to 2016. Histogram analysis of pixel-based ADC data of the whole tumor volume and conventional measurement of the mean ADC by placing regions of interest were performed by two radiologists. The mean, median, and 5th and 95th percentile ADCs obtained from whole-lesion histogram and the ROI-based mean ADC were compared between low-grade and non-low-grade DCIS. Associations of whole-lesion histogram ADC metrics with low-grade DCIS were evaluated by receiver operating characteristics (ROC) curve and logistic regression analyses.

RESULTS

In whole-lesion histogram analysis, the mean, median, and 5th and 95th percentile ADCs were significantly different between low-grade and non-low-grade DCIS (1.522, 1.536, 1.207, and 1.854 × 10-3mm2/s versus 1.270, 1.261, 0.917, and 1.657 × 10-3mm2/s, respectively; P=0.004, P=0.004, P=0.003, and P=0.024, respectively). However, ROI-based mean ADC was not significantly different (P=0.278). ROC curve analysis for the differentiation between low-grade and non-low-grade DCIS groups revealed that the most effective threshold for the 5th percentile ADC was > 1.078 × 10-3mm2/s (sensitivity 80%, specificity 75.9%, area under the curve [AUC] 0.786, P=0.001). No differences in the AUC were found among the ADC metrics of whole-lesion histogram. Multivariate regression analysis revealed that a higher 5th percentile ADC (> 1.078× 10-3 mm2/s; odds ratio [OR]=10.494, P=0.016), smaller tumor size (<= 2cm; OR=12.692, P=0.008), and low Ki-67 status (< 14%; OR=10.879, P=0.046) were significantly associated with low-grade DCIS.

CONCLUSION

Assessment with whole-lesion histogram analysis of the ADC could be helpful for identifying patients with low-risk DCIS.

CLINICAL RELEVANCE/APPLICATION

Whole-lesion histogram ADC metrics may serve as DWI biomarkers of DCIS biology, which could help to reduce overtreatment in patients with low-risk DCIS.

SSQ01-08 Unenhanced Breast MRI during Pregnancy Using Diffusion Tensor Imaging (DTI) Parametric Maps: A Feasibility Study

Thursday, Nov. 30 11:40AM - 11:50AM Room: E450A

Participants
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PURPOSE

To investigate the feasibility and clinical utility of DTI parametric maps in the diagnostic workup of pregnancy-associated breast cancer

METHOD AND MATERIALS

This prospective study was approved by our institutional IRB, and a signed informed consent was obtained from all participants. Since November 2016, thirteen pregnant patients (median gestational age: 17 weeks, range:8-30w) were examined by unenhanced breast MRI protocol. Indications included: newly diagnosed pregnancy-associated breast cancer (PABC) (n=5), follow-up on high-risk patients (n=7) and on neoadjuvant-chemotherapy (NAC) treated patient (n=1). MRI protocol included T2-weighted and DTI sequences, recorded at 1.5T (GE) using a breast coil, with total scan duration of ~12min. DTI was acquired using 32 directional diffusion gradients and 0, 700 s/mm2 b-values. DTI parametric maps of the principal diffusion coefficients (λ1,λ2,λ3), mean diffusivity (MD), fractional anisotropy (FA) and maximal anisotropy index (λ1-λ3) were generated and analyzed at pixel resolution using a proprietary software. Regions of interest (ROIs) of lesions and the normal fibroglandular tissue were delineated on λ1 maps and were statistically compared using Student's t-tests.

RESULTS

All scans were completed. One patient complained on positional discomfort during the scan which was endured with extra supports but still ended up with significant artifacts. All other scans were in diagnostic quality and artifact-free. All five known tumors were detected by DTI maps of λ1, λ2, λ3, MD and λ1-λ3 in agreement with their localization based on clinical/mammographic/sonographic findings, exhibiting substantial contrast compared with the ROIs of the apparently-normal surrounding tissue (p<0.001, for all). Representative images of 36 y patient diagnosed with IDC at the 17th week of pregnancy are presented in Fig1. FA ROIs did not help in differentiating malignant and normal tissues (p=0.48). Scans of high risk patients did not

reveal any new suspicious finding, in agreement with US exam. Residual tumor was not identified in the scan of the patient receiving NAC, in agreement with DCE MRI, performed several weeks later after delivery.

CONCLUSION

DTI examination is safe, non-invasive, fast and well-tolerated by pregnant patients and DTI parametric maps helped in characterizing PABC.

CLINICAL RELEVANCE/APPLICATION

DTI appears to have a promising diagnostic value in breast imaging during pregnancy

SSQ01-09 Texture Analysis for Non-Mass Enhancement on Breast MRI: A Preliminary Experience

Thursday, Nov. 30 11:50AM - 12:00PM Room: E450A

Participants
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PURPOSE

To evaluate the usefulness of texture analysis for diagnosis of non-mass enhancement (NME) on breast dynamic contrast enhanced (DCE) magnetic resonance imaging (MRI).

METHOD AND MATERIALS

84 patients with 86 NME lesions on breast MRI (from March 2010 to March 2013) were enrolled in this retrospective study (35 benign and 51 malignant with 33 invasive breast cancers (IBC) and 18 ductal carcinomas in situ (DCIS)). Three-dimensional histogram analysis and gray-level co-occurrence matrix (GLCM) based textural features were extracted from lesions' volume of interest (VOI) depicted on both early and delayed phases of DCE-MRI acquired by a 1.5T MRI scanner. In each NME, two different VOIs were placed; VOI-1 was carefully set to include only the enhancing areas, and VOI-2 was placed to cover the whole enhancing region including intervenient non-enhancing areas. Mann-Whitney U-test with false discovery rate control was applied for two groups to compare the extracted textural features in VOI-1; 1) benign and malignant lesions, 2) IBC and DCIS. Several diagnostic models were constructed with elastic net using VOI-1 and -2 data. Receiver operating characteristic (ROC) analysis was performed to evaluate these models. Then the models from 1.5T MRI were validated by comparing it with 3T DCE-MRI data sets (10 benign and 20 malignant with 10 IBC and 10 DCIS).

RESULTS

Total of 138 textural features were derived from VOI-1, and some of them showed statistical significant difference in benign vs malignant and in IBC vs DCIS. By the ROC analysis of benign vs malignant NME, area under curves (AUC) with best performance were 0.854 and 0.849, respectively for VOI-1 and -2. Analysis of IBC vs DCIS were 0.936 and 0.933, respectively for VOI-1 and -2. Diagnostic performance between different VOI settings did not show statistically significant differences neither in benign vs malignant ($p = 0.891$), nor in IBC vs DCIS ($p = 0.933$). The AUCs of 1.5T were comparable to the results of 3T DCE-MRI.

CONCLUSION

Texture analysis using breast DCE-MRI for NME showed good diagnostic performance for the differentiation of malignant vs benign lesions, and of DCIS vs IBC, regardless of the VOI settings.

CLINICAL RELEVANCE/APPLICATION

Texture analysis of breast MRI may be one of the promising tools to improve the diagnostic performance and may provide us with quantitative measures of internal structure for non-mass enhancement.

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SSQ03

Cardiac (MRI)

Thursday, Nov. 30 10:30AM - 12:00PM Room: S504AB

CA MR

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

SSQ03-01 Multicenter Study Comparing PSIR Motion Correction Late Gadolinium Enhancement Sequence with TurboFLASH and TrueFISP Late Gadolinium Enhancement Sequences

Thursday, Nov. 30 10:30AM - 10:40AM Room: S504AB

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PURPOSE

The Phase-Sensitive Inversion Recovery with Motion Correction (PSIRMoCo) is an improved single-shot rapid LGE sequence, which has higher spatial resolution compared to the traditional TrueFISP sequence and shorten acquisition time compared to the TurboFLASH sequence. This study aims to investigate a PSIRMoCo prototype against TurboFLASH and TrueFISP in terms of acquisition time and image quality.

METHOD AND MATERIALS

Inclusion criteria was patients/volunteers undergoing LGE CMR. Exclusion criteria was patients who did not have late gadolinium enhancement images. A total of 70 subjects (70% male, 17% had arrhythmia, 2% were poor breath-holders) were recruited in two hospitals. Patients were recruited consecutively for a 6-month period. Data was all acquired on 1.5T MAGNETOM Avanto scanner (Siemens Healthcare, Erlangen, Germany). MRI TurboFLASH images were acquired first at 8 minutes post contrast injection followed by the PSIRMoCo sequence and the TrueFISP PSIR sequence. Images with poor contrast differentiation between the myocardium and blood pool were excluded from the analysis. Acquisition time was measured based on the timings from the MRI times stated on the images. Image quality was assessed by 2 doctors separately without access to the image information, using a 4-point Likert scale (4 for the best, 1 for the worst). A P-value<0.05 was regarded as statistically significant. ANOVA, Kruskal-Wallis H test and Mann-Whitney U test were used for comparing the three groups.

RESULTS

The total scan times for PSIRMoCo, TurboFLASH and TrueFISP were 187±43 sec, 636±144 sec, and 164±37sec, respectively (p<0.001). There was no statistically significant difference in scan time between PSIR MoCo and TrueFISP. Image quality scores of the three groups were 3.8±0.26, 3.3±0.47, and 3.5±0.31, respectively (p=0.0001). Separately, PSIRMoCo showed a statistically higher image quality score compared to TurboFLASH (p<0.0001) and TrueFISP (p=0.008).

CONCLUSION

PSIR MoCo shows statistically significant time saving compared to TurboFLASH and better image quality compared to TurboFLASH and TrueFISP.

CLINICAL RELEVANCE/APPLICATION

PSIR MoCo should be considered for routine use instead of TurboFLASH as it saves approximately just under 8 minutes in scan time with improved image quality.

SSQ03-02 Detection of Patients with High-Risk Coronary Artery Disease Using Coronary Flow Velocity Reserve:

3T-MRI Fast Velocity-Encoded Cine Study

Thursday, Nov. 30 10:40AM - 10:50AM Room: S504AB

Participants
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PURPOSE

We previously developed a method to measure coronary flow velocity reserve (CFVR) in the left main trunk (LM) during stress (ATP (0.16mg/kg/min)) and at rest non-invasively mainly using healthy volunteers. The purpose of this current study is to evaluate the method's diagnostic value in detecting patients with high-risk coronary artery disease (CAD).

METHOD AND MATERIALS

Fifty-nine patients with suspected CAD (age; 67 ± 11 yr, male; n = 36) who underwent 3.0-tesla (T) magnetic resonance imaging (MRI) and angiography were studied. Coronary flow velocity in LM was measured with breath-hold velocity-encoded cine using 3.0-T MRI during ATP stress and at rest. CFVR was calculated by dividing peak-velocity during stress by that at rest. The extent and severity of angiographic disease of LM, left anterior descending artery (LAD), and left circumflex artery (LCx) were estimated with the use of the Leaman score (LS) which is able to stratify the risk of coronary artery using angiography.

RESULTS

Among the patients evaluated, 24 had 1-vessel disease (LAD (n = 17), LCx (n = 7)) and 18 patients had 2-vessel disease. Four patients had => 50% stenosis in LM. Fifty-one out of 59 patients showed low LS (0-10) and 8 had high LS (=>10.5 (equivalent to proximal LAD = 90-99%)). CFVR of CAD patients with high LS which means high-risk CAD was significantly lower than that of patients with low LS (1.57 ± 0.31 vs. 2.18 ± 0.73, $p < 0.05$) (Figure). In receiver operating characteristic (ROC) analysis of CFVR for detection of high-risk CAD patients, the area under the ROC curve was 0.79 ($p = 0.0296$). Sensitivity was 100% and specificity was 62.8% using a cutoff of 1.98 for detection of high-risk CAD patients.

CONCLUSION

Low CFVR in LM derived by velocity-encoded cine using 3.0-T MRI can predict downstream coronary atherosclerotic burden. This method is a simple and reliable index to detect patients with high-risk CAD without radiation exposure.

CLINICAL RELEVANCE/APPLICATION

Coronary flow velocity reserve measured using 3.0-T MRI is able to evaluate severity of coronary artery disease with high sensitivity.

SSQ03-03 Gadolinium-enhanced Cardiac MR Exams of Human Subjects are Associated with Significant Increases in the DNA Repair Marker 53BP1 but Not the Damage Marker γH2AX

Thursday, Nov. 30 10:50AM - 11:00AM Room: S504AB

Participants
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PURPOSE

To examine whether MR exams cause double-strand (ds) DNA damage by analyzing changes in the DNA damage and repair markers γH2AX and 53BP1 in patients who underwent a cardiac magnetic resonance (MR) exam.

METHOD AND MATERIALS

Our prospective study of outpatients scheduled for a 1.5 T gadolinium-enhanced cardiac MR exam was subject to Institutional Review Board approval. Patients with history of malignancy or who were receiving chemotherapy, radiation therapy, or steroids were excluded. MR sequence data were recorded for each patient. Blood samples were obtained from immediately before and after MR exposure. An automated immunofluorescence assay quantified γH2AX or 53BP1 foci number in isolated peripheral blood mononuclear cells. Changes in foci number were analyzed within patients using the Wilcoxon signed-rank test. Clinical and MR procedural characteristics were compared between patients who had a >10% increase in γH2AX or 53BP1 foci numbers and patients who did not.

RESULTS

Sixty patients (median age: 55 years, 39 males) were enrolled in our study. The number of γH2AX foci did not significantly change following cardiac MR (median foci per cell pre-MR=0.11, post-MR=0.11, p=.90), but the number of 53BP1 foci significantly increased following MR (median foci per cell pre-MR=0.46, post-MR=0.54, p=0.0140). Clinical and MR characteristics did not differ significantly between patients who had at least a 10% increase in foci per cell and those who did not.

CONCLUSION

MR exposure leads to a small (median 17%) increase in 53BP1 foci, suggesting increased DNA repair. Accordingly, a lack of increase in number of foci of the ds DNA damage marker γH2AX does not necessarily indicate an absence of DNA damage.

CLINICAL RELEVANCE/APPLICATION

1. Elevated DS DNA repair marker levels suggest that cardiac MR may cause DS DNA damage, and further study using both γH2AX and 53BP1 is necessary.

SSQ03-04 Detection of Myocardial Scar by Late Gadolinium Enhancement Cardiac MR using Gadoterate Meglumine

Thursday, Nov. 30 11:00AM - 11:10AM Room: S504AB

Awards
Student Travel Stipend Award

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PURPOSE

To compare the efficacy of late gadolinium enhancement cardiac MR (LGE-CMR) for myocardial scar detection between 2 macrocyclic GBCAs (gadoterate meglumine vs. gadobutrol).

METHOD AND MATERIALS

40 subjects (61±11 years, 67.5% men) who were referred for evaluation of cardiomyopathy with LGE-CMR performed using standard of care 0.2mmol/kg gadobutrol were recruited prospectively within an 8-week period for a research CMR scan using 0.2mmol/kg gadoterate meglumine. Both clinical and research CMR scans were performed at 1.5T. All subjects underwent a standard CMR protocol consisting of multiplanar cine steady state free precession (SSFP) and post contrast delayed enhanced PSIR SSFP and PSIR TurboFlash sequences. Myocardial scar quantification was performed on short-axis PSIR-TurboFlash images using commercially available software (Circle 5.3, Calgary, Canada) and myocardial scar percentage mass was calculated. Qualitative scar analysis was performed by 2 observers using the 16-segment AHA model and the area of scar per segment (0=none, 1=1-25%, 2=26-50%, 3=51-75%, 4=76-100% of the segment area) was scored. Segmental ratings were summed across all 16 segments to derive a global scar score for each scan. Reader confidence in visualizing the scar tissue for each agent was recorded on a 5-point scale (1=poor, 2=fair, 3=good, 4=very good, 5=excellent).

RESULTS

With PSIR SSFP technique, percentage myocardial scar mass averaged 5.9±9.8% and 5.2±7.2% for gadobutrol and gadoterate meglumine, respectively (p>0.05, ICC=0.89, 95% CI:0.78-0.94). With PSIR TurboFlash technique, percentage myocardial scar mass was 7.19±11 and 6.03±8.51 for gadobutrol and gadoterate meglumine, respectively (p>0.05, ICC=0.96, 95% CI:0.93-0.98). Global qualitative segmental LGE scores showed comparable scar detection using gadobutrol vs. gadoterate meglumine (5.3±7.5 vs. 5.4±7.2, p>0.05). Reader confidence for scar visualization was similar between gadobutrol and gadoterate meglumine (4.35±0.7 vs. 4.22±0.6, p>0.05).

CONCLUSION

Gadoterate meglumine is comparable to gadobutrol for identifying myocardial scar on LGE-CMR both qualitatively and quantitatively and can detect scar with a similar degree of diagnostic confidence as Gadobutrol.

CLINICAL RELEVANCE/APPLICATION

Gadoterate Meglumine, an alternative macrocyclic GBCA to the more routinely used Gadobutrol, has recently become available in the U.S. and may have comparable efficacy for detecting myocardial scar on routine LGE-CMR

SSQ03-05 Diffuse Myocardial Fibrosis in Diabetes Mellitus: Findings From t1 Mapping Imaging and Cardiac MRI Strain

Thursday, Nov. 30 11:10AM - 11:20AM Room: S504AB

Participants
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PURPOSE

To investigate diffuse myocardial fibrosis and the relationship between cardiac MRI strain in diabetes mellitus (DM) using T1 mapping and cardiac tissue tracking.

METHOD AND MATERIALS

Thirty-one patients with DM without impairment of renal function (Group1), 21 cases of DM with impairment of renal function (Group2) and 23 normal control individuals were enrolled. All patients underwent cardiovascular magnetic resonance (CMR), including cardiac cine sequence and T1 mapping MOLLI sequence. Cardiac function indexes, tissue tracking and T1 mapping were all measured by cvi42 and compared statistical. Pearson's correlation between the T1 mapping parameters and the left cardiac strain parameters were also investigated.

RESULTS

All the patients recruited finished CMR and the baseline characteristics were recorded. Group2 presented with higher pre-contrast T1 value than Group1 and control group (Group2: 1314.80±43.72ms; Group1: 1259.12±42.48ms; control group: 1264.25±47.45ms, both $P<0.05$). Regarding the post-contrast T1 value, lower post-contrast T1 value were observed in Group2 but the differences were not statistically significant (Group2: 490.25±58.59ms; Group1: 521.61±70.50ms; control group: 508.20±35.82ms, both $P>0.05$). Compared with control group, Group1 and Group2 had significantly higher ECV (Group1: 31.02±2.97ms; Group2: 34.09±4.23; control group: 27.39±2.40ms, both $P<0.05$). Negative correlation was showed between the circumferential peak diastolic strain rate and ECV in Group1 and Group2 ($r=-0.459$, $r=-0.459$, $P<0.05$).

CONCLUSION

T1 mapping is an alternative sequence for the evaluation of diffuse myocardial fibrosis in DM patients. Myocardial fibrosis is correlated with circumferential peak diastolic strain rate in DM patients.

CLINICAL RELEVANCE/APPLICATION

(dealing with T1 mapping imaging and cardiac MRI strain) ' T1 mapping is an alternative sequence for the evaluation of diffuse myocardial fibrosis in DM patients.'

SSQ03-06 Subclinical Left Ventricle Dysfunction in Diabetes Mellitus Patient: Assessed by Cardiac MRI Strain Analysis

Thursday, Nov. 30 11:20AM - 11:30AM Room: S504AB

Participants
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PURPOSE

Cardiovascular disease is the key cause of mortality of diabetes mellitus (DM), for which in-time detection of dysfunction and early intervention can significantly improve the prognosis. The aim of this study is to evaluate the subclinical left ventricle (LV) dysfunction in DM patient and whether the patient with good glycemic control have decreased cardiac function with time using cardiac magnetic resonance (CMR) strain analysis.

METHOD AND MATERIALS

In total, 23 DM patients with normal LVEF, including 13 patients diagnosed not more than 10 years and 10 patients diagnosed more than 10 years, and 25 healthy subjects, underwent CMR examination. LV global myocardial strain parameters including peak strain, peak systolic strain rate and peak diastolic strain rate, as well as global radial, circumferential and longitudinal analysis were calculated and compared among the three patient groups.

RESULTS

DM group had a significantly lower longitudinal peak strain (-15.32 ± 5.18 vs. -19.53 ± 2.76, $p=0.007$) and peak diastolic strain rate (1.22 ± 0.29 vs.1.50± 0.28, $p=0.000$), circumferential peak diastolic strain rate (1.20 ± 0.39 vs. 1.50 ± 0.26, $p=0.000$), and higher radial peak systolic strain (2.59 ± 0.81 vs. 2.0 ± 0.61, $p=0.033$) compared with the normal subjects. The DM patient diagnosed more than 10 years have lower peak systolic strain rate [radial (2.03 ± 0.52 vs. 2.61 ± 0.77, $p < 0.000$), circumferential (-0.89 ± 0.19 vs. -1.02 ± 0.20, $p < 0.000$) and longitudinal (-0.79 ± 0.11 vs. -0.97 ± 0.13, $p < 0.000$), respectively], lower radial peak strain (38.18 ± 9.89 vs. 43.47 ± 10.88, $p < 0.000$) and lower circumferential peak diastolic strain rate(1.01 ± 0.26 vs. 1.24 ± 0.21, $p = 0.004$) compared with diagnosed not more than 10 years.

CONCLUSION

Cardiac MRI strain is sensitive to early dysfunctional of heart, which might help with better management for the DM patients with

normal LVEF. Moreover, the cardiac function is gradually reduced with time, even though the blood glucose controlled well, especially the systolic function.

CLINICAL RELEVANCE/APPLICATION

Cardiac MRI strain is sensitive to early dysfunctional change of DM patients than traditional heart function evaluation parameters, which might help with better management for the DM patients with normal LVEF

SSQ03-07 Aortic Stiffness, Myocardial Fibrosis, Left Ventricular Strain and Epicardial Fat in Hypertension and Diabetes Mellitus

Thursday, Nov. 30 11:30AM - 11:40AM Room: S504AB

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PURPOSE

A combined assessment of aortic stiffness, left ventricular (LV) fibrosis, LV strain and epicardial fat volume (EFV) may decrease risk in patients with cardiovascular risk factors such as hypertension (HTN) or diabetes mellitus (DM). Using a MRI approach these parameters were assessed in 63 patients and related to the presence of HTN and DM.

METHOD AND MATERIALS

20 healthy controls (57.2±8.2years[y]; 26.2±3.9kg/m²), 31 hypertensive patients without DM (HTN-Pts; 59.6±6.7y; 28.4±4.7kg/m²) and 12 with DM (DM-Pts; 58.8±9.9y; 30.7±6.3kg/m²) were examined at 1.5Tesla. No patients had coronary artery disease; all patients had a normal LV ejection fraction. Aortic stiffness was evaluated by velocity encoded MRI to determine pulse wave velocity (PWV) of the aortic arch (Fig. A), EFV by a 3D-Dixon sequence with acquisition of fat-only images and fat-fraction maps (Fig. B&C), LV T1 relaxation times (T1) to detect fibrosis using a MOLLI scheme, and, longitudinal & circumferential systolic strain (LS; CS) by feature tracking software.

RESULTS

Age and gender did not differ significantly; BMI was higher in DM-PTs compared to controls. Results were adjusted for BMI. EFV was highest in DM-PTs followed by HTN-PTs and controls (EFV = 78.4±28.0 vs. 64.2±27.3 vs. 50.3±22.7ml/m²; $P<0.05$). T1 was higher in DM-PTs and HTN-PTs than in controls (T1 = 994.0±43.2 resp. 991.6±35.5 vs. 964.6±40.3ms; $P<0.05$). PWV was significantly higher in DM-PTs and LV strain lower compared to HTN-PTs and controls (PWV = 9.8±3.3 vs. 8.6±1.7 resp. 8.1±1.9m/s; LS = -20.9±5.1 vs. -24.7±4.6 resp. -25.5±3.8%; CS = -24.4±5.7 vs. -27.1±5.0 resp. -28.3±4.1%). Fig. D illustrates a healthy male with a lower T1 compared to a HTN-Pt (Fig. E) and Fig. F with a higher LS compared to a DM-PT.

CONCLUSION

Hypertension and diabetes mellitus are associated with LV fibrosis; cardiac remodeling as well as metabolic and inflammatory mechanisms of an increased EFV may play a role. EFV and aortic stiffness are further increased and LV strain reduced in DM-PTs possibly due to an increased metabolic and inflammatory burden associated with DM. A multi-parameteric assessment of these parameters can easily be integrated into a routine MRI exam and may be supportive for a more accurate cardiovascular risk evaluation.

CLINICAL RELEVANCE/APPLICATION

MRI is an accurate tool for evaluation of cardiovascular risk and prognostic parameters in patients with risk factors, such as hypertension or diabetes mellitus.

SSQ03-08 Strain of Ascending Aorta on Cardiac Magnetic Resonance in 1,027 Patients: Relation with Age, Gender, and Cardiovascular Disease

Thursday, Nov. 30 11:40AM - 11:50AM Room: S504AB

Participants
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PURPOSE

To evaluate aortic strain (AS) with cardiac magnetic resonance (CMR) in a large series of consecutive patients with different cardiovascular diseases (CVDs).

METHOD AND MATERIALS

Two-dimensional phase-contrast gradient-echo sequences of the ascending aorta were retrospectively selected in 1,027 patients (726 males, 301 females). In all images, aortic lumen area was segmented using a semi-automatic approach to calculate AS values. Subgroup analysis was performed for patient with normal CMR, Tetralogy of Fallot (ToF), and ischemic heart disease (IHD). Multivariate and post-hoc analyses were performed to evaluate the effect of age, gender and CVDs on AS values. In order to consider also the age factor, the subjects were grouped into 7 age bins of 10 years (0-9, 10-19, 20-29, 30-39, 40-49, 50-59 and >= 60 years).

RESULTS

Taking into account the whole sample, the AS resulted inversely correlated with age ($\rho = -0.51$, $P<.001$). Multivariate analysis showed significant differences in AS among decades of age ($P<.001$), genders ($P=.007$) and CVD subgroups ($P<.001$) without interaction among these factors. Post-hoc analysis showed significantly lower AS in ToF and IHD patients compared to subjects with normal CMR (P<.001). Gender-related differences were significant in ToF subjects ($P=.008$), in particular men with ToF showed a lower AS when compared with men with normal CMR ($P=.005$). In IHD patient, AS was lower compared to normal CMR subjects (men: $P<.001$, women: $P=.016$), without significant difference between genders ($P=.732$). Aortic strain reduction during aging was observed in all CVD groups.

CONCLUSION

Differences in age, gender, and CVD independently affect AS. The lower AS observed in ToF fosters its assessment during follow-up in adulthood. The gender-related difference gives the basis for future studies focused on its possible causes and clinical implications. Nevertheless, further investigations on elderly patients and, in particular, in adults with congenital heart disease are advised.

CLINICAL RELEVANCE/APPLICATION

Our results showed that age, gender, and CVDs independently affect the ascending AS, highlighting the importance of its follow-up assessment, especially in patients with congenital cardiac diseases.

SSQ03-09 Effectiveness of Multiparametric Structure-Function Cardiac MRI in Detection of Acute Cardiac Allograft Rejection

Thursday, Nov. 30 11:50AM - 12:00PM Room: S504AB

Awards
Student Travel Stipend Award

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PURPOSE

Acute cardiac allograft rejection (ACAR) is a leading cause of morbidity and mortality in heart transplant (Tx) recipients. Non-invasive screening with cardiac magnetic resonance imaging (CMR) is promising given its ability for comprehensive characterization of acute myocardial injury and subtle left ventricular (LV) structural and functional changes. We hypothesized that CMR-derived T2, T1, extracellular volume fraction (ECV), and LV velocities will differ between 1) healthy controls and Tx recipients without history of ACAR and 2) Tx recipients with and without current evidence of ACAR.

METHOD AND MATERIALS

CMR at 1.5T (Magnetom Aera/Avanto, Siemens, Erlangen, Germany) was performed prospectively on 76 Tx recipients (49.9±15.9 yrs, 45% female) and 14 controls (47.7±16.7 yrs, 36% female) for 131 total studies. Analyses were stratified based on myocardial biopsy grade: Controls (N=14), No ACAR (no history of ACAR, N=68), Past ACAR (history of ACAR, N=34), ACAR+ (active grade>=1R ACAR, N=15). CMR included T2-mapping, pre- and post- contrast T1-mapping (to calculate ECV), and tissue phase mapping (TPM; to generate myocardial velocities).

RESULTS

T2 was significantly higher in No ACAR patients compared to controls (49.4±3.4 ms vs. 45.2±2.3 ms, P<0.01). Compared to No ACAR patients, patients with Past ACAR (51.7±4.1 ms vs. 49.4±3.4 ms, P<0.01) or current ACAR+ (53.8±4.9 ms vs. 49.4±3.4 ms,

P<0.01) had greater T2 values. ECV was significantly elevated in ACAR+ patients compared to recipients without ACAR (31.6±3.6% vs. 26.7±3.2%, P<0.01) regardless of history of ACAR (No ACAR and Past ACAR). ROC analysis for the detection of ACAR+ revealed AUC of 0.80 and 0.85 for T2 and ECV respectively. TPM identified lower peak systolic longitudinal velocities and higher peak diastolic radial velocities in No ACAR patients compared to controls (2.8±1.0 cm/s vs. 4.9±1.1 cm/s, P<0.01; -3.7±0.8 cm/s vs. -2.9±0.7 cm/s, P<0.01).

CONCLUSION

CMR parameters are sensitive to structural and functional change in Tx recipients. T2 and ECV are effective at detecting ACAR, supporting further development of CMR for ongoing surveillance post Tx.

CLINICAL RELEVANCE/APPLICATION

CMR-derived T2 and ECV are effective in detecting acute cardiac allograft rejection (ACAR) following heart transplant, promoting use of multiparametric CMR as an alternative ACAR screening tool.

SSQ04

Chest (Interventional/Ablation)

Thursday, Nov. 30 10:30AM - 12:00PM Room: E351

CH CT IR MR

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

SSQ04-01 Analysis of Risk Factors for Hemoptysis after Percutaneous Transthoracic Needle Biopsies in 4,172 Cases: Focusing on the Effects of Diametrical Enlargement of the Main Pulmonary Artery

Thursday, Nov. 30 10:30AM - 10:40AM Room: E351

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PURPOSE

To evaluate risk factors for hemoptysis after cone-beam computed tomography (CBCT)-guided percutaneous transthoracic needle biopsy (PTNB) and, in particular, to determine whether the enlargement of main pulmonary artery diameter (mPAD) is a risk factor for PTNB-related hemoptysis.

METHOD AND MATERIALS

After approval from the Institutional Review Board, 4,172 cases of CBCT-guided PTNBs in 3,840 patients (2299 men and 1541 women; mean age, 63.64 years, ranging from 7-to-94 years) were retrospectively included in this study. Various clinical, radiological, and biopsy-related data including mPAD were evaluated using univariate and multivariate logistic regression analyses to figure out significant risk factors for both hemoptysis and severe hemoptysis. Severe hemoptysis was designated when blood transfusion, vascular embolization, or cardiopulmonary resuscitation were required to manage patients with the diagnosis.

RESULTS

Hemoptysis occurred in 5.78% (n=241) of all PTNB procedures, while severe hemoptysis occurred in 0.18% (n=7). Female sex (Odds ratio [OR]=2.703, P<0.001), history of anti-platelet or anti-coagulative drugs (OR=2.362, P=0.002), prolonged activated partial thromboplastin time (OR=1.951, P=0.042), subsolid nodules (OR=3.529, P<0.001), cavitary nodules (OR=3.205, P=0.038), and long pleura-to-target distance (P<0.001) were independent risk factors for hemoptysis, while mPAD enlargement was not a significant risk factor. Regarding severe hemoptysis, however, mPAD enlargement (OR=5.004, P=0.037) was a significant independent risk factor in combination with subsolid (OR=6.648, P=0.046) and cavitary target nodules (OR=20.284, P=0.008).

CONCLUSION

mPAD enlargement was not a significant risk factor for PTNB-related hemoptysis. However, it was a significant risk factor for severe PTNB-related hemoptysis.

CLINICAL RELEVANCE/APPLICATION

mPAD enlargement was a significant risk factor for severe PTNB-related hemoptysis, along with subsolid and cavitary nodule features.

SSQ04-02 Active Targeting Theranostic Iron Oxide Nanoparticles for MRI and Magnetic Resonance-Guided Focused Ultrasound Ablation of Lung Cancer

Thursday, Nov. 30 10:40AM - 10:50AM Room: E351

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PURPOSE

To evaluate an active targeting and nano-sized SPIO platform for the enhancement of imaging sensitivity and tumor-ablative efficacy in MRgFUS, and applications of a series of MRI approaches for non-invasive monitoring treatment response were demonstrated using nude rat lung tumor models.

METHOD AND MATERIALS

PEGylated SPIO nanoparticles was further decorated with high affinity anti-EGFR monoclonal antibody to form a nanocomposite (anti-EGFR-PEG-SPIO) , and in vitro and vivo MRI was preformed. 24 rats were then randomly divided into positive control group (n=6), negative control group (n=6), PEGylated SPIO group (n=6), and anti-EPS group (n=6). The nude rats tumors were sonicated after injection of the PEGylated SPIO and anti-EPS solution (1ml) via tail vein at 4.0 h. Prior to sonication, T2W SE were acquired. For each nude rat, two to five sonications were planned. The treated areas were about 0.5 cm2 according to the pretreatment plan. Each dynamic temperature was monitored by real-time MRI temperature mapping of the treated area.

RESULTS

The T2 values for the anti-EGFR-PEG-SPIO and PEGylated SPIO contrast agents at 3.0 T MRI were 10.3ms and 11.2ms, respectively. T2 relativity values were 97.1 s-1mM-1 and 89.3 s-1mM-1, respectively.The T2 SI in targeting group decreased significantly compared with non-targeting group. The rate of SI change was -58.2%, -82.7%, -94.4%, and 98.3% respectively, at the iron concentrations. Thirty minutes after the injection of anti-EPS, the T2 SNR in the lung tumor started to decrease. The T2 SNR at the tumor region decreased more significantly at 4 hours post-injection of anti-EPS compared with the nontargeting group ($p<0.01$). The energy of the targeting group was even lower than that of the control (low enegy) group (32W vs 54 W, $P<0.01$) ,Peak temperature significantly higher than control group. T2W SI and ADC significantly after ablation higher than before ablation in targeting, and nontargeting, control group

CONCLUSION

We have successfully developed anti-EGFR modified PEGyloated SPIO nanoparticles as targeted MR imaging contrast agents and the synergistic agents for MRgFUS lung carcinoma thermotherapy. After tumor ablation, tumor therapeutic efficiency monitored by the clinical MRI equipment can be applied as an attractive potential noninvasive strategy.

CLINICAL RELEVANCE/APPLICATION

Applications of a series of MRI approaches can be applied as an attractive potential noninvasive strategy.

SSQ04-03 Non-Diagnostic CT-Guided Percutaneous Needle Biopsy (PTNB): Predictive Factors and Final Diagnoses

Thursday, Nov. 30 10:50AM - 11:00AM Room: E351

Participants
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PURPOSE

To investigate the final diagnosis of pulmonary lesions with an initial non-diagnostic result on CT-guided percutaneous transthoracic needle biopsy (PTNB) and the predictive factors for a non-diagnostic result.

METHOD AND MATERIALS

All PTNB performed over a 4-year period were retrospectively reviewed. The initial pathological results were classified into 3 categories as malignant or suspicious for malignant, benign specific, and non-diagnostic. The demographic data of patients, lesion characteristics, technique, complications, initial pathological results and final diagnosis were reviewed. Statistical analysis was performed using Pearson's X2 test or Fisher's exact test.

RESULTS

Out of a total of 894 consecutive biopsies, 690 (77.2%) were positive or suspicious for malignancy, 55 (6.2%) were specific benign, and 149 (16.7%) were non-diagnostic. Significantly higher non-diagnostic rates were found in cases where the lesion was less than 15mm, the needle tract traversed emphysema, the introducer needle was outside the lesion, total time was greater than 60 minutes and when alveolar hemorrhage was present during the procedure. 122 of 149 non-diagnostic cases had a subsequent diagnosis made by repeat biopsy, surgery or follow-up; and malignancy was confirmed in 44 cases (44/122, 36%). There were statistically significant differences in non-diagnostic biopsy rates for patients with malignant lesions (44/734, 6%) and benign lesions (78/133, 59%) ($p=0.001$). In the non-diagnostic group, patients with history of prior malignancy and patients with atypical cells present in the initial pathological report were more likely to have a final diagnosis of malignancy ($p=0.043$ and $p=0.001$, respectively)..

CONCLUSION

The predictive factors for non-diagnostic results were lesion size less than 15mm, needle tract traversing emphysema, introducer needle outside the lesion, procedure time greater than 60 minutes, presence of alveolar hemorrhage, and a final benign diagnosis. Although the majority of the non-diagnostic cases yielded a benign diagnosis, 36% were malignant. In cases with a history of malignancy or the presence of atypical cells in the biopsy sample repeat biopsy or surgical resection should be considered.

CLINICAL RELEVANCE/APPLICATION

The management of a non-diagnostic PTNB result is difficult, however, the 36% rate of malignancy in this group underscores the need for further diagnostic evaluation in these patients.

SSQ04-04 Evaluation of Rabbit Lung VX2 Tumor after Radiofrequency Ablation by Multi-B Value Based MR Diffusion Weighted Imaging

Thursday, Nov. 30 11:00AM - 11:10AM Room: E351

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PURPOSE

To explore the multi-b value based diffusion weighted imaging (DWI) on evaluation of lung VX2 tumor after radiofrequency ablation (RFA).

METHOD AND MATERIALS

Fifty-three lung VX2 tumor models were examined by multi-b value DWI (b=0,10,20,50,100,150,200,500,800, 1000,2000 s/mm2) at 1 day before RFA, and 1, 3, 7, 14 days after RFA. Both mono-exponential and bi-exponential model (including intravoxel incoherent motion imaging, diffusion kurtosis imaging (DKI) and stretched exponential model (SEM)) were used to calculate corresponding parameters (ADC, D, D*, f, Dk, K, DDC and A) based on ROIs of the maximal cross-sectional tumor before and after RFA by two thoracic radiologists, blindly. The parameters were compared between pre-RFA and post-RFA groups; the complete and incomplete RFA groups based on H&E and TUNEL staining, and correlated with MVD. The t test, Wilcoxon test, or Mann-Whitney U test was used in two-group comparisons. The area under curve (AUC) was used to assess the diagnostic performance. The Spearman correlation was used to analyze the correlation. Bland-Altman method was used to assess the intraobserver repeatability, and the coefficient of variation (CV) <5% was in good repeatability.

RESULTS

ADC, D, Dk, DDC and a values increased after RFA (all p<0.02), while K values decreased at day 3 and day 7, postoperatively (p=0.03; 0.01). ΔADC, ΔD, ΔDk, ΔDDC, Δa and ΔK of the complete RFA group was higher than that of the incomplete RFA group (all p<0.03) at day3; day7; day1-14; day7; day7 and day3, postoperatively, respectively, and the AUC of ΔADC>=0.44×10-3mm2/s; ΔD>=0.18×10-3mm2/s; ΔDk>=0.50, 0.37, 0.19 and 0.19×10-3mm2/s; ΔDDC>=0.16 × 10-3mm2/s; Δa>=0.05; ΔK>=0.23 in determination of tumor with complete ablation, was 0.93; 1.00; 1.00, 0.98, 1.00 and 0.96; 0.88; 0.88; 0.95, respectively. No difference of D*and f value changes was noticed, postoperatively (all P value>0.09). No difference of AUC and no correlation of parameters with MVD (all P values > 0.05). The CV of ADC, DDC, a, Dk, K and D at baseline was 2.18%, 3.33%, 3.45%, 7.18%, 8.65% and 18.62 %, respectively.

CONCLUSION

DKI could be used to evaluate the efficacy of RFA at day 1, postoperatively; ADC (b = 0, 500s/mm2) and DKI could be utilized to evaluate it at day 3, postoperatively; both the DKI and SEM-DWI could evaluate it at day 7 and day 14, postoperatively.

CLINICAL RELEVANCE/APPLICATION

DKI and ADC could be used to early assess the lung tumor after RFA.

SSQ04-05 Risk of Pleural Recurrence after Percutaneous Transthoracic Needle Biopsy in Stage I Non-Small Cell Lung Cancer: A Large Center Experience

Thursday, Nov. 30 11:10AM - 11:20AM Room: E351

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PURPOSE

To determine whether percutaneous transthoracic needle biopsy (PTNB) increase the risk of (a) isolated pleural recurrence and (b) concomitant pleural seeding and metastasis in stage I non-small cell lung cancer (NSCLC).

METHOD AND MATERIALS

In this institutional review board-approved retrospective study, medical records of total of 830 consecutive patients with stage I NSCLC who underwent curative resection between 2004 and 2010 were reviewed. Median duration of follow-up was 1843 days (interquartile range, 1006-2734). Multiple logistic regression analyses were performed to identify risk factors of pleural recurrence.

RESULTS

Of 830 patients, 540 patients (65.1%) underwent PTNB before surgery, while 290 patients (34.9%) underwent non-PTNB procedures including bronchoscopic biopsy or exploratory thoracotomy. An isolated pleural recurrence was found in 26 patients (3.1%, [95%CI, 2.1-4.6%]) (20 in PTNB group, 6 in non-PTNB group). There was no significant association between PTNB and isolated pleural recurrence (P=0.197). Concomitant pleural recurrence occurred in 42 patients (5.1%, [95%CI, 3.8-6.8%]) (34 in PTNB group, and 8 in non-PTNB group). Subpleural location (p=0.007), tumor consistency (solid, part-solid, nonsolid) (p=0.046), PTNB (p=0.027), pathologic T stage (p<0.001), microscopic pleural invasion (p<0.001) and microscopic lymphatic invasion

(p=0.019) were associated with concomitant pleural recurrence. The most significant factor of pleural recurrence was only microscopic pleural invasion (Odds Ratio, 4.28; 95% CI, 2.20 to 8.29) (P<0.001) on multiple logistic analysis. Among 540 patients undergoing PTNB, transfissural approach did not have significant association with pleural recurrence (P=0.220), while the most sole significant factor was microscopic pleural invasion (Odds Ratio, 3.40; 95% CI, 1.54 to 7.51) (P=0.002).

CONCLUSION

PTNB did not increase the risk of isolated or concomitant pleural recurrence in early stage NSCLC. Higher incidence of concomitant pleural seeding in PTNB group was presumably attributed to peripheral lung cancer, potentially accompanying microscopic pleural invasion.

CLINICAL RELEVANCE/APPLICATION

PTNB can be performed for confirmatory diagnosis of early stage lung cancer without raising the risk of isolated or concomitant pleural recurrence.

SSQ04-06 Genomic Profiling of Non-Small Cell Lung Cancer (NSCLC) for Personalized Therapy

Thursday, Nov. 30 11:20AM - 11:30AM Room: E351

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PURPOSE

Genomic profiling for personalized targeted therapy is emerging for NSCLC. Systematic testing for mutations in BRAF, ERBB2, PIK3CA and ALK translocations, in addition to EGFR and KRAS was introduced in our institution in July 2009. We report the utility, efficacy and safety of CT guided trans-thoracic needle biopsy (TTNB) in this cohort.

METHOD AND MATERIALS

Patients with stage IV/relapsed NSCLC who underwent CT guided TTNB to identify driver mutations prior to therapy were reviewed. Pathology specimens were evaluated for tumor adequacy, then manually dissected and analyzed by a variety of methods, including next generation sequencing for mutations in selected exons of EGFR, KRAS, BRAF, PIK3CA and ERBB2. ALK rearrangements were detected with fluorescence in-situ hybridization (FISH) and/or immunohistochemistry. Complications (pneumothorax, hemorrhage and admission) were recorded.

RESULTS

Between 6/12/2009 and 12/30/2016, 764 patients with NSCLC underwent TTNB. The median age was 67 years. 454(59%) were female, 426(56%) were former/current smokers and 580(75%) had stage IIIB/IV disease. 492(64%) of all TTNB performed were profiled for genomic analysis, of which 426(87%) had sufficient tissue on core biopsies for genomic profiling; 75(10%) of the 492 patients failed analysis for ALK rearrangements due to less than 50 tumor cells on the hybridized slide. The number of samples obtained ranged from 1-10 (2 cm 18-20G). Lesions biopsied ranged in size from 0.6-9.9 cm. PET guidance was used in 323(42%) patients. Targetable alterations were identified in 172/426(40%) patients (EGFR:139(18%); KRAS:101(13%);ALK:10(1%);BRAF:9(1%)). 216(28%) had pneumothoraces:137(<10% in size), 42 (10-30%) and 37(>30%). 79(10%) were admitted post procedure. 85(11%) had pulmonary hemorrhage. There was no statistically significant difference in pneumothorax rate by needle size (p=0.8). Pneumothorax rate significantly correlated with distance from the pleura and emphysema. Treatment strategy was changed in 183(24%) patients based on the biopsy result.

CONCLUSION

CT guided TTNB is a feasible, safe and efficacious technique for genomic profiling for targeted therapy, enabling the acquisition of sufficient tissue for gene mutation analyses.

CLINICAL RELEVANCE/APPLICATION

Personalized medicine has increased the need for rebiopsy in NSCLC; the ability to acquire sufficient tissue with minimal morbidity will help design clinical trials and inform management decisions.

SSQ04-07 Repeat Biopsy for the Patients with Acquired Resistance to EGFR TKIs: Implication of Biopsy-related Factors on Detection of T790M Mutation

Thursday, Nov. 30 11:30AM - 11:40AM Room: E351

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PURPOSE

Identification of T790M resistance mutation through repeat biopsy is essential to determine eligibility of the potential candidate patients for the third-generation epidermal growth factor receptor (EGFR) tyrosine kinase inhibitors (TKIs). We aimed to investigate predictors for the successful repeat biopsy specimen acquisition for mutational analysis and T790M mutation detection.

METHOD AND MATERIALS

We retrospectively reviewed 90 advanced non-small cell lung cancer patients harboring EGFR mutation who underwent repeat cone-beam CT-guided transthoracic needle biopsy. Clinical characteristics as well as repeat biopsy-related factors were compared between the patients with and without adequate biopsy specimen acquisition and between the patients with and without T790M mutation. After univariate analysis, multivariate logistic regression analysis was performed to reveal independent predictors.

RESULTS

Appropriate biopsy specimen was obtained in 90% (81/90) and T790M mutation was found in 61.7% (50/81) of the study population. None of the analyzed variables was significantly associated with successful biopsy specimen acquisition. For the T790M mutation detection, duration of EGFR TKI treatment (P=0.066), duration of total chemotherapy treatment (P=0.026), tumor size (P=0.066), and metastatic lesion as a biopsy target (P=0.029) showed P values less than 0.10. Multivariate analysis revealed that smaller target tumor size (odds ratio, 0.765; 95% confidence interval: 0.600, 0.975; P=0.031) and metastatic lesion as a biopsy target (odds ratio, 4.194; 95% confidence interval: 0.997, 17.637; P=0.050) were significant independent predictors of T790M mutation detection.

CONCLUSION

Detection of T790M mutation at repeat biopsy was associated with smaller target tumor size and selection of metastatic lesion as a biopsy target.

CLINICAL RELEVANCE/APPLICATION

Selection of biopsy target can affect detection of T790M mutation in in patients undergoing repeat biopsy (PTNB) as candidates of third-generation EGFR TKIs.

SSQ04-08 Single Institution Experience in Pre-Operative Pulmonary Lesion Marking Using Fiducial Markers and Micro-Coils in Preparation for Fluoroscopic Wedge Resection: Rates of Success, Complications, and Comparison of Two Labeling Devices

Thursday, Nov. 30 11:40AM - 11:50AM Room: E351

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PURPOSE

Evaluate the use of either Fiducial Marker (FM) or Microcoils (MC) to aid image-assisted wedge surgical resection of small pulmonary nodules and explore associations between patient/nodule characteristics and development of complications.

METHOD AND MATERIALS

IRB approved , HIPAA compliant database search identified patients who had CT-guided FM or MC implantation for wedge resection of pulmonary nodules from 01/01/95 - 01/22/2016. EMR was searched to extract patient's demographics including age, gender and body mass index. CT images prior to FM/MC insertion were reviewed by a single radiologist for nodule characteristics including size, location and depth. Post procedure CT images were read to measure distance of FM/MC to the nodule and to assess for complications including hemorrhage, pneumothorax and marker migration. Chi squared analysis at <0.05 was used to explore asssociations between patient/nodule characteristics and the development of complications.

RESULTS

We identified 136 nodules in 127 patients (67M:60F). Preoperatively, 130 FMs and 33 MCs were inserted to aid wedge resection in 112 and 15 patients respectively. 97% [124/127] of patients had successful same day resection as planned, two were delayed due to complications and a single patient needed a lobectomy due to lesion location. 68% of patiebnts [88/127] had complications following FM/MC insertion including hemorrhage [32%], pneumothorax [24%], a combination of hemmorhage and pneumothorax [9%] and marker moigration/emolization [3%]. Depth of lesion from skin was significantly associated with developing a complication. No other patient of nodular characteristic was associated with developing a complication. We observed a smaller percentage of patient complications in MC as compared to FM placement and these were of less severity, although statistical significance was not reached (p=0.06)

CONCLUSION

CT-guided pulmonary marking of pulmonary lesions is effective at aiding wedge resection. Complications are relatively common but mild with no significant effect on patient clinical management. Use of MC rather than FM may improve the saftey profile of lesion marking.

CLINICAL RELEVANCE/APPLICATION

Mild complications are relatively frequent but shoiuld not deter FM or MC placement for wedge resection of pulmonary nodules. Our

data suggests MC may have a better safety profile as compared to FM.

SSQ04-09 Rebiopsy of Non-Small Cell Lung Cancer with Acquired Resistance to EGFR Tyrosine Kinase Inhibitor: Clinical and CT Characteristics of Patients with T790M Mutation

Thursday, Nov. 30 11:50AM - 12:00PM Room: E351

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Re-biopsy for T790M mutation analysis of non-small cell lung cancer (NSCLC) after EGFR-tyrosine kinase inhibitor (TKI) treatment failure is important to determine further chemotherapy regimen. However, little is known regarding the clinical and radiologic differences among patients with or without T790 mutation.

METHOD AND MATERIALS

Between Jan 2011 and Jan 2017, 370 lung cancer patients underwent re-biopsy after TKI failure, and among them, 362 were assessed with adequate specimen. Clinical course, serial CT scans and pathologic reports were retrospectively reviewed. Re-biopsy methods are varied: CT or fluoroscopy-guided lung biopsy (n=130), EBUS or BFS-guided (n=71) biopsies, US-guided lymph node (n=40) or liver (n=20) biopsy, pleura biopsy (n=9), other sites (n=48) biopsies including surgical lung resection and pleural fluid analysis (n=44). CT scans obtained at the time of initial diagnosis and re-biopsy were compared between patients with and without T790M mutation.

RESULTS

Among 362 patients, 150 (41.4%) presented T790M mutation on re-biopsy. Two patients who were negative T790M mutation on pleural fluid analysis finally diagnosed as positive T790M mutation by following CT-guided biopsy or surgical lung resection. Mean interval between initial TKI failure and rebiopsy was longer in T790M positive group than negative group (p=0.01). On initial CT, the presence of pleural metastasis was significantly higher in T790M positive group (p=0.006). On CT obtained at the time of rebiopsy, pleural retraction adjacent to primary lung cancer and pleural metastasis were significantly noted, and number of metastatic sites is also higher in patients with positive T790M mutation ($p < 0.01$).

CONCLUSION

T790M mutation may be related to the interval between initial TKI failure and rebiopsy. Pleural retraction adjacent to primary lung cancer and pleural metastasis on CT at the time of rebiopsy were significantly associated factors to positive T790M mutation in NSCLC patients with TKI failure.

CLINICAL RELEVANCE/APPLICATION

On CT at the time of rebiopsy, pleural retraction and pleural metastasis were significantly noted in patients with positive T790M mutation after TKI failure. Negative T790M on pleural fluid analysis could not give a guarantee for true negative, and further core biopsy might be recommended.

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SSQ07

Gastrointestinal (Multimodality)

Thursday, Nov. 30 10:30AM - 12:00PM Room: E350

CT GI MR

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

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Sub-Events

SSQ07-01 Trauma Related Pseudopneumoperitoneum-Costochondral Vacuum Phenomenon

Thursday, Nov. 30 10:30AM - 10:40AM Room: E350

Participants
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PURPOSE

To determine the typical anatomical distribution of anterior ectopic gas resembling pneumoperitoneum and to determine the relationship of this finding with trauma and clinical outcomes using archival CT.

METHOD AND MATERIALS

In total, 492 consecutive trauma patients between two separate geographical centres were included to be screened. One hundred and eighty-six patients with recognised causes for ectopic gas were excluded, leaving 306 patients (211 male, mean age 44.5) for analysis by dual consensus between the two centres. A further 200 non-trauma CT scans were consecutively selected as a control group.

RESULTS

The pseudopneumoperitoneum was related to trauma (p=0.0001) and identified in 5.2% of patients after exclusions. Pseudopneumoperitoneum occurred bilaterally and consistently found to be adjacent to the lower 6 anterior ribs near the costochondral junction. Pseudopneumoperitoneum was independently associated with high velocity trauma. There were no significant differences between sides, gender or injury severity score. None of the patients with pseudopneumoperitoneum had evidence for hollow viscus perforation at laparotomy or clinical examination.

CONCLUSION

Pseudopneumoperitoneum is a post traumatic phenomenon centred near the costochondral junction of the lower 6 anterior ribs. These findings have potentially significant clinical implications and are therefore important to recognise in order to prevent unnecessary laparotomy in the trauma setting.

SSQ07-02 Misty Mesentery Is Not Associated With Baseline or New Diagnosis of Cancer: A Matched Cohort Study

Thursday, Nov. 30 10:40AM - 10:50AM Room: E350

Awards
Student Travel Stipend Award

Participants
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PURPOSE

To compare the prevalence of a known diagnosis of cancer in patients with and without misty mesentery (MM) at baseline imaging, and to determine its association with the development of a new diagnosis of cancer.

METHOD AND MATERIALS

This was a retrospective, HIPAA compliant, IRB approved study of patients with and without MM on CT scans acquired from January 1, 2000 to December 31, 2010. We searched our RIS database for reports that included keywords associated with MM. All scans were reviewed to confirm the presence of MM. 4:1 age- and gender-matched controls without MM were identified. Medical records were reviewed and the following data noted: date of CT, use of iodinated IV contrast, CT protocol (noncon, single, or multiphase), baseline nonmalignant diagnoses, history of abdominal malignancy known at the time or identified on the CT scan, subsequent diagnosis of cancer, and date of the new diagnosis or last encounter. Data was analysed with Pearson's chi-square test, two-sample Student's t-test, and Cox proportional hazard models (only patients who did not yet have a baseline diagnosis of cancer). We used STATA® for statistical analysis. An a of 0.05 was considered statistical significance.

RESULTS

Our sample consisted of 148 patients with MM (60 women, 40.54%) and 600 patients without it (236 women, 39.3%) . The mean age of patients were 63.5 years and 61.9 years for patients with and without MM, respectively. No statistically significant difference in any non-malignant diagnoses. Patients with MM were less likely to have a malignancy at baseline (RR = 0.764, absolute difference 12.3% p=0.008). Patients with MM had a longer mean follow-up duration than controls (1742 days, standard deviation = 1545.0 versus 1391 days, standard deviation = 1467.4; P = 0.01). On survival analysis, we observed an increased risk of developing any cancer in MM patients, but this effect was not statistically significant (HR = 1.71, 95% CI 0.93-3.15, p=0.083)

CONCLUSION

We found no clear evidence that patients with MM are more likely to have cancer at the time of baseline imaging or to be later diagnosed with cancers previously thought to be associated with misty mesentery, such as lymphoma.

CLINICAL RELEVANCE/APPLICATION

Further testing is not necessary following the diagnosis of MM, and perhaps its identification on cross-sectional reports should be ommitted or at least not emphasized to minimize patient and provider anxiety.

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/ Antonio C. Westphalen, MD - 2017 Honored EducatorSpencer C. Behr, MD - 2017 Honored Educator

SSQ07-03 Can Quantitative and Semi-quantitative Computed Tomography Analysis Predict Outcomes of Complex Ventral Hernia Repair?

Thursday, Nov. 30 10:50AM - 11:00AM Room: E350

Awards
Student Travel Stipend Award

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PURPOSE

Component separation is a commonly used technique allowing for sufficient fascial approximation during complex ventral hernia repair (VHR). However, in certain cases, despite component separation, fascial apposition is not possible resulting in bridged VHR. Prior studies have suggested a role for computed tomography (CT) in preoperative planning for VHR. We hypothesized that CT characteristics of abdominal wall musculature may correlate with the defect size and outcomes of fascial approximation during surgery.

METHOD AND MATERIALS

Consecutive patients who underwent complex VHR using component separation technique and available operative note and pre-operative abdominal CT scans were retrospectively recruited in this IRB-approved study. Specific parameters such as defect size, abdominal wall fat thickness; thickness and mean attenuation of abdominal wall muscles including rectus abdominis (RA), external oblique (EO) and internal oblique (IO) were measured in multiple levels on axial planes using Osirix software (Pixmeo, Bemex, Switzerland) and used for further analysis.

RESULTS

Forty patients meeting inclusion criteria were included. Twenty patients had successful fascial approximation (unbridged group) while in the other 20 patients fascial bridging was used for hernia repair (bridged group). The defect width had a positive correlation with mean EO thickness (Correlation Coefficient (CC)= 0.43, p=0.006), IO thickness (CC=32, p=0.43), abdominal wall fat thickness (CC=0.35, p=0.03) and EO/IO mean attenuation ratio (CC=0.45, p=0.004). Mean defect width on axial plane (15.0±5.2 vs. 9.3±3.7 cm, p<0.001) and EO/IO mean attenuation ratio (1.17±1.9 vs. 0.24±1.12, p=0.02) were significantly higher for patients who

required bridging technique for fascial closure. However, abdominal wall fat thickness did not significantly differ between groups.

CONCLUSION

Characterization of abdominal wall musculature thickness and fat composition by computed tomography might predict the success of fascial approximation in patients undergoing complex VHRs.

CLINICAL RELEVANCE/APPLICATION

Upon validation in larger prospective studies, these findings might enable preoperative planning and intervening to improve the outcomes in this patient population.

SSQ07-04 Role of High Resolution Transperineal Sonography and Its Comparison with MRI in Peri-Anal Fistulous Disease

Thursday, Nov. 30 11:00AM - 11:10AM Room: E350

Participants
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PURPOSE

To describe the high resolution transperineal sonographic findings in perianal fistulous diseases and to compare its efficacy with MRI, considering surgical results as gold standard.

METHOD AND MATERIALS

This prospective study included 180 patients with clinical suspicion of perianal fistulous disease. These patients were subjected to 2-D high resolution transperineal sonography which was performed in lithotomy position using 8MHz linear array transducer, after which they underwent MRI of the perineum on 1.5T Magnet. The results of sonography and MRI were interpreted by two separate radiologists. The preoperative sonographic and MRI findings were compared with the findings of surgical exploration taken as reference standard and the sensitivity, specificity, positive predictive value and negative predictive values of sonography and MRI were calculated and compared.

RESULTS

Transperineal sonography showed a high sensitivity of 91.5%, specificity of 72% and positive predictive value of 92.7% in detection of primary tract. MRI had comparable sensitivity of 93.2% and specificity of 81%, with positive predictive value of 95.6%. MRI showed a higher diagnostic accuracy in detection of secondary tracts, supralevator extension, whist sonography and MRI had comparable results in detecting intersphincteric collection, crypto glandular abscesses and internal opening. In multiple fistulae, post operative recurrence and associated abscesses both sonography and MRI showed comparable diagnostic efficacy.

CONCLUSION

Transperineal sonography is a highly effective tool in pre-operative assessment and classification of perianal fistulous disease. It has a high sensitivity in detection of primary tract and can accurately identify the secondary tracts, abscesses and internal opening. It is also useful in assessing recurrence in post operative cases.

CLINICAL RELEVANCE/APPLICATION

Transperineal sonography, being a relatively cheap and time saving procedure, can be established as a highly useful alternative to MRI perineum, in view of comparable diagnostic accuracy in cases with perinanal fistulous disease.

SSQ07-05 An MR-Derived Standardized Visceral Adipose Tissue Index (VATI) for Prediction of Insulin Sensitivity

Thursday, Nov. 30 11:10AM - 11:20AM Room: E350

Participants
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PURPOSE

Quantification of visceral adipose tissue (VAT) by MRI is currently performed in many cross-sectional, interventional and epidemiological studies and has shown to be of stronger metabolic relevance compared to other adipose tissue compartments in the human body. However, considering the absolute volume of VAT bears inaccuracies as this has to be interpreted different for subjects with different size. Thus, a VAT-index is introduced - comparable to body mass index, BMI - correcting the VAT-volume by

the square of body height.

METHOD AND MATERIALS

VAT volume was assessed between femoral heads and thoracic diaphragm by axial T1-weighted MRI on a 1.5T whole-body imager (Magnetom Sonata, Siemens Healthcare, Germany). Automatic segmentation of VAT and subcutaneous adipose tissue (SCAT) was performed by a fuzzy-clustering algorithm. In total 952 subjects (603f/349m, mean age 44.6 years) at increased risk for metabolic diseases were included in this prospective analysis. Anthropometrics and insulin sensitivity (IS, by oral glucose clamp) were determined immediately after the MR-session. VAT index (VATI) was calculated by dividing VAT volume (given in l) by the squared body height (cm^2).

RESULTS

VAT volume was in a range between 0.25l and 13.9l and the mean value was twice as much for males (5.6l) compared to females (2.8l). Mean BMI was comparable for males (30.6kg/m^2) and females (29.9kg/m^2). VATI was calculated to 1.76l/m^2 for males and 1.02l/m^2 for females and IS was in a broad range. By applying a stepwise multivariate linear regression analyses (IS as dependent variable) to adjust the effects of covariates (including age, BMI, WHR) and to identify independent relationships, VATI remained as the only significant predictive parameter for IS.

CONCLUSION

MRI has been established as a reliable tool for non-invasive phenotyping. In order to correctly interpret the amount of VAT in the framework of metabolic imaging, the absolute volume should be corrected for body height. It has to be mentioned that these results do not reflect the general population and cut-off values for VATI regarding differentiation of insulin sensitive and insulin resistant subjects remain to be determined.

CLINICAL RELEVANCE/APPLICATION

For a correct interpretation of visceral adipose tissue volume assessed by abdominal MRI, standardization and correction for body height - comparable to body mass index - is advisable.

SSQ07-06 Effect of Hepatobiliary MR Contrast Agent Administration on the Signal Intensity of Peritoneal and Pleural Fluid Effusions

Thursday, Nov. 30 11:20AM - 11:30AM Room: E350

Participants
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PURPOSE

To describe the effect of hepatobiliary-specific MR imaging contrast agent (HBCA) administration on the signal intensity of peritoneal and pleural fluid effusions on T1-weighted MR images.

METHOD AND MATERIALS

From October 2015 to May 2016 all consecutive patients with peritoneal or pleural effusions who underwent HBCA-MRI (Gd-BOPTA or Gd-EOB-DTPA) at 1.5T and 3T were retrospectively included from two centers. The signal intensity of peritoneal and pleural fluids was classified as hypo/iso/hyperintense compared to the splenic parenchyma, before and after HBCA administration. The relative signal enhancement (RE) and the signal-to-noise ratio (SNR) were calculated on pre and contrast-enhanced sequences.

RESULTS

139 patients with peritoneal/pleural effusions without biliary or vascular leakage (mean 60±10-yo, 96 males, 69%) were included. MR imaging was performed for chronic liver disease (n=105), cancer staging (n=21), and other causes (n=15). On T1-weighted hepatobiliary phase (HBP) MR images, the peritoneal fluid appeared hyper/isointense in 88-100%, and pleural effusions in 100% of the patients following Gd-BOPTA administration. On T1-weighted HBP images, all effusions remained hypointense following Gd-EOB-DTPA. The signal intensity of fluids increased with both types of HBCA but RE was significantly higher following Gd-BOPTA than Gd-EOB-DTPA ($p=0.002$ and <0.001 for peritoneal and pleural fluids, respectively), whatever the field strength. RE was significantly correlated with the HBP acquisition time ($r=0.42$, $p<0.001$ and $r=0.50$, $p = 0.033$ for peritoneal and pleural fluids, respectively). It was significantly higher in patients with chronic liver disease following Gd-BOPTA administration ($p=0.009$).

CONCLUSION

The signal intensity of pleural and peritoneal fluids progressively increases following HBCA administration, independently of field strength and in the absence of biliary or vascular leakage. Because most patients who underwent Gd-BOPTA enhanced MR imaging had hyperintense fluid effusion during HBP, we do not recommend this contrast agent to diagnose biliary leakage.

CLINICAL RELEVANCE/APPLICATION

Because most patients who underwent Gd-BOPTA enhanced MR imaging show hyperintense fluid effusion during HBP, we do not recommend this contrast agent to diagnose biliary leakage.

SSQ07-07 Utility of the MDCT Scan Measurement of Gas Distended Gastric Volume Pre and Post Sleeve Gastrectomy and Its Correlation with 1-Year Weight Loss

Thursday, Nov. 30 11:30AM - 11:40AM Room: E350

Awards
Student Travel Stipend Award

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PURPOSE

Measure gastric volume pre and postoperatively, and see its evolution over time. Correlate these volumes with weight loss. Determine if the resected or the residual stomach are predictors of weight loss.

METHOD AND MATERIALS

80 patients with BMI >40 kg/m2 or >35 kg/m2 and medical comorbidities underwent LSG between January 2012 and November 2016 and were analysed prospectively. 207 multislice computed tomography data sets acquired in those patients (52 female and 27 male) were evaluated for gastric volume with a dedicated examination protocol In each CT scan, the patient took diluted oral gastrografin (Sodium Amidotrizoate) mixed with sodium bicarbonate, to produce the gastric distension (from liquid plus air), until they feel repleted. Then the CT scan is performed with a thickness of 2mm and a max FOV, a specific 3D software is used for the reconstruction. CT scans were performed preoperatively and 2 months and 1 year after surgery. Parameters were compared to percentage of excess weight loss (%EWL) at 1 year.

RESULTS

Mean preoperative BMI of patients was 47.25 kg/m2, and mean preoperative stomach volume was 690.5 ml. A significant correlation was observed between preoperative gastric volume and preoperative weight (p=0,019 , r=0,401). One year after surgery the mean %EWL was 63.1% and the mean BMI was 35.5kg/m2. A significant correlation was found between the differences in volume of the stomach (preoperatively and 2 months and preoperatively and 1 year) and the %EWL. At 2 months after surgery, the mean difference in gastric volume was 567.8 ml with statistical correlation with the %EWL at 1 year (p=0,013 and r=0,504). At 1 year after surgery the mean difference in gastric volume was 499.5 ml, also with statistical correlation with %EWL at that moment (p=0,021 and r=0,444). No differences were found between the %EWL at 1 year and the remnant volume at 2 months (p=0,467 and r=0,182) or at 1 year (p=0,309 and r=0.198).

CONCLUSION

1. CT Scan pre and postoperatively, proved to be usefull and of great utility measuring the volume of the gas distended stomach. 2. There is a correlation between the differences in the volume of the stomach and the %EWL 1 year after surgery. 3. Gastric remnant volume changes over time.

CLINICAL RELEVANCE/APPLICATION

MDCT Scan can demonstrate in a precise way the changes in gastric volume over time and this data can help the surgeon to decide the best surgical approach.

SSQ07-08 Imaging of Gangrenous Appendicitis: Do Dual Energy Iodine Overlay Images Add Clinical Value?

Thursday, Nov. 30 11:40AM - 11:50AM Room: E350

Participants
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PURPOSE

Appendicitis remains the most common acute surgical condition of the abdomen. One unique form of this disease is gangrenous appendicitis. This form carries a very high perforation risk which leads to an increase in morbidity and mortality.There have been numerous publications on the role of CT in the diagnosis of acute appendicitis, however the accuracy of CT in diagnosing gangrenous appendicitis is less established. In our study, we propose that the use of Dual Energy (DE) and spectral imaging techniques can improve diagnostic accuracy of acute gangrenous appendicitis.

METHOD AND MATERIALS

For this retrospective, IRB-approved study, the hospital RIS was queried for all abdominopelvic CT scans performed in the emergency department between January 1, 2013 to December 31, 2016 that were positive for appendicitis on histopathology. Non DECT studies and those with frank perforation, phlegmon or peri-appendicular abscess formation were excluded. A total of 236

cases were included in our study. 120 kVp simulated images and iodine overlay (IO) images were reviewed by two abdominal radiologists in a randomized fashion who were blinded to the results of the histopathology for presence of gangrene. Sensitivity, specificity, positive and negative likelihood ratios and interobserver agreement were calculated for each set of images. Confidence was rated on a 5 point Likert scale with 1 being completely uncertain and 5 being absolutely confident.

RESULTS

59.7 % (141) of patients were male. The mean age of patients was 43.5 ± 1.2 years. 51 patients (21.6 %) were positive for gangrenous appendicitis on histopathology.The sensitivity, specificity, positive and negative likelihood ratios, confidence and interobserver agreement for IO images were 100 %, 79.5 %, 4.6, 0, 5 and 0.99 respectively ($p < 0.0001$), compared to 21.6 %, 95.1 %, 4.4, 0.82, 3.75 and 0.98 respectively ($p < 0.0001$) for 120 kVp simulated images.

CONCLUSION

Review of IO images adds significant clinical value to the DECT of the abdomen and pelvis for assessment of acute appendicitis as well as the presence of gangrene within the appendix.

CLINICAL RELEVANCE/APPLICATION

IO images should be reviewed along side the simulated 120 kVp in cases of suspected appendicitis to diagnose or exclude presence of gangrenous appendicitis.

SSQ07-09 Dual Energy and Spectral CT Utilization Rates in Acute Abdominopelvic Imaging

Thursday, Nov. 30 11:50AM - 12:00PM Room: E350

Participants
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PURPOSE

The clinical applications of Dual Energy CT (DECT) in the abdomen and pelvis is well established. However, the actual utilization rates of DE/Spectral analysis are less well documented, specifically in the acute setting. Our study aims to assess the utilization rates of DECT in acute abdominopelvic imaging in the emergency department and the clinical value added by DE/spectral interrogation methods.

METHOD AND MATERIALS

For this retrospective, IRB-approved study, the hospital RIS was queried for all abdominopelvic DECT scans performed in the emergency department between January 1 to December 31, 2016. A total of 1238 studies were performed and were included in our study. The reports were reviewed for mention of DE/spectral interrogation as part of the interpretation of the study. Note was made of the number of times DE/spectral interrogation techniques altered management (by changing the diagnosis or detection of an unexpected, clinically relevant finding), confirmed an observation and increased confidence in the definitive diagnosis, provided additional relevant information or characterized an incidental finding - thus avoiding the need for further investigation.

RESULTS

DE/spectral analysis was utilized in 243 studies out of 1238 (19.63 %). DE/spectral analysis altered management in a significant way 10.3 % of interrogated cases, confirmed suspected observations and increased diagnostic confidence in 21 % of cases, provided relevant information on an observation in 66.7 % of cases and characterized an incidental finding in 18.1 % of cases.DE/spectral analysis was most commonly utilized in assessment of the genitourinary tract (68.5 %) followed by the gastrointestinal tract (20.6 %), the hepatobiliary system (7 %), the musculoskeletal system (2.25 %) and the vascular system (1.5 %).

CONCLUSION

There is good utilization of DE/spectral analysis in the acute setting, with nearly 1 out of 5 abdominopelvic DECT studies undergoing DE interrogation, adding clinical value to the examination by providing information that would have otherwise required additional imaging or other investigations. DE interrogation altered clinical management in 10 % cases.

CLINICAL RELEVANCE/APPLICATION

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

SSQ09

Science Session with Keynote: Gastrointestinal (Liver Fibrosis)

Thursday, Nov. 30 10:30AM - 12:00PM Room: E353C

GI MR

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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An Tang, MD, Montreal, QC (*Moderator*) Research Consultant, Imagia Cybernetics Inc; Speaker, Siemens AG
Sudhakar K. Venkatesh, MD, FRCR, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

SSQ09-01 Gastrointestinal Keynote Speaker: Status of Liver Fibrosis Imaging

Thursday, Nov. 30 10:30AM - 10:40AM Room: E353C

Participants
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ABSTRACT

LEARNING OBJECTIVES 1. To review the histological staging of liver fibrosis. 2. To discuss the classification of imaging-based techniques for assessment of liver fibrosis. 3. To highlight key unmet needs and potential future directions in liver fibrosis imaging. ABSTRACT Liver fibrosis is characterized by the accumulation of collagen and other extracellular matrix proteins as a result of repeated injury to the tissue due to chronic liver disease. In this keynote lecture, we will review challenges inherent to using liver biopsy for staging of liver fibrosis, including existence of numerous staging systems, sampling variability, and declining acceptance. We will provide a classification of imaging techniques implemented on US, CT, and MRI which evaluate changes in physical or physiological properties that accompany liver fibrosis. We will highlight key unmet needs in this field, including standardization of biomarkers across imaging systems, need for head-to-head comparison between techniques, and concomitant assessment of biological confounders (such as inflammation and steatosis).

SSQ09-02 Can "Simultaneous Multi-Angular Relaxometry of Tissue" and "Modified Look-Locker Inversion Recovery" T1 Mapping Magnetic Resonance Imaging Sequences Predict the Histopathologic Degree of Liver Fibrosis in Chronic Liver Disease?

Thursday, Nov. 30 10:40AM - 10:50AM Room: E353C

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Determination of the severity of the chronic liver disease (CLD) has a great importance for the decision of the management plan and to predict the prognosis. In this study, we aimed to introduce new magnetic resonance imaging (MRI) sequences for T1 mapping, Modified Look-Locker Inversion Recovery (MOLLI) and Simultaneous Multi-Angular Relaxometry of Tissue (SMART) sequences to predict the degree of liver fibrosis in patients with histopathologically proven CLD.

METHOD AND MATERIALS

Ninety-one cases (51 CLD and 40 control group) were prospectively enrolled in the study, and an MRI of the liver was performed by using a 32-channel body coil with a 1.5T MRI scanner (MR 450w, GE, Chicago, USA). SMART and MOLLI sequences were acquired to create T1 maps. Following the MRI study, a percutaneous ultrasound-guided core biopsy was performed from the parenchyma of the liver to determine the histopathological grade of liver fibrosis in the patient group. T1 mapping values of the liver were measured separately by two different observers independently by using nine separate circular "region of interests" and compared with the histopathological fibrosis grades. Intraclass correlation coefficient (ICC) method was used to assess the variability on

SMART and MOLLI sequences statistically.

RESULTS

ICC for assessing T1 values of the liver on SMART and MOLLI MRI sequences were excellent, yielding 0.982 and 0.960, respectively. SMART and MOLLI values in patients with CLD were significantly higher than the control group ($p < 0.001$). SMART and MOLLI values were positively and significantly correlated with the grade of fibrosis (Table 1). Receiver operating curve analysis showed that SMART sequence was superior to MOLLI sequence for the determination of the grade of the fibrosis (Table 2). The difference between ROC analysis of SMART and MOLLI measurement of observers were statistically significant ($p = 0.042$ and $p= 0.003$).

CONCLUSION

Both SMART and MOLLI sequences can be used for predicting the liver fibrosis in patients with CLD. However, SMART sequence has better diagnostic performance and ICC when compared to MOLLI sequence values.

CLINICAL RELEVANCE/APPLICATION

SMART and MOLLI T1 mapping MRI sequences may have a role for the noninvasive determination of the degree of liver fibrosis which will improve the management plan.

SSQ09-03 Grading of Hepatic Fibrosis using Iodine Map of Spectral Liver CT

Thursday, Nov. 30 10:50AM - 11:00AM Room: E353C

Participants
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PURPOSE

To determine whether iodine map from spectral computed tomography (CT) is able to provide hepatic extracellular volume fractions (fECVs) for grading hepatic fibrosis (HF).

METHOD AND MATERIALS

A total of 57 patients (M:F=42:15, mean age, 54.3 ± 11.9 years) histologically diagnosed with HF underwent quadriphasic liver CT at the scanner with spectral detector (IQon, Philips Healthcare) at 120kVp. Delayed phase was obtained 3 minutes after standard dose of contrast media administration. On the generated iodine maps of iodine, approximately 0.8-1cm2 round regions of interest (ROIs) were drawn avoiding focal lesion and vessels in the liver, and aorta for calculating fECV as follows: fECV (%) = Iodine concentration liver (mg/ml*)/ Iodine concentration aorta (mg/ml*)x (100-Hematocrit [%]). Correlation between fECV and HF stage was evaluated using Spearman's correlation coefficient. fECVs, iodine concentration and effective Z were compared between F0-1 (n=7), F2-3 (n=17) and F4 (n=33), and between F0-3 and cirrhosis (F4).

RESULTS

fECVs showed a moderate correlation with pathologic HF staging ($r=0.55$, $P<0.0001$). fECV was higher in F4 than F2-3 (36.0±8.0% vs. 26.4±4.1, $P<0.01$) but there was no significant difference between F2-3 and F0-1 (28.8±3.7%, $P>0.05$). In comparison between F0-3 and F4, F4 showed significantly higher fECV than F0-3 (36.0±8.0% vs. 27.7±4.2%, $P<0.0001$). In addition, iodine density of the liver (mg/ml*) was significantly higher in F4 than F0-3 (1.87±0.28 vs. 1.63±0.33, $P=0.006$). Effective Z was also higher in F4 than F0-3 (8.42±0.16 vs. 8.31±0.20, $P=0.026$), but there was a substantial overlap of the values.

CONCLUSION

Iodine map of delayed phase from the spectral CT enables to estimate fECV and fECV increased as HF progressed and F4 showed significantly higher fECV than F0-3.

CLINICAL RELEVANCE/APPLICATION

Iodine map can be generated from single phase of routine exam at spectral CT, and it can provide quantitative information regarding HF, without additional contrast media use or scan acquisition.

SSQ09-04 Two-dimensional Shear Wave Elastography for Grading Liver Fibrosis using a Confidence Map: Are Liver Stiffness Measurements Accurate without Breath-holding?

Thursday, Nov. 30 11:00AM - 11:10AM Room: E353C

Participants
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PURPOSE

Ultrasound elastography of the liver for grading liver fibrosis needs to be performed in a resting respiratory position as forceful inspiration or expiration can falsify values. However, in patients with comorbidities optimal breath-holding can be challenging despite coaching. The aim of this study was to assess whether liver stiffness measurements using two-dimensional (2D) shear wave

elastography (SWE) along with a novel confidence map yield similar results in patients with and without breath-holding.

METHOD AND MATERIALS

Liver stiffness measurements were performed in 25 consecutive patients with chronic liver disease (7 non-alcoholic fatty liver disease, 5 hepatitis B, 4 hepatitis C, 4 alcoholic cirrhosis, 2 hemochromatosis; 3 others) by using 2D SWE (prototype software ElastQ; EPIQ7; Philips). In the same imaging session and in each patient, two 6-sec cine loops were obtained each either in resting respiratory position or during free quiet breathing. For each data set, 10 circular regions of interest (ROI; 0.791cm2) were drawn at 2 cm below the liver capsule in the middle of the field of view. A confidence map that automatically highlights areas without breathing artifacts was used to guide ROI placements. The mean and median shear wave velocities obtained by the two methods were compared using the Bland-Altman methodology and concordance correlation.

RESULTS

In both groups, the median shear wave velocity was 1.23 m/s with a concordance correlation of 97% (95%CI; 94-98%) and Bland-Altmann 95% limits of agreement of -0.17 and 0.12. The mean velocity in the breath-hold group was 1.36 m/s and in the free-breathing group 1.34 m/s with a concordance correlation of 97% (95%CI: 94-99%) and Bland-Altmann 95% limits of agreement of -0.17 and 0.12.

CONCLUSION

In 2D SWE using a confidence map for ROI placements, liver stiffness measurements are comparable with and without breath-holding.

CLINICAL RELEVANCE/APPLICATION

The possibility of free breathing makes 2D SWE exams more robust and clinically practical, in particular in patients with difficulties holding their breath in a resting respiratory position.

SSQ09-05 A Prediction Model for Survival in Patients with Cirrhosis by Using Abdominal CT Findings: Compared with MELD Scoring System

Thursday, Nov. 30 11:10AM - 11:20AM Room: E353C

Participants
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PURPOSE

Model for End-stage Liver Disease (MELD) score was developed as a disease severity index for patients with liver cirrhosis (LC) awaiting liver transplantation. Although MELD score is known to be better than Child-Turcott-Pugh score for predicting survival, there are still some limitations. Imaging study contains important information of LC and portal hypertension, and there have been attempts to measure the related imaging parameters. We have tried to establish a new model with abdominal CT for prediction of survival in patients with LC and compare it with MELD score.

METHOD AND MATERIALS

145 patients diagnosed with LC and underwent abdominal CT were included retrospectively. Two radiologists measured the imaging parameters, such as maximum diameters of main portal vein (øMPV), superior mesenteric vein (øSMV), splenic vein (øSV), and estimated splenic volumes. The grade of esophageal, paraesophageal, gastric varices and amount of ascites were also evaluated. Statistically significant CT features related to overall survival were used to establish a model to calculate risk scoring system using multivariate Cox proportional hazard regression and validated this system with data (n=88) of another hospital. To compare the accuracy of two scoring systems, time-dependent C statistics was used.

RESULTS

øSMV/øSV, splenic volume, esophageal varices grade and amount of ascites were significant predictors of survival, and risk score was calculated by following formula: 0.79×øSMV/øSV + 0.001×splenic volume + 1.00×grade 1 esophageal varix(EV) + 0.57×grade 2EV + 1.32×grade 3EV + 1.45×moderate ascites + 2.16×large ascites - 2.07. Patients with same or higher risk scores than 1.74 had significantly poor overall survival rates ($p<0.001$), with median survival of 7 months. Also in validation set, patients with high risk scores (>= 1.74) had significantly poor overall survival rates ($p=0.02$). Time-dependent AUC showed MELD score was superior to imaging model for the first 20 months, but after 50 months, imaging model was better (c-index of imaging and MELD score, 0.768 and 0.735, respectively). Also, in validation set, imaging score was superior to MELD score after 20 months (c-statistics, 0.732 and 0.681, respectively).

CONCLUSION

In patients with LC, this imaging model may be useful in predicting long-term survival compared to MELD score.

CLINICAL RELEVANCE/APPLICATION

A prediction model with abdominal CT may be useful in predicting long-term survival in patients with LC.

SSQ09-06 Point Shear Wave Elastography for Grading Liver Fibrosis: Can the Number of Measurements be Reduced?

Thursday, Nov. 30 11:20AM - 11:30AM Room: E353C

Participants
Isabelle Durot, MD, Stanford, CA (*Presenter*) Nothing to Disclose
Jarrett Rosenberg, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Juergen K. Willmann, MD, Stanford, CA (*Abstract Co-Author*) Research Consultant, Bracco Group Research Grant, Siemens AG

Research Grant, Bracco Group Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Advisory Board, Lantheus Medical Imaging, Inc Advisory Board, Bracco Group

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PURPOSE

To assess whether the number of point shear wave elastography (pSWE) measurements of the liver could be reduced to 5 vs. the currently recommended 10 measurements in patients with chronic liver diseases.

METHOD AND MATERIALS

In 1412 patients with chronic liver disease (694 hepatitis B, 499 hepatitis C, 62 non-alcoholic fatty liver disease, 35 primary biliary cholangitis, 24 post liver transplantation, 18 autoimmune hepatitis, 15 alcoholic cirrhosis, 14 cardiac cirrhosis, 51 others) pSWE measurements were performed on a S2000 scanner (Siemens) following the protocol recommended by the Society of Radiologists in Ultrasound (SRU) with 10 consecutive valid measurements obtained in liver segment 8. Liver fibrosis grading using published cut-off values were compared using 10 vs. 5 measurements with Kendall's tau coefficient and the exact test of symmetry.

RESULTS

The median shear wave velocities using 5 measurements was 1.27 m/s compared to 1.26 m/s using 10 measurements. Overall fibrosis grading highly correlated when using 5 vs. 10 measurements (tau=0.96; P<0.001). Similarly, there was high correlation when grading clinically significant (>= F2) vs. non-significant (F0/1) fibrosis (tau=0.95; P<0.001). A change in grading was observed in 34/1412 patients (2.4%; 95%CI; 1.7-3.3%) of exams when classifying clinically significant from non-significant fibrosis. Changes in grading occurred primarily when velocities ranged between 1.1 and 1.5 m/s. When the median values from 5 measurements were either <1.1 or >1.5 m/s (in 794 patients; 56%), a change of grading was observed in 0/1412 measurements (0%; 95%CI; 0-0.4%).

CONCLUSION

Clinically significant changes in grading liver fibrosis using only 5 measurements was observed in only a small portion of patients. In patients with known F0 or F4 fibrosis, 5 measurements may be sufficient on surveillance ultrasound elastography exams.

CLINICAL RELEVANCE/APPLICATION

Five instead of 10 measurements may decrease scanning time, cost, and discomfort in both sonographers and patients.

SSQ09-07 Novel Mapping of Fibrosis and Hepatic Inflammation in NASH Patients with Dual R2 MRI Relaxometry

Thursday, Nov. 30 11:30AM - 11:40AM Room: E353C

Participants
Hilton M. Leao Filho, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose
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PURPOSE

Hepatic inflammation and fibrosis are two of the most important factors for the stratification, treatment and prognosis of patients with liver disease. Our objective is to evaluate a MRI multi-component relaxometry (MCR) technique to map fibrosis and inflammation in patients with non-alcoholic steatohepatitis (NASH). The extracellular water fraction (ECWF) was investigated for fibrosis, and the ratio of the transverse relaxation rate (R2) between intra and extra-cellular water (R2I/E) was assessed for inflammation.

METHOD AND MATERIALS

101 NASH diagnosed patients with liver biopsy were selected within 6 months for MRI exam. A 3T Philips Achieva was used with a multi-spin echo sequence. The images were analysed by a radiologist and physicist with over 12 years experience in abdominal imaging. The biopsies were reviewed by a pathologist with 14 years experience using the NASH-CRN score. 15 volunteers with normal lab results and no known liver disease were used for control.

RESULTS

The mean ECWF for the 101 NASH patients was 24.5(±3.1)% and 18.7(±1.6)% for the 15 volunteers. There was a significant correlation between ECWF and fibrosis stage (rs=0.83, p<1.0-06). In distinguishing healthy from fibrotic patients we achieved an AUROC of 0.98, with a sensitivity of 93% and specificity of 94% for a threshold ECWF of 20.6%. There was a significant difference between all stages of fibrosis by ECWF (p<0.001).The mean R2I/E for the 101 NASH patients was 3.2(±0.6) and 2.4(±0.3) for the 15 volunteers. For distinction of normal parenchyma from any lobular inflammation we achieved an AUROC of 0.91, with sensitivity of 83% and specificity of 83% at an R2I/E threshold of 2.7.

CONCLUSION

ECWF demonstrated very good performance in quantifying all stages of fibrosis, whereas R2I/E correlated more strongly with inflammation. The maps and distributions of ECWF and R2I/E also allow assessment of heterogeneity in liver pathology.

CLINICAL RELEVANCE/APPLICATION

The excellent performance of MRI ECWF in quantifying the earliest stage of NASH promises better selection of patients for biopsy.

Assessing inflammation with R2I/E offers an additional tool for patient selection. ECWF and R2I/E offer biomarkers of liver fibrosis and inflammation that are independent of field strength, are obtained without contrast or radiation, and help in the diagnostic and follow-up of NASH patients.

SSQ09-08 Reversibility of HCV-Related Liver Disease and Sustained Virology Response after Interferon-Free Antiviral Therapy

Thursday, Nov. 30 11:40AM - 11:50AM Room: E353C

Awards
Student Travel Stipend Award

Participants
Elena Lopez Banet, MD, Murcia, Spain (*Presenter*) Nothing to Disclose
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Juan De Dios Berna Mestre, MD, El Palmar, Spain (*Abstract Co-Author*) Nothing to Disclose
Manuel Santa-Olalla, MD, Murcia, Spain (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The aim of this study was to assess:the evolution of hepatitis C-related liver disease by comparing analytical and elastography data before and after treatment with new antiviral agents.

METHOD AND MATERIALS

For this prospective study, we conducted a:randomized sampling of patients with hepatitis C virus (HCV) who had completed treatment with new drugs between May 2015 and March 2016. It was required that all patients included had undergone blood tests, viral load, liver B-mode ultrasonography and ARFI elastography with the determination of shear wave velocity (SWV) before starting treatment. These tests were repeated after a year of the completion of treatment for comparing results. The criteria for exclusion were as follows: coinfection with other hepatitis viruses or human immunodeficiency virus, liver transplant, alpha-1 antitrypsin deficit, metal deposition diseases and alcohol consumption of greater than 20g/day. Finally, we obtained 100 patients. Comparisons of means were performed using Student t-test for matching data. A p value of <0.05 was considered significant.

RESULTS

It was verified:a significant decrease of liver ARFI values since the average shear wave velocity declined from 1.98 to 1.66 m/s ($p<0.01$), which meant an improvement of liver parenchymal injury associated to HCV.Furthermore, it was determined reversibility in METAVIR stages, specially in F>=3 and F>=4 levels, in which more than half of patients improved their METAVIR stage after treatment ($p<0.05$).Moreover, sustained viral response was confirmed in all patients as well as an improvement of analytical data with hepatic profile (Alanine aminotransferase- ALT-, Aspartate aminotransferase -ALT-) ($p<0.05$).:

CONCLUSION

It has been verified a significant improvement of analytical and structural liver parameters in patients with HCV-related hepatic fibrosis who underwent treatment with interferon-free antiviral therapies.

CLINICAL RELEVANCE/APPLICATION

Reversibility of liver stifness after treatment might be monitored with ARFI elastography and it is essential for prognosis and management of these patients.

SSQ09-09 A Deep Convolutional Neural Network for the Prediction of METAVIR Score Using B-Mode Ultrasonography Images

Thursday, Nov. 30 11:50AM - 12:00PM Room: E353C

Participants
Jeong Hyun Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Tae Wook Kang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seong Hyun Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Dong Hyun Sinn, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Liver fibrosis is one of the most important prognostic factors in patients with chronic liver disease. We developed a deep convolutional neural network (CNN) for the prediction of METAVIR score using B-mode ultrasonography (US) images.

METHOD AND MATERIALS

Among 7,273 patients with 140,605 B-mode US images, who had undergone either histopathologic examination or transient elastography, 2,798 patients with 5,517 B-mode US images were used for training the CNN. METAVIR score of the specimens, determined by pathologists specializing in liver pathology, and estimated METAVIR score derived from transient elastography were used as reference standards. Our training model (S-Detect for liver quantification) was based on the Visual Geometry Group-16 neural network with image appearance normalization technique. Two-class (F0, F1, F2, F3 vs. F4) and four-class (F0 vs. F1 vs. F23 vs. F4) models were developed. After training, 675 patients' images were tested to evaluate the models' performance in classifying the images to the correct METAVIR score.

RESULTS

Performance of the two-class model was as follows: sensitivity 81.6%, specificity 96.4%, and accuracy 88.3%. Performance of the four-class algorithm was as follows: sensitivity 64.5%, specificity 89.0%, and accuracy 72.7%. The expected METAVIR score was

displayed in the application within 2 seconds of analysis on average.

CONCLUSION

The engineered deep CNN-based METAVIR score prediction system revealed remarkable diagnostic accuracy using B-mode US images.

CLINICAL RELEVANCE/APPLICATION

This technology can assist radiologists in identifying the degree of liver fibrosis in a convenient fashion, leading to reduction in time and labor costs, while also providing a means for objective evaluation of liver fibrosis.

SSQ10

Science Session with Keynote: Genitourinary (Imaging of Gynecological Malignancy)

Thursday, Nov. 30 10:30AM - 12:00PM Room: E353B

GU MR OI

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

Participants
Elizabeth A. Sadowski, MD, Madison, WI (*Moderator*) Nothing to Disclose
Evis Sala, MD, PhD, New York, NY (*Moderator*) Nothing to Disclose

Sub-Events

SSQ10-01 Genitourinary Keynote Speaker: The Added Value of MRI in Evaluation of Gynecological Malignancies

Thursday, Nov. 30 10:30AM - 10:40AM Room: E353B

Participants
Evis Sala, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

SSQ10-02 Clinical Application of PET/MR in Staging of Cervical Cancer and Diagnosis of Pelvic Lymph Node Metastasis

Thursday, Nov. 30 10:40AM - 10:50AM Room: E353B

Participants
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PURPOSE

The present study aimed to evaluate the clinical value of PET/MR in the staging of cervical cancer and diagnosis of pelvic lymph node metastasis.

METHOD AND MATERIALS

Seventy patients with cervical cancer were prospectively enrolled. Pelvic PET/MR scan and whole-body PET scan were performed before treatment. All images were evaluated by two experienced radiologists using a randomized, double-blind method. The diagnostic consistency of PET/MR staging, clinical staging, and gold standard staging of cervical cancer was evaluated with the Kappa consistency test, and the diagnostic consistency between each two methods was calculated. The difference between PET/MR staging and clinical staging was evaluated with the paired chi-square test ($P<0.05$). The value of PET/MR in the diagnosis of pelvic lymph node metastasis of cervical cancer was analyzed using diagnostic consistent rate, sensitivity, specificity, positive predictive value, and negative predictive value. The statistical software SPSS 19.0 was used in the analyses.

RESULTS

The consistency between PET/MR staging and the gold standard method for the diagnosis of cervical cancer was 91.43%. Kappa analysis indicated that the consistency between PET/MR staging and gold standard staging was satisfactory (kappa = 0.908). The consistency between clinical staging and gold standard staging of cervical cancer was fair (Kappa = 0.542). There was a significant difference between pre-treatment PET/MR staging and clinical staging ($X2 = 9.278$, $P<0.05$). In the patient-based analysis, the accuracy of PET/MR diagnosis of pelvic lymph node metastasis was 95.71%, sensitivity was 95.65%, and specificity was 95.74%. In the lymph node-based analysis, the accuracy, sensitivity, and specificity of PET/MR diagnosis were 97.61%, 92.16%, and 98.13%, respectively.

CONCLUSION

The diagnostic value of PET/MR for the staging of cervical cancer is significantly superior to clinical staging, and the former can be used as a one-stop diagnostic method for cervical cancer by accurately diagnosing and identifying pelvic lymph node metastasis.

CLINICAL RELEVANCE/APPLICATION

PET/MR without gadolinium administration will stage cervical cancer and identify pelvic lymph node metastasis accurately, and is strongly recommended as a one-stop diagnostic method in cervical cancer.

SSQ10-03 How to Differentiate Benign Atypical Myomas from Malignant Uterine Sarcomas Using MR Imaging

Thursday, Nov. 30 10:50AM - 11:00AM Room: E353B

Participants
Cendos Abdel Wahab, Paris, France (*Presenter*) Nothing to Disclose
Anne-Sophie Jannot, Paris, France (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To retrospectively evaluate MRI charateristics to differentiate malignant uterine sarcomas from benign myomas with atypical presentation on MRI.

METHOD AND MATERIALS

IRB-approved monocentric case-control study including 113 women (51 sarcomas and 62 atypical myomas) with an atypical uterine mass on MRI were underwent before surgery. Clinical and MRI data (heterogeneity on T2-weighted and diffusion sequences, ADC and perfusion curves relative to outer myometrium) were collected and compared with pathological findings.

RESULTS

Only 50% of sarcomas presented as a single uterine mass. Predictive criterias for malignancy were age (64 vs 48 years, p <0.0001), menopausal status (84% vs 20%, p <0.0001, OR = 20.82), irregular contours (73% vs 5%, p <0.0001; OR = 46.69), intra-tumoral hemorrhage (38% vs 13%, p = 0.003), high signal greater than the endometrium on DWI (100% vs 16%, p <0.0001 OR = 12.01), ADC (0.7 vs 1, 2.10-3 mm^2 / s, p <0.0001). Conversely, the presence of a portion, even partial, with low T2 signal or a type I perfusion curve had a VPN of 100% (p <0.0001).

CONCLUSION

Beyond the previously known clinical and morphologic criteria, adding functional sequences on MRI better differentiates malignant sarcomas from atypical myomas.

CLINICAL RELEVANCE/APPLICATION

Diffusion and perfusion MRI sequences may allow better predicting malignancy when facing an atypical uterine mass, to guide optimal therapeutic management.

SSQ10-05 Accuracy of Time Intensity Curves Generated From 4-Point DCE MRI in Differentiating Benign and Malignant Adnexal Lesions

Thursday, Nov. 30 11:10AM - 11:20AM Room: E353B

Participants
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PURPOSE

To assess the accuracy of time intensity curves (TIC) generated from 4-point dynamic contrast-enhanced magnetic resonance imaging (DCE MRI) in differentiating benign and malignant ovarian lesions with solid tissue.

METHOD AND MATERIALS

Patient consent was waived by the Ethics Review Board for this retrospective study. From April 2006 to January 2017, 98 patients with ovarian DCE MRI studies with evidence of solid tissue at MRI were included (45 benign, 10 borderline and 43 malignant lesions). Semiquantitative analysis of signal intensity (SI) over time curves was performed using region-of-interest on the most enhancing solid tissue. TICs were classified according to three patterns of enhancement: a minimal increase with no well-defined shoulder "type 1, benign." A moderate initial rise in the SI of solid tissue relative to myometrium "type 2, borderline." An initial rise in the SI of solid tissue that was equal or steeper than myometrium "type 3, malignant". In patients with hysterectomy (n=11), the lesion SI was normalized to psoas and compared to a standard normalized myometrium curve. Standard of reference was histopathology in all patients.

RESULTS

Accuracy, sensitivity, specificity, PPV, and NPV of TIC for differentiating benign from malignant/borderline lesions was 85.9%, 96.2%, 74.5%, 80.6% and 94.6% respectively. TIC yielded comparable results to prospective clinical radiological diagnosis using standard morphological assessments (acc 85.7%, sens 93.9%, spec 80.0%, PPV 76.7%, NPV 94.9%). However, out of the 12 misdiagnosed patients during the clinical reads, (2 false negatives, 10 false positives), TIC was able to accurately reclassify 6 of them, resulting in an overall acc 93.9%, sens 100%, spec 87.5%, PPV 89.3%, NPV 100%.

CONCLUSION

The enhancement patterns of ovarian lesions on 4-point DCE MRI can help distinguish between benign and borderline/malignant tumors. Although pharmacokinetic parameters have been proposed by research-based groups, they have not been widely adopted or validated in the clinic. TIC based on 4-point DCE MRI can be a useful adjunct to standard qualitative morphological reads, with

the potential to improve diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

Time intensity contrast-enhanced curves generated from 4-point DCE MRI are a useful adjunct to standard morphological imaging and can improve the accuracy for discriminating between benign and malignant ovarian lesions.

SSQ10-06 Amide Proton Transfer Imaging of Early Radiotherapy Response in High-Risk HPV+ Gynecologic Cancer

Thursday, Nov. 30 11:20AM - 11:30AM Room: E353B

Participants
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PURPOSE

HPV-associated gynecologic cancers are treated primarily with radiation, with cervical cancer being the most common cancer among women in the developing world. Anatomical MRI can be challenging to interpret following radiation when the morphological appearance of residual or early recurrent tumor tissue mimics post-radiotherapy inflammation and/or fibrosis. Amide proton transfer (APT) MRI, a subset of chemical exchange saturation transfer (CEST) MRI, has the potential to provide molecular information regarding tissue pH and mobile protein content, which may be beneficial in distinguishing radiation necrosis from recurrent disease. Necrotic lesions should demonstrate less cytosolic protein and peptide content as a result of the loss of cytoplasm compared to viable tumor tissue. We investigated the prognostic value of APT MRI following radiothearpy in a murine model of high risk HPV+ cervical cancer.

METHOD AND MATERIALS

A clinically relevant HPV+ orthotopic cervical cancer model was developed that expresses the E6 and E7 oncogenes of HPV-16 and the Ras oncogene. 4 animals received 9 Gy radiation and were imaged on days -1 and +1. A CEST-RARE pulse sequence was used with a 3 second saturation period consisting of a 2.0 uT continuous wave saturation pulse. 40 saturation frequencies between +5 and -5 ppm were acquired to generate a CEST spectrum in 8 minutes on a 7T Bruker MRI (Bruker Corporation, Billerica MA). Pixelwise analyses of magnetization transfer asymmetry (MTRasym) was performed to measure mobile protein content.

RESULTS

Preliminary results show that MTRasym measurements decreased the day after radiation treatment indicating a decrease in mobile protein content. This result supports the hypothesis that necrotic lesions have less cytosolic protein content than viable tumor, which can be detected with APT MRI.

CONCLUSION

Initial results indicate that as early as one day after radiation treatment, APT MRI can be used to distinguish necrotic tissue vs. viable tumor through a decrease in MTRasym. Additional mice will be imaged to confirm this trend and determine statistical significance.

CLINICAL RELEVANCE/APPLICATION

These findings may be beneficial to clinicians in identifying a new functional MRI technique to monitor early radiotherapy response of HPV+ gynecologic cancers.

SSQ10-07 Preoperative Tumor Texture Analysis from MRI Predicts High-Risk Status and Reduced Survival in Endometrial Carcinomas

Thursday, Nov. 30 11:30AM - 11:40AM Room: E353B

Participants
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PURPOSE

Tumor heterogeneity is a key feature of malignant disease. Heterogeneity at MRI can be quantified by texture analysis. We aimed to explore whether high-risk clinical and histological features in endometrial cancer are reflected in tumor texture parameters from preoperative MRI, and to assess the prognostic value of tumor texture parameters.

METHOD AND MATERIALS

Preoperative pelvic MRI (1.5T) including contrast-enhanced (CE) T1-weighted, T2-weighted and diffusion-weighted imaging was

Preoperative pelvic MRI (1.5T) including contrast-enhanced (CE) T1-weighted, T2-weighted and diffusion-weighted imaging was performed in 180 patients with histologically confirmed endometrial carcinomas. Using the software TexRAD, tumor regions of interest (ROIs) were manually drawn on the slice displaying the largest cross-section tumor area. Histogram based texture parameters (standard deviation, entropy, mean of positive pixels (Mpp), skewness and kurtosis) were calculated from these tumor ROIs on non-filtered and filtered images. The derived texture parameters were included in multivariate logistic regression models assessing their predictive value for identifying high tumor grade, deep myometrial invasion (DMI), cervical stroma invasion (CSI) and lymph node metastases. Preoperative histological risk from biopsy, conventional MRI findings and MRI-measured tumor volume were included as covariates, and the best cutoff values of texture parameters were determined by ROC curve analysis. Multivariate Cox regression was used for survival analysis.

RESULTS

High entropy in ADC-maps independently predicted DMI (OR 5.1, p=0.001), low Mpp in T2 images independently predicted CSI (OR 3.5, p=0.01) and high Mpp in CE T1 images independently predicted high grade (OR 3.5, p=0.005). High kurtosis in CE T1 images independently predicted reduced recurrence- and progression-free survival (HR 1.5, p<0.001). Different levels of filtration, including no filtration, were represented among the high ranked texture parameters.

CONCLUSION

MRI derived tumor texture parameters, reflecting tumor heterogeneity, independently predict high tumor grade, deep myometrial invasion, cervical stroma invasion and reduced survival in endometrial carcinomas. Thus, tumor texture parameters based on MRI represent promising biomarkers to aid preoperative tumor characterization for risk stratified surgical treatment.

CLINICAL RELEVANCE/APPLICATION

Tumor texture features at MRI are associated with high-risk phenotype and may aid preoperative risk classification for stratified surgery in endometrial cancer.

SSQ10-09 Machine Learning to Differentiate Uterine Sarcoma from Leiomyoma with High Signal Intensity on T2-Weighted Imaging Based on Multi-Parametric Magnetic Resonance Quantitative Imaging Features

Thursday, Nov. 30 11:50AM - 12:00PM Room: E353B

Participants
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Yasuyuki Yamashita, MD, Kumamoto, Japan (*Abstract Co-Author*) Consultant, DAIICHI SANKYO Group

PURPOSE

To determine whether a prediction model using machine learning based on quantitative multi-parametric magnetic resonance imaging (MRI) features has adequate diagnostic performance for differentiating uterine sarcomas from benign leiomyomas with high signal intensity on T2-weighted imaging (T2WI).

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. The need for informed consent was waived. We included 62 patients who underwent pelvic 3T MRI examination for evaluation of uterine myometrial smooth muscle masses with high signal intensity on T2WI. Of the 62 patients, 38 had benign leiomyoma and 24 had uterine sarcoma. Age, tumor size, and 12 histogram and texture parameters (minimum, mean, standard deviation of, and maximum normalized signal; skewness; kurtosis; homogeneity; energy; contrast; correlation; entropy; and dissimilarity) were assessed on T1WI, T2WI, ADC maps, and contrast-enhanced T1WI. We developed a prediction model with machine learning (extreme gradient boosting) and calculated the area under the receiver operating characteristic curve (AUC) of this model by 10-fold cross validation, and compared the performance of this model with two board-certified radiologists.

RESULTS

Age had the highest importance (myoma, 43.8±9.9; sarcoma, 59.2±15.5; p=0.0001), followed by the minimum normalized T2 signal (myoma, 0.35±0.45; sarcoma, 0.82±0.54; p=0.0009), ADC skewness (myoma, 0.33±0.85; sarcoma, 0.86±0.89; p=0.0237), mean ADC (myoma, 1.56±0.40; sarcoma, 1.29±0.33; p=0.0057), and T2WI correlation (myoma, 0.86±0.08; sarcoma, 0.91±0.04; p=0.0041). In the validation analysis, the AUC of the machine learning is significantly higher than two radiologists (0.92 vs. 0.75 and 0.64, respectively; p<0.001).

CONCLUSION

Age was the most important factor for differentiation of uterine sarcoma from myoma with high-signal intensity on T2WI. The performance of machine learning was superior to that of experienced radiologists.

CLINICAL RELEVANCE/APPLICATION

Machine learning based on patient age and the texture of multi-parametric MRI has adequate diagnostic performance for differentiating uterine sarcoma from myoma with high signal intensity on T2WI.

SSQ12

Molecular Imaging (Theranostics)

Thursday, Nov. 30 10:30AM - 12:00PM Room: S505AB

CT MR MI NM

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

FDA Discussions may include off-label uses.

Participants
Gabriel C. Fine, MD, Seattle, WA (*Moderator*) Nothing to Disclose
Pedram Heidari, MD, Boston, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSQ12-01 HIF-Prolyl Hydroxylase 2 Silencing Using siRNA Delivered by MRI-Visible Nanoparticles Improves Therapy Efficacy of EPCs for Ischemic Stroke

Thursday, Nov. 30 10:30AM - 10:40AM Room: S505AB

Awards
Trainee Research Prize - Medical Student

Participants
Congxiao Wang, Nanjing, China (*Presenter*) Nothing to Disclose
Gao-Jun Teng, MD, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Stroke is a leading cause of death and disability worldwide. Stem cell therapy has brought substantial benefits to patients as an important restorative therapeutics. However, its efficacy was limited by poor migration and survival ability. In this study, we aimed to enhance therapy efficacy of EPCs for ischemic stroke via PHD2 silencing using siRNA delivered by MRI visible nanoparticles.

METHOD AND MATERIALS

Human umbilical cord blood derived EPCs was transfected with siRNA targeting PHD2 delivered by MRI visible nanoparticles. Expression of CXCR4 and HIF-1a was detected by western blot 48h after siRNA transfection. In vitro transwell assay and H2O2 apoptosis assay was used to detect the migration and survival ability of EPCs respectively. 5×10^5 EPCs with or without PHD2 silencing (siPHD2-EPCs, siCON-EPCs) were transplanted intracardically 1 day after photothrombotic model of stroke was induced in nude mice. Functional recovery was assessed with mNSS and foot-faults test at 1 day before ischemic stroke induction and 1, 3, 7, 14 days after EPCs implantation. MRI and Bioluminescent imaging (BLI) were carried out at 1, 3, 7 days after EPCs transplantation. Prussian blue and GFP staining were carried out at 1 day and 7 day after EPCs transplantation. Angiogenesis, neurogenesis and white matter recovery were assessed at 7 days and 14 days respectively.

RESULTS

PHD2 silencing increased expression of CXCR4 and HIF-1a of EPCs. Both in vivo and in vitro results suggested that PHD2 silencing increased migration and survival ability of EPCs. Mice treated with siPHD2-EPCs showed significantly decreased infarct volume and increased fractional anisotropy (FA) in the ipsilesional corpus callosum than the other groups. Improved functional recovery was observed in the siPHD2-EPCs treated mice. At 7 days, increased BDFN expression was observed in the siPHD2-EPCs treated group. Histological analysis showed that angiogenesis, neurogenesis and white matter recovery were increased after siPHD2-EPCs treated than the other groups.

CONCLUSION

PHD2 silencing increased therapy efficacy of EPCs for ischemic stroke due to increased migration and survival ability.

CLINICAL RELEVANCE/APPLICATION

Our study provides an effective solution for the limitations of clinical stem cell therapy for ischemic stroke.

SSQ12-02 Tracking Stem Cell Transplants in Femoral Osteonecrosis of Pediatric Patients

Thursday, Nov. 30 10:40AM - 10:50AM Room: S505AB

Participants
Hossein Nejadnik, MD, PhD, Stanford, CA (*Presenter*) Nothing to Disclose
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Sandra Luna-Fineman, MD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose
Stuart Goodman, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Heike E. Daldrup-Link, MD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To monitor stem cell transplants in osteonecrotic lesions of pediatric cancer survivors with ferumoxytol-enhanced MRI and correlate T2* signal kinetics with outcomes.

METHOD AND MATERIALS

In an ongoing prospective clinical trial (NCT02893293), we performed serial MR imaging studies of seven hip joints of six cancer survivors before and after decompression surgery for osteonecrosis (ON) treatment. We injected ferumoxytol prior to the surgery to label mesenchymal stem cells (MSC) in the bone marrow before their transplantation into osteonecrotic bone. We hypothesized that MR tracking of stem cells in the osteonecrotic bone would enable differentiation of successful and failed cell therapies. We compared T2* values of cell transplants with presence or absence of joint collapse at 12 months using a Student t-test.

RESULTS

Pre-surgical MRI scans of the patients' hip joints confirmed an osteonecrosis (ON) in the epiphysis of the femur, with an intact joint surface (eligibility criteria for the decompression procedure). Ferumoxytol administration lead to hypointense bone marrow enhancement on pre-surgical T2-FSE sequences. Following decompression surgery and transplantation of iron labeled MSC from the iliac crest into the ON, iron-labeled cells could be seen in the access canal. Five ON remained stable over 12 months after decompression surgery. Two ON showed a decreasing volume over time, ultimately collapsed and required artificial joint replacement. At 1-3 weeks after decompression surgery, T2* values of cell transplants in stable ON (2.797 ± 0.07) were significantly shorter ($p<0.05$) compared to T2* values of cell transplants in ON that ultimately collapsed (3.498 ± 0.2383).

CONCLUSION

Stem cell transplants in pediatric cancer survivors can be monitored with ferumoxytol-enhanced MRI. T2* signal kinetics of MSC in osteonecrotic lesions predict clinical outcomes. This immediately clinically applicable stem cell imaging test could become a powerful tool to diagnose success or failure of stem cell transplants in osteonecrotic bone in pediatric patients, monitor engraftment non-invasively and predict bone repair outcomes.

CLINICAL RELEVANCE/APPLICATION

This is the first study that shows the feasibility of tracking in vivo labeled stem cells in patients. The rapid disappearance of the cell transplant, as indicated by the iron signal on MR images, correlates with unfavorable clinical outcomes.

SSQ12-03 Integrin-Targeted Quantitative Multispectral Optoacoustic Tomography with MRI Correlation for Monitoring a BRAF/MEK Inhibitor Combination Therapy in Experimental Human Melanoma Xenografts in Mice

Thursday, Nov. 30 10:50AM - 11:00AM Room: S505AB

Participants
Philipp M. Kazmierczak, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Neal Burton, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Georg Keinrath, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Moritz Schneider, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Heidrun Hirner, PhD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Clemens C. Cyran, MD, Munich, Germany (*Presenter*) Research Grant, iThera Medical GmbH; Speakers Bureau, Siemens AG
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PURPOSE

To investigate a multimodal imaging protocol of avß3-integrin-targeted multispectral optoacoustic tomography (MSOT) and MRI for monitoring a BRAF/MEK inhibitor combination therapy in a murine model of human melanoma.

METHOD AND MATERIALS

Human BRAF V600E-positive melanoma xenografts (A375) were implanted subcutaneously in the lateral flank of n=10 balb/c nude mice. Imaging was performed before (day 0) and after (day 7) a BRAF/MEK inhibitor combination therapy (encorafenib, 0.03 mg/d; binimetinib, 0.012 mg/d, Array BioPharma Inc., therapy n=5) or placebo treatment (control n=5), respectively. MSOT was conducted on a preclinical system (inVision 256-TF, iThera Medical GmbH) unenhanced and 5 h after i.v. injection of a avß3-integrin-targeted fluorescent probe (IntegriSense 750, Perkin Elmer, 4 nmol). For tumor volume assessments, T2w MRI data sets were subsequently acquired on a clinical 3 Tesla scanner (Magnetom Skyra, Siemens Healthineers). MSOT data acquired at multiple wavelengths was spectrally unmixed to derive the avß3-integrin-specific signal. Imaging results were validated by ex vivo immunohistochemistry with regard to microvascular density (CD31).

RESULTS

A significant decrease of avß3-integrin specific tumor signal was observed in the therapy group (-79 %, from 7.98±2.22 to 1.67±1.30, p=0.030), whereas no significant change was detected in the control group (-55 %, from 6.60±6.51 to 3.69±1.93, p=0.348). Immunohistochemistry demonstrated a significant decrease in microvascular density under therapy (CD31; therapy: 119±15, control: 312±62, p=0.008). Tumor volumes increased in both groups with no significant intergroup difference (therapy: +107±42 mm3; control +112±44mm3, p>0.05). Competitive in vivo blocking studies using avß3-integrin receptor antagonist cilengitide (Selleck Chemicals) confirmed the selective binding of the targeted fluorescent probe.

CONCLUSION

Quantitative MSOT allowed for the early non-invasive monitoring of a BRAF/MEK inhibitor combination therapy in BRAF V600E-

positive human melanoma xenografts in mice, adding molecular information on tumor avß3-integrin receptor status to morphology-based tumor response assessments.

CLINICAL RELEVANCE/APPLICATION

Quantitative MSOT with targeted probes may generate additional clinical imaging biomarkers of early tumor response in human melanoma under novel targeted treatment regimens.

SSQ12-04 Why Iron Oxide Labeling Matters for Stem Cell Mediated Cartilage Repair: Insights from a Large Animal Model

Thursday, Nov. 30 11:00AM - 11:10AM Room: S505AB

Awards
Student Travel Stipend Award

Participants
Ashok Joseph Theruvath, MD, Mainz, CA (*Presenter*) Nothing to Disclose
Hossein Nejadnik, MD, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The success or failure of matrix associated stem cell implants (MASI) in cartilage defects is evaluated on MR images at 6-12 months after MASI, based on the degree of cartilage repair. We evaluated if iron oxide nanoparticle labeling could accelerate this diagnosis based on different iron signal kinetics of successful and failed implants.

METHOD AND MATERIALS

Studies were performed in seven Göttingen minipigs with artificially created cartilage defects of the distal femur. We aspirated and isolated mesenchymal stromal cells from the iliac crest and labeled the cells with ferumoxytol (Feraheme), using a clinically translatable, transfection agent-free protocol. We implanted viable and apoptotic ferumoxytol-labeled MSCs into 22 cartilage defects and monitored the signal of the implants with a clinical 3T MRI scanner at week 1, 2, 4, 8, 12 and 24, using a proton density sequence (3700/34/90 TR/TE/alpha) and a multiecho spin echo sequence (3500/45 TR/TE). Implants without ferumoxytol label served as controls. Quantitative T2 relaxation times were compared for significant differences between labeled and unlabeled as well as viable and apoptotic MASI using Student t-tests.

RESULTS

Iron oxide labeled MASI showed significant T2 shortening compared to adjacent normal cartilage and unlabeled implants. At week 1, viable and apoptotic MASI did not show significant differences in T2 relaxation times (20.91±2.12 ms versus 20.97±2.07 ms). At week 2, T2 relaxation times of viable ferumoxytol-labeled implants (21.79±2.59) ms were significantly lower compared to apoptotic ferumoxytol-labeled implants (27.93±3.49 ms, $p<0.05$). The label disappeared in both groups at 4 weeks. Histological correlation at 24 weeks showed complete defect repair of viable MASI and incomplete defect repair of apoptotic MASI.

CONCLUSION

Rapid loss of iron signal early after MASI indicates cell death and predicts incomplete defect repair many weeks later. To our knowledge, this is the first study to detect early engraftment failure of MASI with MRI in a large animal model.

CLINICAL RELEVANCE/APPLICATION

MRI of ferumoxytol-labeled MASI represents an easily clinically translatable method for detection of early engraftment failure in arthritic joints.

SSQ12-05 A Case Series of NSCLC Patients Performing both C-11 Erlotinib and F-18 FDG PET/CT Comparing with EGFR Mutation Status

Thursday, Nov. 30 11:10AM - 11:20AM Room: S505AB

Participants
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PURPOSE

To evaluate the ability of C-11 erlotinib PET/CT as a non-invasive approach to identify EGFR mutation status and to study various PET parameters that may serve as a potential proxy for selecting the patient who could benefit from erlotinib treatment.

METHOD AND MATERIALS

We performed PET/CT in 5 NSCLC patients, each with both C-11 erlotinib and F-18 FDG. All had EGFR mutation status of the

tumors. There were two patients who had wild-type EGFR and three patients who had EGFR mutation i.e., exon 21 mutation (L858R), exon 19 insertion and exon 19 deletion. Three experienced nuclear medicine physicians, unknown of the patients' EGFR status, read the C-11 erlotinib PET/CT by visual analysis and gave the result as positive or negative. PET parameters i.e., SUVmax, SUVavg, MTV, TLG, Tumor to background ratio were analysis in both C-11 erlotinib and FDG studies.

RESULTS

There was a wide range of C-11 erlotinib uptake in primary tumor and metastatic sites. By visual analysis, 67% correction was observed (10/15). The average SUVmax and tumor to background mediastinal blood pool ratio were 2.04±0.68 vs 2.18±1.45 (p = 0.77) and 3.44±1.63 vs 1.56±1.10 (p = 0.02) in EGFR mutation positive vs EGFR mutation negative, respectively. Sub-group analysis of SUV parameters in primary tumor, lymph node and distant metastases including adrenal, bone, brain and muscle showed no significant difference between each group. There was no significant correlation between FDG parameters (SUVmax, SUVavg, MTV, TLG) and C-11 erlotinib parameters as well as EGFR mutation status.

CONCLUSION

Our study confirmed the tumor heterogeneity of C-11 erlotinib binding in primary tumor and each metastatic sites. The tumor to mediastinal blood pool ratio of C-11 erlotinib uptake was the only parameter that seems to be significantly different between EGFR mutation positive vs negative group.

CLINICAL RELEVANCE/APPLICATION

C-11 erlotinin PET/CT confirmed the tumor heterogeniety of erlotib binding in primary NSCLC and metastastic sites in the same patient as well as different patients with different EGFR mutation status.

SSQ12-06 MR Molecular Imaging and Tumor Theranostic 2D Ultrathin MnO2 Nanosheets with Fast Responsibility to Endogenous Tumor Microenvironment and Exogenous NIR Irradiation

Thursday, Nov. 30 11:20AM - 11:30AM Room: S505AB

Participants
Zhuang Liu, PhD,MD, Shanghai, China (*Presenter*) Nothing to Disclose
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Shengjian Zhang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To study the feasibility of using two-dimensional (2D) ultrathin MnO2 nanosheets with ultra-sensitivity to tumor microenvironment (TME) to enhance MR molecular imaging and photothermal therapy (PTT).

METHOD AND MATERIALS

The fabrication of ultrathin 2D MnO2 nanosheets were based on an exfoliation strategy. The surface of MnO2 nanosheets were modified by Soybean phospholipid (SP) to enhance stability in physiological environments without significant toxicity. The MnO2 nanosheets and MnO2-SPs were characterized by various methods. The murine breast cancer cell line (4T1) and Kunming mice were cultured to evaluate *in vitro* cell and *in vivo* biological toxicity. Importantly, we investigated *in vitro* and *in vivo* MR imaging evaluations and photothermal therapy on mice breast tumor xenografted tumor model.

RESULTS

These ultrathin 2D MnO2 nanosheets show the intriguing characteristic of disintegration and releasing of Mn2+ in response to the mild acidic and elevated reducing conditions of TME, which has successfully realized the pH- and reducing-responsive T1-weighted magnetic resonance imaging of tumor without obvious biological toxicity. *In vivo* MRI, it has been found that the positive T1-weighted MRI signal increased significantly after the intravenous administration of MnO2-SPs nanosheets into mice bearing the breast 4T1 cancer xenograft. Furthermore, the high PTT efficiency of 2D MnO2 nanosheets responsive to exogenous NIR irradiation have been systematically demonstrated both *in vitro* and *in vivo* for suppressing the tumor growth.

CONCLUSION

For the first time, we have successfully demonstrated that the exfoliated ultrathin 2D MnO2 nanosheets feature the high intrinsic photothermal-conversion capability for PTT against tumor, which are also the first paradigm of inorganic photothermal agents with the ultra-sensitivity to the endogenous TME, including mild acidic and reducing conditions. This tumor sensitivity could not only realize the pH- and reducing-responsive T1-weighted MR imaging, but also possibly facilitate the metabolism and excretion of the MnO2 nanosheets after the tumor theranostics.

CLINICAL RELEVANCE/APPLICATION

2D MnO2 nanosheets can serve as powerful MR imaging-guided photothermal agents for excellent tumor ablation.

SSQ12-07 Non-Invasive Imaging of Transplanted Therapeutic Cells in the Inflamed Rat Brain by Spectral Photon Counting Computed Tomography (SPCCT)

Thursday, Nov. 30 11:30AM - 11:40AM Room: S505AB

Participants
Elisa Cuccione, Lyon, France (*Abstract Co-Author*) Nothing to Disclose
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Marlene Wiart, PhD, Lyon, France (*Presenter*) Nothing to Disclose

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PURPOSE

Cell therapy holds promise for treatment of ischemic stroke in the chronic phase. To foster translation into the clinic, there is a need for non-invasive techniques that enable long-term follow-up of cell fate. Our purpose is to provide proof of concept of specific and quantitative in vivo imaging of therapeutic cells by an innovative, translational technique: K-edge imaging by spectral photon counting computed tomography (SPCCT).

METHOD AND MATERIALS

M2-polarized anti-inflammatory macrophages were labelled with gold nanoparticles (AuNPs, 0.1 mg/mL, 15 h) and gold/cell quantified by mass spectroscopy. Rats underwent intracerebral (IC) injection of lipopolysaccharide to induce chronic neuroinflammation. Two weeks after, the same rats were scanned in vivo using a pre-clinical SPCCT prototype after IC delivery of 5x105 AuNPs-labelled or control unlabeled cells. A phantom with a concentration range of AuNPs (0 to 8 mg/mL) was scanned for calibration of in vivo quantification. Anode tube voltage of 120 kVp and current of 100 mA were used. The same phantom and rats (ex-vivo) were then scanned by µCT and K-edge imaging by synchrotron X-rays (SXR) as gold standards for validation. Gold K-edge images were reconstructed and gold signal was manually delineated for quantification.

RESULTS

K-edge imaging of gold with SPCCT detected gold-labelled cells within the brain, in agreement with µCT and SXR. Mass spectroscopy detected an amount of 165 gold pg/cell, corresponding to 82.5 µg of gold injected within cells. The measured concentrations in phantom linearly correlated with the known concentrations (R2 = 0.99, slope: 0.82, intercept: 0.19), supporting the potential for accurate in vivo gold-cell quantification, which is currently in progress.

CONCLUSION

Our initial results provide proof-of-concept for non-invasive in vivo imaging of AuNPs-labelled therapeutic cells by SPCCT, which has the advantage of being specific and quantitative.

CLINICAL RELEVANCE/APPLICATION

SPCCT may be valuable to improve cell therapy in chronic stroke patients.

SSQ12-08 PET/CT Imaging of the Alkylphosphocholine Analog 124I-CLR1404 in High and Low-Grade Brain Tumors

Thursday, Nov. 30 11:40AM - 11:50AM Room: S505AB

Participants
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Benjamin Titz, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

CLR1404 is a cancer-selective alkyl phosphocholine (APC) analog that can be radiolabeled with 124I for PET imaging, 131I for targeted radiotherapy and/or SPECT imaging, or 125I for targeted radiotherapy. Studies have demonstrated avid CLR1404 uptake and prolonged retention in a broad spectrum of preclinical tumor models. The purpose of this pilot trial was to demonstrate avidity of 124I-CLR1404 in human brain tumors and develop a framework to evaluate this uptake for use in larger studies.

METHOD AND MATERIALS

12 patients (8 men and 4 women; mean age of 43.9 ± 15.1 y; range 23 - 66 y) with 13 tumors were enrolled. Eleven patients had suspected tumor recurrence and 1 patient had a new diagnosis of high grade tumor. Patients were injected with 185 MBq ± 10% of 124I-CLR1404 followed by PET/CT imaging at 6-, 24-, and 48-hours. 124I-CLR1404 PET uptake was assessed qualitatively and compared with MRI. After PET image segmentation SUV values and tumor to background ratios were calculated.

RESULTS

There was no significant uptake of 124I-CLR1404 in normal brain. In tumors, uptake tended to increase to 48 hours. Positive uptake was detected in 9 of 13 lesions: 5/5 high grade tumors, 1/2 low grade tumors, 1/1 meningioma, and 2/4 patients with treatment related changes. 124I-CLR1404 uptake was not detected in 1/2 low grade tumors, 2/4 lesions from treatment related changes, and 1/1 indeterminate lesion. For 6 malignant tumors, the average tumor to background ratios (TBR) were 9.32 ± 4.33 (range 3.46 to

15.42) at 24 hours and 10.04 ± 3.15 (range 5.17 to 13.17) at 48 hours. For 2 lesions from treatment related change, the average TBR were 5.05 ± 0.4 (range 4.76 to 5.33) at 24 hours and 4.88 ± 1.19 (range 4.04 to 5.72) at 48 hours. PET uptake had areas of both concordance and discordance compared with MRI.

CONCLUSION

124I-CLR1404 PET demonstrated avid tumor uptake in a variety of brain tumors with high tumor-to-background ratios. There were regions of concordance and discordance compared with MRI, which has potential clinical relevance. Expansion of these studies is required to delineate the clinical significance of these PET findings.

CLINICAL RELEVANCE/APPLICATION

124-CLR1404 PET provides unique molecular imaging properties in brain tumors and may add complementary diagnostic information to MRI and thus has potential to improve diagnostic certainty.

SSQ12-09 Early Stage Detection of Stem Cell Transplant Rejection with a Ferumoxytol-Based Dual-Modality Imaging Probe

Thursday, Nov. 30 11:50AM - 12:00PM Room: S505AB

Participants
Hossein Nejadnik, MD, PhD, Stanford, CA (*Presenter*) Nothing to Disclose
Kai Li, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
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Olga Lenkov, BSC, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Cody Wolterman, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Heike E. Daldrup-Link, MD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Limited survival of transplanted stem cells represents a significant bottleneck for successful tissue regeneration. The goal of this study was to develop a novel dual-modality imaging probe, composed of a superparamagnetic nanoparticle backbone for cell detection and a fluorescent apoptosis marker.

METHOD AND MATERIALS

We immobilized caspase-3 cleavable peptides (KKKKDEVD-AFC) on the surface of the FDA approved nanoparticle compound ferumoxytol to prepare ferumoxytol-AFC nanoparticles (Feru-AFC NPs). Size distribution and Zeta potential of Feru-AFC NPs were measured by Dynamic Light Scattering (DLS). Mesenchymal stem cells (MSCs) were incubated with Feru-AFC NPs or ferumoxytol (control group) and underwent Prussian blue stains and ICP mass spectrometry as well as in vitro fluorescent and MR imaging. Then, intravital microscopy (IVM) was performed on matched (syngeneic) or mismatched (porcine-derived) MSCs, implanted in skull defects of six C57BL/6J mice. The mice underwent MR and fluorescent imaging on day 1, 3, 6, and 9. T2 relaxation time and fluorescent signal of the two groups were compared with a Student's t-test, using a $p<0.05$.

RESULTS

Feru-AFC NPs could be efficiently internalized into MSCs, as confirmed by Prussian blue stains and ICP mass spectrometry. Labeled MSC showed a significantly shorter T2-relaxation time compared to unlabeled MSCs ($p<0.05$). Feru-AFC NPs did not show significant fluorescence, however, in the presence of recombinant human caspase-3 or extract of apoptotic MSCs, Feru-AFC NPs showed significant green fluorescence due to cleavage of DEVD and release of AFC fluorophores. Accordingly, viable Feru-AFC NP-labeled MSCs showed no detectable fluorescence, while apoptotic Feru-AFC NP-labeled MSCs showed significant green fluorescence. In vivo, MR imaging enabled localization of cell transplants in skull defects. Mismatched MSC implants showed significantly higher fluorescent signal compared to matched MSC implants three days after implantation ($p<0.05$).

CONCLUSION

Feru-AFC NPs represent a novel tool for long-term stem cell tracking through MRI and early diagnosis of cell apoptosis through simultaneous fluorescence imaging.

CLINICAL RELEVANCE/APPLICATION

The described dual-modality contrast agent could improve monitoring of the localization and early diagnosis of cell rejection/apoptosis and direct patients with failed implants to repeated interventions.

SSQ13

Science Session with Keynote: Musculoskeletal (Metal Artifact Reduction Techniques)

Thursday, Nov. 30 10:30AM - 12:00PM Room: E451A

CT MK MR

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

FDA Discussions may include off-label uses.

Participants
Kenneth A. Buckwalter, MD, Indianapolis, IN (*Moderator*) Research Grant, Siemens AG
Naveen Subhas, MD, Cleveland, OH (*Moderator*) Research Grant, Siemens AG

Sub-Events

SSQ13-01 Musculoskeletal Keynote Speaker: Update on Metal Artifact Reduction Techniques

Thursday, Nov. 30 10:30AM - 10:40AM Room: E451A

Participants
Christine B. Chung, MD, La Jolla, CA (*Presenter*) Nothing to Disclose

SSQ13-02 Quantitative Evaluation of Fracture Healing After Internal Fixation of Spinal Fractures by Dual-Energy Technology

Thursday, Nov. 30 10:40AM - 10:50AM Room: E451A

Participants
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Kai Sun, Shanxi, China (*Abstract Co-Author*) Nothing to Disclose
Peng Zhang, Shanxi, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Objective: To investigate the value of dual-energy technology in the treatment of fracture healing after internal fixation of spinal fractures.

METHOD AND MATERIALS

Methods: 60 cases of spine (cervical spine 5 cases, thoracic vertebrae 25 cases, lumbar vertebrae 30 cases) were collected and examined by dual-energy X-ray absorptiometry (DXA).The bone mineral density (BMD) measurements were performed at the same time by gemstone spectral imaging (GSI) scan for patients with spinal fractures, before operation, after metal internal fixation, and after removal of metal internal fixation. The data used in the analyzing were obtained by the energy spectrum analysis software. The single energy images at different energy levels of 40-140 keV, the base substance diagram of calcium and water were obtained. The ROIs were measured by different parameters among 40-140 keV (with interval 10 keV) and the CT values of different energy levels, the calcium and water based material density, and the bone density values were calculated.

RESULTS

Results: The best single energy image was obtained at 60 keV. Before operation, there was statistical significance ($P < 0.05$) between the bone mineral densities getting from GSI (0.440 ± 0.056 g / cm3) and QCT (0.404 ± 0.069 g / cm3) , and the former was greater than that of the QCT. The GSI measurement was (0.360 ± 0.026 g / cm3) in the 6 patients healing well,(0.281 ± 0.032g / cm3) in the 8 patients delayed healing, and (0.121 ± 0.021g / cm3) in the 8 patients nonunion.

CONCLUSION

Conclusion: The energy spectrum CT scanning technique can effectively remove metal artifacts and ray beam hardening artifacts, and clearly show the fine structure after metal fixation for fracture, and the image quality is higher. The best single energy image was achieved at the 60keV. By using of calcium-water-based substance pairs, the bone density could be measured more accurately than by QCT, and can be used as a new bone density measurement method to predict the degree of fracture healing.

CLINICAL RELEVANCE/APPLICATION

can be used as a new bone density measurement method to predict the degree of fracture healing.

SSQ13-03 The Value of a New Single Energy Metal Artifact Reduction (SEMAR) Algorithm in Post-Surgery Follow-Up of Patients with Knee Tumor Prostheses

Thursday, Nov. 30 10:50AM - 11:00AM Room: E451A

Participants
Lei Ding, Guangzhou, China (*Presenter*) Nothing to Disclose
Fang-Ling Zhang, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Ling Ma, MD, Canton, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the effect of a new single energy metal artifact reduction (SEMAR) algorithm with a 320 Multidetector computed tomography (MDCT) volume scanner in post-surgery follow-up of patients with knee tumor prostheses.

METHOD AND MATERIALS

From November 2015 to February 2017, 95 consecutive patients (59 males, 36 females; mean age, 24.2 years; age range, 9-64 years) with a tumor prosthesis of knee joint underwent a 320-MDCT scan. The images were reconstructed using two different methods: conventional iterative reconstruction (IR) alone and IR associated with SEMAR. Four radiologists visually graded the whole image quality at articular level on a 6-point scale from 0 (periprosthetic anatomic structures are completely obscured by metal artifacts) to 5 (periprosthetic structures are recognized with high confidence). Additionally, the readers assessed the presence of periprosthetic complication on a similar 6-point scale from 0 (extensive artifacts, prosthetic complications are unable to be recognized) to 5 (minimal artifacts, prosthetic complications are recognized with high confidence). Wilcoxon matched-pairs signed rank test and Intra-class correlation coefficients (ICCs) were used for the scores of image quality and prosthetic complications.

RESULTS

Visualization of periprosthetic structures were significantly improved by the SEMAR algorithm (3.8~4.3 vs. 1.2~1.6, $P<0.05$). In 66 of 95 patients, prosthetic complications were confirmed by other imaging examination, clinical or pathology. and prosthetic complications. The new algorithm also increased diagnostic confidence of prosthetic complications (4.3~4.7 vs 1.3~1.9, $P<0.05$). The sensitivity of diagnostic confidence of prosthetic complications was increased (98.5% vs. 45.5%, $P<0.05$).

CONCLUSION

The SEMAR visibly reduces the metal artifact and can increase diagnostic confidence of prosthetic complications in patients with knee tumor prostheses.

CLINICAL RELEVANCE/APPLICATION

The SEMAR can visibly reduces the metal artifact and increase diagnostic confidence of prosthetic complications in patients with knee tumor prostheses.

SSQ13-04 Cross-sectional Imaging of the Bone-Implant Interface of Total Ankle Arthroplasty Implants: CS-SEMAC MRI versus IMAR CT

Thursday, Nov. 30 11:00AM - 11:10AM Room: E451A

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PURPOSE

Imaging evaluation of the bone-implant interfaces of total ankle arthroplasty is helpful for the assessment of osseous implant integration; however, it is unclear which imaging modality performs best. Therefore, we evaluated the visibility of the bone-implant interface of total ankle arthroplasty implants by comparing two state-of-the-art metal artifact reduction MRI and CT techniques.

METHOD AND MATERIALS

After institutional review board approval, a total ankle arthroplasty system (TMTA, Titanium and Cobalt-Chromium alloy, Zimmer, Warsaw, Indiana) was implanted into 6 fresh frozen human cadaver ankles. Each specimen underwent cross-sectional imaging using Compressed Sensing (CS) SEMAC MRI at 1.5T and Iterative Metal Artifact Reduction (IMAR) CT at 120 keV. A total of 12 studies (6 CT, 6 MRI) were created, which consisted of axial, sagittal and coronal images with 3 mm slice thickness and similar slice orientations. The blinded and randomized data sets were subsequently independently analyzed by two experienced observers. After three months, both observers analyzed the data sets again. Using a four quadrant scheme, the visibility of the bone-implant

interface was evaluated on each slice orientation using equidistant 5-point Likert scales. Descriptive statistics, ICC, and Mann-Whitney U test were used for analysis. A p-value of <0.05 was considered significant.

RESULTS

The inter-observer agreement (kappa 0.815, 95%-CI 0.729-0.874) and intra-observer agreement (kappa intra-observer 1 0.904, 95% CI 0.859-0.934; kappa intra-observer 2 0.835, 95%-CI 0.758-0.887) were high with > 80% exact matching ratings for each image orientation, quadrant and imaging modality. The average 4-quadrant visibility score was 18 for CS-SEMAC MRI and 15 for IMAR CT ($p < 0.001$). Additionally, CS-SEMAC MRI consistently showed significantly higher scores for matched slice orientation and cadavers (axial: $p<0.001$, sagittal: $p<0.001$, coronal; $p<0.001$, cadaver 1: $p<0.001$, cadaver 2: $p=0.011$, cadaver 3: $p<0.001$, cadaver 4: $p=0.001$, cadaver 5: $p<0.001$, cadaver 6: $p<0.001$).

CONCLUSION

CS-SEMAC MRI is superior to IMAR CT for the visualization of the bone-implant interface of total ankle arthroplasty implants.

CLINICAL RELEVANCE/APPLICATION

CS-SEMAC metal artifact reduction MRI technique substantially improves the visibility of the host bone-implant interfaces of total ankle arthroplasty implants, suggesting a change of postoperative imaging from CT toward MRI.

SSQ13-05 Reduction of Metallic Artefacts from Spinal Fusions Using Virtual Monoenergetic Imaging by Dual Layer Spectral Computed Tomography

Thursday, Nov. 30 11:10AM - 11:20AM Room: E451A

Participants
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PURPOSE

To evaluate the clinical potential of virtual monoenergetic images generated with a dual-layer spectral Computed Tomography (CT) system and determine the optimal settings for reduction of metallic artefacts from posterior spinal fusions.

METHOD AND MATERIALS

Twenty patients with posterior spinal fusion who underwent a spectral CT scan (IQon Spectral CT, Philips Healthcare, USA) for various clinical indications were included in this study. Two independent readers evaluated axial 0.9 mm slides with soft tissue and bone window settings. Image quality of the conventional scan was compared with virtual monoenergetic images at 40, 60, 80, 100, 120, 140, 160, 180 and 200 keV. A four point Likert-scale was used to document subjective impression of overall and specific diagnostic image quality for either the implant inheriting bone, muscle, spinal canal or retroperitoneal vessels. The Hounsfield Units of the area with the most pronounced streak artefact as well as the Hounsfield Units of a reference area containing fat and muscle was documented for every keV-setting.

RESULTS

Quantitative analysis showed statistically significant artefact reduction for higher monoenenergetic levels compared to conventional images ($p<0.05$). Analogously, qualitative analysis revealed significant improvement of overall image quality ($p<0.05$) and benefit for all:tissues separately compared:to the original images in the range from 80 to 200 keV ($p<0,05$). Optimal overall keV-setting was 180 keV and ranged from 160 to 200 keV for the implant inheriting bone, the spinal canal, adjacent muscle and retroperitoneal vessels. Our results reveal high inter-reader agreement for qualitative evaluations (ICCs >0.927; $p<0.05$).

CONCLUSION

Dedicated keV-settings to evaluate either the implant inheriting bone, the spinal canal, adjacent muscle or retroperitoneal vessels - structures which are frequently of peculiar interest after posterior spinal fusions - are recommended.

CLINICAL RELEVANCE/APPLICATION

Virtual monoenergetic images of higher energies provide significant reduction of metallic artefacts from posterior spinal fusions.

SSQ13-06 SMART (Sequences for Metal Artifact Reduction around a Tumor Prosthesis) MRI: Diagnostic Performance for Detection of Recurrence and Complications around a Tumor Prosthesis

Thursday, Nov. 30 11:20AM - 11:30AM Room: E451A

Participants
Laura M. Fayad, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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Jan Fritz, MD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG; Scientific Advisor, Siemens AG; Scientific Advisor, Alexion Pharmaceuticals, Inc; Speaker, Siemens AG

PURPOSE

To assess the feasibility and performance of an MRI protocol including conventional and fast metal-reduction anatomic (T1/STIR, contrast-enhanced) and functional (dynamic contrast-enhanced (DCE)) imaging for the surveillance of patients who have undergone limb-salvage reconstruction with a tumor prosthesis.

METHOD AND MATERIALS

Following IRB approval and informed consent, 15 subjects with tumor prostheses, underwent 17 MRIs at 1.5T. MRI included two-plane anatomic imaging (T1-weighted/STIR, post-contrast T1-weighted, subtraction of pre-contrast from post-contrast) with both conventional WARP and fast compressed-sensing (CS)-SEMAC sequences, and functional imaging (DCE-MRI with 7-second resolution). One observer recorded the quality of each sequence (1=>75%, 2=25-75%, 3=10-25%, 4=no substantial-artifacts) adjacent to and remote from the prosthesis, and the presence of recurrence by three interpretation sessions (WARP, WARP+CS-SEMAC, WARP+CS-SEMAC+DCE) using a 5-point confidence scale (definitely-not, probably-not, possibly-present, probably-present, definitely-present). ROC analysis was performed, using histology as the reference for positive recurrence, and minimum 6-month stability for absence of recurrence.

RESULTS

Of 17 studies, there were 4 histologically-proven intramuscular recurrences. Average image quality was different adjacent to the prosthesis compared with remote from the prosthesis on T1, STIR and contrast-T1 sequences (WARP:1.2 vs 3.9, CS-SEMAC: 2.9 vs 3.4, respectively). ROC analysis revealed improved diagnostic performance for the detection of tumor recurrence with the successive addition of CS-SEMAC and DCE imaging to WARP (area-under-the-curve: WARP=0.84, +CS-SEMAC=0.92, +DCE=1.0).

CONCLUSION

An MRI protocol including conventional metal reduction (WARP), and fast CS-SEMAC and DCE-MRI offers good diagnostic performance for the detection of recurrence in patients with a history of limb salvage surgery and tumor prostheses.

CLINICAL RELEVANCE/APPLICATION

Following resection and reconstruction with a tumor prosthesis, cross-sectional imaging has traditionally been limited. With the advent of SMART-MRI, surveillance imaging of patients with tumors prostheses is now possible with high diagnostic accuracy.

SSQ13-07 Minimizing CT Radiation Dose in Total Hip Arthroplasty Patients Using Model-Based Iterative Reconstruction and Orthopedic Metal Artifact Reduction

Thursday, Nov. 30 11:30AM - 11:40AM Room: E451A

Participants
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PURPOSE

To minimize CT radiation dose in patients with large metal-on-metal total hip prostheses using model-based iterative reconstruction (iMR) combined with orthopedic metal artifact reduction (O-MAR).

METHOD AND MATERIALS

Patients with a unilateral or bilateral metal-on-metal total hip prosthesis were included. Patients were scanned on a Philips iCT 256-slice CT scanner. Each patient received a conventional CT pelvis and a low-dose CT pelvis with respectively -20%, -43%, -60% or -80% lower CT radiation dose for patients in group 1, 2, 3 or 4 respectively. The conventional CT pelvis was reconstructed with iterative reconstruction, iDose4 level 4. The low-dose CT pelvis was reconstructed with iDose4 level 4 and model-based iterative reconstruction (iMR, levels 1, 2 and 3). All images were reconstructed with and without the use of O-MAR. CT numbers, noise or standard deviations (SDs) and contrast-to-noise-ratios (CNRs) were determined in muscle, fat, the bladder and background.

RESULTS

In this ongoing study, 23/80 patients were included for first analysis. In total 5, 6, 7 and 5 patients were included in group 1, 2, 3 and 4 respectively. Dose-length-products (DLPs) were reduced from 767.4 to 659.3 (-16%), 637.6 to 380.8 (-41%), 670.3 to 306.6 (-56%) and 840.1 to 199.6 (-77%) for group 1, 2, 3 and 4 respectively. While reducing radiation dose with 20%, 43%, 60% or 80%, CT numbers accuracy was maintained, SDs decreased ($p<0.01$) and CNRs ($p<0.001$) increased in iMR and O-MAR images compared to iDose4 and O-MAR images. In iMR level 1 and O-MAR images, CNRs between muscle and fat were on average 94%, 74%, 54% and 47% higher compared to iDose4 and O-MAR images while reducing radiation dose with 20%, 43%, 60% or 80%.

CONCLUSION

The use of iMR and O-MAR reduces standard deviations, increases CNRs and maintains CT number accuracy while reducing radiation dose in total hip arthroplasty patients up to 80% compared to iDose4 and O-MAR.

CLINICAL RELEVANCE/APPLICATION

Despite quantitative measurements show that the use of iMR enables a radiation dose reduction up to 80% compared to iDose4 in total hip arthroplasty patients, qualitative analysis is essential.

SSQ13-08 Evaluation of CT Metal Artifact Reduction Techniques in Patients with Total Shoulder Arthroplasties

Thursday, Nov. 30 11:40AM - 11:50AM Room: E451A

Awards

Student Travel Stipend Award

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PURPOSE

To determine the CT metal reduction technique that optimizes visualization of bone and soft tissue adjacent to a total shoulder arthroplasty.

METHOD AND MATERIALS

19 patients with TSA underwent dual energy CT (DECT). Post processing was performed for each study, creating 4 different image sets, each in soft tissue and bone kernels: (1) routine reconstruction (2) iterative metal reduction technique (iMAR) (3) DECT with virtual mono-energetic images at 130 keV and (4) combined iMAR and DECT virtual mono-energetic images at 130 keV. 2 experienced MSK Radiologists and 1 MSK Fellow blinded to processing data independently graded extent of artifact and image quality of one reconstruction for each patient, randomly ordered across 4 weekly reading sessions. A fifth reading session compared the 4 techniques side-by-side for each patient and a rank order preference was submitted. Attenuation measurements within bone and soft tissue at areas of greatest artifact near the hardware were collected for each reconstruction and compared to standard attenuation measurements collected from areas unaffected by artifact.

RESULTS

Of the four techniques utilized, iMAR combined with DECT with virtual mono-energetic images at 130 keV ranked best in overall image quality and in rank order preference by each of the 3 readers. The difference between attenuation measurements of bone and soft tissue in areas of greatest artifact and standard attenuation measurements was greatest in standard technique and lowest in iMAR combined with DECT Mono+.

CONCLUSION

In the setting of TSA, iMAR combined with DECT with virtual mono-energetic images at 130 keV objectively and subjectively decreases metal artifact when compared to standard reconstruction, iMAR alone and DECT with mono-energetic images at 130 keV alone.

CLINICAL RELEVANCE/APPLICATION

Orthopedic surgeons often utilize CT imaging to assess the necessity and nature of intervention. Metallic implants contribute to substantial artifact on CT imaging limiting visualization of adjacent structures. This is particularly relevant when trying to evaluate shoulder arthroplasties for evidence of loosening or fracture and to assess adjacent bone stock for revision surgery. This study demonstrates that utilization of iMAR with DECT with virtual mono-energetic technique in the setting of TSA provides optimal imaging quality of the adjacent osseous and soft tissue structures thus improving diagnostic evaluation.

SSQ13-09 Metal Artifact Reduction Using Spectral Dual-Energy CT with Virtual Monoengergetic Images for Patients with Metallic Orthopedic Implants of the Distal Radius

Thursday, Nov. 30 11:50AM - 12:00PM Room: E451A

Participants
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PURPOSE

To evaluate the image qualities of virtual monoenergetic images obtained from spectral dual-energy CT (DECT) for patients with metallic orthopedic implants of the distal radius

METHOD AND MATERIALS

Forty-three consecutive patients with internal metallic implants for distal radius fracture underwent spectral DECT (33 women and 11 men, with a mean age of 50.7 ± 15.4 years (24-77 years). Sixteen virtual monoengergetic image sets ranging from 50 keV to 200 keV were generated at one single slice with the most pronounced hypodense streak artifacts of implants in axial plane. The image quality of sixteen monoengergetic images were assessed quantitatively and qualitatively by two independent musculoskeletal radiologists. Quantitative analysis included the density of most hypodense artifact and reference tissue, background image noise and artifact index (AI). Qualitative assessment included degree of artifacts, diagnostic image quality of peri-implent bones, and delineation of fracture lines if present. Friedman rank-sum test with post hoc tests and kappa analysis were used for the statistical analysis.

RESULTS

There was a statistically significant difference in CT number of most pronounced hypodense streak in peri-prosthetic region depending on monoenergy level ($p < 0.001$). There was a statistically significant difference in AI of most pronounced hypodense streak in periprosthetic region depending on monoenergy level ($p < 0.001$). AI of different monoenergy level was the lowest at 120-200 keV to provide the most significant metal artifact removal. The degree of artifacts, diagnostic image quality, and delineation of

fracture lines were significantly different among the keV settings (both $p < 0.001$). The hypodense streak in peri-prosthetic region was least pronounced at 110 keV and diagnostic image quality of peri-implant bones was best at 130 keV. Fracture lines were found in 22 patients, which was well delineated in all cases at 80~110 keV settings ($p < 0.001$).

CONCLUSION

Virtual monoenergetic images at high-energy levels have a well-concordant effect of reducing metal artifacts, and 110-130 keV monoenergetic images provided a least peri-implant artifact and best diagnostic image quality in patients with implants of the distal radius.

CLINICAL RELEVANCE/APPLICATION

Virtual monoenergetic images acquired from spectral DECT was useful to reduce metal artifacts caused by metallic implatns in patients with distal radius fracture

SSQ14

Nuclear Medicine (Endocrine and Musculoskeletal Imaging)

Thursday, Nov. 30 10:30AM - 12:00PM Room: S504CD

CT MR MK NM

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

Participants
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Matthew S. Robertson, MD, Cleveland, OH (*Moderator*) Nothing to Disclose

Sub-Events

SSQ14-01 Measurement Repeatability of Cold-Activated Brown Adipose Tissue Volume on [18F]FDG-PET Using both PET/CT and PET/MRI

Thursday, Nov. 30 10:30AM - 10:40AM Room: S504CD

Participants
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PURPOSE

Brown adipose tissue (BAT) is a promising target for anti-obesity interventions, which may entail induction of BAT volume expansion. Valid assessments of changes in BAT volumes require knowledge of intrinsic volumetric variability. Our aim was to determine the repeatability of cold-activated BAT volumes using [18F]FDG, the gold standard for detecting BAT activity, with both PET/CT and PET/MRI.

METHOD AND MATERIALS

To date, our study has enrolled 25 healthy volunteers (21 female, 4 male). As young, normal weight individuals are more likely to have detectable BAT, we included only subjects 18-35 y/o with BMI <= 25 kg/m2. A 5 mCi dose of [18F]FDG was injected midway through a 120 min cooling period, using a target temperature just above the shivering point. Subjects then underwent PET/CT immediately followed by PET/MRI. Imaging extended from the skull base to the upper abdomen, covering all common BAT areas. Repeat imaging occurred 2-7 days later per an identical protocol. BAT volumes were defined per BARCIST 1.0 criteria (Figure), incorporating a validated Dixon-based fat segmentation method for PET/MRI. Repeatability coefficients (RCs), based on percent differences between measurements (0% = perfect repeatability), were calculated.

RESULTS

Three subjects failed to complete the imaging protocol, and 6 had no detectable BAT. For the 16 evaluable subjects, RCs for BAT volumes (range, 24-315 ml) were 138.8% (PET/CT) and 98.8% (PET/MRI). Considering only the 8 subjects with the largest BAT volumes (range, 150-315 ml), RCs improved to 32.2% (PET/CT) and 36.4% (PET/MRI). The degree of BAT volume correlation between PET/CT and PET/MRI was significantly (p = 0.04) greater at baseline (R2, 0.96) than at repeat imaging (R2, 0.80). There was no difference (p = 0.88) in the degree of BAT volume correlation on serial PET/CT (R2, 0.85) compared with serial PET/MRI (R2, 0.87).

CONCLUSION

Volumetric repeatability was better for patients with more BAT. The higher degree of BAT volume correlation between PET/CT and PET/MRI on baseline imaging than between imaging sessions for either PET/CT or PET/MRI suggests that BAT activation factors (e.g., cooling protocol) may be a greater source of variability than imaging-related factors.

CLINICAL RELEVANCE/APPLICATION

Although repeatability of cold-activated BAT volumes on [18F]FDG-PET was acceptable for subjects with large amounts of BAT, further work is needed to improve the repeatability of small BAT volumes.

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 L. Wahl, MD - 2013 Honored Educator

SSQ14-02 Localization of the Elusive Parathyroid Adenoma by 18F-choline PET/CT: Preliminary Results

Thursday, Nov. 30 10:40AM - 10:50AM Room: S504CD

Participants
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PURPOSE

Preliminary studies have shown choline-PET/CT to be of value in the preoperative localisation of parathyroid adenoma in primary hyperparathyroidism. Choline-PET/CT is used in our centre for patients with persistent hyperparathyroidism and in whom sestamibi scintigraphy, ultrasound, and either contrast enhanced CT or MRI, and venous sampling localisation investigations, and prior neck exploration have failed to identify the adenoma. This retrospective study aims to evaluate choline-PET/CT as a tool for localisation of parathyroid adenoma in a cohort of patients with repeatedly inconclusive conventional imaging.

METHOD AND MATERIALS

10 patients with biochemical hyperparathyroidism underwent choline-PET/CT. The findings were analysed and correlated with the prior localisation investigations. The reference standard was based on results of surgical exploration and histopathological correlation.

RESULTS

The patient cohort had undergone investigation for a mean of 5 years 3 months, had a mean of 9 previous localisation investigations (range 2-18) and a mean of 2 previous failed neck explorations (range 1-4), with 9/10 being symptomatic from their hyperparathyroidism. Choline-PET/CT identified likely causative lesions with relative certainty in 9/10 of cases. 7 cases had histologically-proven parathyroid adenoma following surgical exploration of the site identified by choline-PET/CT. A post-operative drop in serum parathyroid and/or calcium levels has been observed in all patients with positive histology.

CONCLUSION

In this challenging cohort of patients with persistent symptomatic hyperparathyroidism, with failed localization despite extensive non-invasive and invasive investigations, choline-PET/CT was able to accurately identify the location of the parathyroid adenoma in 70% cases, showing excellent promise as a second-line imaging tool.

CLINICAL RELEVANCE/APPLICATION

Choline-PET/CT shows initial promise at localising parathyroid adenoma in symptomatic patients with persistent primary hyperparathyroidism in whom conventional imaging has proved inconclusive.

SSQ14-03 Does the Risk of Development of Graves' Eye Disease after I-131 Therapy Depend On the I-131 Dosage?

Thursday, Nov. 30 10:50AM - 11:00AM Room: S504CD

Participants
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PURPOSE

Graves' ophthalmopathy, or Graves' eye disease (GED) is sometimes a manifestitation of Graves' disease. It is controversial in the medical literature as to whether or not GED can be precipitated or worsened by Radioiodine therapy with I-131 (RAI). The aim of this study was to determine if there is a relationship between the dosage of I-131 administered and the onset of GED.

METHOD AND MATERIALS

We reviewed the cases of all patients receiving RAI for Graves' disease for the last 5 years. Those patients who already had GED prior to RAI were excluded from this study. Follow-up was achieved by review of medical records as well as follow-up notes of the patients' ophthalmologists. The I-131 dosage of each patient and whether or not GED later developed was then recorded. The I-131 dosage calculation was based on a desired dose of 160-200 microcuries of I-131 per gram of thyroid tissue, ranging from 10 mCi to 25 mCi of I-131.

RESULTS

A total of 83 patients received RAI for Graves' disease. Eight patients had pre-existing GED prior to RAI and 30 patients were lost to

A total of 82 patients received RAI for Graves' disease. Eight patients had known GED prior to RAI, and 20 patients were lost to follow-up; therefore these 2 groups were excluded. Of the remaining 54 patients, 17 (31.5%) developed GED. The remaining 37 patients thus far have not. There was no correlation between the incidence of GED and the dosage of I-131 dispensed. Statistical analysis indicates only a 1% chance to observe a correlation greater than 0.30, based on the observed incidence.

CONCLUSION

There is no relationship between the likelihood of the onset of Graves' eye disease and the dosage of I-131 in the range of 10-25 mCi dispensed.

CLINICAL RELEVANCE/APPLICATION

In RAI therapy for Graves' disease, the I-131 dosage contemplated should not be influenced by the concern for the development of Graves' ophthalmopathy.

SSQ14-04 Two Weeks' Withdrawal of Inorganic Iodine Therapy is Appropriate for Radioiodine Therapy for Graves' Hyperthyroidism

Thursday, Nov. 30 11:00AM - 11:10AM Room: S504CD

Participants
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PURPOSE

Inorganic iodine therapy has been getting wide popularity as an adjunctive to anti-thyroid drugs (ATDs) in treating hyperthyroidism in countries where dietary iodine intake is sufficient. The aim of this study was to investigate whether 2 weeks' withdrawal of inorganic iodine therapy was appropriate for radioactive iodine I-131 therapy (RAI) for Graves' hyperthyroidism (GH).

METHOD AND MATERIALS

We used potassium iodide (KI) pill which contains 38mg of iodine per pill. 37 patients with GH (M 5/F 32. Age 42.6 ±13.9yrs), who had been pretreated by combination of ATD and KI and were to undergo RAI, were enrolled. Thyroid weight ranged from 26 to 97g. Dose of KI (mg/day) ranged from 50 to 300mg/day (average:141). KI was withdrawn 14 days prior to RAI while ATDs were withdrawn 3 to 4 days prior to RAI. Patient were instructed to follow low iodine diet from 7days before to 3 days after administration of I-131. As a parameter for total body iodine, urinary iodine concentration normalized by urinary creatinine (UIC: μg/gCRE) was measured before withdrawal of KI (UIC1) and on the day of RIA UIC2). Thyroid function and TRAb(IU/ml) were determined on the day of RIA. 24hr uptake of radioiodine (RU; %) was determined using gamma camera and I-123. All patients were followed up for more than 2years after RAI. Results of UIC, RU, and efficacy of RAI in patients (KI group) were compared with those in 39 patients with GH, who underwent RAI with pretreatment by ATD alone (ATD group).

RESULTS

The average value of UIC2 in KI group was less than 0.1% of UIC1(147330 vs. 131.9. p=0.0008), but was higher than that in ATD group (131.9 vs.89.0, p=0.032). However, difference in RU was not significant between KI group and ATD group (64.9 vs. 71.0, ns). There was a inverse correlation between UIC2 in KI group and RI (r=-0.523, p=0.045). Additionally, successful rate of RAI in KI group was comparable to that in ATD group (78 vs.82%, ns). TRAb value in KI group was higher compared to ATD group (22.9 vs. 15.1, p=0.013).

CONCLUSION

Pretreatment by KI does not impair therapeutic efficacy of RAI for GH if the drug is discontinued 2 weeks before administration of I-131 and is combined with a low iodine diet.

CLINICAL RELEVANCE/APPLICATION

Combination therapy of KI and ATD seems feasible as a pretreatment for radioiodine therapy for Graves' hyperthyroidism.

SSQ14-05 The Relationship among FDG Uptake: Thyroglobulin Doubling Time and Behavior of Tumor in Radioiodine Negative Metastasis from Thyroid Cancer

Thursday, Nov. 30 11:10AM - 11:20AM Room: S504CD

Participants
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PURPOSE

Recent studies have suggested that doubling time of serum Tg (Tg-DT) under TSH suppression may better predict prognosis of

postoperative thyroid carcinomas. Aim of the present study was to investigate relationship between FDG uptake and Tg-DT in radioiodine- negative metastasis from differentiated thyroid cancer (DTC).

METHOD AND MATERIALS

66 patients with metastatic thyroid cancer (PCA/FCA 64/5) who had received total thyroidectomy followed by radioiodine ablation and had negative I-131 scan results underwent FDG PET/CT. TgAb was negative in all patients. Location of metastatic tumor was lymph nodes in the neck and/or the mediastinum in 29, lung in 21, and both lymph nodes and lung in 16. Intensity of FDG uptake in the tumor was visually compared with that of the mediastinum to be determined as positive or negative. Additionally, tumors with positive FDG uptake were classified into 2 subgroups based on SUVmax (high uptake: SUV max>=5.0, low uptake: SUV Max<5.0). When a patient had more than 2 tumors, the largest tumor was used for evaluation of FDG uptake. Tg-DT was determined as previously described (Thyroid 2011; 21:707-716). All patients were followed up for 36-85 months. Imaging modalities including US, CT, MRI and/or PET/CT were performed at a regular interval to investigate relationship among FDG uptake, Tg-DT, and behavior of tumor.

RESULTS

FDG uptake was negative (N) in 16 pts., was low (L) in 28 pts., and was high (H) in the remaining 22 pts. The average of Tg-DT(yrs) in N group, L group, and H group were 9.1, 4.7, and 1.7, respectively. There were significant differences in Tg-DT between H group and other 2 groups ($p<0.001$ for L group and $p<0.01$ for). Additionally, more than 20% increase in the short diameter of the largest tumor and/or appearance of new lesions during the follow up period were seen in 0/16 (0%) in N group, 6/21 (26%) in L group, and 17/22(77%) in H group. 2 patients in H group showed rapid growth of metastatic tumors despite of longer Tg-DT(>3 yrs.).

CONCLUSION

Negative FDG uptake in metastatic tumors may indicate longer Tg-DT and stable disease for long period while tumors with high FDG uptake tend to have shorter Tg-DT and aggressive clinical behavior. FDG PET/CT correlates well with Tg-DT and is a valuable predictor for prognosis of metastasis from DTC.

CLINICAL RELEVANCE/APPLICATION

FDG PET/CT has a positive role as an alternative to Tg-DT in management of metastasis from thyroid cancer.

SSQ14-06 I-131 Thyroid Dosimetry in Patients with Abnormal Renal Function

Thursday, Nov. 30 11:20AM - 11:30AM Room: S504CD

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PURPOSE

Maximum permissible activity (MPA) of administered I-131 to treat thyroid cancer conventionally is estimated by combining whole body gamma camera & blood sample well counter measurements following oral administration of I-131. In attempting to simplify methodology by computing MPA from blood sample measurements, it is important to determine potential influence of various factors on methods used for estimating MPA. We retrospectively investigated the effects of previous treatment (PT) &/or abnormal renal function (AF) on MPA estimates derived from whole body counting and blood samples.

METHOD AND MATERIALS

Data were reviewed for 71 pts (age = 60±14 yrs; 38 female; 33 male) who previously had undergone total thyroidectomy for thyroid cancer and who were referred for pretreatment dosimetry to determine MPA. 30 pts (42%) had PT (PT+) & 41 pts (58%) did not (PT-), while 23 pts (32%) had AF (AF+) & 48 (68%) did not (AF-). Anterior & posterior whole body counts were measured by un-collimated gamma camera & blood samples were drawn & assayed in vitro by a well counter 1, 4, 24, 48, 72-96, & 96-144 hrs after 37-148 MBq I-131 administration to compute whole body γ & in-vivo ß dose contributions to compute conventional (Method1) total dose D, with MPA = 200 cGy/D. Linear regression comparing in-vitro blood sample measurements alone to conventional D yielded Method 2 predictions of D & MPA based on well counter blood measurements alone. Method 2 D & MPA were compared to conventional Method1 values by the paired t-test or Wilcoxon test & by linear regression.

RESULTS

MPA was similar for Method1 & Method2 for all 71 pts (21±14 versus 21±14 cGy/GBq, $p=0.97$), & for each pt subgroup: PT+ & AF- (N=24) MPA = 22±9 versus 22±9 GBq ($p=0.20$); PT- & AF- (N=24) MPA = 14±8 versus 14±8 GBq ($p=0.78$); PT- & AF+ (N=17) MPA = 8±2 versus 8±3 GBq ($p=0.92$); PT+ & AF+ (N=6) MPA = 7±3 versus 7±3 GBq ($p=0.29$). Correlation of Method2 to Method1 MPA was similar for PT-, PT+, AF- & AF+ subgroups ($r = 0.98, 0.99, 0.99$ & 0.94, respectively).

CONCLUSION

In pts with metastatic thyroid carcinoma or compromised renal function, MPA can be accurately estimated by measuring I-131 blood clearance, without the need to perform wholebody counting.

CLINICAL RELEVANCE/APPLICATION

Blood sampling alone suffices to estimate I-131 dose, regardless of renal function..

SSQ14-07 Utility of Fused Images by 99mtc-MDP SPECT and Low Dose CT in Detecting for Chronic-Infected Nonunion of the Lower Limb

Thursday, Nov. 30 11:30AM - 11:40AM Room: S504CD

Participants
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PURPOSE

To evaluate the benefits of using SPECT/CT fused images than using simple SPECT or CT in diagnosis and positioning of chronic-osteomyelitis nonunion of the lower limb.

METHOD AND MATERIALS

1.Patients are intravenous-injected typically 740-1110 MBq 99mTc-MDP. Images were acquired on a SPECT/CT (Dicovery™NM/CT670,GE) 2.The hybrid SPECT/CT system has a 16 slice multidetector CT. The SPECT was followed by CT examination with settings of 80-100 kV, 240 mAs, pitch-1. The CT images were reconstructed with 0.625mm slice thickness in multiplanar reformatting(MPR). 3.The author presents 36 cases of lower limb fracture nonunion, associated with or be suspicious of chronic osteomyelitis. For data analysis findings of three bone imaging models for every patients were categorized as yes(osteomyelitis), no(no osteomyelitis), or equivocal for the presence of osteomyelitis. Secondly, SPECT/CT fused imaging were compared to SPECT and CT with respect to localization ,extent of lesions, the body surface location consistency and the influence of internal and external fixed on each method.

RESULTS

The degree of interobserver agreement was evaluated by computing the kappa coefficient (κ=0.759 for SPECT/CT, κ=0.184 for CT, κ=0.192 forSPECT). Sensitivity of whole body bone scan for osteomyelitis was 52.2%, specificity 15.4%. Sensitivity of CT was 65.2%, specificity 23.1%. SPECT/CT fused images was sensitivity 91.3%, specificity 84.6%. It is the best choice in our study.Definition of anatomical localization of inflammatory foci was much easier by SPECT/CT fused images due to better description of anatomical details and concentration areas of eye-catching.

CONCLUSION

SPECT/CT fused images increased specificity than SPECT or CT.In distinguishing between soft tissue infection with osteomyelitis ,it is more accurate than only using SPECT. Hybrid SPECT/CT (With 16 row diagnositic CT)at the same time provide both anatomical and functions information. 99mTc-MDP SPECT/CT is more suitable for detecting osteomyelitis in China. Because it is more efficient, convenient(no special training), cheap than radiolabelled autologous white cells and 99mTc labelled monoclonal antibodies. Because of combination of SPECT and CT, radiation dose of patients has been increased. In order to reduce the radiation dose, the author adopts the method of low dose for lower limb CT scans(about 40% off).

CLINICAL RELEVANCE/APPLICATION

osteomyelitis

SSQ14-08 Correlation of Bone SPECT/CT and Plain Radiography with Clinical Findings in Painful Hip Prostheses

Thursday, Nov. 30 11:40AM - 11:50AM Room: S504CD

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PURPOSE

The concomitant use of plain radiography (PR) and bone SPECT/CT scans (BSCS) have greater potential to accurately detect complications after hip arthroplasty compared to each modality alone. We aimed to correlate patient-reported sites of pain with findings on BSCS and PR in patients with painful hip prostheses.

METHOD AND MATERIALS

A retrospective review of 12 consecutive patients with painful hip prosthesis who received BSCS was performed. The pain location and duration and prosthesis type, treatment, and surgical pathology were noted from nuclear medicine and orthopedic clinic reports. Each BSCS was interpreted side-by-side with the most recent hip PR obtained prior to each BSCS. The Gruen zones and De Lee and Charnley zones were noted for sites with increased uptake on BSCS. For each zone, an uptake ratio (UR) was measured as uptake intensity in counts/1.8 cm3 divided by a background uptake value of half the average uptake at the iliac crests, and a pixel value ratio (PVR) was obtained from dividing the average pixel value by a background pixel value of the adjacent normal bone-prosthesis or cement-prosthesis (BPCP) interface. Qualitative and quantitative grades were applied to sites of increased uptake on BSCS and areas of increased bone formation on PR.

RESULTS

In each case, UR on BSCS and PVR on PR were increased at each patient-reported site of pain upon evaluation with both qualitative and quantitative grading. The pain location had concordance rates of 83.3% with the zone of greatest PVR (10/12 cases) and 83.3% with the zone of highest UR (10/12 cases). The concordance rate between the zone of greatest PVR and the zone of greatest UR was 83.3%. Focal areas of increased bone formation/density on PR in the BPCP interface were noted

contralateral to the side of the prosthesis with loosening with BSCS demonstrating increased uptake in a pattern of prosthesis loosening.

CONCLUSION

Each patient-reported site of pain demonstrated increased uptake on BSCS and increased pixel value on PR. Focal areas of increased bone density contralateral to periprosthetic loosening sites may suggest loosening in the absence of the characteristic greater-than-2-mm radiolucent zone at the BPBC interface and be an earlier radiographic indication of loosening.

CLINICAL RELEVANCE/APPLICATION

Correlations between findings on BSCS and PR may help overcome interpretive challenges on either modality alone, important when only one modality is available.

SSQ14-09 F-18 FDG PET Trumps MRI on PET MRI evaluation of Diabetic Pedal Osteomyelitis

Thursday, Nov. 30 11:50AM - 12:00PM Room: S504CD

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PURPOSE

The purpose of this study is to evaluate the relative senstivity of PET and MRI in diabetic osteomyelitis of foot as detected on PET MRI and confirmed by histopathological correlation.

METHOD AND MATERIALS

Retrospective evaluation of PET MRI imaging and correlation with histopathology was performed on 12 consecutive cases of suspected diabetic pedal osteomyelitis. On MRI imaging signal abnormalities were clasified as grade 0 (normal), grade I (edema) and grade II (confluent T1 hypointense signal).Grade II signal was diagnosed as osteomyelitis. Focal abnormal FDG uptake in the bones on PET was diagnosed as osteomyelitis. Of the 12 patients 10 (83.3%) had histopathological confirmation from surgery.

RESULTS

Ten of the twelve patients (83.3%) had osteomyelitis diagnosed on PET MRI which was confirmed at pathology (100% specificity). The two patients without evidence of osteomyelitis on PET MRI who were followed up were concluded not to have osteomyeltis according to clinical end points. Of the ten patients all ten had abnormal FDG uptake (100% senstivity FDG) localizing to bone. Only 7 of the 10 had MRI signal abnormalities Grade II represeneting osteomyelitis (70% senstivity MRI).Sites of pedal osteomyelitis included distal phalanges (N=6), tarsals (N=2), metatrasal (N=3) and calcaneus (N=1). Three of the ten patients had focal abscesses in the soft tissues.

CONCLUSION

FDG PET abnormalities on PET MRI are more senstive than MRI component for detection of diabetic osteomyeltis of the foot. Localisation to the bone however is only possible because of the simultaneous MRI accquistion which makes it an invaluable component of this modlaity.

CLINICAL RELEVANCE/APPLICATION

Diabetic osteomyelitis of the foot is a common problem that has significant clinical ramifications. Diagnosing osteomyelitis in diabetic foot especially on MRI and CT is complicated by preexisting chronic bony changes from neuropathy and non healing ulcers. Magnetic Resonance Imaging (MRI) is a useful modality for diagnosis of osteomyelitis and is more sensitive than CT. FDG PET is a very senstive modality for diagnosing osteomyelitis however in PET alone or PET CT anatomcal localisation to the bone is not optimal, a problem that is remedied by excellent anatomical detail on MRI. PET MRI serves as a one stop investigation for evaluation of osteomyeltis in diabetic foot.

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SSQ17

Science Session with Keynote: Pediatrics (Neuroradiology)

Thursday, Nov. 30 10:30AM - 12:00PM Room: S103CD

MR NR PD

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

FDA Discussions may include off-label uses.

Participants
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Daniela Prayer, MD, Vienna, Austria (*Moderator*) Nothing to Disclose

Sub-Events

SSQ17-01 Pediatrics Keynote Speaker: Pediatric Neuroimaging in the Age of Precision Medicine

Thursday, Nov. 30 10:30AM - 10:40AM Room: S103CD

Participants
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SSQ17-02 Association of Childhood Obesity with the Central Nervous System (CNS): Study of Diffuse Tensor Imaging (DTI)

Thursday, Nov. 30 10:40AM - 10:50AM Room: S103CD

Participants
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PURPOSE

The aim of this work is to investigate the influence of childhood obesity on changes in anatomy and cerebral connectivity, using the DTI by Magnetic Resonance Imaging (MRI). The hypothesis is that the brain is an organ also affected by high adiposity, particularly the hypothalamus, which is a complex region involved in the regulation of appetite and hormonal homeostasis.

METHOD AND MATERIALS

The images were obtained on Achieva 3T Phillips Magnetic Resonance. The sample for statistical analysis consisted of 120 subjects: 59 obese adolescents and 61 healthy adolescents, aged 11 years to 18 years, and matched regarding gender, age, and schooling. The images were processed with the FSL-Tbss (Tract Based Spatial Statistics) program and analyzed statistically by the same program with Randomize.

RESULTS

Statistical analysis showed decrease in the values of Fractional Anisotropy (FA) of obese pediatric patients compared with healthy controls in amygdala, hippocampus, thalamus, cingulate gyrus, fornix, insula, putamen, orbital gyrus and bilateral hypothalamus. There was no region of higher FA in obese patients in relation to the control group.

CONCLUSION

The data reveal a pattern of involvement in important regions in the control of appetite and emotions. Limbic structures, such as amygdala, hippocampus, thalamus, cingulate gyrus, fornix and insula are altered. Important regions related to impulse control, reward and pleasure in eating (putamen and orbital gyrus) and autonomic appetite control (bilateral hypothalamus) were also shown to have decreased FA.

CLINICAL RELEVANCE/APPLICATION

Childhood obesity is a subject of high clinical importance, and presents data of ascent from 10 to 40% of the last 10 years in most countries. Previous studies have pointed to obesity as a risk factor for neurodegenerative disorders through DTI tractography. In this way, we investigated previous or early cerebral changes in obesity.

SSQ17-03 Voxel-Based Morphometry (VBM) and Tract-Based Spatial Statistics-Diffusion Tensor Imaging

(TBSS-DTI) in Rett Syndrome: Alterations in Visuomotor Areas and Limbic System

Thursday, Nov. 30 10:50AM - 11:00AM Room: S103CD

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PURPOSE

Rett syndrome (RTT) is a neurodevelopmental disorder presenting with loss of motor and speech abilities, stereotypic movements, gait disturbance, autistic behavior and seizures. We aimed to investigate underlying morphometric and white matter (WM) changes in patients with RTT using MRI.

METHOD AND MATERIALS

IRB approved this study and all the participants/ parents gave signed consent form. T1-weighted 3D images (MPRAGE) (TR/TE/TI: 1910/3,5/1100ms) and diffusion tensor imaging (DTI) of the brain along 60 non-collinear directions (TR/TE: 5814 /98 ms, bmax:1000s/mm2) were obtained from 15 female patients with classical Rett syndrome and MECP2 mutation, and 14 healthy age and sex-matched subjects (median ages, 3.99 and 5.08 respectively; p>0.95). We used SPM12 for voxel-based morphometry (VBM) and TBSS, a part of FSL 4.0 software package for voxel-wise statistical DTI analysis. From VBM analysis, segmented GM, WM and CSF volume, total intracranial volume (TIV), and normalized volumes by diving to TIV were measured. Statistically significant clusters in VBM and TBSS-FA map (all, FEW correction, p<0.05) were determined using MNI atlas.

RESULTS

Although GM, WM, CSF volumes were significantly smaller in patients (p<0.02), the significance didn't remain in comparison of normalized volumes (p>0.1). Patients showed significantly reduced WM density in frontal and parieto-occipital areas related with visuomotor coordination, sensorimotor areas and cognition; also significantly less GM density in superior and middle temporal gyri and left prefrontal cortex (p<0.05). Patients showed reduced FA in the cerebellar hemispheres, corpus callosum, inferior frontooccipital fascicles, anterior thalamic radiations, thalami, external capsules, fornices, cinguli, superior longitudinal fascicles (p<0.05).

CONCLUSION

When normalized to TIV, no significant volume loss was observed in patients with RTT. VBM and TBSS-DTI revealed mostly WM density and FA reductions in bilateral visuomotor areas and limbic system components such as cingulum and fornices related with cognition, behavior and seizures.

CLINICAL RELEVANCE/APPLICATION

Multimodal neuroimaging link structural and connectivity alterations related with diverse clinical features in patients with RTT.

SSQ17-04 Preterm Neonates Show a 'Catch-Up' Pattern toward Term in Motor Development during the Neonatal Period: A Diffusion Tensor Imaging Study

Thursday, Nov. 30 11:00AM - 11:10AM Room: S103CD

Participants
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PURPOSE

To detail the postnatal trajectory of neonatal sensorimotor functions by comparing the postnatal age-related changes of brain white matter (WM) microstructure and neurobehavioral abilities between preterm and term neonates during the neonatal stage.

METHOD AND MATERIALS

118 neonates (within 28 days after birth) with no abnormality who underwent conventional MRI and DTI were included (Table1). The DTI-derived fractional anisotropy (FA) and neonatal neurobehavioral assessment were separately used to characterize the brain WM microstructure and neurobehavioral development levels. The scatterplot with linear fitting was used to investigate the relations of FA and neurobehavioral scores (active tone and behavior) with postnatal age (day), setting gestational age (GA) as a covariate. Here, OR (optical radiation), AR (auditory radiation), CST (corticospinal tract), PTR (posterior thalamic radiation) and thal-PSC (thalamus-primary somatosensory cortex) were selected as regions of interest; active tone and behavior were used to separately evaluate the abilities of motor and integrated visual, auditory and sensory. All statistical analysis were performed by using Matlab; p<0.05 was considered as statistically significant difference.

RESULTS

Significant correlations of adjusted FA with postnatal age were found in preterm CST (p=0.042), term OR (p=0.018) and PTR

Significant correlations of adjusted FA with postnatal age were found in preterm CST ($p=0.042$), term OR ($p=0.018$) and PTR ($p=0.002$). Compared to term neonates, preterm showed an obviously higher correlation in CST (0.29 vs 0.08), while less correlations in visual, auditory and somatosensory-associated WMs (Figure 1). Being relatively consistent, neurobehavioral results indicated that preterm neonates presented relatively higher and lower correlations than term in active tone (0.48 vs 0.35) and behavior scores (0.36 vs 0.52), respectively (Figure 2).

CONCLUSION

Although being delayed, preterm neonates show a 'catch-up' pattern toward the term in motor development during the neonatal period.

CLINICAL RELEVANCE/APPLICATION

Postnatal trajectory of neonatal sensorimotor function e.g. preterm 'catch-up' motor development provide valuable references in guiding the early intervention and thus gaining more effective outcomes.

SSQ17-05 Visually Accessible Rembrandt Imaging (VASARI) Features Predict Survival and Identify Distinct Groups of Pediatric High Grade Glioma

Thursday, Nov. 30 11:10AM - 11:20AM Room: S103CD

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PURPOSE

To understand the relationship of Visually Accessible Rembrandt Imaging (VASARI) features to prognosis and disease subgroups in pediatric high grade glioma (pHGG).

METHOD AND MATERIALS

Seventy one consecutive cases of newly diagnosed pHGG were systematically reviewed and scored for VASARI features by two expert radiologists. Agreement between reviewers was scored for each VASARI feature. The inter-correlation between VASARI features and impact on hierarchical clustering of patients were evaluated. The distance between variables is as follows; Pearson correlation was used among the continuous variables, Kendall's correlation was used among binary/ordinal variables, and Spearman correlation was used between continuous variables and binary/ordinal variables. Pearson correlation was used to measure the distance between subjects. The number of clusters was determined using the hybrid method proposed by Langfelder and Zhang (2008). Patient clusters were evaluated for their subgroup specific survival. Analyses were completed in either SAS v9.3 or R 3.3.3.

RESULTS

The median concordance between reviewers for VASARI features was 60% (range, 29-79%). The most concordant features include tumor location, diffusion characteristics, and pial invasion, while the most discordant features were ependymal invasion, proportion of non-contrast enhancing tumor (nCET), and proportion of edema. Univariate cox proportional hazards analysis identified hemorrhage (HR 5.6, 95% CI 1.1-28.2, p=0.035), nCET crossing midline (HR 2.5 95% CI 1.2-5.2, p=0.048), and size (HR 1.15 95% CI 1.01-1.33, p=0.05) as features which increased the hazard for progression. Hierarchical clustering identified 5 patient subgroups with distinctive correlated imaging features and varied survival.

CONCLUSION

VASARI features require refinement in their definition before broad acceptance for pHGG. Some features may be prognostic at diagnosis, and may aid further risk classification beyond classic clinical and pathologic factors.

CLINICAL RELEVANCE/APPLICATION

VASARI features may be prognostic and identify distinct populations in pHGG.

SSQ17-06 Post Treatment DSC-MRI is Predictive of Early Treatment Failure in Children with Supratentorial High-Grade Glioma Treated with Erlotinib

Thursday, Nov. 30 11:20AM - 11:30AM Room: S103CD

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PURPOSE

The role of perfusion imaging in the management of pediatric high grade glioma is unclear. We evaluated the ability of DSC-MRI to determine grade, evaluate post-treatment response and predict treatment failure.

METHOD AND MATERIALS

Twenty-two patients with high-grade glioma underwent biopsy and were treated with concurrent and sequential radiotherapy and erlotinib as part of a phase I/II clinical trial (NCTXXXX). Pre-, immediate post-radiotherapy, 6-month, and treatment failure DSC MR images were reviewed, registered, and processed for the ratio of CBF and CBV. Processed, derived perfusion, and T1WI, T2WI, and FLAIR MRI sequences were used for segmentation and extraction of tumor perfusion parameters at all time-points. Patient, tumor, treatment, and outcome data were summarized and related to perfusion data.

RESULTS

Regional CBF in tumors increased from diagnosis to post radiotherapy, while they decreased to levels below those at diagnosis from post radiotherapy to 6-month follow up. At 6 months, the median regional CBF was higher in tumors that progressed (median, 1.16) than in those that did not (median, 0.95;P< .05). Patients with CBF ratios above 1.4 at diagnosis had shorter survival times relative to CBF ratios below 1.4 (P= .77). Tumors with a regional CBV above 1.15 at the post-radiotherapy (1- to 3-month) follow-up scan were associated with an earlier time to death than that of tumors with a CBV below 1.15 (P< .05).

CONCLUSION

Post-treatment perfusion characteristics are prognostic and may predict survival. Perfusion MRI is useful for managing pediatric high-grade glioma and should be incorporated into future trials.

CLINICAL RELEVANCE/APPLICATION

DSC-MRI is recommended in the evaluation of treatment response in pediatric patients with high grade glioma

SSQ17-07 Differentiation of Medulloblastoma and Astrocytoma in Children Using Histogram Analysis of Enhancement MRI

Thursday, Nov. 30 11:30AM - 11:40AM Room: S103CD

Participants
Weijian WANG, Zhengzhou, China (*Presenter*) Nothing to Disclose
Jingliang Cheng, MD,PhD, Zhengzhou, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the diagnostic value of the histogram analysis derived from enhancement MR imaging in differentiating medulloblastomas from astrocytomas.

METHOD AND MATERIALS

Retrospective analysis of 47 patients which were pathologically confirmed posterior fossa tumors, including 29 cases of medulloblastoma,18 cases of astrocytoma.Drawing the region of interest(ROI) on the maximum level of enhanced MR sagittal image and going on histogram analysis,these two steps are all performed on the software named Mazda.Performed a statistical analysis on the histogram parameters to find out the characteristics of the significant differences between the two groups.

RESULTS

In the 9 parameters which are extracted from histogram,C99 has the statistical significance.The maximum area under the ROC curve was 0.85.The optimum C99 to distinguish medulloblastomas from astrocytomas was 176.5(76% specificity and 61% sensitivity).

CONCLUSION

Histogram analysis of enhancement MR imaging can provide reliably objective basis for differentiating medulloblastomas from astrocytomas.

CLINICAL RELEVANCE/APPLICATION

Histogram analysis of enhancement MR imaging is a new method,can provide reliably objective basis for differentiating medulloblastomas from astrocytomas.

SSQ17-08 Diagnostic Accuracy of MRI Perfusion (DSC) to Determine Grades and Types of Pediatric Primary Brain Tumors: A Multiparametric Approach

Thursday, Nov. 30 11:40AM - 11:50AM Room: S103CD

Participants
Simona Gaudino, MD, Rome, Italy (*Presenter*) Nothing to Disclose
Matia Martucci, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Annibale Botto, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Marco Gessi, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Federica Mazio, MD, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Luca Massimi, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Massimo Caldarelli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Giuseppe M. Di Lella, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Emanuela Ruberto, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Antonia Ramaglia, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Amato Infante, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Cesare Colosimo, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The goal of this prospective study was to assess the diagnostic accuracy of multiple parameters from dynamic susceptibility contrast (DSC) perfusion, in the distinction of pediatric brain tumor grades and types.

METHOD AND MATERIALS

A retrospective blinded review of 53 histologically proven pediatric brain tumors with DSC perfusion was performed independently by two neuroradiologists. Tumors were categorized by grade and by histological. Maximum rCBV (rCBVmax), Percentage Signal Recovery (PSR) and Contrast Leakage Patterns (CLP) were measured from manual ROI placement for each reviewer and averaged. Results from all three analyses were compared to WHO grade and tumors type. Multivariate statistical analysis was performed to evaluate the diagnostic accuracy of single and combined perfusion parameters, and of single parameters to distinguish the different groups.

RESULTS

rCBVmax demonstrated a positive correlation with tumor grade, but limited specificity for tumors type. PSR and CLP demonstrated a positive correlation with tumor type when tumors were grouped by astrocytic and non-astrocytic. The highest diagnostic accuracy for tumor grading and typing was obtained using all three perfusion parameters. Pilocytic astrocytomas demonstrated a peculiar perfusional pattern: rCBV<1.6, high PSR and T1-dominant leak.

CONCLUSION

Multiparametric MR imaging can be accurate in determining tumor grades and types (mainly pilocytic astrocytomas and embryonal tumors) in children.

CLINICAL RELEVANCE/APPLICATION

Perfusion MRI is of utility to increase diagnostic accuracy for adult brain tumor. In pediatric population the heterogeneity of tumors need more than one perfusion parameter to gain an higher sensitivity and specificity for grading and distinguishing brain neoplasms

SSQ17-09 MRI Surrogates of Molecular Subgroups in Pediatric Atypical Teratoid / Rhabdoid Tumor

Thursday, Nov. 30 11:50AM - 12:00PM Room: S103CD

Participants
Annika Hohm, Wuerzburg, Germany (*Presenter*) Nothing to Disclose
Johannes Nowak, MD, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Martin Hasselblatt, Munster, Germany (*Abstract Co-Author*) Nothing to Disclose
Karolina Nemes, Augsburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael C. Fruhwald, Augsburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Monika Warmuth-Metz, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

annika.hohm@stud-mail.uni-wuerzburg.de

PURPOSE

Recent research identified new molecular subgroups in atypical teratoid / rhabdoid tumor (AT/RT). MRI characteristics of AT/RT have not yet been analyzed according to molecular parameters. We aimed to identify morphological features that may help predict molecular subgroups by means of MRI.

METHOD AND MATERIALS

A total of 43 consecutive patients with known molecular subtyping (AT/RT-TYR n=16, -SHH n=17, -MYC n=10) were obtained from the EU-RHAB register. We analyzed epidemiologic and standardized imaging parameters as well as meningeal dissemination status. Statistical analysis between molecular subgroups was performed by Mann-Whitney U test and chi-squared test.

RESULTS

In contrast to distinct origin (supra-/infratentorial, p=.002) of molecular AT/RT subgroups, a midline/off-midline localization was not significantly different. Typical cysts in the tumor periphery were found most frequently in AT/RT-TYR (p=.012). There was a tendency (p=.052) to strong contrast enhancement in AT/RT-TYR and AT/RT-MYC, whereas enhancement was absent in almost one third of -SHH tumors. Patient age and gender as well as tumor volume and visible meningeal dissemination were not significantly different between molecular subgroups.

CONCLUSION

This is the first study that describes and compares MR imaging features according to molecular subgroups in pediatric AT/RT. In contrast to previous studies, we show that an off-midline location is not specific for infratentorial AT/RT. Peripheral cysts and/or a band-like 'wavy" enhancement, if present, are important characteristics to differentiate AT/RT from other tumor entities in children < 3 years of age. These findings could be observed throughout all molecular subgroups, but with different frequencies. Correlation of initial MR imaging features with clinical outcome might be of great interest for individual risk assessment and patient stratification.

CLINICAL RELEVANCE/APPLICATION

Beyond typical anatomical distribution of molecular subgroups, we identified morphological parameters that may help to differentiate pediatric AT/RT with MR imaging.

MSCB51

Case-based Review of Breast (An Interactive Session)

Thursday, Nov. 30 1:30PM - 3:00PM Room: S406A

BR MR US

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

Participants
Jiyon Lee, MD, New York, NY (*Director*) Nothing to Disclose

For information about this presentation, contact:

Jiyon.Lee@nyumc.org

LEARNING OBJECTIVES

1) Identify appropriate application of multimodality breast imaging for routine screening, supplemental screening, and diagnostic indications. 2) Select appropriate methods for image-guided percutaneous biopsy and perform post-biopsy radiologic-pathologic correlation for next management recommendation. 3) Review appropriateness criteria and performance benchmarks, and guidelines for ongoing breast imaging audits.

ABSTRACT

Our case-based review course will use the interactive audience response system (ARS) to walk and skip through the fundamentals of breast imaging. We will present how we use mammography, ultrasound, and MRI in daily screening and diagnostic scenarios, along with reminders of overarching principles of ACR appropriateness criteria and performance metrics. Our international faculty (sessions 1 and 2) will also add depth, and the fun added dimensions of how breast imaging works around the world. Varying breast cancer statistics, possible innate ethnic variations, differing cultural expectations and socioeconomic context can and do impact how we carry out our discretionary work. Such interesting details will inform the narrative of the speakers' case scenarios, while the core diagnostic radiology skills aim to be constant, and teachable. The focus is using lots of cases to demonstrate breast imaging now and evolving. Please join us for smart tun!

Sub-Events

MSCB51A Mammography and Ultrasound: Appropriateness Criteria and Performance Measures in the United States

Participants
Priscilla J. Slanetz, MD, MPH, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

pslanetz@bidmc.harvard.edu

LEARNING OBJECTIVES

1) Discuss the appropriate indications for screening and diagnostic mammography for symptomatic and asymptomatic patients. 2) Describe the target metrics of performance for interpretation of mammography and breast ultrasound in the United States. 3) Understand the components of the MQSA audit and their implications for clinical practice. 4) Preview emerging imaging tools for which performance metrics have yet to be established and discuss their potential clinical utility.

MSCB51B Screening and the Rest: Use the Tools You've Got

Participants
Jean M. Seely, MD, Ottawa, ON (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jeseely@toh.ca

LEARNING OBJECTIVES

1) Recognize the fundamental tools available to evaluate screening mammography performance. 2) Understand the target metrics of performance in the Canadian screening mammography program. 3) Identify some practical educational methods to help improve screening mammography performance. 4) Perform a basic audit of a screening mammography program.

ABSTRACT

This course will provide basic information about performance metrics used in the Canadian population based screening program and show how these metrics can be applied to help improve performance with an educational approach. Using a case-based approach the course will provide practical ways for evaluating and improving performance in screening mammography.

MSCB51C Breast MRI Cases: Appropriateness Criteria and Performance Measures in the United States

Participants

Peter R. Eby, MD, Seattle, WA (*Presenter*) Consultant, Leica Biosystems Nussloch GmbH

For information about this presentation, contact:

peter.eby@virginiamason.org

LEARNING OBJECTIVES

1) Recognize and discuss the appropriate and inappropriate indications for breast MRI in the United States. 2) Understand the target metrics of performance for individuals and groups reading breast MRI in the United States. 3) Perform a basic audit of a breast MRI program and interpret the results. 4) Discuss the risks and benefits of breast MRI in terms of general test performance with patients.

Active Handout:Peter R. Eby

http://abstract.rsna.org/uploads/2017/17000531/Active MSCB51C.pdf

MSCB51D Breast MRI in Netherlands and Europe

Participants
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research agreement, Siemens AG; Research agreement, Seno Medical Instruments, Inc; Research agreement, Identification Solutions Inc; Research agreement, Micrima Limited; Scientific Advisor, ScreenPoint Medical BV

LEARNING OBJECTIVES

1) Have a feeling for the breast radiology within the Netherlands and Europe and the varying use of guidelines. 2) Discuss the patient information to women prior to breast MRI. 3) Understand the use and indications for breast MRI in Europe. 4) Describe common European protocols for breast MRI.

ABSTRACT

This session will provide insight in the European use of breast imaging with a specific focus on breast MRI

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RC703

Imaging of Atherosclerosis

Thursday, Nov. 30 4:30PM - 6:00PM Room: E353B

CA VA CT MI MR

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

FDA Discussions may include off-label uses.

Participants
John J. Carr, MD, MS, Nashville, TN (*Moderator*) Nothing to Disclose

Sub-Events

RC703A The Biology and Molecular Imaging of Atherosclerosis

Participants
Pamela K. Woodard, MD, Saint Louis, MO (*Presenter*) Research agreement, Siemens AG; Research, Eli Lilly and Company; Research, F. Hoffmann-La Roche Ltd; ; ; ; ;

For information about this presentation, contact:

woodardp@mir.wustl.edu

LEARNING OBJECTIVES

1) Discuss the initiation of the atherosclerotic disease process, including chemical, mechanical and immunological factors. 2) Discuss the molecular biology of atherosclerosis and cellular mechanisms involved in plaque remodeling, progression, instability and repair. 3) Discuss potential molecular targets in atherosclerosis imaging.

RC703B MR Imaging of Atherosclerosis

Participants
Chun Yuan, PhD, Seattle, WA (*Presenter*) Research Grant, Koninklijke Philips NV; Consultant, BGI; ;

For information about this presentation, contact:

cyuan@u.washington.edu

LEARNING OBJECTIVES

1) Identify the clinical goals of MRI of atherosclerosis, describe the critical information needed for imaging atheorsclerosis at different vascular beds; 2) Explain the technical need and challenges in imaging atherosclerosis; 3) Assess current approaches and applications and future directions.

RC703C CT Imaging of Atherosclerosis

Participants
Pal Maurovich-Horvat, MD, PhD, Pecs, Hungary (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

p.maurovich-horvat@cirg.hu

LEARNING OBJECTIVES

1) Discuss the morphologic characteristics of vulnerable plaques on coronary CT angiography images, including positive remodelling, low-attenuation and napkin-ring sign. 2) Discuss comprehensive plaque assessment strategies. 3) Discuss the potential link between plaque features and lesion specific ischemia. 4) Discuss novel radiomic techniques for atherosclerotic plaque assessment.

ABSTRACT

The quest to identify vulnerable patients and predict acute coronary events on an individual atherosclerotic coronary plaque level remain to be the greatest challenges of modern cardiovascular imaging. Current guidelines focus on the detection of significant coronary artery stenosis that causes symptoms and myocardial ischemia, but not on the detection, characterisation and quantification of atherosclerotic lesions. This strategy ignores the fact that >50% of those who die suddenly due to acute coronary events lack prior clinical symptoms related to coronary artery disease. It has been demonstrated by post-mortem investigations that majority of acute coronary syndromes are caused by plaque rupture and subsequent sudden luminal thrombosis. Rupture prone atherosclerotic lesions have been termed as vulnerable plaques, which have a distinct characteristics from stable lesions. The differences in morphology, functional and metabolic characteristics provide unique opportunity for non-invasive coronary imaging to identify these lesions before they cause acute events. Moreover, it has been demonstrated that on a patient level the total quantity of plaques (i.e. plaque burden) has a strong predictive value for myocardial infarction. Therefore, it seems that the assessment of coronary plaque morphology and plaque burden are potentially more important in prediction of these devastating events than the detection of luminal stenosis. Coronary computed tomography angiography is a unique imaging technique that allows for the non-invasive depiction of the global coronary plaque burden, not just the individual plaques and luminal stenoses.

RC704

Sports MRI - Arthroscopy Correlation

Thursday, Nov. 30 4:30PM - 6:00PM Room: E450A

MR MK

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

Participants
William E. Palmer, MD, Boston, MA (*Director*) Nothing to Disclose

LEARNING OBJECTIVES

1) Compare MRI and arthroscopic findings. 2) Illustrate sports-related MRI abnormalities. 3) Discuss arthroscopic diagnoses and treatments.

Sub-Events

RC704A Hip: Labral Tears and Femoroacetabular Impingement

Participants
Soterios Gyftopoulos, MD,MSc, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

Soterios.Gyftopoulos@nyumc.org

LEARNING OBJECTIVES

1) Review the MR imaging appearance of common hip pathologies, such as labral tears and femoroacetabular impingement. 2) Identify the clinically relevant MR imaging findings that are important in terms of hip arthroscopy planning. 3) Correlate arthroscopic and MRI evaluations of common hip pathologies.

RC704B Knee: Ligaments and Menisci

Participants
Lawrence M. White, MD, FRCPC, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the etiologic mechanisms and MR imaging appearance of meniscal and cruciate ligament injuries in the knee. 2) Identify MR imaging findings of importance in triage and pre-surgical planning for knee arthroscopy. 3) Correlate MRI and arthroscopic evaluation of the menisci and cruciate ligaments of the knee.

RC704C Shoulder: Labrum and Instability

Participants
William E. Palmer, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Illustrate labral tears in the shoulder. 2) Describe signs of glenohumeral instability. 3) Correlate MRI and arthroscopic findings.

RC704D Shoulder: Rotator Cuff and Impingement

Participants
Michael J. Tuite, MD, Madison, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Assess the rotator cuff on MR and distinguish normal findings from tendinosis and tears. 2) Practice viewing the appearance of rotator cuff tears on arthroscopic videos and correlate with MR findings. 3) Apply the MR/Arthroscopy correlation knowledge to improve accuracy for interpreting the rotator cuff on MR.

RC704E Wrist and Elbow

Participants
Maha Torabi, MD, Winston Salem, NC (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

mtorabi@wakehealth.edu

LEARNING OBJECTIVES

1) Discuss elbow and wrist arthroscopy setup. 2) Correlate osseous and ligamentous anatomy on MR and arthroscopy images. 3) Correlate common pathology on MR and arthroscopy images. 4) Discuss common arthroscopic interventions.

ABSTRACT

Elbow arthroscopy has been performed since the 1980s. It has made diagnosis, treatment, and recovery from surgery easier and faster than was once thought possible. Major indications for elbow arthroscopy include lateral epicondylitis, osteochondral lesions, ligament repair, inflammatory arthropathies and osteoarthritis. Common arthroscopic interventions including extensor carpi radialis brevis release, loose body removal, synovectomy, lateral collateral ligament repair and chondroplasty. Since its introduction in 1979, wrist arthroscopy has continuously evolved as a diagnostic and therapeutic tool. With advances in arthroscopy, new classification schemes are being introduced for various osseous and soft tissue wrist disorders. Common osseous pathology indications include fracture management and Kienbock's disease. Common soft tissue pathology indications include assessment of triangular fibrocartilage complex (TFCC) lesions, evaluation of carpal instability with dynamic maneuvering to assess scapholunate (SL) and lunotriquetral (LT) ligament injuries, evaluation and treatment of chondral lesions, resection of synovitis and scar tissue in cases of radiocarpal arthritis, ganglion excisions, and release of contractures. The goal of this presentation is to provide a primer for any radiologist interested in correlating Magnetic Resonance (MR) and arthroscopy images of the elbow and wrist joints.

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RC715

BIRADS-Difficult Cases (Interactive Session)

Thursday, Nov. 30 4:30PM - 6:00PM Room: E451B

BR MR US

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

Participants
Cherie M. Kuzmiak, DO, Chapel Hill, NC (*Moderator*) Nothing to Disclose

Sub-Events

RC715A Mammography

Participants
Carol H. Lee, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize situations in which choosing the appropriate BI-RADS assessment may difficult. 2) Learn how to assign the appropriate BI-RADS assessment for cases in which the assessment and management may not be concordant. 3) Apply principles of BI-RADS assessment to difficult cases.

RC715B Ultrasound

Participants
Rachel F. Brem, MD, Washington, DC (*Presenter*) Board of Directors, iCAD, Inc; Board of Directors, Dilon Technologies, Inc; Stock options, iCAD, Inc; Stockholder, Dilon Technologies, Inc; Consultant, Dilon Technologies, Inc; Consultant, ClearCut Medical Ltd; Consultant, Delphinus Medical Technologies, Inc

For information about this presentation, contact:

rbrem@mfa.gwu.edu

LEARNING OBJECTIVES

1) Appropriately use BIRADS descriptors for breast lesions using ultrasound. 2) Assess lesion characteristics to appropriately assign BIRADS for breast lesions. 3) Identify appropriate and inappropriate use of ultrasound for challenging cases. 4) Access resources to assist with challenging cases for the appropriate use of BIRADS for ultrasound.

ABSTRACT

This presentation will discuss challenging ultrasound cases and how to appropriately assess the BIRAD categories. Examples of appropriate and inappropriate cases will be presented using an interactive, audience participation format.

RC715C MRI

Participants
Bonnie N. Joe, MD, PhD, San Francisco, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

bonnie.joe@ucsf.edu

LEARNING OBJECTIVES

1) Be able to apply a systematic approach to using MRI BI-RADS. 2) Recognize the similarities between BI-RADS for MRI and mammography. 3) Recognize situations where a BI-RADS assessment is not used for MRI.

ABSTRACT

Breast MRI BI-RADS follows a systematic approach analogous to mammography BI-RADS. BI-RADS includes three important components: (a) a lexicon of descriptors, (b) a reporting structure to include final assessment categories and management recommendations,and (c) a framework for data collection and auditing. This session will use an interactive format (audience response system) to review appropriate use of BI-RADS for breast MRI interpretation including scenarios where BI-RADS assessments are not appropriate.

RC718

Challenging Cases in Body Oncologic Imaging (An Interactive Session)

Thursday, Nov. 30 4:30PM - 6:00PM Room: E351

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

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. *This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.*

ABSTRACT

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC718A 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).

RC718B 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

RC718C PET/CT

Participants
Gary A. Ulaner, MD, PhD, New York, NY (*Presenter*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd

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.

RC729

Pancreaticobiliary MR Imaging (An Interactive Session)

Thursday, Nov. 30 4:30PM - 6:00PM Room: N228

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

RC729A The Incidentally Detected Cystic Pancreatic Lesion: What to Do Next

Participants
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG

For information about this presentation, contact:

ikamel@jhmi.edu

LEARNING OBJECTIVES

1) Illustrate the imaging features of various pancreatic cysts. 2) Discuss the differential diagnosis of incidental pancreatic cysts. 3) Compare various follow up algorithms.

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/ Ihab R. Kamel, MD, PhD - 2015 Honored Educator

RC729B The Value of Secretin-Enhanced MR Imaging

Participants
Kumaresan Sandrasegaran, MD, Indianapolis, IN (*Presenter*) Consultant, Guerbet SA

For information about this presentation, contact:

ksandras@iupui.edu

LEARNING OBJECTIVES

1) To learn the rationale and technique for using secretin-enhanced MRCP (S-MRCP). 2) To understand the uses and limitations of S-MRCP in diagnosing pancreatic diseases. 3) To comprehend functional information about exocrine reserve of pancreas that may be obtained from S-MRCP.

ABSTRACT

Secretin causes temporary dilation of pancreatic ducts principally by increasing pancreatic exocrine secretions. This allows better visualization of pancreatic ducts on MRCP. In this presentation, we discuss the use of secretin-enhanced MRCP in congenital, inflammatory and neoplastic conditions of the pancreas as well as potential use in assessing pancreatic function in chronic pancreatitis and sphincter of Oddi disturbance.

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/ Kumaresan Sandrasegaran, MD - 2013 Honored EducatorKumaresan Sandrasegaran, MD - 2014 Honored EducatorKumaresan Sandrasegaran, MD - 2016 Honored Educator

RC729C MRI for Staging and Treatment Planning of Hilar Cholangiocarcinoma

Participants
Peter S. Liu, MD, Cleveland, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review important concepts for staging hilar cholangiocarcinoma, including biliary and vascular considerations. 2) Describe modern magnetic resonance imaging (MRI) techniques which can be used for preoperative evaluation of hilar cholangiocarcinoma. 3) Discuss the diagnostic accuracy and potential pitfalls of MRI for staging hilar cholangiocarcinoma with case examples.

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RC750

MR Imaging-guided Breast Biopsy (Hands-on)

Thursday, Nov. 30 4:30PM - 6:00PM Room: E260

BR MR

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

Participants
Beatriz E. Adrada, MD, Houston, TX (*Presenter*) Nothing to Disclose
Chloe M. Chhor, MD, Brooklyn, NY (*Presenter*) Nothing to Disclose
Mark J. Dryden, MD, Houston, TX (*Presenter*) Nothing to Disclose
Sarah M. Friedewald, MD, Chicago, IL (*Presenter*) Consultant, Hologic, Inc; Research Grant, Hologic, Inc;
Sujata V. Ghate, MD, Durham, NC (*Presenter*) Research Grant, Bracco Group; Reader, QT Ultrasound; Travel support, QT Ultrasound; ; ;
Richard S. Ha, MD, New York, NY (*Presenter*) Nothing to Disclose
Brian Johnston, MD, Gilbert, AZ (*Presenter*) Nothing to Disclose
Jennifer R. Kohr, MD, Seattle, WA (*Presenter*) Nothing to Disclose
Santo Maimone IV, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose
Erin I. Neuschler, MD, Chicago, IL (*Presenter*) Research Grant, Seno Medical Instruments, Inc; Speaker, Northwest Imaging Forums, Inc; Faculty, ABC Medical Education, LLC; Speakers Bureau, General Electric Company; Speakers Bureau, Anderson Publishing, Ltd;
Bethany L. Niell, MD, Tampa, FL (*Presenter*) Nothing to Disclose
Elissa R. Price, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
John R. Scheel, MD,PhD, Seattle, WA (*Presenter*) Research support, General Electric Company
Jean M. Seely, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Stephen J. Seiler, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Toma Omofoye, MD , Houston, TX (*Presenter*) Nothing to Disclose
Roberta M. Strigel, MD, MS, Madison, WI (*Presenter*) Research support, General Electric Company
Jocelyn A. Rapelyea, MD, Washington, DC (*Presenter*) Speakers Bureau, General Electric Company;
Ryan W. Woods, MD, MPH, Madison, WI (*Presenter*) Nothing to Disclose
Lizza Lebron, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Explain why MR-guided breast biopsy is needed for patient care. 2) Identify relative and absolute contraindications to MR-guided breast biopsy. 3) Describe criteria for MR-guided breast biopsy patient selection. 4) Debate risks and benefits of pre-biopsy targeted ultrasound for suspicious MRI findings. 5) Understand the basic MR-guided biopsy procedure, protocol and requirements for appropriate coil, needle and approach selection. 6) Manage patients before, during and after MR-guided breast biopsy. 7) Define the benefits and limitations of MR-guided vacuum assisted breast biopsy. 8) Apply positioning and other techniques to challenging combinations of lesion location and patient anatomy for successful MR-guided biopsy.

ABSTRACT

This course is intended to provide basic didactic instruction and hands-on experience for MR-guided breast biopsy. Because of the established role of breast MRI in the evaluation of breast cancer through screening and staging, there is a proven need for MR-guided biopsy of the abnormalities that can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls and 6) practice audits. Participants will spend 30 minutes in didactic instruction followed by 60 minutes practicing MR-guided biopsy using provided phantoms. Various combinations of full size state-of-the-art breast MRI coils, biopsy localization equipment and needles from multiple different vendors will be available for hands-on practice. Some stations will have monitors loaded with targeting software. Expert breast imagers from around the world will be at each of 10 stations to provide live coaching, tips, techniques and advice.

Active Handout:Roberta Marie Strigel

http://abstract.rsna.org/uploads/2017/4426451/Active RC750.pdf

RC804

Osteoarthritis: Beyond the Basics

Friday, Dec. 1 8:30AM - 10:00AM Room: E450A

MR MK

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

Participants
Thomas M. Link, MD, PhD, San Francisco, CA (*Director*) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, InSightec Ltd; Research Grant, InSightec Ltd; Royalties, Springer Nature; Consultant, Springer Nature; Research Consultant, Pfizer Inc;

For information about this presentation, contact:

thomas.link@ucsf.edu

LEARNING OBJECTIVES

1) To comprehend the epidemiology of osteoarthritis and the role of imaging in diagnosing osteoarthritis and evaluating its disease burden. 2) To understand the role of biomechanics in the evolution of osteoarthritis. 3) To know radiographic findings associated with osteoarthritis and what technique is best suited to evaluate osteoarthritis. 4) To be able to recognize MRI findings related to osteoarthritis and to know what MR sequences are most suitable. 5) To be familiar with new MR imaging technologies and new concepts in interpreting osteoarthritis.

SAM

New in 2017: PLEASE NOTE - All courses designated for SAM credit at RSNA 2017 will require attendees bring a personal device e.g. phone, iPad, laptop to complete the required test questions during the live session.

Sub-Events

RC804A Epidemiology of Osteoarthritis and the Role of Imaging

Participants
Leena Sharma, MD, Chicago, IL (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of MRI in the investigation of the natural history of osteoarthritis (OA). 2) Gain insight into the current state of knowledge concerning early OA disease pathogenesis, as illuminated by MRI. 3) Gain familiarity with recent studies of OA risk prediction models incorporating MRI findings. 4) Understand potential application of MRI to define presence of osteoarthritic disease.

RC804B Impact of Biomechanics on the Evolution of Osteoarthritis

Participants
Christine B. Chung, MD, La Jolla, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View Learning Objectives under main course title

RC804C Radiographic Techniques and Evaluation

Participants
Frank W. Roemer, MD, Erlangen, Germany (*Presenter*) Chief Medical Officer, Boston Imaging Core Lab LLC; Director of Research, Boston Imaging Core Lab LLC; Shareholder, Boston Imaging Core Lab LLC; ;

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To understand the challenges of radiographic acquisition in a clinical and research context. 2) To learn about the different assessment instruments currently available including semi-quantitative and quantitative approaches. 3) To gain insight into advanced radiographic assessment including bone structural analysis. 4) To understand the shortcomings of radiography as a predictor or outcome measure.

ABSTRACT

Conventional radiography remains the most commonly applied imaging technique for the evaluation of osteoarthritis (OA) in both clinical practice and research. Radiography allows the detection of OA-associated bony features such as osteopyhtes, subchondral sclerosis and cysts but has limitations in visualizing soft tissue changes. Radiography can also determine joint space width, a surrogate marker for cartilage thickness and meniscal integrity in knees, but direct visualization of these articular structures is impossible using radiographic techniques. The lack of sensitivity and specificity of radiography for the detection of most of OA-

associated articular tissue damage and its poor sensitivity to change over time are other limitations of radiography. Changes in joint positionng will affect measurment of various radiographic parameters including joint space width. Despite these limitations radiography remains to be the gold standard for establishing an imaging-based diagnosis of OA and for assessment of structural modification in clinical trials of OA.

RC804D MRI - Morphological Imaging - Techniques and Findings

Participants
Thomas M. Link, MD, PhD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, InSightec Ltd; Research Grant, InSightec Ltd; Royalties, Springer Nature; Consultant, Springer Nature; Research Consultant, Pfizer Inc;

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) To be able to apply optimized sequence protocols to MR imaging of osteoarthritis. 2) To analyze typical MRI findings related to osteoarthritis including cartilage defects, meniscal tears, bone marrow edema pattern and ligamentous abnormalities. 3) To comprehend the differential diagnosis of typical MRI findings and to be familiar with more uncommon abnormalities seen in osteoarthritis.

RC804E MRI - Compositional Imaging - Techniques and Interpretation

Participants
Hollis G. Potter, MD, New York, NY (*Presenter*) Research support, General Electric Company; Institutional research agreement, General Electric Company

LEARNING OBJECTIVES

1) To become familiar with the options for assessment of early matrix depletion in hyaline and fibrocartilage. 2) To understand the technical limitations and requirements for each of these applications. 3) To demonstrate the clinical utility of parametric mapping in clinical and research design, both to assess the rate of progression of osteoarthritis in susceptible cohorts as well as in cartilage repair.

RC804F Imaging of Synovitis and New Concepts in OA Imaging

Participants
Ali Guermazi, MD, PhD, Boston, MA (*Presenter*) President, 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

For information about this presentation, contact:

guermazi@bu.edu

LEARNING OBJECTIVES

1) To understand various ways of imaging synovitis in osteoarthritis. 2) To appreciate the limitations of radiography as an imaging tool to define an outcome for clinical trials. 3) To understand available quantitative measurement techniques in osteoarthritis. 4) To gain insight into the different phenotypes of osteoarthritis.

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/ Ali Guermazi, MD, PhD - 2012 Honored Educator

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

RC812

Peripheral Artery Disease (PAD)

Friday, Dec. 1 8:30AM - 10:00AM Room: E351

VA CT MR

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

FDA Discussions may include off-label uses.

Participants
Stephen T. Kee, MD, Stanford, CA (*Moderator*) Nothing to Disclose
Jeremy D. Collins, MD, Chicago, IL (*Moderator*) Consultant, Guerbet SA; Grant, Siemens AG; Grant, C. R. Bard, Inc

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LEARNING OBJECTIVES

1) Discuss the basic pathology of peripheral artery disease. 2) Describe the risk factors associated with the development of peripheral artery disease. 3) Outline the benefits of providing a comprehensive clinical service in the management of PVD. 4) Discuss how to build a PVD practice. 5) Describe the basic techniques employed in the treatment of PVD.

Sub-Events

RC812A Clinical Overview of PAD

Participants
Stephen T. Kee, MD, Stanford, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC812B Lower Extremity CTA

Participants
Richard L. Hallett II, MD, Stanford, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

hallett@stanford.edu

LEARNING OBJECTIVES

1) Describe techniques for patient selection, acquisition, reconstruction, and interpretation of lower extremity CTA. 2) Describe evidence-based results for lower extremity CTA, and expected impact on patient care. 3) Describe a coherent plan that integrates lower extremity CTA into cost-effective clinical care.

ABSTRACT

Peripheral arterial disease (PAD) is a common cause of morbidity and mortality in developed countries. Traditionally, imaging for risk stratification and therapeutic planning involved catheter angiography. In recent years, cross-sectional imaging by CTA and MRA has proven a robust technique for non-invasive PAD assessment. Given ubiquity of CT scanning technology, CTA is widely available. High resolution datasets can be acquired rapidly, which facilitates assessment of clinically labile or trauma patients. To be optimally effective, CTA techniques require particular attention to contrast medium and scan protocol. With appropriate protocol design, data acquisition requires limited operator dependence. The acquired 3D dataset is rich with information, but requires careful scrutiny by the interpreting physician. Volumetric review of these datasets produces the most accurate results. Extensive small vessel calcification remains a potential barrier to full assessment of pedal vessels by CTA. Recent published data validates the clinical effectiveness of CTA for diagnosis of PAD and for the direction of treatment planning. Ongoing research aims to exploit the newest generation of CT scanners to acquire additional information, including dual energy data, time-resolved information, and radiation dose savings.

Active Handout:Richard Lee Hallett

http://abstract.rsna.org/uploads/2017/13012018/Active RC812B.pdf

RC812C Lower Extremity MRA

Participants
Harald Kramer, MD, Munich, Germany (*Presenter*) Research Consultant, Bayer AG; Speakers Bureau, b.e. imaging AG

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LEARNING OBJECTIVES

1) Identify the appropriate technique for peripheral MRA depending on the available hardware and the clinical question and condition of the patient. 2) Differentiate between different contrast agents and their specific characteristics. 3) Chose between different contrast agent application schemes depending on the technique used and the clinical question. 4) Compare the pros and cons of contrast-enhanced and non contrast-enhanced techniques for peripheral MRA.

ABSTRACT

The prevalence of symptomatic peripheral artery disease (PAD) ranges around 3% in patients aged 40 and 6% at an age of 60 years. Additionally, the prevalence of asymptomatic PAD lies between 3% and 10% in the general population increasing to 15% to 20% in persons older than 70 years of age. However, these data still might underestimate the total prevalence of PAD since screening studies showed that between 10% and 50% of all patients with intermittent claudication (IC) never consult a doctor about their symptoms.These data prove the need for an accurate and reliable method for assessment of the peripheral vasculature. Digital subtraction angiography (DSA) still serves as the reference standard for all vascular imaging techniques. However, because of the absence of ionizing radiation, the use of non-nephrotoxic contrast agents or even non contrast-enhanced sequences and the large toolbox of available techniques for high-resolution static and dynamic imaging Magnetic Resonance Angiography (MRA) constitute an excellent non-invasive alternative. Different acquisition schemes and contrast agent application protocols as well as different types of data sampling for static, dynamic, contrast- and non contrast-enhanced imaging enable to tailor each exam to a specific question and patient respectively.

RC812D Endovascular Treatment of PAD

Participants
Stephen T. Kee, MD, Stanford, CA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RSNA 2017 Explore. Invent. Transform.
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RC829

Six Common Difficult Problems in GI and GU MRI: The Experts' Approach

Friday, Dec. 1 8:30AM - 10:00AM Room: E450B

GI GU MR

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

FDA Discussions may include off-label uses.

Participants
Hero K. Hussain, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the differences between extracellular and hepatobiliary contrast. 2) Explain the types of liver lesion seen on CT that may benefit from imaging with hepatobiliary contrast. 3) Limitation of CT imaging in characterization of small renal masses (with focus on discriminating benign/indolent renal tumors from aggressive renal cancer). 4) Role of MRI as a problem solving tool in characterizing cystic and solid renal masses. 5) Evolving role of MRI in renal mass (histologic) subtyping and assessment of renal tumor aggressiveness. 6) Review normal anatomy of the anal sphincter complex and surrounding pelvic structures. 7) Discuss etiology, pathophysiology and classification of perianal fistulas. 8) Correlate implication of imaging findings on disease management. 9) Familiarize themselves with MR protocol for assessment of pelvic floor dysfunction. 10) Learn techniques for improving patient cooperation for dynamic images. 11) Identify normal anatomy of anterior, middle and posterior compartments. 12) Apply reference lines and angles used in assessment of pelvic floor dysfunction. 13) Identify and grade the severity of pelvic floor relaxation. 14) Identify and grade the severity of pelvic organ prolapse. 15) Review the common causes of non obstetric pelvic pain in pregnancy. 16) Recognize the unique diagnostic and therapeutic challenges in the pregnant patient with pelvic pain. 17) Discuss the safety considerations of imaging in pregnancy. 18) Review the evolving imaging and clinical literature on appropriate investigation of acute pelvic pain pregnancy. 19) Discuss the utility of MRI as a supplement to US in the pregnant patient.

SAM

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Sub-Events

RC829A The CT Indeterminate Lesion in the Non-Cirrhotic Liver: Extracellular or Hepatobiliary Contrast-Enhanced MRI

Participants
Hero K. Hussain, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the differences between extracellular and hepatobiliary contrast. 2) Explain the types of liver lesion seen on CT that may benefit from imaging with hepatobiliary contrast.

RC829B Is MRI Needed to Further Evaluate a CT Indeterminate Renal Mass?

Participants
Hersh Chandarana, MD, New York, NY (*Presenter*) Equipment support, Siemens AG; Software support, Siemens AG; Advisory Board, Siemens AG;

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Limitation of CT imaging in characterization of small renal masses (with focus on discriminating benign/indolent renal tumors from aggressive renal cancer). 2) Role of MRI as a problem solving tool in characterizing cystic and solid renal masses. 3) Evolving role of MRI in renal mass (histologic) subtyping and assessment of renal tumor aggressiveness.

RC829C Perianal Fistulae: What Does the Surgeon Want to Know?

Participants
Mahmoud M. Al-Hawary, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review normal anatomy of the anal sphincter complex and surrounding pelvic structures. 2) Discuss etiology, pathophysiology and classification of perianal fistulas. 3) Correlate implication of imaging findings on disease management.

RC829D How Do I Perform and Interpret MRI of Pelvic Floor Weakness?

Participants
Victoria Chernyak, MD,MS, Bronx, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

vichka17@hotmail.com

LEARNING OBJECTIVES

1) Familiarize themselves with MR protocol for assessment of pelvic floor dysfunction. 2) Learn techniques for improving patient cooperation for dynamic images. 3) Identify normal anatomy of anterior, middle and posterior compartments. 4) Apply reference lines and angles used in assessment of pelvic floor dysfunction. 5) Identify and grade the severity of pelvic floor relaxation. 5) Identify and grade the severity of pelvic organ prolapse.

RC829E Is MRI the Next Step after US to Evaluate Non-Obstetric Pelvic Pain in Pregnancy?

Participants
Reena C. Jha, MD, Washington, DC (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Review the common causes of non obstetric pelvic pain in pregnancy. 2) Recognize the unique diagnostic and therapeutic challenges in the pregnant patient with pelvic pain. 3) Discuss the safety considerations of imaging in pregnancy. 4) Review the evolving imaging and clinical literature on appropriate investigation of acute pelvic pain pregnancy. 5) Discuss the utility of MRI as a supplement to US in the pregnant patient.

RC829F How Do I Perform a Diagnostic MRI in a Non-Cooperative Patient?

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

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Describe patient and technical factors that may contribute to suboptimal or nondiagnostic body MRI examinations.2) Discuss methods for reducing the impact of the above factors using clinically-available MRI techniques.

ABSTRACT

Patient motion is a major issue in abdominal MRI. Not only are some patients unable to sustain a breath-hold, but breathing motion can be unpredictable. In this talk we will discuss a variety of techniques for combating motion, including fast imaging, special k-space filling trajectories, and respiratory gating using extrinsic and intrinsic signals.

SST01

Breast Imaging (Multimodality Diagnostic)

Friday, Dec. 1 10:30AM - 12:00PM Room: E450B

BR MR

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

FDA Discussions may include off-label uses.

Participants
Mary S. Newell, MD, Atlanta, GA (*Moderator*) Stockholder, Kimberly-Clark Corporation ; Stockholder, E. I. du Pont de Nemours & Company ; Stockholder, Bristol-Myers Squibb Company; Stockholder, Merck & Co, Inc; Stockholder, Johnson & Johnson ; Stockholder, Eli Lilly and Company
Sarah M. Friedewald, MD, Chicago, IL (*Moderator*) Consultant, Hologic, Inc; Research Grant, Hologic, Inc;

Sub-Events

SST01-01 Specialized Second Opinion Interpretations of Breast Imaging: Impact on Additional Workup and Management

Friday, Dec. 1 10:30AM - 10:40AM Room: E450B

Participants
Robert J. Weinfurtner, MD, Tampa, FL (*Presenter*) Nothing to Disclose
Leena Kamat, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Yasmin Mekhail, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Emily Aguila, BS, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Bethany L. Niell, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Jennifer S. Drukteinis, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Shannon Falcon, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Patients with breast imaging often seek second opinion review at tertiary care centers. The goal of our study is to evaluate the impact of these second opinions on patient management.

METHOD AND MATERIALS

A retrospective chart review was conducted on 504 consecutive patients with second opinion radiology interpretations performed by six sub-specialized breast radiologists at a cancer center from January 1st through September 1st of 2014. Outside imaging reports were compared to second opinion reports to categorize interpretation discrepancies. Interpretations were considered discrepant in cases with a clinically relevant BI-RADS category change or identification of previously undiagnosed additional extent of disease greater than 5 cm. The frequencies of discrepant BI-RADS categorizations, clinically significant alterations in surgical management, and incremental cancer detection were measured. Statistical analyses were performed with Fisher's exact test with a p-value <0.05 considered significant.

RESULTS

Presenting diagnoses at second opinion interpretation included invasive malignancy (356), Ductal Carcinoma in Situ (78), high risk lesions (16), suspicious findings (21), probably benign findings (4), BI-RADS 0 (1), and negative or benign findings (28). Second opinions resulted in interpretation discrepancies in 287 patients (57%) and percutaneous image-guided biopsies in 94 (19%). Additional sites of cancer were detected in 48 (10%), including 13 ipsilateral and 8 contralateral breast malignancies, and 27 axillary metastases. Another 5 biopsies yielded high-risk pathology. Second opinion interpretations altered surgical management in 58 (12%) due to the detection of additional cancer, a high risk lesion at biopsy, additional extent of disease, or stage 4 disease. Factors associated with increased discrepancy frequency included diagnosis of invasive or in situ cancer at presentation (p=0.003), dense breasts (p=0.005), and the absence of prior studies available for comparison (p=0.007).

CONCLUSION

Though additional imaging and resources are required, pre-operative second opinion radiology review by subspecialized radiologists increases cancer detection and results in clinically relevant changes in patient management.

CLINICAL RELEVANCE/APPLICATION

Second opinion interpretation of breast imaging by subspecialized breast radiologists resulted in additional cancer detection in 10% and altered surgical management in 12% of patients.

SST01-02 Radiomics Signature on 3T DCE-MRI for Estrogen Receptor-Positive Invasive Breast Cancers: Preliminary Results in Predicting Oncotype DX Test Recurrence Score

Friday, Dec. 1 10:40AM - 10:50AM Room: E450B

Participants
Kyung Jin Nam, MD,PhD, Yangsan-si, Korea, Republic Of (*Presenter*) Nothing to Disclose

Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) 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
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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PURPOSE

To evaluate the ability of quantitative computer extracted imaging features on 3T dynamic contrast-enhanced (DCE) magnetic resonance imaging (MRI) to distinguish estrogen receptor (ER)-positive invasive breast cancers between the low and non-low Oncotype DX risk categories.

METHOD AND MATERIALS

Between May 2011 to March 2016, we retrospectively enrolled 67 ER-positive invasive breast cancer patients who performed preoperative 3T breast DCE-MRI and Oncotype DX assay. We divided the patients into low (Oncotype DX recurrence score [RS] <18) and non-low risk (RS >= 18) groups. Extracted radiomics features included morphological, histogram-based, and higher-order texture features. The least absolute shrinkage and selection operator (LASSO) method was used for feature selection, and radiomics signature (Rad-score) was calculated via a linear combination of selected radiomics features. Logistic regression analysis was performed to investigate the association between Oncotype DX risk groups and clinicopathologic, MR imaging, and Rad-score. Receiver operating characteristic analysis and the area under the receiver operating characteristic curve (Az) were used to assess classification performance.

RESULTS

The Rad-score was constructed for each tumor by extracting thirteen of 158 radiomics features (8.2 %). Multivariate regression analysis showed that there was a significant difference in the Rad-score between the low and non-low Oncotype DX risk groups (P = 0.001). The Rad-score was able to differentiate between low and non-low risk Oncotype DX groups with an Az of 0.822 . The significant pathologic factors in univariate analysis achieved an Az of 0.574. Addition of Rad-score to the significant pathologic factors in univariate analysis showed an Az of 0.889.

CONCLUSION

The Rad-score that incorporates the radiomics features of DCE-MRI was highly associated with the low and non-low Oncotype DX risk classifications in patients with ER-positive invasive breast cancers.

CLINICAL RELEVANCE/APPLICATION

The Rad-score could allow for non-invasively predicting which ER-positive patients might have little to no benefit from adjuvant chemotherapy.

SST01-03 Volume-Based Metabolic Parameter of Tumor on Preoperative 18F-FDG PET/CT May Predict Axillary Lymph Node Metastasis

Friday, Dec. 1 10:50AM - 11:00AM Room: E450B

Participants
Seon Young Park, MD, Suwon-si, Korea, Republic Of (*Presenter*) Nothing to Disclose
Youngjin Yoo, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Lin Kim, MD, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Doo Kyoung Kang, MD, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Taehee Kim, MD, PhD, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of our study was to evaluate the association between metabolic parameters on FDG PET/CT and axillary lymph node metastasis (ALNM) in patients with invasive breast cancer.

METHOD AND MATERIALS

From January 2012 to December 2012, we analyzed 173 patients with invasive ductal carcinoma (IDC) who underwent both initial breast MRI and 18F-FDG PET/CT examinations. All metabolic parameters were measured from the tumor volume segmented by a gradient-based method. Once the primary target lesion was segmented, maximum standardized uptake value (SUVmax), mean standardized uptake value (SUVmean), metabolic tumor volume (MTV) and total lesion glycolysis (TLG) were calculated automatically by the MIMvista software.

RESULTS

Mean age of 173 patients was 49 years old. Of 173 patients, 45 (26%) showed axillary lymph node metastasis. On univariate analysis, larger tumor size (> 2.2 cm; p=0.002), presence of lymphovascular invasion (p < 0.001), higher SUVmax (> 2.82; p=0.038), higher SUVmean (> 1.2; p=0.027), higher MTV (> 2.38; p < 0.001) and higher TLG (> 3.98; p = 0.007) were associated with a higher probability of axillary lymph node metastasis. On multivariate analysis, presence of lymphovascular invasion (adjusted odds ratio [OR], 11.053; 95% CI, 4.403-27.751; p < 0.001) and higher MTV (> 2.38) (adjusted OR, 2.696; 95% CI, 1.079-6.739; p=0.034) maintained independent significance in predicting ALNM. In subgroup analysis of T2/T3 breast cancer, lymphovascular invasion (adjusted OR, 20.976; 95% CI, 5.431-81.010; p < 0.001) and higher MTV (> 2.38) (adjusted OR, 4.906; 95% CI, 1.616-14.896; p=0.005) were independent predictors of ALNM. However in T1 breast cancer, lymphovascular invasion (adjusted OR, 16.096; 95% CI, 2.517-102.939; p=0.003) and larger SUV mean (> 1.2) (adjusted OR, 13.275; 95% CI, 1.233-142.908; p=0.033) were independent predictors while MTV was not.

CONCLUSION

MTV may be associated with ALNM in patients with invasive breast cancer, particularly T2 and T3 stages. In T1 breast cancer, SUVmean was associated with ALNM.

CLINICAL RELEVANCE/APPLICATION

Metabolic tumor volume in 18F-FDG PET/CT may be associated with axillary lymph node metastasis in patients with invasive breast cancer, particularly T2 and T3 stages.

SST01-04 Visibility of Mammographically Occult Breast Cancer on Diffusion-Weighted MRI versus Ultrasound

Friday, Dec. 1 11:00AM - 11:10AM Room: E450B

Awards
Student Travel Stipend Award

Participants
Nita Amornsiripanitch, MD, Worcester, MA (*Presenter*) Nothing to Disclose
Habib Rahbar, MD, Seattle, WA (*Abstract Co-Author*) Research Grant, General Electric Company
Averi Kitsch, BS, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Diana L. Lam, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Brett Weitzel, MD, Salt Lake Cty, UT (*Abstract Co-Author*) Nothing to Disclose
Savannah C. Partridge, PhD, Seattle, WA (*Abstract Co-Author*) Research Grant, General Electric Company

For information about this presentation, contact:

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PURPOSE

There is widespread interest in identifying an effective and affordable breast cancer screening exam that can supplement mammography. While dynamic contrast-enhanced (DCE)-MRI is highly sensitive and currently recommended for high-risk women, cost and gadolinium-related safety concerns limit its wider use. Screening ultrasound (US) can identify some mammographically-occult malignancies but is time consuming and associated with low specificity. Diffusion-weighted MRI (DWI) is emerging as a promising non-contrast technique for breast cancer detection. We sought to investigate the visibility of mammographically-occult cancers on DWI versus US.

METHOD AND MATERIALS

This IRB-approved study retrospectively evaluated patients with 3T DCE-MRI detected mammographically-occult cancers who underwent pre-biopsy targeted US (12/2010 to 12/2013). DWI was performed during clinical breast MRI exams (b= 0, 100, and 800 s/mm2). Lesion visibility on DWI was scored visually (1=isointense to 5=focal hyperintensity) by three independent readers (not blinded to DCE). DWI visibility was defined as a mean score of >=2.5. US visibility was determined from imaging reports. Clinical factors (age, breast density, lesion size, morphology, and histology) were collected, and DWI and US lesion visibility were compared across and within subgroups using McNemar's Test.

RESULTS

During the study period, 60 mammographically-occult cancers (53 invasive; 7 DCIS) were imaged by both DWI and US in 53 women (median age 53 years, range 23-75 years). Cancers ranged in size from 4 to 102mm (median, 12mm) and included 39 masses, 20 non-masses, and 1 focus. More cancers were visible on DWI (47/60, 78%) than on US (38/60, 63%; p=0.049), with 32 (53%) visible on both modalities and 7 (12%) not visible on either. Subanalyses suggested better visualization by DWI versus US in particular for larger cancers (>=1cm; p=0.011), which had a higher proportion of non-masses than smaller cancers (51% vs. 8%), and for cancers in younger women (<50years; p=0.06, trend).

CONCLUSION

Mammographically-occult breast cancers may be more visible on DWI than ultrasound. DWI continues to show promise as a cost-effective supplemental screening tool, and warrants further investigation.

CLINICAL RELEVANCE/APPLICATION

Diffusion-weighted MRI may be more sensitive than ultrasound for detecting mammographically occult cancer, and may provide a safe, fast, and affordable supplemental tool for screening women.

SST01-05 Outcomes in Patients with a Focal Area of Clinical Concern Assessed as Probably Benign on Diagnostic Imaging

Friday, Dec. 1 11:10AM - 11:20AM Room: E450B

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PURPOSE

The American College of Radiology (ACR) Appropriateness Criteria support either short-term follow-up or biopsy for women presenting with a palpable solid breast mass demonstrating probably benign (BIRADS category 3) features on imaging. To support

decision-making in this clinical scenario, we measured outcomes of BIRADS 3 cases in a large population of women presenting with a focal area of clinical concern.

METHOD AND MATERIALS

Following IRB approval, review of the electronic medical records identified 15,548 cases of diagnostic mammography with ultrasound that evaluated a focal area of clinical concern from 3/2006 to 3/2014. Each breast with one or more focal areas of clinical concern was designated as a case. Outcomes were determined by imaging, biopsy or any pathology in our hospital tumor registry at 24-month follow-up. Performance measures were defined according to the ACR BIRADS atlas, 5th edition.

RESULTS

Of the 15,548 cases, 965 (6.2%) were assessed as BIRADS 3 in 861 women (average age 47.7, range 24-89). During the 24-month follow-up, only one cancer, an invasive ductal carcinoma, was diagnosed with a cancer yield of 0.1% (1/965). In addition to the one biopsy-proven malignancy, another 29 cases underwent biopsy/tissue sampling for a positive predictive value (PPV3) of 3.3% (1/30) within the follow-up period.

CONCLUSION

The risk of subsequent breast malignancy diagnosis in patients presenting with focal areas of clinical concern assessed as BIRADS 3 is extremely low (0.1%). These findings strongly support the current ACR guidelines suggesting surveillance as a safe alternative to biopsy in these patients. Given the high likelihood of benignity and the low PPV3 (3.3%), additional research may facilitate reclassification of a subgroup of probably benign lesions as benign by imaging (BIRADS 2) with recommendation for clinical follow-up.

CLINICAL RELEVANCE/APPLICATION

Follow-up of symptomatic probably benign lesions has a low rate of malignancy, supporting the ACR guidelines with opportunity to improve stratification of benign vs. probably benign palpable masses.

SST01-06 Deep Learning through Convolution Neural Networks Using a Breast MRI Tumor Dataset Can Predict Oncotype Dx Recurrence Score

Friday, Dec. 1 11:20AM - 11:30AM Room: E450B

Participants
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PURPOSE

We hypothesize that CNNs can be used to predict Oncotype Dx Recurrence Score (RS), which is a validated, gene-expression-based, aggressiveness assay using a breast MRI tumor dataset.

METHOD AND MATERIALS

An IRB approved retrospective review of our database from 1/2010 to 6/2016 identified 134 patients with ER+/HER2- invasive ductal carcinoma who underwent both breast MRI and Oncotype Dx RS evaluation. Patients were classified to 3 groups: Low risk (group 1, RS < 18), intermediate risk (group 2, RS of 18- 30) and high risk (group 3, RS > 30). For deep learning, 134 cases were separated into 80% (107/134) training set and 20% (27/134) test set. For each breast MRI, tumor was identified on first T1 post contrast dynamic images and underwent 3D segmentation using an open source software platform 3D Slicer. Then, 32x32 patch was extracted from the center slice of the segmented tumor data. A CNN was designed for Oncotype DX class prediction based on each of these cropped images. In brief, CNN consisted of 4 convolution layers, max-pooling layers and dropout of 0.25 after each convolution layer. Two models were created, one for three class Oncotype Dx prediction (group 1, group 2 or group 3) and a second for two class prediction (group 1 vs. group 2 and group 3). Code was implemented in open source software Keras with TensorFlow on a Linux workstation with NVIDIA GTX 1070 Pascal GPU.

RESULTS

Three class Oncotype Dx prediction model was evaluated in 3 groups consisting of 77, 40 and 17 patients in groups 1, 2 and 3. The CNN achieved an overall accuracy of 80% in three class prediction. Two class Oncotype Dx prediction model was evaluated in 2 groups consisting of 77 and 57 patients (group 1 vs. groups 2 and 3). The CNN achieved an overall accuracy of 92% in two class prediction.

CONCLUSION

Current deep CNN architectures can be trained with relatively small MRI data set to achieve useful performance at predicting Oncotype DX RS. Research is underway with a larger dataset to improve our prediction model.

CLINICAL RELEVANCE/APPLICATION

Deep learning through convolution neural networks (CNNs) have demonstrated strong performance in various image classification tasks in recent years and may be used to predict patients' likelihood of breast cancer recurrence.

SST01-07 Classifying Breast Lesions with Initial Enhancement Kinetics from High Temporal-Resolution DCE-MRI

Friday, Dec. 1 11:30AM - 11:40AM Room: E450B

Participants
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PURPOSE

To identify parameters descriptive of initial lesion enhancement on high-temporal resolution breast DCE-MRI that may aid in ruling out malignancies

METHOD AND MATERIALS

46 patients with dense breasts and BIRADS 4 or 5 on screening mammograms were enrolled. Participants received an MRI prior to biopsy, including high temporal resolution DCE-MRI ('ultrafast') during the first minute after contrast administration, followed by a standard high-spatial resolution acquisition. Patients were scanned on 1.5T and 3T scanners with temporal resolutions from 3.5 to 10 seconds. Relative signal enhancement was calculated on a voxel-by-voxel basis. Signal enhancement was fit to an empirical model with 3 parameters: upper limit of enhancement, uptake rate, and time of initial enhancement (TIE). Initial slope and initial area under the curve (iAUC) were calculated from the fit parameters. The time of initial arterial enhancement was measured in the internal mammary arteries and lesion enhancement times were calculated relative to this time

RESULTS

65 lesions were included in this analysis (27 benign, 38 malignant). Two cases showed no abnormal enhancement (on ultrafast or standard DCE); both biopsy results were benign. Benign and malignant lesions had average TIEs of 9.5 ± 12.8s and 5.7 ± 3.3s, respectively. the difference was not significant but 10 benign lesions (37%) had higher TIEs than the maximum TIE for all malignant lesions (12.1s). Initial slope and iAUC were significantly different ($p<0.005$) between benign and malignant lesions, with average malignant-to-benign ratios of 1.96±0.06 and 1.49±0.04. The negative predictive value of iAUC was 93%

CONCLUSION

These preliminary results suggest that IAUC, initial slope, and TIE from ultrafast DCE-MRI have strong negative predictive value, and may be used to rule out cancer and reduce unnecessary biopsies. This type of analysis requires only 1 minute of high-temporal resolution imaging. Ultrafast imaging allows reliable measurements of initial kinetics that are less sensitive to global variables (e.g., cardiac output) and descriptive of lesion physiology

CLINICAL RELEVANCE/APPLICATION

High-temporal resolution DCE allows accurate measurements of very early enhancement kinetics, when differences between benign and malignant lesions may be largest, and may provide strong negative predictive power

SST01-08 A Reader Study of MARIA Radiowave Breast Imaging Compared with X-Ray Mammography for the Symptomatic Breast

Friday, Dec. 1 11:40AM - 11:50AM Room: E450B

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PURPOSE

MARIA is a new, non-ionising, non-compressing radiowave breast imaging modality with good dense breast performance which has early potential as an adjunct to x-ray mammography (MMG). This study presents a sensitivity comparison of MARIA and MMG using offline reads of the respective images.

METHOD AND MATERIALS

Females attending a symptomatic breast clinic at one of 3 UK symptomatic clinics (Southmead - Bristol, Thirlestaine - Cheltenham, Great Western - Swindon), were identified by clinicians as having a palpable lump. Following informed consent, eligible patients meeting inclusion criteria were scanned in the prone position with MARIA, a non-ionising, multi-static radar system (Yorkshire & The Humber and South Yorkshire REC 15/YH/0084) ClinicalTrials.gov NCT02493595. Patients had ultrasound scan (US) and/or mammography (MMG). Cytology/ histology was conducted as necessary as part of normal clinical procedure and final diagnosis was determined. Both MARIA and MMG were read offline by independent readers who had no knowledge of the clinical outcome. Features identified in either modality were subsequently compared to the diagnosis on discharge (including histology/ cytology where available) to determine a sensitivity score.

RESULTS

145 single breast studies were analysed. MMG sensitivity, defined as successful detection of the symptomatic index lesion, was 79% (42/52) in lucent (BI-RAD a,b) while MARIA sensitivity in lucent was 71% (37/42). For dense breasts (BI-RAD c, d), sensitivity for MMG was 54% (50/92) while for MARIA it was 77% (71/92).

CONCLUSION

Initial results suggest that the MARIA system offers the provision of a safer (non-ionising), more comfortable (no breast

Initial results suggest that the MARIA system offers the provision of a safer (non-ionising), more comfortable (no breast compression) and inexpensive breast screening alternative compared to other modalities, which has been shown to be effective at detecting cancers in younger, pre-menopausal women with dense breasts. MARIA may also overcome some of the challenges posed by trying to optimise the balance between benefit and harm of MMG screening in women of younger age.

CLINICAL RELEVANCE/APPLICATION

The sensitivity of MMG is low for women with dense breasts (DB). MARIA shows great promise as a whole-breast adjunct offering a benign, more comfortable, sensitive diagnostic for women with DB.

SST01-09 Quantitative Assessment of Breast DCE-MRI BPE and Mammographic Breast Density Changes over Time

Friday, Dec. 1 11:50AM - 12:00PM Room: E450B

Participants
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PURPOSE

Breast DCE-MRI background parenchymal enhancement (BPE) has been reported associated with breast cancer risk, potentially independent of the established mammographic breast density (MBD). We investigated quantitative characteristics and temporal changing patterns of BPE and MBD on a large (1792) set of MRI scans and mammogram examinations acquired from breast cancer-free women.

METHOD AND MATERIALS

We retrospectively identified 886 longitudinal breast DCE-MRI scans (2006-2015) and 886 mammogram examinations acquired in the same year with the MRI from 266 high-risk screening women (each with 2-9 sequential scans). For the 886 MRIs, the average age-at-scan was 50.4±9.3 YO, average between-scan time was 419±165 days, and 552 (62%) were post-menopausal with the rest pre-menopausal. All 266 women remain breast cancer-free at the time of this study. Fully automated computerized methods were applied to quantify BPE and area-based MBD (an average on CC and MLO view), both at unilateral and bilateral levels. BPE was computed from the first post-contrast sequence as the volumetric percentage of enhanced voxels over the fibroglandular tissue. Descriptive statistics, nonparametric regression, and linear mixed effects modeling were used to assess distributions and changing patterns of BPE and MPD over time.

RESULTS

Mean BPE was 22.2%±13.5 for all scans, and was 25.3%±14.8 for pre- and 20.4%±12.4 for post-menopausal scans (unpaired t-test $p<0.0001$). Likewise for MBD, mean was 29.7%±16.6 for all mammogram examinations, 31.9%±16.5 for pre- and 28.4%±16.7 for post-menopausal ($p=0.0027$). The Pearson's correlation coefficient between left and right BPE (or MBD) was 0.85 (or 0.90). Both BPE and MBD change over time in a roughly linear decreasing trend and both statistically significant ($p<0.05$) with respect to the evaluation of accumulated-years-since-first-scan, but the rate of change for MBD (0.7 percentage point/year, 95% CI 0.2-1.2) is somewhat less than for BPE (0.9 percentage point/year, 95% CI 0.5-1.3).

CONCLUSION

In longitudinal imaging scans of breast cancer-free women, both BPE and MBD are higher among pre- than post-menopausal women. They both decrease roughly linearly over time, but the trend of MBD is less pronounced than BPE.

CLINICAL RELEVANCE/APPLICATION

Quantitative assessment of temporal changing characteristics of BPE and MPD in cancer-free women can help determine their performance and mechanisms as independent breast cancer risk biomarkers.

RSNA 2017 Explore. Invent. Transform.
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SST03

Chest (Functional Lung Imaging/Radiation Dose Reduction)

Friday, Dec. 1 10:30AM - 12:00PM Room: E451B

CH CT MR SQ

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

FDA Discussions may include off-label uses.

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Sub-Events

SST03-01 Measuring Specific Ventilation using Four-dimensional Magnetic Resonance Ventilation Imaging: A Novel Physiological Biomarker of Asthma

Friday, Dec. 1 10:30AM - 10:40AM Room: E451B

Awards
Trainee Research Prize - Resident

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PURPOSE

Specific ventilation (SV) is defined as a dimensionless quantity of inhaled gas ventilation that occurs during tidal breathing and is calculated as tidal volume divided by functional residual capacity (Lewis *et al*, 1978). 1H MRI was previously proposed to regionally quantify SV, using inhaled O2 as a contrast agent (Sa *et al*, 2010). Our objective was to develop a novel and rapid way to measure whole lung and regional SV using free-breathing 1H MRI without exogenous contrast agents and over a short tidal breathing scan using conventional equipment. We also aimed to directly compare 1H MRI SV with hyperpolarized inhaled noble gas MRI ventilation and ventilation percent (VP).

METHOD AND MATERIALS

We evaluated 10 asthmatics (50±12yrs) and two healthy volunteers (27±6yrs) who provided written informed consent to MRI, spirometry and whole body plethysmography. Pulmonary hyperpolarized noble gas MRI (Kirby *et al*, 2012) and dynamic 2D multi-slice, whole lung coverage, free tidal-breathing 1H MRI using a bSSFP sequence (Capaldi *et al*, 2015) were acquired on a 3T system (GEHC). Free-breathing 1H MRI was retrospectively gated to generate tidal inspiration/expiration lung volumes that were co-registered using optical flow deformable registration (Lucas *et al*, 1981). 4DMRI SV maps were generated on a voxel-by-voxel basis using the co-registered volumes to generate local SV distribution maps. MRI ventilation percent (VP=ventilation volume normalized to thoracic cavity volume) and whole lung mean 4DMRI specific ventilation were determined and compared using Pearson correlation coefficients (r).

RESULTS

In Figure 1, 4DMRI SV and 3He MRI for an asthmatic (27yr female FEV1=74%pred, SV=0.08, VP=97.4%) shows qualitative agreement in the right-upper-lobe. For all subjects, there was a significant relationship for MRI specific ventilation and inhaled noble gas MRI ventilation percent (r=.67, p=.02), FEV1/FVC (r=.74, p=.007) and plethysmography SV (r=.77, p=.003).

CONCLUSION

In asthmatics, 4DMRI ventilation defects were spatially related with hyperpolarized inhaled noble gas MRI ventilation defects; 4DMRI SV also strongly correlated with experimentally measured SV and inhaled gas MRI ventilation percent.

CLINICAL RELEVANCE/APPLICATION

Free-breathing 4DMRI was exploited to generate specific ventilation maps that strongly correlated with experimentally acquired specific ventilation and inhaled noble gas MRI ventilation percent.

SST03-02 Preoperative Assessment of Localized Pleural Adhesion: Utility of Software-Assisted Analysis on 4-Dimensional Ultra-Low-Dose CT (4D-ULDCT)

Friday, Dec. 1 10:40AM - 10:50AM Room: E451B

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PURPOSE

To assess the usefulness of software analysis using 4-dimensional ultra-low-dose CT (4D-ULDCT) for localized pleural adhesion (LPA).

METHOD AND MATERIALS

Twenty-four consecutive patients scheduled to undergo surgery underwent both 4D-ULDCT during a single respiration and conventional high-resolution chest CT as preoperative assessments. Four radiologists, who were blinded to patient status, independently evaluated the presence and severity of LPA in 3 grading-scale (non-LPA, mild LPA and severe LPA) for 6 measurement points (MPs) (upper and lower area on ventral, lateral and dorsal aspects) on the chest CT by 2 different methods: (i) observing conventional high-resolution CT images (static), reconstructed in the axial, coronal, and sagittal directions; (ii) observing 4D-ULDCT images (movie), while another radiologist similarly evaluated the presence and severity of LPA by the other method: (iii) observing adhesion map (A-map), which is colored gradient map created by research software using 4D-ULDCT that suggested the absence/presence of LPA based on the difference in the movements between the lung surface and chest wall. The presence and severity of LPA was confirmed in an identical fusion by their intraoperative thoracoscopic findings. Diagnostic accuracy in 3 grade scaling and the LPA presence were conducted between (i) and (iii), between (ii) and (iii) using t-test for a single sample, and between (ii) and (iii) using Wilcoxon signed-rank test.

RESULTS

The presence of LPA was surgically confirmed on 23MPs in 8 patients: 20MPs with mild LPA, 3MPs with severe LPA. For the LPA assessment, A-map method (iii) achieved significant better diagnostic performance with higher accuracy in 3-grade scaling of 78.5%, and higher sensitivity of 73.9%, PPV of 44.7% and NPV of 94.3%, comparable specificity of 82.6% for the LPA presence, in comparison with the other methods ((i), (ii)) ($p<0.05$). No significant difference in diagnostic performance were showed between conventional CT (i) and 4D-ULDCT (ii) ($p >0.05$)

CONCLUSION

Four-D ULDCT in combination with A-map method could be useful as a novel imaging approach for accurate preoperative analysis of LPA.

CLINICAL RELEVANCE/APPLICATION

This is the first study to demonstrate the clinical usefulness of software-aided, 4D-ULDCT images for the preoperative diagnosis of the presence and severity of LPA.

SST03-03 Quantification of Lung Perfusion and Ventilation in Patients with Chronic Thromboembolic Pulmonary Hypertension (CTEPH) Before and After Pulmonary Endarterectomy Using Phase Resolved Fourier Decomposition MRI

Friday, Dec. 1 10:50AM - 11:00AM Room: E451B

Participants
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PURPOSE

To evaluate Fourier decomposition (FD) imaging of the lung as a radiation free, non-contrast-enhanced method for detection of perfusion and ventilation changes in CTEPH patients before and after pulmonary endarterectomy (PEA).

METHOD AND MATERIALS

We investigated 27 patients with diagnosed CTEPH before and 2 weeks after PEA. All patients underwent DCE time-resolved angiography with stochastic trajectories (TWIST) in one breathhold and a 2D fast low-angle shot (FLASH) sequence in free breathing in supine position, on a 1.5 T MRI. Coronal acquisition of FD imaging of the lung was performed. After nonrigid image registration (ANTS), and manual segmentation, perfusion and ventilation maps were generated using a image-sorting algorithm.

Histograms were calculated to visualize the distribution of ventilation and perfusion. Ventilated, but not perfused lung voxels were defined as perfusion defect, perfused, but not ventilated lung voxels were classified as ventilation defect.

RESULTS

Using DCE MRI as reference, the median PBF increased from 30,1ml/min/100ml (25-75% quartile range: 26-50) to 54,5ml/min/100ml (25-75 quartile range: 49-71, p<0,0001). Using FD MRI, the median perfusion defect percentage of the whole lung decreased from 46% (25-75% quartile range: 39-50%) to 33% (25%-75% quartile range: 27 -39%) after PEA (p<0.0001). The ventilation defect percentage of the whole lung was minimal and did not change (pre and post procedural median: 1% (25-75% quartile range: 0-3%). There was a significant difference of the perfusion defect percentage in the right lower lobe (median: pre 42%, median post: 17%, p<0,0001), the right upper lobe (median: pre 53%, median post: 28%, p=0.0005) and in the middle lobe (median: pre 46%, median post: 25%, p=0.0002). No significant difference of perfusion defect percentage was observed in the left lower (median: pre 48%, median post: 52%, p=0.48) and upper (median: pre 35%, median post: 41%, p=0.13) lobes.

CONCLUSION

Phase resolved Fourier Decomposition MRI is a feasible method to monitor regional ventilation and perfusion in CTEPH patients pre and post PEA. Especially left lower lobe results may be influenced by cardiac motion, which could interfere with the phase measurements of the parenchymal blood flow.

CLINICAL RELEVANCE/APPLICATION

These promising results may enable a proton-based, radiation and contrast free monitoring option of therapeutic effects after PEA in CTEPH patients in the future.

SST03-04 Blood Volume-Based MR Imaging with Ultra-Short TE vs Quantitatively and Qualitatively Assessed CT vs Perfusion SPECT: Capability for Prediction of Postoperative Lung Function in Non-Small Cell Lung Cancer Patients

Friday, Dec. 1 11:00AM - 11:10AM Room: E451B

Participants
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PURPOSE

To directly compare the capability of contrast-enhanced (CE-) pulmonary thin-section MR imaging with ultra-short TE (UTE) as semi-quantitatively assessed blood-volume based MR imaging (BV-MRI with UTE) for prediction of postoperative lung function in non-small cell lung cancer (NSCLC) patients as compared with quantitatively and qualitatively assessed CT and perfusion SPECT.

METHOD AND MATERIALS

29 NSCLC patients (16 men and 13 women) underwent unenhanced and contrast-enhanced pulmonary thin-section MR imaging with UTE at a 3T system, thin-section CT, perfusion SPECT, and measurements of FEV1% before and after lung resection. In each patient, BV MRI was generated as percent signal change between unenhanced and CE-pulmonary thin-section MR imaging by pixel-by-pixel analyses after non-rigid registration. On BV-MRI with UTE, postoperative FEV1% (poFEV1%) was predicted from semi-quantitatively assessed blood volumes within total and resected lungs. Quantitatively predicted poFEV1% using CT was determined from the functional lung volumes within total and resected lungs by commercially available software. Qualitatively predicted poFEV1% using CT was determined from the number of segments of total and resected lungs. On perfusion SPECT, poFEV1% was predicted from uptakes within total and resected lungs. Then, each predicted poFEV1% was correlated with actual poFEV1%, and the limits of agreement between actual and each predicted poFEV1% were also evaluated by Bland-Altman analysis.

RESULTS

poFEV1%s predicted by BV-MRI with UTE (r=0.82, p<0.0001) and quantitative CT (r=0.86, p<0.0001) had better correlation with actual poFEV1%, when compared with qualitatively assessed CT (r=0.79, p<0.0001) and SPECT (r=0.78, p<0.0001). The limits of agreement between predicted and actual poFEV1% by BV-MRI with UTE (4.3±12.7 %) and quantitatively assessed CT (3.5±10.8 %) were smaller than those by qualitatively assessed CT (5.1±13.9 %) and SPECT (4.2±14.5 %).

CONCLUSION

BV-MRI with UTE can more accurately predict postoperative lung function than qualitatively assessed CT and perfusion SPECT, and is at least as valuable as quantitatively assessed CT in NSCLC patients.

CLINICAL RELEVANCE/APPLICATION

Blood volume-based MRI with UTE can more accurately predict postoperative lung function than qualitatively assessed CT and perfusion SPECT, and is at least as valuable as quantitatively assessed CT in NSCLC patients.

SST03-05 Correlation between Diaphragmatic Excursion and Decrease in Lung Volume on Expiratory Phase Imaging in Asthma Patients

Friday, Dec. 1 11:10AM - 11:20AM Room: E451B

Awards
Student Travel Stipend Award

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PURPOSE

Inspiratory and expiratory phase imaging is often requested in asthma patients to evaluate air trapping, however, there is no radiographic measure of optimal expiration. Diaphragmatic excursion may be a reliable surrogate for lung volume assessment to gauge adequacy of expiration, particularly as the trachea may not change in configuration despite decrease in tracheal and/or lung volume.

METHOD AND MATERIALS

Between January 1, 2016 and December 31, 2016, a total of 226 CT exams with inspiratory and expiratory phase imaging were performed, 63 in individuals with asthma. Patients with supine imaging acquired with the same parameters in each phase were included (n= 33, mean age = 62, M=15, F=15). Diaphragmatic excursion was calculated as the difference between axial slices through the lungs on inspiration and expiration, using the lung apex and the cranial bound and diaphragm caudally. Lung and tracheal volumes were measured for each patient at inspiration and expiration.

RESULTS

Average inspiratory (I) and expiratory (E) lung volume was greater for men (I=5007 mL, E=3122 mL) than women (I=3122mL, E=1503mL). Similarly, average tracheal volumes were higher in men (I=61mL, E=45) than women (I=44, E=30). Average change in lung volume was 1500mL (range -564mL to 4109mL). Diaphragmatic excursion was found to range from -0.6cm to 6.8cm, with an average change in diaphragmatic excursion of 2.5 cm between inspiratory and expiratory scans (2.3 cm in women, and 2.7 cm in men). There was a very strong positive correlation between diaphragmatic excursion and change in lung volume between inspiratory and expiratory scans (r=0.83), and strong positive correlation with change in tracheal volume (r=0.79). A strong correlation was also found between change in tracheal volume and change in lung volume (r=0.67).

CONCLUSION

Diaphragmatic excursion is a strong quantitative measure of actual expiratory effort as validated by both lung and tracheal volumes, and may be more reliable than qualitative features such as tracheal morphology.

CLINICAL RELEVANCE/APPLICATION

Diaphragmatic excursion is a reliable quantitative surrogate for lung volume, and is an easily applicable clinical tool to assess the adequacy of expiratory phase image acquisition.

SST03-06 Pulmonary Function Diagnosis Based On Temporal Changes in Lung Density with Dynamic Flat-Panel Detector (FPD) Imaging: An Animal-Based Study

Friday, Dec. 1 11:20AM - 11:30AM Room: E451B

Participants
Rie Tanaka, PhD, Kanazawa, Japan (*Presenter*) Nothing to Disclose
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PURPOSE

X-ray translucency of the lungs changes with respiration. This is caused by relative increases and decreases in the volume of the lung vessels and bronchi per unit lung volume; pulmonary function can be evaluated based on temporal changes in the image density of the lung regions. The aim of the present study was to investigate the diagnostic performance of dynamic chest radiography for pulmonary function diagnosis based on respiratory changes in lung density.

METHOD AND MATERIALS

Sequential chest radiographs of six domestic pigs (body weight ca. 20-30 kg) were obtained during respiration using a dynamic flat-panel detector system (100 kV; 0.25 mAs/pulse; 15 frames/s; Test model, Konica Minolta). The pigs were intubated under

anesthesia, and respiratory control was ensured with a ventilator (100, 200, 300, 400, and 500 mL). We created porcine models of atelectasis using a catheter procedure, and analyzed the correlation between the inspired volume and changes in the pixel value measured in the lungs. To facilitate visual evaluation, differences in pixel values between an image taken at maximum expiration and those during respiration were sequentially calculated and then superimposed on the original images as a color display, employing a color table in which higher X-ray translucency (increased air) is shown in cold colors, creating functionally colored images.

RESULTS

Average pixel values in the lung regions changed according to forced respiration. High linearity was seen between changes in pixel value and inspired volume ($r = 0.9$). Changes in pixel value related to the inspired volume were successfully visualized as changes in color intensity on the functional colored images. In addition, areas of atelectasis were revealed as decreased changes in pixel values. Trapped air and airflow restriction were detected as higher and lower color intensity on functionally colored images, respectively (Fig. 1).

CONCLUSION

Dynamic chest radiography allowed for the evaluation of pulmonary function based on temporal changes in lung tissue image density. Inspired volume is quantified as changes in pixel value, and ventilation defects are detected as reduced changes in pixel value even without the use of contrast media.

CLINICAL RELEVANCE/APPLICATION

The method presented here is a simple and cost-effective functional imaging technique that can be performed as an adjunctive examination for conventional chest radiography.

SST03-07 CT Measurement of Atrioesophageal Adipose Tissue and Correlation with Metabolic Syndrome: Preliminary Results

Friday, Dec. 1 11:30AM - 11:40AM Room: E451B

Participants
Dennis P. Gilroy, DO, Rochester, NY (*Presenter*) Nothing to Disclose
Hakan Sahin, MD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Epicardial adipose tissue measurements on cardiac imaging planes have demonstrated association with atrial fibrillation and coronary artery disease. We wanted to investigate the utility of adipose measurements between the left atrium and esophagus on conventional axial and sagittal planes of routine chest CTs performed with ECG-gating in predicting the presence/complications of metabolic syndrome.

METHOD AND MATERIALS

The study protocol has been approved by the IRB. In this preliminary analysis, 50 patients with cardiac-gated CT performed for cardiac morphology or suspected aortic dissection were included, prospectively recorded, and retrospectively analyzed. The size of the atrioesophageal adipose tissue was measured on axial and sagittal images. Clinical conditions associated with metabolic syndrome were also recorded (hypertension, diabetes mellitus, BMI, dyslipidemia and atrial fibrillation). The association between the size of the adipose tissue and the clinical conditions was investigated.

RESULTS

Preliminary analysis reveals statistically significantly larger atrioesophageal fat in patients with dyslipidemia, compared with those who did not (p value 0.006). Additionally, this relationship extends to those with elevated systolic blood pressure (p value 0.05). The optimal threshold within the atrioesophageal fat measurement was determined to be greater than 4.1 mm in the sagittal plane (72.7% sensitivity and 62.5% specificity for the presence of dyslipidemia). Additional correlation exists between the axial measurement of atrioesophageal fat and BMI, albeit not statistically significant with the current data.

CONCLUSION

CT based epicardial fat quantification, using conventional imaging planes, is a simple tool that can be applied in everyday practice to identify patients with components of metabolic syndrome and possibly predict complications. While these results are preliminary, it is felt that the correlation between atrioesophageal fat measurement and additional various clinical parameters of metabolic syndrome will exist at statistically significant levels with a larger population.

CLINICAL RELEVANCE/APPLICATION

CT-based identification of patients with metabolic syndrome during routine CT evaluation using conventional imaging planes can serve as a value-added service leading to prediction of complications such as atrial fibrillation and alter therapeutic management due to known subsequent recurrence.

SST03-08 Effect of New Model-Based Iterative Reconstruction on Computer-Aided Detection for Quantitative Analysis of Airway Tree in Low-Dose Chest CT: Comparison with Adaptive Statistical Iterative Reconstruction in Routine Dose

Friday, Dec. 1 11:40AM - 11:50AM Room: E451B

Participants
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Taiping He, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the new model-based iterative reconstruction (MBIRn) with balanced setting (MBIRSTND) and spatial resolution preference (MBIRRP20) and adaptive statistical iterative reconstruction (ASIR) in low-dose and ASIR in routine dose on the performance of computer-aided detection (CAD) for quantitative airway analysis.

METHOD AND MATERIALS

30 patients had follow up scan for pulmonary disease on a GE Discovery CT750 HD system. Image acquisition was performed at routine dose and reduced dose level by increasing noise index (NI) from 14HU to 28HU using automatic tube current modulation. Tube voltage was fixed at 120kVp. Data of routine dose were reconstructed with ASIR, while low-dose were reconstructed with ASIR, MBIRSTND and MBIRRP20. Airway dimensions measured from the four reconstructions using an automated, quantitative software that was designed to segment and quantify the bronchial tree, and a skeletonization algorithm to extract the center-line of airway trees automatically (Figure 1). For each patients and reconstruction algorithm chose the right middle lobe bronchus with the least tortuous and bifurcation to measure the bronchial length of the matched airways. Two radiologists used a semi-quantitative 5-point scale (-2: inferior; 0, equal to ASIR in routine dose; 2: superior) to rate subjective image quality of airway trees on the low-dose images reconstructed with ASIR and MBIRn. Using paired t and Wilcoxon signed-rank tests for comparison.

RESULTS

Median effective dose was 3.01±1.89mSv at routine dose and 0.88±0.83mSv at 71% dose reduction. Algorithm impacts the measurement variability of the length of bronchus in low-dose chest CT, and MBIRSTND and MBIRRP20 were better than ASIR for the airway trees, while MBIRSTND displayed longer bronchus than ASIR in routine dose ($P<0.05$) (Table 1,Figure 2). MBIRSTND for the low dose chest CT also had higher subjective scores for the airway trees than ASIR in routine dose (Table 2,Figure 2).

CONCLUSION

The quantification accuracy of airway is strongly influenced by reconstructions. MBIRSTND and MBIRRP20 algorithms allow the desired airway quantification accuracy of CAD for chest to be achieved for 71% radiation dose reduction.

CLINICAL RELEVANCE/APPLICATION

Compare ASIR,MBIRSTND and MBIRRP20 from MBIRn algorithm potentially allows the desired airway quantification accuracy to be achieved on the performance of CAD with low-dose chest CT, especially for MBIRSTND.

SST03-09 Modified CT Fluoroscopy-Guided Lung Nodule Biopsy versus Conventional CT-Guided Biopsy: A Prospective Controlled Study to Assess Radiation Doses and Complication Rate

Friday, Dec. 1 11:50AM - 12:00PM Room: E451B

Participants
Ting Liang, Xian, China (*Presenter*) Nothing to Disclose
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Jin Shang, Xian, China (*Abstract Co-Author*) Nothing to Disclose
Jian Yang, MD, PhD, Xian, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The aim of the study was to evaluate complication rate and radiation doses of lung nodule biopsy by the CT modified fluoroscopy-guided and conventional CT-guided methods.

METHOD AND MATERIALS

A total of 100 patients in single radiology unit were prospectively enrolled to receive CT-guided lung biopsy. 50 patients were undergoing modified CT fluoroscopy-guided (CTF) biopsy (Group 1), and other half was checked by traditional CT-guided methods (Group 2). The modified biopsy plan referred to the method of using axial scan with step by step for the nodule. 2 experienced chest radiologists performing thoracic biopsies performed CT-guided biopsy. 64 slice spiral CT (Toshiba) were performed with CT-guided pulmonary biopsy with the Japan 16G cutting biopsy needle. Radiation dose and diagnostic accuracy of patient were outcome measurements. Differences between proportions were analyzed with the chi-square test. Dose-length product (DLP) was compared between 2 groups. Sensitivity, specificity and accuracy were calculated based on 80 patient's results.

RESULTS

There were no significant between the two groups for the pulmonary nodules characteristics : size, group 1: 34±18mm (mean±standard deviation) vs. group 2: 38±20 mm ($p=0.845$); depth from pleura, 13±12 mm vs. 12±9 mm ($p=0.595$) (Table 1). The total DLP of the study group (median 3.8 mSv) was significantly reduced compared to that of the comparison group (median 11.1 mSv, p?0.05).

CONCLUSION

CT modified fluoroscopy-guided lung nodule biopsy provides high diagnostic accuracy and more lower radiation doses compared to conventional methods, and may be alternatively used for appropriate lung nodule.

CLINICAL RELEVANCE/APPLICATION

The CT modified fluoroscopy-guided pulmonary biopsy which can significant reduce the radiation dose and complication rate should be selected in clinical practice.

SST04

Science Session with Keynote: Gastrointestinal (Hepato-Biliary Imaging)

Friday, Dec. 1 10:30AM - 12:00PM Room: E353B

CT GI MR

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

Participants
Aliya Qayyum, MBBS, Houston, TX (*Moderator*) Spouse, Founder, In Context Reporting
Shahid M. Hussain, MD,PhD, Omaha, NE (*Moderator*) Nothing to Disclose
David D. Bates, MD, Boston, MA (*Moderator*) Director, Imaginglink Inc

Sub-Events

SST04-01 Gastrointestinal Keynote Speaker: What is New and Hot in Hepato Biliary MR imaging

Friday, Dec. 1 10:30AM - 10:40AM Room: E353B

Participants
Shahid M. Hussain, MD,PhD, Omaha, NE (*Presenter*) Nothing to Disclose

SST04-02 Utility of Longitudinal Measurement of the Liver on Ultrasound in Comparison to CT Liver Volume in Assessing Hepatomegaly

Friday, Dec. 1 10:40AM - 10:50AM Room: E353B

Awards
Student Travel Stipend Award

Participants
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PURPOSE

The purpose of the study is to retrospectively compare the longitudinal measurement of the liver on ultrasound (US) with liver volume as measured on CT.

METHOD AND MATERIALS

This IRB approved retrospective study with prospective image analysis included adult patients with US examinations of the liver or abdomen and CT examinations of the abdomen or abdomen/pelvis performed within 2 weeks of each other from 1/1/2010 to 4/30/2016. We recorded the longitudinal length measurement of the right lobe of the liver on the US study. The liver volume was calculated using manual 3D segmentation (AW suite). Hepatomegaly was defined as a liver volume of 2000 cc or greater. SPSS software was used for statistical analysis which included Receiver operating characteristic curve (ROC) analysis.

RESULTS

The sample had 130 patients including 64 males and 66 females. Liver length measured on US had a moderate positive correlation with liver volume measured on CT, with a Pearson correlation coefficient of 0.71. ROC curve was generated with area under the curve (AUC) of 0.78 (95% CI of 0.70-0.86/Standard error of 0.04). Based on this, an US cutoff of 16.4 cm was found to be an optimal threshold to identify hepatomegaly. Using this cutoff, the sensitivity for hepatomegaly was 83.3% (95% CI of 71.3 - 91%) and the specificity was 63.2% (51.9% - 73.1%). Using a maximum ultrasound liver length of 17 cm, the sensitivity for hepatomegaly was 81.5% (95% CI of 69.7% - 90.3%) and the specificity was 76.3% (65.6% - 84.5%). Using a maximum ultrasound liver length of 18 cm, the sensitivity was 63.0% (49.6%-74.6%) and the specificity was 84.2% (74.4% - 90.7%).

CONCLUSION

Liver length measured with US has only a moderate correlation with liver volume. Commonly used US liver length maximum values of 17 cm and 18 cm produce a significant number of false negatives and false positives. US length of 16.4 cm was found to be an optimal threshold to identify hepatomegaly. Improved methods for measuring liver size with US are needed.

CLINICAL RELEVANCE/APPLICATION

There is only a moderate correlation between liver length measured with US and liver volume measured on volumetric CT, potentially resulting in incorrect liver size estimates with US.

SST04-03 Acute Cholecystitis: Implications of Ultrasound Findings on Surgical and Clinical Outcomes

Friday, Dec. 1 10:50AM - 11:00AM Room: E353B

Participants
Daniel Van Roekel, MD, Boston, MA (*Presenter*) Nothing to Disclose
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Deepan Paul, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To identify sonographic signs of acute cholecystitis that predict surgical and clinical outcomes.

METHOD AND MATERIALS

The Institutional Review Board approved this HIPAA-compliant retrospective study. Informed consent was waived. 380 patients who underwent cholecystectomy between 06/22/2014 and 03/01/2016 and received abdominal ultrasound (US) prior to surgery were included. Individual US signs, including the presence of stones, gallbladder distention (> 4 cm transverse or > 10 cm long), wall thickening (> 3 mm), pericholecystic fluid, and abscess were graded in a blinded fashion. Outcomes included operating room (OR) duration, drain placement, surgical pathology, bile leak and surgical site infection. The US signs and outcomes were analyzed using an ANOVA or Chi square test.

RESULTS

Of 380 patients, 366 had documented OR times, of which 155 showed gallbladder distention on US. Patients with distention had increased OR times (22.7 minutes longer, p< 0.0001), increased rate of partial cholecystectomy (odds ratio 5.9, 95% CI: 1.22 to 28.01; p= 0.0192), surgical drain placement (odds ratio 2.7; 95% CI: 1.278-5.629, p=0.0071) and pathology diagnosis of acute and chronic cholecystitis (odds ratio 4.3; 95 % CI: 2.60 to 7.12, p <0.001) when compared with the non-distended group. Of 380 patients, 144 showed wall thickening. Patients with wall thickening had increased OR times (18.7 minutes longer, p=0.0008), increased rate of partial cholecystectomy (odds ratio 4.0; 95 % CI: 1.01 to 15.60, p=0.0455), drain placement (odds ratio 3.2; 95% CI 1.52-6.70, p =0.0014), and pathology diagnosis of acute and chronic cholecystitis (odds ratio 2.7, 95 % CI: 1.66 to 4.35, p <0.0001) than the group with normal wall thickness. US findings including gallstones, pericholecystic fluid and abscess were not positively associated with any of the studied clinical outcomes. Likewise, bile leak, site infection and pathology diagnosis of acute or chronic cholecystitis did not show a positive association with any of the US parameters.

CONCLUSION

Gallbladder distention and wall thickening on US are predictive of extended operating room times, partial cholecystectomy and surgical drain placement in patients presenting with acute cholecystitis.

CLINICAL RELEVANCE/APPLICATION

Gallbladder distention and wall thickening are important sonographic findings that can help the surgeon to predict difficult cholecystectomy cases.

SST04-04 Improved Detection of Small Liver Metastases Located Adjacent to Vessels Using Single Shot 2-Dimensional (2D) Magnetization-Prepared Gradient-Echo (MPGRE) Images Acquired at Hepatocytic Phase (HP) of Liver-Specific Contrast Agent (LSCA)

Friday, Dec. 1 11:00AM - 11:10AM Room: E353B

Awards
Student Travel Stipend Award

Participants
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PURPOSE

MRI with LSCA (Gadoxetic-Disodium, Gd-EOB-DTPA) performed 20-40 mins after intravenous administration has become the standard for assessing liver metastases. Image acquisition is typically done with a 3D fat saturated gradient echo (FSGRE) technique. At HP metastases display low signal intensity (SI) and are well seen against the high SI liver background. Since vessels also display low SI, detection of small lesions may be difficult, particularly when adjacent to vessels. MPGRE, also known as TurboFLASH (Siemens), IR FSPGR (GE), or TFE (Philips), with use of a slice selective MP pulse, provides high SI of the vessels from inflowing unsaturated blood. The goal was to investigate the use of HP-MPGRE for improved lesion detection, especially those adjacent to vessels.

METHOD AND MATERIALS

Thirty-eight consecutive patients with known liver metastases had HP FSGRE (3mm slice thickness) and MPGRE (4mm) at 20 min after LSCA dosing; 23 were imaged at 1.5T and 15 at 3T. Regions of interest were drawn in each case to measure the signal of the largest lesion, the normal liver tissue while avoiding the major vessels, the inferior vena cava representative of vessels, and the

background noise. Contrast-to-noise ratios (CNR) were calculated using the formula (S1-S2)/SD, where S1 was the SI of tissue 1, S2 the SI for tissue 2, and SD the standard deviation of background noise.

RESULTS

Mean (SD) lesion/vessel CNR for the 23 cases imaged at 1.5T and the 15 at 3T were -61.2 (24.4) and -169.3 (75.9) for MPGRE, and 5.3 (53.4) and -9.6 (11.3) for FSGRE, respectively, which, in absolute value, was greater for the former technique than the latter ($p<0.05$ for both). Mean (SD) lesion/liver CNR for the 23 at 1.5T and the 15 at 3T were 24.4 (18.7) and 51.2 (52.2), and 43.8 (18.9) and 60.2 (21.4), respectively, which is greater for the latter than the former ($p<0.05$ for both). While both MPGRE and FSGRE yielded high CNR for lesions compared to liver, only MPGRE provided consistently high CNR for lesions compared to vessels.

CONCLUSION

Lesion/vessel CNR on HP-LSCA-enhanced MRI was significantly and substantially greater for MPGRE than FSGRE, indicating visualization of liver metastases adjacent to vessels was markedly improved using the former technique.

CLINICAL RELEVANCE/APPLICATION

The addition of HP-MPGRE in a LSCA-enhanced liver metastasis MRI protocol is recommended as it markedly facilitates the detection of lesions, particularly those adjacent to vessels.

SST04-05 Abbreviated Liver-MRI vs Full Protocol Liver-MRI Including Hepatobiliary Phase Imaging to Screen for Liver Metastases in Patients with Solid Tumors: Preliminary Results

Friday, Dec. 1 11:10AM - 11:20AM Room: E353B

Participants
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PURPOSE

To investigate whether an abbreviated liver-MRI protocol (AP), consisting of axial T2w-TSE, DWI and pre-contrast T1w-GRE in- and opposed phase (IP/OP) is appropriate to detect and classify liver metastases.

METHOD AND MATERIALS

Ongoing reader study on so far 71 consecutive patients with solid tumors who underwent liver-MRI to search for metastatic disease. All patients underwent a standardized full protocol (FP) hepatic MRI at 1.5T with axial and coronal T2w-TSE ± fat-saturation (fs), axial T1w-GRE (IP/OP), axial and coronal DWI (b=0, 50, 800), multi-phase T1w-dynamic GRE before and after i.v. gadoxetate disodium, and axial T1w-GRE + fs in the hepatobiliary phase. Body radiologists with between 9 and 12 years of experience first reviewed only the abbreviated protocol, and made their diagnosis regarding the presence or absence of focal liver lesions, as well as to the likelihood of malignancy on a 5-point scale. Results of the full MRI-protocol as well as imaging follow-up or histopathology of liver lesion was used as ground truth.

RESULTS

Acquisition time for the AP was 10.3 min., vs 39.8 min. for the FP. Based on the interpretation of the AP images, reader 1 identified all 56 patients with focal liver lesions that were also identified by reading images of the FP; reader 2 identified 54 of the 55 patients with focal liver lesions identified by the respective FP readings. Accordingly, the sensitivity to identify patients with focal liver lesions based on the AP- vs. the FP-readings was 100% (for reader 1) and 98.2% (for reader 2). Regarding characterization of focal liver lesions (positive predictive value), reader 1 had one additional false-positive diagnosis with AP compared to FP, for a PPV of 92% vs.. 94% (35/38 vs. 34/36); 95%-CI: 79 %-98 % vs 81% -99%. Reader 2 had 3 additional false-positive diagnoses with AP vs. FP, for a PPV of 88% vs. 97% (30/34 vs. 33/34); CI: 73%-97% vs. 85%-100%). Average time to read the AP was 43sec. for reader 1 and 72sec. for reader 2.

CONCLUSION

An MRI acquisition time of 10.3 min. and a reading time between 43 and 72 sec. is sufficient to identify patients with malignant focal liver lesions; it offers identical sensitivity and similar specificity and PPV as does a full, dynamic contrast enhanced liver MRI protocol that included hepatobiliary phase imaging.

CLINICAL RELEVANCE/APPLICATION

Abbreviated liver MRI seems useful to allow fast MRI-screening for metastatic spread to the liver in cancer patients.

SST04-06 Diagnostic Performance of an Abbreviated Gadoxetic Acid-Enhanced MRI Protocol for Colorectal Cancer Liver Metastases Surveillance

Friday, Dec. 1 11:20AM - 11:30AM Room: E353B

Participants
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Aoife Kilcoyne, MBBCh, 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

To evaluate the diagnostic performance of an abbreviated gadoxetic acid-enhanced MRI protocol in colorectal cancer (CRC) liver metastases surveillance.

METHOD AND MATERIALS

In this IRB approved retrospective study, gadoxetic acid-enhanced (Eovist, Bayer healthcare) MRI scans of 43 patients with histologically proven liver metastases from colorectal cancer (mCRC) were assessed. Two readers independently assessed two sets of images of each patient. The first set consisted of T2WI + 15-20 min delayed T1-WFS followed by DWI (b values ranging from 50 to 800 s/mm2) and ADC maps. Readers evaluated liver lesions and characterized them as being or malignant. A maximum number of 10 lesions per patient were recorded. Malignant classification was based on low signal on the 15-20 min T1-FS, high signal on the DWI and low signal on ADC. Benign diagnosis was based on T2 bright, hypo-intense 15-20 min T1-FS and no restricted diffusion. The full MRI protocol (set 1 + set 2 + dynamic study + other sequences) was used as our reference standard. Cohen kappa analysis was used to assess the agreement between the readers.

RESULTS

Reader 1 characterized 184 lesions as malignant and reader 2 characterized 200 lesions as malignant with a good inter-reader agreement. Although useful in lesion characterization, DWI did not add much in terms of lesion detection compared to hepatobiliary phase T1-WFS. Full MRI exam with dynamic study was found useful in characterizing previously treated 3 small metastatic lesions, but did not improve the detection of metastatic liver lesions nor the characterization of few small lesions deemed indeterminate by the abbreviated protocol. The mean time for an abbreviated protocol takes around 15 minutes to be completed compared to 35 minutes of the the full MRI protocol.

CONCLUSION

An abbreviated gadoxetic acid-enhanced MRI protocol (T2WI, DWI and 15-20 min delayed T1FS) is faster, has robust quality and provides high diagnostic performance in detection and characterization of liver lesions in mCRC surveillance.

CLINICAL RELEVANCE/APPLICATION

MRI is a scarce resource and has high demand due to the clinical benefits in variety of clinical settings. Workflow strategies need to be engineered to meet the clinical demands without compromising the diagnostic performance of MRI. An abbreviated liver MRI protocol can serve as potentially faster and lower-cost alternative to conventional MRI protocol.

SST04-07 Multiparametric Imaging Correlations with Pathology in a HCC Rat Model

Friday, Dec. 1 11:30AM - 11:40AM Room: E353B

Participants
David Fuentes, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
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James Bankson, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rony Avritscher, MD, Houston, TX (*Presenter*) Nothing to Disclose

PURPOSE

To correlate multiparametric MR imaging with histopathological features of tumor response using a computer-implemented predictive model. This work quantifies MR imaging and pathology correlations in a hepatocellular carcinoma (HCC) rat model treated with sorafenib. Correlations of characteristic tissue hypoxia and nuclear crowding pathology features with MRI enable a non-invasive 'virtual biopsy' for understanding HCC response to sorafenib.

METHOD AND MATERIALS

Rat HCC McA-RH7777 cells were orthotopically implanted in the liver of 22 male Bufallo rats, and after 2 weeks, the animals were assigned to receive 7.5 mg/kg of sorafenib daily for 2 weeks (n=12) or to remain untreated (n=10). MR Imaging at 4.7 T was performed weekly, including anatomic, dynamic contrast-enhanced (DCE) and blood oxygenation level-dependent (BOLD) sequences. Pathology was co-registered with imaging using anatomical landmarks. Pimonidazole (PIMO) and Haemotoxylin and Eosin (H&E) staining were segmented using Gaussian mixture model to identify hypoxia, viable, and necrotic tissue. Tumor heterogeneity on pathology was quantified using the entropy of the hypoxic, viable, and necrotic tissue. The Maurer distance of each tissue type was compute to characterize the necrotic core and hypoxia relative to the HCC tumor boundary.

RESULTS

Lower entropy of the necrotic tissue was observed in the control group ($p<.05$) than the treatment group. For the PIMO stains, the distance of the hypoxic tissue in the treatment group was closer ($p=.1$) to the tumor boundary than the control group. Entropy in the pathology staining was also strongly correlated with T2star imaging ($r=.29$) but weakly correlated with BOLD effect.

CONCLUSION

Initial results demonstrate the feasibility of establishing quantitative correlations of imaging and pathology in this HCC rat model. Significant differences in entropy between groups can be used to evaluate treatment effect. Our analytical modeling platform has the potential to help predict response to sorafenib.

CLINICAL RELEVANCE/APPLICATION

Sorafenib is the only approved systemic therapy for advanced hepatocellular carcinoma. Disease control rate is achieved in less than 50% of advanced HCC patients, while nearly 10% experience grade 3-4. Therefore, imaging biomarkers are needed to identify

patients most likely to respond to sorafenib therapy.

SST04-08 Magnetic Resonance Imaging Biomarkers in Hepato-cellular Carcinoma: Correlation to Outcomes in Liver Transplant Candidates

Friday, Dec. 1 11:40AM - 11:50AM Room: E353B

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PURPOSE

To determine hepatocellular carcinoma (HCC) magnetic resonance imaging (MRI) biomarkers that enable prediction of delisting from tumor progression versus successful orthotopic liver transplantation (OLT).

METHOD AND MATERIALS

With IRB approval and HIPPA compliance, from a database of 1108 OLT listed patients with HCC from 2006-2015, patients who were delisted due to tumor progression and who had MRI at HCC diagnosis were identified. A comparison cohort of patients who went on to successful OLT without tumor recurrence matched for tumor stage and bridging therapies were then identified. Patient characteristics and MRI features upon consensus read by 3 abdominal radiologists were compared between the groups by bivariable and multivariable analsyis. The significant features were used to generate a prediction model based on MRI. Statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

There were 53 patients included in each cohort (delist-ed vs OLT with no recurrence). Significant ($p< 0.05$) MR features associated with tumor progression resulting in delisting were: T2 hyper-intensity (odds ratio [OR]= 16; 95% confidence interval [CI]: 2.49, 670.95), internal rim enhancement (OR=23.32; 95% CI: 3.42, inf), infiltrative margins (OR= 22.45; 95% CI: 4.37, 115.22), corona enhancement (OR= 4.0; 95% CI: 1.13, 14.18), and bileduct dilatation (OR= 8.17, CI: 1.54, inf). A significant favorable MR features associated with successful OLT was intralesional fat, (OR=0.36, 95% CI: 0.13, 0.99). A prediction model derived from theses variables showed an area under the receiver operating characteristic curve (AUC) of 0.86 in the prediction of delisting versus successful transplantation.

CONCLUSION

MRI findings are significantly associated with risk of tumor progression in patients awaiting liver transplantation.

CLINICAL RELEVANCE/APPLICATION

MRI features of HCC has the potential to be included in an integrated liver transplantation selection model as biomarkers of tumor biology.

SST04-09 CT Attenuation of Liver Metastases before Chemotherapy is a Predictor of Overall Survival in Colorectal Cancer: Results from the Randomized, Open-Label FIRE-3/AIO KRK0306 Trial

Friday, Dec. 1 11:50AM - 12:00PM Room: E353B

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PURPOSE

To investigate the prognostic value of pretherapeutic computed tomography (CT) attenuation values of liver metastases for overall survival (OS) in metastatic colorectal cancer (mCRC).

METHOD AND MATERIALS

In the open-label, randomized, prospective phase III FIRE-3 trial, 592 patients with histologically confirmed mCRC received 5-fluorouracil, leucovorin, and irinotecan (FOLFIRI) with either EGFR-antibody cetuximab or VEGF-antibody bevacizumab. Mean baseline attenuation [Hounsfield units (HU)] of up to five liver metastases was retrospectively measured in contrast-enhanced CT

scans of the abdomen (n=338, portal venous phase, slice thickness <=5 mm) using semi-automated volumetry. We analyzed the prognostic value of baseline HU values on overall survival (OS) using Kaplan-Meier estimate, log-rank statistics, and Cox proportional hazard regression. In addition, Receiver Operating Characteristic (ROC) analysis was employed to determine the optimal cutoff for baseline HU as predictor of prolonged OS.

RESULTS

Median baseline CT attenuation of liver metastases was 59.49 HU (IQR 49.08-68.73). In ROC analysis, baseline attenuation >61.66 HU was determined as optimal cutoff for increased OS (649 (95%-CI 587-730) days vs. 931 (777-1128), $p < 0.01$). This result was confirmed in univariate parametric Cox-regression (per 1 HU: HR=0.984, 95%-CI 0.975-0.993, $p < 0.01$). Results were consistent for subgroups based on quartiles with higher HU values being consistently associated with longer OS (median OS Q1 588 (95%-CI 460-806) days vs. Q2 663 (578-853) vs. Q3 800 (663-1096) vs. Q4 990 (777-1198)).

CONCLUSION

Increased baseline CT attenuation values >62 HU are a predictor of prolonged OS in mCRC. Measurements of CT attenuation are fast- and easy-to-perform in clinical routine and may serve as valuable prognostic imaging biomarkers in mCRC patients. Higher CT attenuation values may be the radiological representation of better vascularization of lesions. As a result, these lesions may be better to reach by and therefore more susceptible to systemic treatments.

CLINICAL RELEVANCE/APPLICATION

Liver lesions are the most common metastatic site in colorectal cancer. This work provides insights on the predictive value of the routinely assessed baseline attenuation of liver lesions on overall survival in patients from a large phase III trial.

RSNA 2017 Explore. Invent. Transform.
103rd Scientific Assembly and Annual Meeting
November 26 to December 1
McCormick Place, Chicago
Explore Invent Transform

SST05

Genitourinary (CT and MRI of Urothelium)

Friday, Dec. 1 10:30AM - 12:00PM Room: E351

CT GU MR

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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David D. Childs, MD, Clemmons, NC (*Moderator*) Nothing to Disclose

Sub-Events

SST05-01 Upper Tract Urothelial Carcinoma: Characterization of Lesions Missing with Ureterorenoscopy despite Previous Detection and Localization with CT Urography

Friday, Dec. 1 10:30AM - 10:40AM Room: E351

Participants
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PURPOSE

To retrospectively determine nondiminutive upper tract urothelial carcinomas (UTUCs) prospectively detected by using CT urography (CTU) but not confirmed with subsequent nonblinded ureterorenoscopy (URS).

METHOD AND MATERIALS

The institutional review board approved our study. Between 2003 and 2016, 8250 consecutive patients (mean age, 58 years±10.3) underwent 9133 CTU, which yielded 450 unique nondiminutive suspected UTUC lesions. Of 425 lesions that underwent subsequent nonblinded URS with knowledge of CTU findings-including size, location and morphology, 75 (17.7%) discordant lesions were not found at the initial unblended URS. After discordant lesions review, 30 lesions were classified as likely CTU false-positive findings without the necessity of further follow-up, and 45 lesions were classified as possible URS false-negative (FN) findings.

RESULTS

Nineteen of 75 (25.3%) of all discordant lesions after initial nonblinded URS were confirmed to be actual URS FN results, including 57.5% (19 of 33) of lesions with URS and/or CTU follow-up assessment. The average size of lesions with URS FN results was 7.5mm±3.2 and were identified with higher confidence at the prospective CTU by using the three-point scale (2.7±0.4 vs. 2.0±0.3, P=0.002). URS FN lesions were significantly more likely than concordant lesions in the calyceopelvis (73.6%, 14 of 19 vs. 41.4 %, 145 of 350; P=0.015). Eight lesions missed by using URS but confirmed by subsequent URS with surgical resection revealed adherent blood clot in one lesion and benign disease in seven lesions, and five lesions (62.5%) located in the calyceopelvis.

CONCLUSION

A priori knowledge of CTU for lesions missed at URS is more likely to have higher diagnostic confidence of the initial CTU.

CLINICAL RELEVANCE/APPLICATION

A priori knowledge of CTU for lesions missed at URS is more likely to have higher diagnostic confidence of the initial CTU.

SST05-02 Does Split-Bolus Injection Truly Influence the Ability of Renal and Urinary Lesion Detection at CT Urography? Multi-Center Prospective Randomized Comparison between Split-Bolus and Single-Bolus Injection Techniques

Friday, Dec. 1 10:40AM - 10:50AM Room: E351

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PURPOSE

To determine if split-bolus injection influences the ability of CT urography (CTU) for diagnosing the lesions in the kidney and the urinary tract.

METHOD AND MATERIALS

Institutional review board approved this multicenter prospective study. 299 patients from 11 institutions (male: female = 211: 88) had been randomly assigned to undergo CTU with split-bolus (n=148) or single-bolus (n=151) injection of CM. The degree of the renal enhancement was assessed with 3-point scale, and presence of renal cystic or solid lesion were evaluated. The urinary tract was divided into four regions (renal pelvis, upper, middle, and lower ureter), and the degree of opacification, as well as the suspicion of lesions were evaluated for each region. CT values of the renal parenchyma, renal lesions, and the renal pelvis were measured in each phase [nephrographic (NP) and excretory (EP) for single-bolus; mixed (MP) for split-bolus] and contrast ratio (CR) were calculated.

RESULTS

Although there were no differences in CTDIvol between single- and split-bolus injection, total DLP of split-bolus was significantly lower than those of single-bolus (1,425±60 vs. 2,013±59 mGycm; p<.0001). There was no difference in the degree of the urinary tract opacification between single- and split-bolus (p>.05). The renal parenchymal enhancement in NP of single-bolus achieved significantly better qualitative score than those in MP of split-bolus (p<.05), and significantly greater CT values than MP of split-bolus (162±31 vs. 128±22 HU; p<.0001). Nevertheless, there was no statistically significant difference in CR of renal lesion between in NP of single-bolus and MP of split-bolus (0.72±0.21 vs. 0.68±0.26; p>.05). CT values of the renal pelvis were significantly higher in EP of single-dose than MP of split bolus (730±505 vs. 560±421HU; p=.0009). The AUC, Sens, Spec, and Accu of urinary tract lesions were; 0.99, 100%, 94.6%, 94.7% for split-bolus, 0.99, 100%, 95.8%, 95.8% for single-bolus without NP, 0.97, 92.3%, 94.7%, 94.7% for single-bolus including NP.

CONCLUSION

CTU with split-bolus injection technique can accurately depict the lesions in the renal parenchyma and the urinary tract as single-bolus injection with reduced radiation dose.

CLINICAL RELEVANCE/APPLICATION

Split-bolus technique should be applied for the CTU considering radiation dose.

SST05-03 Analysis of Treatment Response of Bladder Cancer on CT Scans: Improved Assessment by Synergistic Combination of Radiomic Features and Clinically Estimated Feature

Friday, Dec. 1 10:50AM - 11:00AM Room: E351

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PURPOSE

To evaluate the accuracy of automatically extracted radiomic features from CT scans and clinically estimated feature in treatment response assessment of bladder cancer.

METHOD AND MATERIALS

Our Auto-Initialized Cascaded Level Set (AI-CALS) system is designed to extract 3D lesion boundary based on level sets. 47 radiomic features (RF) based on pre- and post- treatment changes in volume (V), 5 gray level (GL) and 9 shape (S) descriptors and 32 texture features (RLS) were extracted from the segmented lesions. A clinically estimated feature, the bimanual exam under anesthesia (EUA), was also collected from the clinical reports. Linear discriminant analysis was used to generate two combined response indices: one by the RFs alone (CRI-RF), and the other with both RFs and EUA (CRI-RF-EUA). With IRB approval, pre- and post-chemotherapy treatment CT scans of 98 patients with bladder cancers were collected. 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 and receiver operating characteristic (ROC) analysis were performed. The area under the ROC curve (AUC) was calculated to estimate the accuracy for predicting pT0 stage (complete response) at cystectomy by V, CRI-RF and CRI-RF-EUA methods. Two radiologists also provided 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 prediction of pT0 disease at cystectomy was 0.70±0.05 for V. The AUC for CRI-RF based on 2 Contrast and 2 RLS features was 0.74±0.05 and increased to 0.78±0.05 when EUA was added (CRI-RF-EUA). Prediction of pT0 disease by radiologists resulted in AUCs of 0.77±0.05 and 0.75±0.05, respectively. The differences did not reach significance (p>0.05).

CONCLUSION

Both CRI-RF and CRI-RF-EUA performed similar to the radiologists and better than V for estimation of treatment response. The addition of EUA further improved the accuracy of treatment response assessment.

CLINICAL RELEVANCE/APPLICATION

The combined response index using both the radiomic features and clinically estimated EUA has the potential to provide accurate treatment response assessment and is superior to volume change alone.

SST05-04 Quantification of Microvascular Changes to Predict ypT1N0 in Chemotherapeutic Response in Bladder Cancer

Friday, Dec. 1 11:00AM - 11:10AM Room: E351

Participants
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PURPOSE

To apply a parametric MRI methodology to quantify the microvascular changes in bladder tumors at the mid-treatment point of neoadjuvant chemotherapy (NAC) to predict the response with ypT1N0 endpoint.

METHOD AND MATERIALS

Thirty-eight muscle-invasive bladder cancer patients were included. Each patient had a pre-chemotherapy, a mid-chemotherapy (after 2 cycles), and a post-chemotherapy MRI, followed by radical cystectomy. The pathological findings of cystectomy specimens were used as reference standard. A patient with <=ypT1N0 was defined as a responder. MRI was performed with T2W-MRI prior to DCE-MRI on a 3T multi-transmit system (Ingenia CX, Philips Healthcare). Two pharmacokinetic parameters (Amp - signal enhancement amplitude, and kep - the exchange rate between the interstitial space and the plasma space) were estimated. For each patient, the k-means clustering of a voxel-wise Amp and kep data matrix was performed to segment their bladder tumor in 3 clusters. The volume fraction (VF) changes of 3 clusters from pre- to mid-chemotherapy MRIs were calculated and correlated with NAC response. P<0.017 was considered statistically significant for tri-parametric analysis. ROC curve analysis was performed when significant difference was found.

RESULTS

Based on pathological findings, nineteen patients with <=ypT1N0 were classified as responders, and the other nineteen patients as non-responders. The k-means clustering segmented a tumor in 3 clusters: Cluster 1 contained voxels with both low Amp and kep; Cluster 2 had voxels with high Amp and low kep; Cluster 3 had voxels with low Amp and high kep. The correlation with chemotherapeutic response showed that responders had significantly higher VF change of cluster 2 (P<0.001) and lower VF change of cluster 1 (P<0.005). There was no correlation found in the VF change of cluster 3. The ROC curve analysis calculated that AUC values were 0.81 for cluster 1 VF change and 0.78 for cluster 2 VF change.

CONCLUSION

The quantitative MRI methodology can quantify the complex microvascular changes in bladder tumor at the mid-treatment point to characterize the tumor response. The quantitative assessment can provide valuable information to predict pT1N0 endpoint before the end of NAC.

CLINICAL RELEVANCE/APPLICATION

Accurate prediction of NAC response can make substantial impact on treatment stratification to improve the outcomes of bladder cancer patients.

SST05-05 Bladder Cancer Staging in CT Urography Using Radiomic Biomarkers

Friday, Dec. 1 11:10AM - 11:20AM Room: E351

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PURPOSE

To evaluate the accuracy of a decision support system for staging of bladder cancers based on automatically extracted radiomic biomarkers from CT urography (CTU) merged in a predictive model by machine learning techniques.

METHOD AND MATERIALS

Bladder cancers at stage T2 or above are recommended for neoadjuvant chemotherapy treatment clinically. Correct staging is crucial for the decision of neoadjuvant chemotherapy and minimizing the risk of under- or over-treatment. Pre-treatment CTUs of 84 patients with bladder cancers were retrospectively collected with IRB approval. 43 cancers were below stage T2 and 41 cancers were at stage T2 or above. Our Auto-Initialized Cascaded Level Set (AI-CALS) system was used to extract 3D lesion boundary from all lesions. 87 radiomic biomarkers including 55 tumor heterogeneity and 32 morphological features (volume (V), 23 gray level (GL) and 8 shape (S)) were extracted from the segmented lesions. Linear discriminant classifier (LDA), support vector machine (SVM), and backpropagation neural network (NN), with stepwise feature selection based on F-statistics, as well as a random forest (RAF) classifier were used to combine the biomarkers into 4 predictive models for comparison. The dataset was partitioned into independent Set 1 and Set 2 for two-fold cross validation. The predictive models including feature selection were trained on one partition set and tested on the other partition set and vice versa. The area under the receiver operating characteristic curve (AUC) was calculated for each model to estimate its performance in predicting cancer stage (>= T2 or < T2).

RESULTS

The test AUC on Set 1 was 0.89, 0.92, 0.91, and 0.86 for LDA, SVM, NN and RAF, respectively. The test AUC on Set 2 was 0.90, 0.89, 0.95, and 0.96 for LDA, SVM, NN and RAF, respectively. The differences between the models did not reach statistical significance. The useful biomarkers included 2 heterogeneity features, 2 gray level features, and a contrast feature.

CONCLUSION

The machine learning techniques are promising in selecting effective radiomic biomarkers and merging them into predictive models that may provide useful decision support for bladder cancer stage assessment.

CLINICAL RELEVANCE/APPLICATION

An objective decision support system that merges computer-extracted radiomic biomarkers in a predictive model may assist clinicians in making more accurate and consistent cancer staging assessment.

SST05-06 Prospective Study of DWI and Intravoxel Incoherent Motion (IVIM) MRI as Biomarkers to Predict Clinical Aggressiveness in Bladder Cancer

Friday, Dec. 1 11:20AM - 11:30AM Room: E351

Participants
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PURPOSE

To evaluate the utility of the DWI and IVIM-MRI derived parameters in prediction of aggressiveness in bladder cancer.

METHOD AND MATERIALS

Fifty-eight patients (49 men, 9 women, mean age 61 years) were inspected through DWI and IVIM MR examination from April 2016 to March 2017. Bladder cancer (BC) was categorized in three different aggressiveness levels according to the classification criterion proposed by Kobayshi et al. The aggressiveness was classified as low- (including stage Ta and histological low-grade T1), intermediate- (high-grade T1) or high-aggressiveness (stage T2 or greater). Spearman Correlation Analysis was adopted to assess the correlation between aggressiveness and all parameters (apparent diffusion coefficient ADC, true diffusion coefficient D, pseudodiffusion coefficient D*, and perfusion fraction f). Comparisons of ADC value and IVIM parameters in different aggressiveness levels were performed using One-way analysis of variance (ANOVA). Diagnostic performance was calculated by means of receiver operating characteristics (ROC) analysis.

RESULTS

Aggressiveness of bladder cancer was negatively correlated with ADC value(r=-5.99, P < 0.001), D value(r=-5.07, P < 0.001) and f value(r=-3.64, P < 0.05). ADC, D, and f values in high-aggressive BC were significantly lower than both those in low-aggressive BC(P < 0.05) and those in intermediate-aggressive BC(P<0.05). There was not any significant difference between values of low- and intermediate-aggressive BC. The ROC analysis provided an AUC for ADC value to differentiate high-aggressive BC from low- and intermediate-aggressive BC(AUC=0.858, cut-off value =1.38mm2/s) with a sensitivity of 63.16%, a specificity of 100% and an accuracy of 75.87%, an AUC for D value(AUC=0.818, cut-off value =0.877mm2/s) with a sensitivity of 65.79%, a specificity of 95% and an accuracy of 75.86%, and an AUC for f value(AUC=0.782, cut-off value =0.33) with a sensitivity of 84.21%, a specificity of 70% and an accuracy of 79.3%.

CONCLUSION

ADC value and IVIM-derived parameters are promising biomarkers to predict aggressiveness in BC.

CLINICAL RELEVANCE/APPLICATION

(dealing with ADC value and aggressiveness)"The ADC value in DW-MRI can serve as a biomarker to predict the clinical aggressiveness of bladder cancer."

SST05-07 Comparison between Conventional Cystourethrography and MRI with Voiding MR-Cystourethrography in the Evaluation of Male Urethral Strictures

Friday, Dec. 1 11:30AM - 11:40AM Room: E351

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PURPOSE

To evaluate the accuracy of conventional retrograde and voiding cystourethrography and MRI together with voiding MR-cystourethrography in the evaluation of male urethral strictures.

METHOD AND MATERIALS

We evaluated 39 male patients with urethral strictures diagnosed with urine flow velocity recording and conventional retrograde and voiding cystourethrography. All these patients underwent MRI and voiding MR-cystourethrography using a 1.5T superconductive magnet. The patients had urine-filled bladders and high-resolution sagittal TSE T2-weighted scans were performed (TR:6250ms; TE:90ms;sl.thick.:3mm; acq.time:3'38"). Voiding MR-cystourethrography was performed with T1-weighted spoiled 3D gradient-echo acquisitions on sagittal plane (TR:12ms; TE:2,7ms; flip-angle:40°; sl.thickness: 2mm; acq.time:12s) after the filling of bladder lumen with contrast-material-enhanced urine obtainded by the i.v administration 20 mg of furosemide followed by ¾ of the normal dose of a paramagnetic contrast agent (Magnevist, Bayer Pharma, Germany). After micturition high-resolution coronal TSE T2-weighted scans were performed at the level of the stenosis. Two radiologists in consensus evaluated the morphology and length of the urethral stenosis with the two modalities and with MRI the entity and the site of spongio-fibrosis was assessed.

RESULTS

6 patients were not able to perform voiding MR-cystourethrography. In 33 patients evaluated with two imaging modalities 42 urethral strictures were detected. The measurement of the stenosis length was equal or superior with voiding MR cystourethrography and the analysis of 3D sagittal scans allowed a better evaluation of the morphology of the urethral strictures in comparison with conventional cystourethrography. 32 strictures with Spongio-fibrosis were found (76%). The site of spongio-fibrosis was always assessed with MRI (dorsal, ventral, dorsal and ventral and circular fibrosis).

CONCLUSION

MRI with voiding MR-cystourethrography shows the morphology and the length of the urethral strictures better than conventional cystourethrography and allows the detection and site of spongio-fibrosis, avoiding radiation exposure to the gonads and urinary catheterization.

CLINICAL RELEVANCE/APPLICATION

MRI could be proposed as all-in-one technique for the evaluation of urethral stenosis, allowing their detection and length assessment and determining the presence and site of spongiofibrosis.

SST05-08 Diagnostic Accuracy of MRI for T-Staging of Urothelial Bladder Cancer: Systematic Review and Meta-Analysis

Friday, Dec. 1 11:40AM - 11:50AM Room: E351

Awards
Student Travel Stipend Award

Participants
Niket Gandhi, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
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PURPOSE

To determine the diagnostic accuracy of MRI for T-staging (≥T2) of urothelial bladder cancer (UBCa). Multi-disciplinary panel determined *a priori* that a sensitivity of >95% was necessary to obviate the need for re-resection of tumor after initial TURBT identifying

METHOD AND MATERIALS

Search of multiple databases was performed on Jan 26, 2017. Inclusion criteria: humans with UBCa who underwent pelvic MRI (>1.5T) for local staging; reference standard (surgical pathology); no chemo- or radiotherapy prior to imaging. Inclusion and data extraction was performed independently. Risk of bias was assessed using QUADAS-2. Summary estimates for diagnostic accuracy

were generated using bivariate random effects model and subgroup analyses evaluated for sources of heterogeneity.

RESULTS

13 studies (979 patients) were included. Pooled sensitivity and specificity for: A) 7 studies using only T2-W MRI = 89% (95%CI 78-95) and 55% (95%CI 45-65) and B) 8 studies using DWI = 78% (95%CI 69-85) and 78% (95%CI 70-84). Area under ROC curve (AUC) for T2WI was 0.71 and for DWI was 0.84. Summary ROC curve (SROC) is depicted in Figure 1; 95% prediction regions for T2WI and DWI do not overlap. Moderate risk of bias was identified in patient selection (3/13 studies), index test (4/13) and, reference standard (12/13); all primarily from lack of clear reporting.

CONCLUSION

MRI for T staging of UBCa demonstrates higher specificity and overall accuracy for DWI compared to only T2W-MRI. Caution is warranted; most comparisons were indirect and the majority of studies had moderate risk of bias in at least one domain.

CLINICAL RELEVANCE/APPLICATION

T-staging accuracy of UBCa (>T2) with MRI demonstrates variability with higher accuracy identified using DWI compared to T2W-MRI alone. Neither DWI nor T2W-MRI met our pre-specified criteria of >95% sensitivity suggesting that MRI is not an appropriate replacement test for re-resection of tumor following initial TURBT identifying

SST05-09 Bladder Cancer: MRI as an Alternative to Repeat Transurethral Resection of Bladder Tumor for Local Staging

Friday, Dec. 1 11:50AM - 12:00PM Room: E351

Awards
Student Travel Stipend Award

Participants
Christian B. Van Der Pol, MD, Boston, MA (*Presenter*) Nothing to Disclose
Atul B. Shinagare, MD, Boston, MA (*Abstract Co-Author*) Advisory Board, Arog Pharmaceuticals, Inc.; Research grant, GTx, Inc.
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Mark Preston, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Transurethral resection of bladder tumor (TURBT) frequently understages muscle invasive bladder cancer and needs to be repeated. The purpose of this study was to determine test characteristics of multiparametric MRI (mpMRI) for the local staging of bladder cancer following TURBT, using cystectomy as the reference standard.

METHOD AND MATERIALS

This retrospective study was institutional review board approved and is HIPAA compliant. Between August 2011 and October 2016, 45 consecutive patients (median age 73 years) met inclusion criteria, which included a TURBT procedure followed by mpMRI then cystectomy without intervening neoadjuvant or intra-vesical therapies. Median time between TURBT and MRI was 43 days (SD 130, range 17-627 days). Two fellowship-trained abdominal radiologists, blinded to cystectomy staging, reviewed each mpMRI independently to document tumor T stage and regional nodal disease using all available sequences and each sequence in isolation. Sensitivity and specificity for the presence of muscle invasion (>=T2) and peri-vesical invasion (>=T3) were calculated on a stage-by-stage basis. Sensitivity and specificity for presence of regional nodal disease was assessed. Inter-observer agreement was measured using Cohen's Kappa coefficient.

RESULTS

Sensitivity/specificity for presence of muscle invasion was 92%/74% for reader 1 and 88%/84% for reader 2. Sensitivity/specificity for presence of peri-vesical invasion was 72%/92% for reader 1 and 67%/92% for reader 2. Sensitivity/specificity for regional nodal disease was 45%/93% for reader 1 and 45%/90% for reader 2. T2-WI was the most sensitive sequence for both readers for determining the presence of muscle invasion and peri-vesical invasion, while DWI was the most sensitive for regional nodal disease. The most specific sequence varied between readers. Inter-observer agreement was substantial for presence of muscle invasion, peri-vesical invasion and regional nodal disease when all sequences were used.

CONCLUSION

mpMRI is sensitive and specific at determining bladder cancer muscle and peri-vesical invasion in patients who have undergone prior TURBT. mpMRI was specific but not sensitive for assessing regional nodal disease.

CLINICAL RELEVANCE/APPLICATION

Multiparametric MRI is sensitive and specific at bladder cancer local staging following TURBT. Current bladder cancer management guidelines could consider mpMRI as an alternative to repeat TURBT.

SST06

Science Session with Keynote: Musculoskeletal (Spine)

Friday, Dec. 1 10:30AM - 12:00PM Room: E451A

CT MK MR

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

Participants
William E. Palmer, MD, Boston, MA (*Moderator*) Nothing to Disclose
Marcelo Bordalo-Rodrigues, MD,PhD, Sao Paulo, Brazil (*Moderator*) Nothing to Disclose

Sub-Events

SST06-01 Musculoskeletal Keynote Speaker: Update in Spine Imaging

Friday, Dec. 1 10:30AM - 10:40AM Room: E451A

Participants
William E. Palmer, MD, Boston, MA (*Presenter*) Nothing to Disclose

SST06-02 CT-Based Structural Analysis Predicts Failure of Human Spines with Simulated Osteolytic Defects under Functional Loads

Friday, Dec. 1 10:40AM - 10:50AM Room: E451A

Participants
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Robert Adamson, MSc, Bosotn, MA (*Abstract Co-Author*) Nothing to Disclose
David B. Hackney, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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N/A

PURPOSE

To compare the accuracy of a) CT based structural analysis protocol (CT-SAP) b) bone mineral density (BMD) and c) lesion size in predicting vertebral strength in a lytic lesion model of human vertebral metastatic disease.

METHOD AND MATERIALS

We created lytic defects in the middle vertebra of 40 cadaver thoracic and lumbar 3-level spinal segments from donors aged 48-57 years (Fig 1). The segments were imaged using a clinical CT spine protocol (field of view = 16cm, voxel dimensions: (0.31*0.31*0.625)mm . The segments were then tested to failure in either compression or in compression + torsion (3Nm). Linear regression models (JMP 9, SAS, NC) tested the correlations of a) defect size, b) BMD and c) CT-SAP predicted failure load with measured vertebral strength.

RESULTS

- Compression loading: Within an intentionally small range of defect diameters, lesion size was not correlated with vertebral strength (Fig 2.C). CT-SAP showed significantly higher prediction accuracy for vertebral strength than did BMD (Fig 2.B), (ANCOVA, $p<0.01$), Fig 2.A. - Compression + torsion loading: Lumbar vertebrae showed 12% reduction in mean strength than in pure compression Thoracic spines showed 34% higher strength than in compression alone ($p<0.05$). CT-SAP again had significantly higher prediction accuracy than BMD (Fig 2.C), $p<0.05$, but both measures showed lower prediction accuracy compared to the compression-only tests.

CONCLUSION

CT-SAP is superior to lesion size and BMD in predicting the strength of human vertebrae with lytic defects. These results are achieved by modeling the material properties and spatial distribution of the bone throughout the vertebral volume. Incorporation of a more realistic loading regime (compression + torsion) brings this in vitro model closer to actual stresses applied in vivo. The novel finding of regional differences in the effect of torsional loading on vertebral strength highlights the need to incorporate local variation in facet geometry in intervertebral kinematics, effecting local load transfer, in order to improve CT-SAP prediction accuracy.

CLINICAL RELEVANCE/APPLICATION

There are no objective and precise methods for predicting fracture risk in patients with spinal metastases. Subjective protocols such as SINS have limited accuracy. CT-SAP appears to provide more reliable objective predictions.

SST06-03 The Differential Diagnosis of Benign and Malignant Vertebral Compression Fracture with MR Fat-Water Separation Dixon Technique at 3.0T: A Retrospective Study

Friday, Dec. 1 10:50AM - 11:00AM Room: E451A

Participants
Hui Tan, Xianyang, China (*Presenter*) Nothing to Disclose
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Nan Yu, MD, Xian Yang, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The purpose of our study was to explore the value of fat-water separation Dixon technique in differential diagnosis of benign and malignant vertebral compression fractures.

METHOD AND MATERIALS

We retrospectively analyzed 76 patients with vertebral lesions who scanned at a CT scanner, and can not confirm the diagnosis. Then all patients underwent fat-water separation Dixon T1WI sequence on a MAGNETOM Skyra 3.0T MR scanner (Siemens AG, Erlangen, Germany). The patients were identified as either benign compression fractures (35 osteoporotic fractures,5 traumatic fractures, 3 infective fractures;age,28-76 years) or malignant compression fractures (28 metastatic fractures,3 multiple myeloma, 2 non-Hodgkin lymphoma; age,34-81 years) based on clinical follow-up or pathologically results. Besides general protocols for vertebral disease, the water-fat separation Dixon T1-VIBE protocol was included with the following parameters, TR/TE= 600/9.5ms, slice thickness=3mm, FOV= 340mm, matrix =384x384, iPAT = 2, Number of slices=16, and Average= 1. Four series of images (in/opposed phases, fat/water only) generated by the system were used for FF analysis. The signal intensity ratio was defined as SIR= SIopp-phase/ SIin-phase and the fat fraction was defined as FF= SIfat/ SIin-phase×100%.

RESULTS

The value of FF (27.43±6.77) in the benign group was significantly higher than that in the malignant group (11.88±4.23) (P<0.01).The SIR (0.72±0.28) in the benign group was significantly lower than that in the malignant group (1.38±0.21) (P<0.01).Through drawing ROC curve used the FF and SIR of benign and malignant vertebral compression fractures, the diagnostic critical value of benign and malignant vertebral compression fractures was12.75 and 0.86. The AUC of FF and SIR were 0.75 and 0.86.

CONCLUSION

The vertebral signal intensity and fat fraction through 3.0T MR fat-water separation Dixon technique can reflect the change of the vertebral body fat content in patients, and is helpful in differentiation in between benign and malignant vertebral compression fractures.

CLINICAL RELEVANCE/APPLICATION

(dealing with MR Dixon technique) '3.0T MR fat-water separation Dixon technique can demonstrate alterations in vertebral body fat content and this exam is recommended when the underlying cause of vertebral lesion is unclear.'

SST06-04 Validation of T2 Weighted Images for Assessing Fat Infiltration in Paraspinal Muscles Using an Osirix Application

Friday, Dec. 1 11:00AM - 11:10AM Room: E451A

Participants
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PURPOSE

Fat infiltration in paraspinal muscles has shown to be related to low back pain risk and it has been quantified using a manual thresholding yielding to quantification errors. Moreover, although the segmentation is typically done in T2w images, this has not been validated. We proposed a software to automatically segment FI in PM using T2w images. The software was validated against manual segmentations using Dixon images as a gold standard since they do not contain water nor B0 inhomogeneities.

METHOD AND MATERIALS

We used T2w and Dixon images from 10 healthy volunteers and 10 patients, acquired in a Philips Ingenia 3.0T scanner (TE 110ms, TR 4160ms for T2w) with an acquisition matrix of 324x324 and a pixel resolution of 0.4x0.4x4mm. To segment fat, we developed an Osirix plugin based on PyOsirix, which allows for running Phyton scripts over the Osirix database. We manually define 4 ROIs per slice for the erector spinae and multifidus muscles and from L1-L2 to L5-S1. An automatic threshold is determined for each ROI. For the gold standards, we copy the same ROIs into the Dixon images and then we found a threshold manually. For the statistical analysis, we performed two-tail paired t-test, Pearson correlation, Bland Altman analysis and linear regression.

RESULTS

Two-tail paired t-test of the segmented areas showed that there is not significant difference between gold standard and our method (P=0.61). Linear regression showed the good agreement between the two methods (Y=0.91X+0.21 cm2). Pearson correlation was 0.89 and Bland Altman plots showed a low bias (-0.016 cm2) and limits of agreement of [-1.270, 1.238] cm2. Fortin and Batiié (2012) reported 9 minutes for manually finding the threshold for fat segmentation in T2w images. Our Osirix plugin performs the segmentation in a fraction of second per ROI.

CONCLUSION

We developed an Osirix plugin to automatically quantify FI in PM using T2w images. Our plugin showed an excellent agreement and no significant difference with manual segmentation using Dixon images. Our plugin reduces the processing time from minutes to a few seconds. As future work, we are developing techniques for facilitating the PM delimitations to define the ROIs.

CLINICAL RELEVANCE/APPLICATION

We validated a software to automatically segment the fat infiltration in paraspinal muscles using T2w images. We used manual segmentation in Dixon images as a gold standard.

SST06-05 Quantitative T2 Magnetic Resonance Imaging Compared to Morphological Grading of the Early Cervical Disc Degeneration in Asymptomatic Volunteers by T2 Relaxation Mapping

Friday, Dec. 1 11:10AM - 11:20AM Room: E451A

Participants
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PURPOSE

The purpose of this study was to assess cervical disc degeneration quantitatively by using T2 Relaxation mapping.

METHOD AND MATERIALS

22 asymptomatic young subjects (11 men and 11 women; 21.73±2.01 years) were enrolled in this study. All date were collected on a 3.0 T MRI(Skyra,Siemens Healthcare, Erlangen, Germany);Therefore, the morphological date of 132 cervical disc covering C2 to T1 were obtained (Cervical sagittal T2-weighted, sagittal and axial T2 relaxation MRI) covering discs C2-C3 to C7-T1. All MR images in this study were acquired in the afternoon to minimize the diurnal variation of T2 values in the discs. All the discs were morphologically assessed according to the Miyazaki grade. Morphological evaluation of images were carried out by 2 radiologists with 10 years experience of musculoskeletal radiology in consensus. Six discs (C2-T1) of the cervical spine were put Regions of interest (ROIs) over axial T2 mappings images, including nucleus pulposus (NP),anterior and posterior annulus fibrosus (AF). To minimize the error in identifying nucleus pulposus (NP) anatomic structure, free hand ROIs were put carefully matched to the NP shape.The value of AF was calculated by the average between AAF and PAF. Mean T2 values were recorded using Siemens SyngoVIA workstation.Wilcoxon signed rank test, Kruskal-Wallis test, and Spearman rank correlation were performed. Correlations were considered as strong for r>0.7, moderate for 0.5< r<0.7, and weak for r<0.5. All statistical analysis was performed by SPSS software (v16.0, SPSS Inc., Chicago, IL, USA), P<0.05 was considered statistically significant.

RESULTS

The difference in T2 values between NP and AF were highly significant (P<0.001). The trends of decreasing T2 mapping values of both NP and AF with increasing Miyazaki grades was significant (P<0.01), particularly between Miyazaki grade I and II (P<0.001). Miyazaki grades were inversely significantly correlated with T2 values in the NP (r=-0.8901, P<0.001) and AF (r=-0.7446, P<0.001).

CONCLUSION

The process of cervical disc degeneration can be detected by T2 mapping, particularly at early stage. It displays comparable trends as Miyazaki grades does.

CLINICAL RELEVANCE/APPLICATION

Quantitative, objective and non-invasive evaluation of T2 mapping in intervertebral disc degeneration can prevent, diagnose and evaluate the clinical effect of spinal diseases.

SST06-06 Value of Psoas Proximal Insertion for Numbering Lumbar Vertebrae

Friday, Dec. 1 11:20AM - 11:30AM Room: E451A

Participants
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PURPOSE

To evaluate the value of psoas muscle proximal insertion for correct numbering of the lumbar vertebrae in MRI, in particular in case of lumbosacral transitional vertebra (LSTV).

METHOD AND MATERIALS

Two radiologists assessed independently 477 MRI of the lumbar spine with coronal STIR sequence and a sagittal localizer sequence on the whole spine. The last lumbar vertebra was by counting caudally from C2, and its morphology was evaluated according to Castellvi classification as modal lumbosacral junction (N) or LSTV (C). The proximal insertion level of psoas muscle was assessed on coronal STIR sequence. It was named as the most proximal vertebrae with psoas over half of its body. The same parameters were assessed on 207 PET-CT of other patients including the whole spine to compare MRI and CT data with a Fisher's exact test, considering CT as gold standard for anatomical consideration, due to millimetric slices and possibility of multiplanar reconstructions.

RESULTS

Among the 477 patients, 405 patients (84,9%) had a modal last lumbar vertebra (L5N), 43 patients (9%) a LSTV (L4/5/6C+) and 29 patients (6,1%) a missing or supernumerary lumbar vertebra without LSTV (L4/6N). The psoas proximal insertion was L1 in 449 patients (94,1%), T12 in 8 patients (1,7%) and L2 in 20 patients (4,2%). It was L1 in 98,5% in case of L5N, 81,0% in case of LSTV, and 81,3% and 15,4% in case of L4N or L6N respectively. The interreader agreement for determination of psoas proximal insertion was excellent (Kappa = 0.96). There was no statistically significant difference between MRI and CT data ($p<0,05$).

CONCLUSION

Coronal STIR sequence has a high-performance for the determination of the psoas proximal insertion. Determination of psoas proximal insertion is an accurate, valuable and easy way for correctly number lumbar vertebrae. In case of a modal anatomy (L5N), it's almost always L1 (98%). Controversely, this insertion is not necessarily T12 or L2 according to the presence of missing or supernumerary lumbar vertebrae, with or without LSTV. In these situations, psoas even keeps an insertion on L1 in the majority of cases, except in L6N group.

CLINICAL RELEVANCE/APPLICATION

Radiologists should have a look on psoas proximal insertion in lumbar spine MRI. If this insertion is not 5 vertebral bodies above the lumbosacral joint, there is a high probability of variation in the number of lumbar vertebrae.

SST06-07 The Value of Golden-Angle RAdial Sparse Parallel (GRASP) Imaging for Differentiation between Infectious Degenerative Modic Type 1 Changes of the Spine

Friday, Dec. 1 11:30AM - 11:40AM Room: E451A

Participants
Meritxell Garcia, Basel, Switzerland (*Presenter*) Nothing to Disclose
Kai Tobias Block, PhD, New York, NY (*Abstract Co-Author*) Royalties, Siemens AG
Oliver Bieri, PhD, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Dorothee Harder, Basel, Switzerland (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The aim was to assess whether a T1w3D sequence with contrast for dynamic MR imaging, Golden-angle RAdial Sparse Parallel (GRASP) was able to distinguish between benign and pathologic vertebral compression fractures.

METHOD AND MATERIALS

Twelve patients with non-necrotic metastases in non-fractured VBs (mean 66 years), 11 patients with VB compression fractures without a history of a malig-nancy (mean 74 years), and 8 patients with VB compression fractures caused by osseous metastases (63 years) were examined by conventional MRI and GRASP at 1.5 or 3T (Siemens). Imaging parameters of the GRASP sequence were: TA 4:20 min, TR/TE 5.92/1.78 msec, slice thickness 2.5 mm, voxel size 1x1x2.5 mm. A region of interest (ROI) was placed in the pathologic-appearing VB and in a normal-appearing VB, whereby the latter served as a reference. The ROIs of metastatic non-fractured VBs served as a further reference.

RESULTS

The three patients groups did no show any difference in the maximum contrast-enhancement intensity, and all showed a higher contrast-enhancement than the normal-appearing VBs. In all VB fractures without malignancy the time-contrast-enhancement intensity course was almost parallel to that of the normal-appearing VB consisting of a fast increase of contrast enhancement (at 40-85 sec) shortly afterwards reaching a plateau (80-175 sec). On the other side, all metastases without fracture manifested a slightly earlier and very fast increase of contrast-enhancement (at 30-55 sec) immediately fol-lowed by a prolonged and weak decrease of enhancement towards a late plateau (>175 sec). The time-intensity contrast-enhancement curves of the pathologic fractures were quite similar to that of the metastatic non-fractured VBs (slope 35-65 sec, plateau >175 sec).

CONCLUSION

Pathologic VB fractures, however, can be distinguished from benign compression fractures by a different time intensity contrast-enhancement curve, whereby the dynamic differences can be attributed to differences in cellularity, edema, and vascularity of the bone. We conclude that GRASP imaging may be a promising sequence for the differentiation between benign and pathologic fractures, which may be of great value in patients in which the primary cause for the fracture cannot be evaluated by conventional MRI.

CLINICAL RELEVANCE/APPLICATION

GRASP imaging may be a promising tool for the differentiation between benign and pathologic fractures with MRI.

SST06-08 Texture Analysis of Paraspinal Musculature in MRI of the Lumbar Spine: Analysis of the Lumbar Spinal Outcome Study (LSOS) Data

Friday, Dec. 1 11:40AM - 11:50AM Room: E451A

Participants
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Roman Guggenberger, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the clinical impact of fatty infiltration in paraspinal musculature on Spinal Stenosis Measure (SSM) Score and Walking Distance, at baseline and regarding changes after 12 months in patients suffering from lumbar spinal stenosis (LSS) using the qualitative Goutallier staging and quantitative Texture Analysis (TA) in Magnetic Resonance Imaging (MRI).

METHOD AND MATERIALS

In this retrospective, institutional review board approved study, TA was performed on axial T2 weighted MR images at level L3/4 using dedicated software (MaZda) in 62 patients with LSS. The association between Goutallier and TA findings with two clinical outcome measures, Spinal Stenosis Measure (SSM) Score and Walking Distance, at baseline and regarding changes after 12 months were assessed using machine learning algorithms (Random Forest) for TA feature reduction, followed by multiple logistic regression models.

RESULTS

Quantitative assessment of fatty infiltration using the histogram TA feature „mean" showed higher interreader reliability (ICC 0.83-0.97) compared to the Goutallier staging (κ = 0.69 to 0.93). No correlation between Goutallier staging and two clinical outcome measures at baseline and after 12 months was observed. Among 151 TA features in all paraspinal muscle groups, only TA feature "mean" of the spinotransverse group showed a significant but weak correlation with worsened SSM (p = 0.046) and TA feature "S(3,3) Entropy" as a measure of altered microarchitecture showed a significant but weak association with worsened walking distance over 12 months (p = 0.046). However, after correction for multiple testing no clear association can be observed.

CONCLUSION

MR TA is a reproducible tool to quantitatively assess paraspinal fatty infiltration, but its association with clinical outcomes in LSS patients is very limited.

CLINICAL RELEVANCE/APPLICATION

MR TA is a reproducible tool to quantitatively assess paraspinal fatty infiltration and mircoarchitectural changes, but its association with clinical outcomes in Lumbar Spinal Stenosis patients is limited.

SST06-09 Optimization of 2nd TE with Subtraction Image Using Ultra-Short TE for the Lumbar Cartilaginous Endplates in Human in Vivo

Friday, Dec. 1 11:50AM - 12:00PM Room: E451A

Participants
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PURPOSE

Dual echo acquisition with later echo subtraction has been used for suppressing long T2 signals in ultra-short TE (UTE) imaging.In this study, we evaluated the optimal 2nd TE with subtraction images using UTE for lumbar cartilaginous endplates (CEP) in human in vivo.

METHOD AND MATERIALS

The subjects were 20 patients who had low back pain and degenerative lumbar disorders (12 males, 8 females; average age: 41.3±8.7 years). All subjects were performed with a 3-tesla MR system (Ingenia, Philips Healthcare, The Netherlands) using a dS Torso coil. We used a 3D sequence (TR, 23ms; flip angle, 15°) with fat suppression that UTE was acquired with a phased-encoded stack of spirals trajectory as the first TE and four gradient echoes as the second TE following the first echo. TEs were set at 0.16, 4.6, 9.2, 13.8, and 18.2ms. Scanning was performed around lumbar spine, sagittal slice orientation, 60 slices, 0.94mm×0.94mm×4.8mm voxel size, and 17-minute scan time. Signal intensity of CEP and intervertebral discs (IVD) and vertebral bodies (VB) at the level of L3/L4 in region of interests (ROIs) were measured on the subtraction images (first TE minus second TEs). The ROIs were measured by a research scientist analyzing MR images and a spine surgeon. Furthermore, we calculated the contrast ratio (CR) of CEP/IVD and CEP/VB. To calculate the inter measurers variability, we expressed an intraclass correlation (ICC) with CR. The Friedman test was used for statistical significance, which was set at a p-value of <0.05. All statistics were performed in SPSS version 20.0 (IBM, SPSS Inc.).

RESULTS

CR for CEP/IVD was 47.9±15.5 for 4.6ms, 62.6±21.6 for 9.2ms, 65.8±20.4 for 13.8ms, and 48.5±22.0 for 18.2ms. CR of 9.2 and 13.8ms was significantly higher than that of 4.6 and 18.2ms (p<0.01). Furthermore, CR for CEP/VB was 9.3±4.1 for 4.6ms, 9.5±3.5 for 9.2ms, 18.7±4.3 for 13.8ms, and 22.3±5.8 for 18.2ms. CR of 13.8 and 18.2ms was significantly higher than that of 4.6 and 9.2ms (p<0.01). ICC of two measurers was 0.939 for CEP/IVD and 0.924 for CEP/VB.

CONCLUSION

The optimal 2nd TE with subtraction image was 13.8ms in human CEPs.

CLINICAL RELEVANCE/APPLICATION

Dual echo acquisition with UTE is useful for diagnosing degenerative changes of CEPs such as Modic changes.

RSNA 2017 Explore. Invent. Transform.
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SST07

Nuclear Medicine (Chest Imaging)

Friday, Dec. 1 10:30AM - 12:00PM Room: E353C

CH CT MR NM

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

SST07-01 Whole-Body FDG-PET/MRI: Comparison of its Capability for TNM Staging with that of Whole-Body MRI, Integrated FDG-PET/CT and Conventional Radiological Examination in Patients with Malignant Pleural Mesotheliom

Friday, Dec. 1 10:30AM - 10:40AM Room: E353C

Participants
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PURPOSE

To directly and prospectively compare the TNM staging capability among whole-body co-registered FDG-PET/MRI, MRI with diffusion-weighted imaging (DWI), integrated FDG-PET/CT and conventional radiological examination in patients with malignant pleural mesothelioma.

METHOD AND MATERIALS

23 consecutive pathologically diagnosed malignant mesothelioma patients (14 men, 9 women, mean age 69.2 years old) underwent whole-body MRI including DWI, integrated PET/CTs, conventional radiological examinations, pathological examinations and surgical reports as well as follow-up examinations. TNM staging was evaluated by three different reader groups including radiologists with more than three year experiences of whole-body MRI and PET/CT and nuclear medicine physicians. Kappa statistics were determined for evaluations of agreements of each factor and the clinical stage between each of the methods and final diagnosis. Finally, the diagnostic accuracy of each factor and of determination of the clinical stage was statistically compared with each other by using McNemar's test.

RESULTS

T factor agreements were determined as substantial (PET/CT and conventional examination: kappa value=0.61) or almost perfect (PET/MRI and MRI: kappa value=0.86). N factor agreements were also determined as substantial (PET/CT: kappa value=0.73, conventional examination: kappa value=0.61) or almost perfect (PET/MRI and MRI: kappa value=1.00). M factor assessment, agreements were also determined as moderate (conventional examination: kappa value=0.47), substantial (MRI: kappa value=0.78) or almost perfect (PET/MRI and PET/CT: kappa value=1.00). In addition, clinical stage agreements were determined as substantial (PET/CT and conventional examination: kappa value=0.70) or almost perfect (PET/MRI and MRI: kappa value=0.87). Finally, accuracies of N factor evaluation on PET/MRI and MRI (100 [23/23] %) were significantly higher than that of conventional examination (73.9 [17/23] %, p=0.03).

CONCLUSION

Whole-body PET/MRI and MRI with DWI are potentially more useful for TNM stage assessment than conventional radiological examination, and can be considered at least as effective as PET/CT.

CLINICAL RELEVANCE/APPLICATION

Whole-body PET/MRI and MRI with DWI are potentially more useful for TNM stage assessment than conventional radiological

examination, and can be considered at least as effective as PET/CT.

SST07-02 Prognostic Value of Metabolic Variables of [18F]FDG PET/CT in Surgically Resected Stage I Lung Adenocarcinoma

Friday, Dec. 1 10:40AM - 10:50AM Room: E353C

Participants
Xiaoyi Wang, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

The objective of this study was to assess the prognostic value of metabolic tumor burden measured by positron emission tomography/computed tomography (PET/CT) in patients with stage I lung adenocarcinoma.

METHOD AND MATERIALS

We reviewed 127 consecutive patients with pathologically proven stage I lung adenocarcinoma who underwent pre-treatment [18F]FDG PET/CT scans in our hospital from 2005 June to 2012 June. The maximum, mean and peak standardized uptake value (SUVmax, SUVmean and SUVpeak), metabolic tumor volume (MTV), total lesion glycolysis (TLG) and computed tomography volume (CTV) were measured. The Kaplan-Meier and Cox proportional hazards model were used with age, gender, TNM stage, clinical stage, histological grade, nodule type, tumor size and metabolic parameters to predict progression-free survival (PFS). The cut-off point was determined through ROC curve.

RESULTS

In univariate analysis, the histological grade, nodule type, diameter (cut-off value of 2.0cm), CTV (6.56cm3), SUVmax (3.25g/ml), SUVmean (1.58g/ml), SUVpeak (1.84g/ml), MTV (4.80cm3) and TLG (10.40) were significantly associated with PFS (all P value <0.05). Patients with poorly differentiated adenocarcinoma, solid nodule type, large size, high metabolic tumor burden were associated with poor prognosis. In multivariate analysis, only histological grade was independent prognostic factors for progression with a P value of 0.005 (RR, 0.355; 95 % CI, 0.173-0.728). Among five PET/CT metabolic parameters, only MTV was independent prognostic factors for progression with a P value of 0.031 (RR, 1.118; 95 % CI, 1.010-1.237).

CONCLUSION

Histological grade was an independent predictor for progression in patients with stage I lung adenocarcinoma. Among five PET/CT metabolic parameters, only MTV was an independent predictor for progression.

CLINICAL RELEVANCE/APPLICATION

Owing to the high heterogeneity, there is quite a limitation in treatment planning and prognosis predicting only based upon TNM stage and pathological type. Recently, several researches have already proved that SUVmax, MTV and TLG had prognostic and predictive value in NSCLC patients. Howerer, previous studies focused primarily on advanced stage disease, few studies have reported the role of those parameters in early stage adenocarcinoma. This study was conducted to document the prognostic role of metabolic tumor burden parameters in patients with stage I lung adenocarcinoma.

SST07-03 Comparison of Different Automated Lesion Delineation Methods for Metabolic Tumor Volume of 18F-FDG PET/CT in Patients with Stage I Lung Adenocarcinoma

Friday, Dec. 1 10:50AM - 11:00AM Room: E353C

Participants
Xiaoyi Wang, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

Defining metabolic tumor volume (MTV) of small and/or low uptake lesions using positron emission tomography/ computed tomography (PET/CT) is usually challenging since the variation is generally high. The aim of this paper is to investigate the suitable segmentation method in small, low uptake and heterogeneous stage I lung adenocarcinoma.

METHOD AND MATERIALS

One-hundred and thirty-three stage I lung adenocarcinoma patients with 2-deoxy-2-[18F]fluoro-D-glucose PET/CT scans were enrolled in this retrospective study. All lesions were divided into different groups according to nodule density (16 non-solid, 30 part-solid and 87 solid), nodule size (53 small lesions with longest diameter <= 20 mm; 80 large lesions with longest diameter >20 mm) and the maximum standard uptake value (SUVmax) level (57 low uptake lesions with SUVmax <= 2; 76 high uptake lesions with SUVmax > 2). The MTVs of the four different PET segmentation methods were evaluated and compared with CT volume (CTV). Percentage volume error (%VE) compared to CTV was calculated and the correlations between MTVs and CTV were analyzed.

RESULTS

The adaptive iterative algorithm (AT-AIA) had the highest accuracy in large, high uptake and solid nodules (72.5%, 72.4% and 65.6%, respectively). The method of adaptive thresholding at 40% SUVmax (AT40%) had the highest accuracy in small, low uptake and non-solid nodules (56.6%, 56.1% and 62.6%, respectively). In part-solid nodules, the accuracy of AT-AIA (60.0%) and AT40% (56.7%) were higher than that of the other two methods. The MTV of AT-AIA was in excellent consistent with the CTV in solid nodules (R=0.831, P=0.000) and in high uptake nodules (R=0.830, P=0.000). The MTV of AT40% was in good consistent with the CTV in non-solid nodules (R=0.686, P=0.003) and in part-solid nodules (R=0.731, P=0.000).

CONCLUSION

AT40% showed best performance in small, low uptake, non-solid and part-solid lesions. AT-AIA was suitable for large, high uptake and solid lesions.

CLINICAL RELEVANCE/APPLICATION

Up to now, defining metabolic tumour volume of small and/or low uptake lesions is still challenging since the variation is generally high. The aim of this study is to investigate the suitable segmentation method in small, low uptake and heterogeneous stage I lung

adenocarcinoma.

SST07-04 Decrease in SUV Max of a Solitary Pulmonary Nodule (SPN) in Dual-Time FDG-PET/CT Imaging: Does it Reliably Exclude Malignancy?

Friday, Dec. 1 11:00AM - 11:10AM Room: E353C

Participants
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PURPOSE

FDG-PET/CT is a well established modality for evaluating indeterminate solitary pulmonary nodules (SPN). Although the sensitivity for detecting malignancy is considered quite high, the specificity is lower. By adding delayed imaging (Dual-Time PET/CT), the specificity for malignancy improves, since malignant SPN increase glucose utilization over time, i.e. an increase by > 10% in the maximum standardized uptake value (SUV Max). By contrast, a decrease or no significant change in SUV Max suggests benign etiology. We observed, however, that it was not uncommon for biopsy-proven malignant nodules to show either no significant change or a decrease in SUV Max on delayed imaging. Our aim was to (1) determine the frequency of this pattern and (2) to correlate with histopathology.

METHOD AND MATERIALS

From 2007 through 2016, we collected all cases of FDG-PET/CT scans used for SPN evaluation in which the final diagnosis was lung malignancy, yet the SUV Max either did not significantly change, or decreased by 10% or more on delayed imaging.

RESULTS

A total of 86 patients met the above criteria, 50 men and 36 women. In 40 of the patients (Group A), the SUV Max decreased by $\geq$ 10%, which was considered a significant decrease. Of these, 23 patients had adenocarcinoma, 4 had squamous cell, 4 had small cell, and 13 had bronchoalveolar (BAC). The remaining 46 patients (Group B) demonstrated either no significant change in SUV Max, or a decrease less than 10%; 15 had adenocarcinoma, 13 had small cell, 7 had BAC, and 11 had squamous cell cancer.

CONCLUSION

(1) Although a significant increase in SUV Max in dual-point FDG PET/CT imaging generally indicates SPN malignancy, a decrease or lack of change in SUV does not necessarily mean a benign etiology. (2) Adenocarcinoma is the most common cell type in which SUV Max decreases or does not significantly change, likely a reflection of tumor differentiation.

CLINICAL RELEVANCE/APPLICATION

A lack of change or a significant decrease in SUV Max over time of an SPN does not exclude malignancy and this pattern is unreliable in SPN evaluation.

SST07-05 18FDG Uptake Patterns by Mediastinal Lymph Nodes and EBUS in the Nodal Staging of Patients with Non-Pulmonary Malignancies

Friday, Dec. 1 11:10AM - 11:20AM Room: E353C

Participants
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Josh Escabach, BMedSc, Westmead, Australia (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To retrospectively compare 18FDG-PET scans and EBUS findings in patients with documented mediastinal lymphadenopathy and non-pulmonary primary malignancies.

METHOD AND MATERIALS

25 patients with documented mediastinal lymphadenopathy and non-pulmonary primary malignancies underwent 18FDG-PET scintigraphy followed by EBUS within the ensuing 3 weeks. One-two nodes (n = 29) were assessed in each patient, determined by 18FDG-PET findings and accessibility of the 18FDG-positive nodes. The mediastinal nodal status from each procedure was compared.

RESULTS

EBUS resulted in mediastinal nodal status downgrading in 60% patients. No upgrading was noted. Downgrading most likely occurred when there several non-enlarged lymph nodes of similar 18FDG-avidity distributed randomly and bilaterally in the mediastinum, often with bilateral hilar uptake (~80% of patients). 100% patients with positive EBUS findings for malignant disease demonstrated discrete 18FDG-avid lymph nodes ipsilaterally, with minimal-to-no 18FDG-avid nodes contralaterally. EBUS findings in 20% of patients were inconclusive, despite multiple sampling. Enlarged, rounded lymph nodes with avid FDG uptake (SUV>4) were also more likely to harbour metastatic disease.

CONCLUSION

The pattern of mediastinal 18FDG uptake was highly predictive of metastatic disease, and may circumvent the need for EBUS

evaluation. Prospective analysis of these parameters will be undertaken.

CLINICAL RELEVANCE/APPLICATION

Patterns of 18FDG uptake in mediastinal lymph nodes may circumvent the need for EBUS assessment.

SST07-06 Short TE and Low Flip Angle VIBE Sequence for Lung Evaluation in PET-MRI

Friday, Dec. 1 11:20AM - 11:30AM Room: E353C

Participants
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PURPOSE

Low-dose CT in standard PET/CT offers a better morphological lung characterization when compared with Dixon sequences in PET/MRI. Our aim is to improve diagnostic accuracy for lung lesions detection with PET/MRI avoiding a significant increase in the acquisition time, adding a short TE (Echo Time) and low FA (Flip Angle) T1-weighted sequence (gradient-echo volumetric interpolated breath-hold examination [VIBE]) to the standard acquisition protocol.

METHOD AND MATERIALS

We enrolled 21 oncological patients (11 M and 10 F) who underwent both thoracic CT scan and 3T PET-MRI (Siemens Biograph mMR) including lung dedicated short TE and low FA VIBE (inspiration, 3 mm slice thickness, axial plane). Time interval between the two examinations was < 2 weeks. VIBE sequences were retrospectively and independently evaluated by two radiologists for the detection of pulmonary nodules, parenchymal consolidations and dense bands; to assess inter-observer agreement Cohen's kappa coefficient (κ) was calculated. Results were then compared with CT scans findings, considered as the gold standard. Sensitivity and specificity were calculated.

RESULTS

VIBE sensitivity in lung nodules evaluation was 80% (8/10 patients) for nodules >5 mm and 57,1 % (4/7 patients) for nodules <= 5 mm, compared to CT imaging. In both cases specificity was 100%. All dense bands and parenchymal consolidation were found both with CT scan and VIBE. Inter-observer agreement was 95 % for nodules >5 mm (κ =0.90, $p<0.001$), 85% for nodules <= 5 mm (κ=0.44 $p<0.005$), 90% for dense bands (κ =0.56, $p<0.001$) and 100% for parenchymal consolidations.

CONCLUSION

VIBE showed high sensitivity in the evaluation of lung nodules > 5 mm; sensitivity was less satisfactory for smaller nodules. This sequence obtained also a very good inter-observer agreement, resulting a very reproducible imaging technique in pulmonary lesion investigation. Considering also the short acquisition time (15-18 s), it seems be reasonable to integrate PET/MRI protocols with a short TE and low FA VIBE, improving its diagnostic performance in lung evaluation.

CLINICAL RELEVANCE/APPLICATION

Short TE and low FA VIBE sequence can improve PET-MRI diagnostic performance in pulmonary lesions detection, without a significant increase in the acquisition time.

SST07-07 Relative Effect Size of Different Clinical & PET Variables on NSCLC Patient's Survival Estimated with Random Survival Forest Model

Friday, Dec. 1 11:30AM - 11:40AM Room: E353C

Participants
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PURPOSE

To assess relative effect size of the different clinical & PET variables on the overall survival (OS) in patients with non-small cell lung cancer (NSCLC), using permutation Variable Importance (VIMP) measure with a Random Survival Forest (RSF) model.

METHOD AND MATERIALS

A RSF model, which can address right censored data problem, was constructed based on 952 Consecutive NSCLC patients with baseline PET/CT studies, but no brain metastasis or other type of primary cancer (separated into 604 for training and 348 for testing, according to their PET/CT study acquisition scanners). The RSF model included gender, age, race, smoking status, TNM stage (according to the 8th edition of the clinical TNM staging system), histology type, treatment types (with surgery, without surgery and no treatment), and maximum standard uptake value of whole-body tumor (SUVmaxWB) and whole-body metabolic

tumor volume (MTVWB) measured on the PET/CT studies. The overall survival (OS) time served as independent variable. The VIMP, which is a measure of relative importance of parameters on survival (the higher value indicates higher importance), was calculated using permutation method included in the RSF R package (randomForestSRC). The trained RSF model was used to predict the survival rate for the patients in the test dataset and the results were compared to the standard Cox model.

RESULTS

The top 3 highest VIMP coefficients of 0.047, 0.036 and 0.032, were from treatment type, clinical TNM stage and MTVWB, respectively. The coefficient of SUVmaxWB was 0.011. The histology type, race, smoking status and gender had similar coefficients of about 0.003, while age had the smallest VIMP of 0.001. When predicting the test patients' survival rate with the identical variables, our RSF model achieved moderate performance with C-index (a measure of predictive ability of a model) of 0.73, compared to 0.71 by the Cox model.

CONCLUSION

Our model suggests that treatment types, TNM stage and MTVWB are relatively important variables on NSCLC patient's survival, among the commonly used clinical prognostic and PET tumor variables. SUVmaxWB has a moderate effect, while the histology type, race, smoking status, gender and age have small effect on patients overall survival.

CLINICAL RELEVANCE/APPLICATION

This work suggests that treatment type, TNM stage, MTVWB and SUVmaxWB are important prognostic factors useful for the treatment decision making and prognosis of NSCLC patients.

SST07-08 Active Contour-Based Segmentation for 18F-FDG PET Thoracic Oncology: A Powerful Alternative to the Clinical State-of-the-Art Expert-Based Segmentation

Friday, Dec. 1 11:40AM - 11:50AM Room: E353C

Participants
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PURPOSE

The aim of this study was to assess the performances of an active contour-based user GUI approach for the PET segmentation of complex-shaped lung tumours, in comparison to an optimized expert-based manual reference standard.

METHOD AND MATERIALS

In this retrospective study, 75 complex-shaped lung tumours were blindly segmented using the same graphical user interface (GUI) ITK snap software. For each tumour, four independent raters semi-automatically segmented the 75 tumours twice (sessions 1 and 2) using the active contour based-procedure of the GUI software. A probabilistic estimate of each tumour ground truth was also computed from the set of six independent expert-based manual segmentation results using the Simultaneous Truth And Performance Level Estimate (STAPLE) algorithm. Accuracy of the semi-automatic procedure was assessed by measuring the spatial overlap between the raters segmentation outputs and the corresponding expert probabilistic reference standards, using the DICE similarity coefficient (DSC). Interrater and intrarater reliability analyses were also performed using the intra class correlation coefficients (ICC) estimates of the output volumes,(two-way mixed-model, individual-rating, absolute-agreement). For all tumours segmentation procedures, average time per procedure was also estimated.

RESULTS

Overall accuracy of the user GUI active contour-based procedure was excellent with a DSC of 0.835 (95%CI = 0.775-0.895). Interrater reliabilities provided the following results: ICC = 0.941 (95%CI = 0.913-0.961) for the first session and ICC = 0.935 (95%CI = 0.906-0.956) for the second session. Intrarater reliabilities provided the following results: ICC = 0.993 (95%CI = 0.990-0.996) for the rater 1; ICC = 0.987 (95%CI = 0.976-0.993) for the rater 2; ICC = 0.972 (95%CI = 0.956-0.982) for the rater 3; and ICC = 0.977 (95%CI = 0.964-0.985) for the rater 4. Average time was 631 seconds for manual segmentation procedure, and 130 seconds for active contour-based procedure.

CONCLUSION

Compared to the state of the art expert-based manual segmentation, the GUI-based active contour procedure provided excellent accuracy and reliability, with a mean procedure duration almost five-times faster than the manual reference standard.

CLINICAL RELEVANCE/APPLICATION

Active contour-based segmentation from ITK-snap software is robust, fast, and easy enough to be routinely applied to segment

Active contour based-segmentation from ITK snap software is robust, fast, and easy enough to be routinely applied to segment heterogeneous and complex-shaped lung tumours.

SST07-09 FDG-PET/CT Predicts Development of Thyroiditis due to Immunotherapy for Lung Cancer

Friday, Dec. 1 11:50AM - 12:00PM Room: E353C

Participants
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PURPOSE

Determine if PET/CT parameters of FDG uptake in the thyroid gland pre-and post-immunotherapy with nivolumab for advanced lung cancer could predict the development of the immune-related adverse event, thyroiditis.

METHOD AND MATERIALS

An IRB-approved retrospective chart review over 2 years found 18 patients with advanced lung cancer treated with nivolumab and with FDG-PET/CT scans pre and post therapy. The post-treatment FDG-PET/CT was performed approximately 6-9 weeks after the first dose of nivolumab. The standardized uptake value (mean and max) and total lesion glycolysis (TLG) of the thyroid gland were measured. Patients obtained monthly thyroid function testing as standard of care while receiving nivolumab. Results of the thyroid testing separated the patients into two groups, patients who developed new hypothyroidism (thyroiditis) and those who did not. Statistical t-test analysis used the FDG-PET/CT parameters to compare the two groups.

RESULTS

In the hypothyroid group, 7 patients developed hypothyroidism after immunotherapy. In the euthyroid group, 9 patients remained euthyroid and 2 patients had a pre-existing history of hypothyroidism (including these 2 did not significantly affect statistics). T-test analysis demonstrated statistically significant higher post-therapy SUVs in the hypothyroid versus euthyroid group. The differences in average values between the two groups were SUV mean 0.77 ($p<0.04$), SUV max 0.96 ($p<0.04$) and TLG 0.96 ($p<0.02$). Pre-therapy SUVs showed no statistical difference. 4 out of 7 patients in the hypothyroid group were euthyroid at the time of the post-therapy PET scan and developed hypothyroidism months later.

CONCLUSION

Nivolumab is an immune checkpoint inhibitor which works by activation of T cells against tumors and is associated with immune-related adverse events like thyroiditis. Increases in FDG uptake in the thyroid gland after immunotherapy indicate inflammation from thyroiditis and therefore predict the development of immunotherapy-induced hypothyroidism, potentially before laboratory testing or development of symptoms.

CLINICAL RELEVANCE/APPLICATION

FDG-PET/CT can predict the development of immunotherapy-induced hypothyroidism and therefore the necessity for thyroid hormone replacement.

Honored Educators

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SST11

Vascular Interventional (PAD)

Friday, Dec. 1 10:30AM - 12:00PM Room: E352

IR MR VA

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

FDA Discussions may include off-label uses.

Participants

Gordon McLennan, MD, Chagrin Falls, OH (*Moderator*) Research Grant, Siemens AG; Research Consultant, Medtronic plc; Advisory Board, Siemens AG; Advisory Board, Surefire Medical, Inc; Advisory Board, Stealth Medical; Advisory Board, Rene Medical; Data Safety Monitoring Board, B. Braun Melsungen AG
Charles Martin III, MD, Pepper Pike, OH (*Moderator*) Scientific Advisory Board, Boston Scientific Corporation

Sub-Events

SST11-01 MR Angiography in Small Animals Using Hyperpolarized Water

Friday, Dec. 1 10:30AM - 10:40AM Room: E352

Participants
Sebastian Fischer, MD, Frankfurt, Germany (*Presenter*) Nothing to Disclose
Richard D. Maeder, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Vasyl Denysenkov, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The administration of Gadolinium based contrast agents is associated with the risk of allergic reactions and the development of a systemic nephrogenic fibrosis (NSF). Current research showed remnants of some types of Gadolinium based MR contrast agents in the brain - with unknown long-term effects. Purpose of our work is to examine dynamic nuclear polarization (DNP) as an alternative method for MR angiography.

METHOD AND MATERIALS

The used liquid-state Overhauser DNP is a technique to achieve hyperpolarization by microwave irradiation of electron spins in TEMPOL radicals, which are coupled with the nuclear spins of water molecules. Our setup comprises a 42 GHz microwave source and a 1.5 T in-bore DNP MRI polarizer, equipped with a multimode resonator. The continuously hyperpolarized water was administered with a flow of 1.2 ml/min into the aorta of five C57BL/6 mice via catheterization (0.15 mm ID) through iliac vessels. The aorta and its branches were visualized with GRE-sequences (TR 110s, TE 3.8s, FoV 78x58x2 mm, Matrix 256x192 px) and intravascular DNP signal intensities, SNR and CNR values were measured and compared to its native values.

RESULTS

Maximum intravascular signal intensities were increased 4.3-fold from 231±47 to 994±194 by infusion of hyperpolarized water. Thus better SNR and CNR values were measured for hyperpolarized vessels with an SNR increased 5.3-fold from 24±2 to 126±62 and CNR increased 26.3-fold from 3±2 to 79±49.

CONCLUSION

The used in-bore DNP setup continuously creates hyperpolarized water, which features high T1 signal enhancements in MR imaging and a short relaxation time. In our mice experiments the strong enhancement and its high CNR made a visualization of the aorta and its branches possible - even using a standard clinical 1.5 T scanner.

CLINICAL RELEVANCE/APPLICATION

Hyperpolarized water might be a promising future alternative to Gadolinium based contrast agents in MR angiographies without risking the potential adverse effects or intracorporal remnants of Gadolinium based contrast agents.

SST11-02 Type 2 Diabetes is Related to Increased Carotid Plaque Inflammation: A Novel Finding of Dynamic Contrast-Enhanced MR Imaging

Friday, Dec. 1 10:40AM - 10:50AM Room: E352

Participants
Beibei Sun, Shanghai, China (*Presenter*) Nothing to Disclose

Huilin Zhao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Although many pathological study have demonstrated that more microvessels and macrophages which associated with increased inflammation was exhibit in diabetic plaques, in vivo study of carotid plaque inflammtion in type 2 diabetes mellitus(T2DM) with dynamic contrast-enhanced (DCE) magnetic resonance (MR) imaging is rare. Thus our study aim to evaluate carotid plaque inflammation in stroke patients with and those without type 2 diabetes(T2DM) and to determine which risk factors might be associated with plaque inflammation in T2DM subjects.

METHOD AND MATERIALS

A total of 55 patients(25 T2DM and 30 non-T2DM) with carotid plaque ipsilateral to ischemic event were underwent bilateral carotid artery MRI examination. Multicontrast sequences for characterizing plaque morphologic and DCE MR images for assessing atherosclerotic plaque inflammation were obtained in T2DM and non-T2DM patients.

RESULTS

Compared with non-T2DM patients, patients with T2DM had more severe inflammtion, as evidenced by higher Ktrans(transfer constant) (0.099 vs 0.061, P=0.005). Compared with well controlled diabetes(Hemoglobin A1c[HbA1c] <7%), poorly controlled diabetes(HbA1c >=7%) also have increased inflammation, as evidenced by higher Ktrans (0.126 vs 0.074±; P=0.009) and ve (extracellular extravascular volume fraction) (2.301% vs 6.187%; P=0.026). HbA1c level was independently associated with Ktrans in overall patients and T2DM patients after adjusting for plaque characterization and comprehensive confounding factors.

CONCLUSION

This study demonstrated an increased plaque inflammation in T2DM patients and poorly controlled T2DM patients. There have an independent pathophysiological link between the HbA1c level and Ktrans. Thus, DCE-MRI may be useful in monitoring the efficacy of some anti-hyperglycemic agents on atherosclerotic plaque inflammation in T2DM patients.

CLINICAL RELEVANCE/APPLICATION

Thus, this in vivo plaque inflammation imaging may potentially useful in providing a clinical tool to better understand the role of inflammation and angiogenesis in plaque progression/regression, and to monitor and predict therapeutic response to inflammation-targeted pharmacotherapy.

SST11-03 Comparison of [18F] FDG-PET/CT and 3D-Black-Blood 3T-MRI for the Diagnosis of Large Vessel Vasculitis

Friday, Dec. 1 10:50AM - 11:00AM Room: E352

Participants
Stefan Maurus, MD, Munich, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

To investigate the concordance of a high-resolution three-dimensional (3D) black-blood turbo spin echo (TSE) MRI sequence with variable flip angles and [18F]FDG-PET/CT for the diagnosis of large vessel vasculitis (LVV).

METHOD AND MATERIALS

24 consecutive patients with suspected LVV who underwent 3D-black-blood 3T-MRI and [18F]FDG-PET/CT imaging between 2013 and 2016 in our center were retrospectively reviewed. For image analysis 11 different vessel segments were evaluated in both modalities. The MRI-slides were analyzed for signs of vessel wall inflammation, which are concentric contrast enhancement (CCE) and concentric wall thickening (CWT) as well as image quality (IQ) and flow artifact intensity (FAI), using 4-point Likert scales. [18F]FDG-PET/CT analysis comprised qualitative, quantitative and semiquantitative methods. [18F]FDG uptake was analyzed in patients with and without immunosuppressive medication. Imaging findings were correlated with the final clinical diagnosis for each diagnostic method.

RESULTS

In 19 of 24 patients (79%), active or inactive LVV was confirmed by clinical follow-up. 3T-MRI was positive in 17 patients, while [18F]FDG-PET/CT identified vasculitis in 14 patients. On MRI, 72% of vessel segments showed no or only minor flow artifacts and 82% disposed an excellent or good IQ (82.2%). Among the patients with LVV, the frequency of CWT and CCE was comparable (62.5% vs. 63.1%) and both parameters showed high correlation (Spearman`s R = 0.933; P<0.001). The subgroup analysis of patients with anti-inflammatory medication revealed no statistical difference regarding the results of the [18F]FDG-PET/CT examination.

CONCLUSION

Free breathing navigated black-blood MRI and [18F]FDG-PET/CT are promising imaging tools in diagnosing patients with LVV.

CLINICAL RELEVANCE/APPLICATION

3D-black-blood 3T-MRI could be a future radiation-free alternative to PET-CT for the diagnosis and follow-up of patients with LVV,

especially in young patients.

SST11-04 Correlation of the Potential Biomarker for Ascending Aortic Aneurysms, MMP-9 with Quantitative Flow Parameters Measured by 4D Flow MRI

Friday, Dec. 1 11:00AM - 11:10AM Room: E352

Participants
Nadja M. Kocher, MD, Freiburg, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

This translational study intends to evaluate if MMP-9, a matrix metallopeptidase involved in the degradation of extracellular matrix, in the serum of patients with thoracic aortic aneurysms (TAAs) could be used as potential biomarker for TAAs in the future. Therefore MMP-9 serum levels were correlated with quantitative hemodynamic flow parameters measured by 4D flow MRI.

METHOD AND MATERIALS

16 patients (age 56±13years) with aortic root/ascending aortic aneurysms >45mm underwent 4D flow MRI. Flow quantification was performed using ECG gated three-directional velocity encoding with full 3D coverage of the thoracic aorta. 4D flow MRIs were acquired in a sagittal oblique 3D volume using a flip angle of 8°, VENC: 150 cm/s, spatial resolution = (2.0-2,4)³mm³, and temporal resolution: 20-40 ms. Data analysis included 3D blood flow visualization (EnSight, CEI, USA) based on 3D particle traces and 3D streamlines. Time-resolved 2D data was extracted on a plane. The diameter, mean wall shear stress magnitude (meanWSSmag), 3D oscillatory shear index (OSI 3D) and percentage of retrograde flow were derived. MMP-9 levels in blood samples of these 16 patients were identified by ELISA tests. Patients were divided into two groups; Group A with bicuspid aortic valves (5 patients), Group B with tricuspid aortic valves (11 patients).

RESULTS

The following differences and correlations were shown in Groups A and B: MMP-9 levels were significantly higher in patients with BAV (Group A: 645.4(±203.9)ng/ml; Group B: 393.7(±129.1)ng/ml; +64%; p-value <0.05). Furthermore, within each group exist high correlations between MMP-9 levels and both meanWSSmag (Group A: r=0.74; Group B: r=0.5) and percentage of retrograde flow (Group A: r=0.69; Group B: r=0.5). There was also found to be a high negative correlation between MMP-9 and OSI 3D in Group B (r=0.54). The biggest diameters correlate in Group B to MMP-9 levels (r=0.54). No correlation was found for both of these parameters in Group A.

CONCLUSION

These results revealed a high correlation between quantifiable blood flow within TAAs and MMP-9. Further studies are warranted to investigate the influence of specific aneurysmatic blood circulation on the aortic wall and if MMP-9 can be used as potential biomarker for TAAs.

CLINICAL RELEVANCE/APPLICATION

MMP-9 could be used as an easy to gain biomarker for TAAs in the future. This would simplify the diagnosis.

SST11-05 Diagnostic Efficacy of Free-Breathing Contrast-Enhanced T1 Gradient Echo Sequences Compared to Standard Breath-Hold T1 Gradient Echo Sequences in the Assessment of Thoraco-Abdominal Aorta Having CT Angiography as Standard of Reference

Friday, Dec. 1 11:10AM - 11:20AM Room: E352

Participants
Cammillo R. Talei Franzesi, Milan, Italy (*Presenter*) Nothing to Disclose
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Silvia Girolama Drago, Monza, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the diagnostic accuracy of contrast-enhanced T1 free-breathing gradient echo sequences in the evaluation of aortic disease, in comparison with standard MR-angiographic sequences and CT-angiography studies.

METHOD AND MATERIALS

Fifty-three patients, with known aortic disease at CT-angiography evaluation, were prospectively evaluated with a 1.5T magnet (Achieva,Philips), with a phased array multi-coil, after the intravenous injection of 0.1 mL*Kg of gadobutrol. A standard MR angiography examination was performed with 3D-angiographic sequences and T1 breath-hold sequences (THRIVE). Multiplanar T1 free-breathing gradient-echo fat-suppressed (THRIVE-FB) sequences were additionally performed in all the examinations. Two radiologists independently compared the diagnostic quality of MR-angiographic sequences and CT-angiography studies, in terms of visualization of aortic wall and lumen and main arterial branches. Vascular calipers measured at different aortic levels were compared between the MR-sequences and CT evaluations and statistically analyzed. The interobserver agreement was investigated using the Intraclass Correlation Coefficient (ICC).

RESULTS

Free breathing sequences showed good diagnostic accuracy in the assessment of vascular calipers, with no significant differences compared to standard breath-hold MR-sequences and CT-studies. THRIVE-FB also demonstrated high sensitivity and specificity in the evaluation of vascular wall, plaques, thrombus and adjacent structures. Not significant differences were obtained in terms of diagnostic quality, between THRIVE-FB sequences, standard angiographic sequences and CT-angiography, with a good interobserver agreement (ICC of 0.85).

CONCLUSION

Free-breathing contrast-enhanced T1 gradient-echo fat-suppressed sequences, combined with high relaxivity contrast agent, demonstrated high diagnostic efficacy, permitting to correctly evaluate the aorta and its major branches, with no significant differences in comparison with standard breath-hold MR-sequences and CT studies.

CLINICAL RELEVANCE/APPLICATION

Angiographic free-breathing sequences may represent a useful tool in not-compliant patients, allowing to correctly evaluate main thoraco-abdominal arteries, with good diagnostic quality images.

SST11-06 Computed Tomography Guided Lumbar Sympathectomy (CTLS) as a Palliative Treatment in Patients with Critical Limb Ischemia Not Amenable to Therapeutic Revascularization

Friday, Dec. 1 11:20AM - 11:30AM Room: E352

Participants
Anurag Chahal, MD, New Delhi, India (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate the safety and efficacy of CTLS in the management of patients of critical limb ischemia without revascularization optionsTo assess the effects of technical parameters of CTLS on the clinical success of the procedure

METHOD AND MATERIALS

Patients with critical limb ischemia with angiographic anatomy not amenable for revascularization were included in the study. Exclusion criteria were patients not giving consent, unable to lay prone and deranged coagulation parameters. CTLS was performed with patient in prone position using 22 G chiba needle at L1-L3 vertebral level with a mixture of neurolytic solution (99% alcohol) and non-ionic contrast in the ratio of 10:1 after confirming the spread with a check solution of diluted contrast. Patients were observed for 4 hours before discharge. Periprocedural complications were noted; Numerical pain score (NPS) and limb changes were assessed before and after the procedure at 3 weeks and 3 months. Spread of neurolytic mixture was categorised as medial or lateral with respect to lateral edge of vertebral body. Treatment results were categorized into improved, unchanged or worsened.

RESULTS

22 patients (19 males, 3 females) with mean age 45.3 years (range: 25-78 years) were included. Bilateral procedure was done in 19 patients and unilateral in 3 patients. The mean volume of absolute alcohol injected per side was 7.5 mL. No procedure related complications were noted. 18 (81.8%) patients improved and 4 patients (18.2%) were unchanged. The mean NPS pre-procedure, 3 weeks and 3 months post procedure were 6.82, 3.32 and 3.05 respectively.($p<0.0001$). Pain relief was significantly better in patients with medial spread of the neurolytic agent compared to those without medial spread ($p=0.027$). Interestingly, 7/16(43.75%) patients reported ulcer healing in 3 months follow up.

CONCLUSION

CTLS is a simple, safe and effective procedure in patients with critical limb ischemia due to infragenicular diffuse arterial disease. Medial spread of the neurolytic agent provides significantly better results.

CLINICAL RELEVANCE/APPLICATION

CT guidance is optimal for exact needle positioning to achieve medial spread of neurolytic mixture which gives better results as seen in this study. CTLS helps in ulcer healing especially in patients with buergers disease who quit smoking since it provides pain relief and helps in opening collateral vessels via chemical sympatheticolysis.

SST11-07 String-Like Lumen in Below-the-Knee Chronic Total Occlusions on Contrast-Enhanced Magnetic Resonance Angiography Predicts Intraluminal Recanalization and Better Blood Flow Restoration

Friday, Dec. 1 11:30AM - 11:40AM Room: E352

Participants
Yingsheng Cheng, MD, Shanghai, China (*Presenter*) Nothing to Disclose

CONCLUSION

In patients with BTK CTOs, SL predicted intraluminal angioplasty and good blood-flow restoration for BTK CTOs.

Background

To determine whether string-like lumina (SLs) on contrast-enhanced magnetic resonance angiography (CE-MRA) predict better outcomes in diabetic patients with below-the-knee (BTK) chronic total occlusions (CTOs)

Evaluation

This study involved 317 long-segment (>5cm) BTK CTOs of 245 patients that were examined using CE-MRA and treated using endovascular angioplasty. A SL with a CTO was slowly filled with blood on conventional CE-MRA. SL-positive CTOs (n=60) achieved a higher technique success rate, preferred intraluminal angioplasty and better blood flow restoration than SL-negative CTOs (n=257 P<0.05). Multivariate analyses revealed that lesion length was the independent predictor of procedural success (P=0.028). SL was a predictor of intraluminal angioplasty (P<0.001) and good blood-flow restoration (P=0.004). Kaplan-Meier analyses at 12 months revealed a higher target lesion patency rate (P=0.04) and limb-salvage rate (P=0.35) in SL-positive CTOs.

Discussion

Our main findings are as follows: (1) intraluminal recanalization was more frequently used for BTK CTOs with SLs than without SLs; (2) CTO length was the only independent predictor of successful CTO recanalization; (3) SL was the only predictor of intraluminal angioplasty in the BTK CTOs; (4) SL and CTO length were predictors of good blood-flow restoration after recanalization; and (5) restenosis-free and limb-salvage rates were better for SL-positive CTOs than SL-negative CTOs.

SST11-08 Ultrasound-Guided Percutaneous Thrombin Injection for the Treatment of Iatrogenic Femoral Pseudoaneurysms

Friday, Dec. 1 11:40AM - 11:50AM Room: E352

Participants
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PURPOSE

To evaluate clinical and imaging factors that may affect successful ultrasound-guided percutaneous thrombin injection of iatrogenic femoral artery pseudoaneurysms.

METHOD AND MATERIALS

This was an IRB approved, HIPAA compliant retrospective study. The study population consisted of 326 consecutive subjects (138 males, 188 females; mean age 68 years, range 18 - 95 years) who underwent ultrasound guided percutaneous thrombin injection for the treatment of an iatrogenic femoral artery pseudoaneurysm. The number of pseudoaneurysm lobes, longest dimension, and volume of thrombin injected was recorded along with pre-procedure laboratory values of international normalized ratio (INR), activated partial thromboplastin time (aPTT) and platelet count. A follow up ultrasound was available in 146 subjects.

RESULTS

Technical success was achieved in 99.4% (324/326) of subjects. Technique efficacy, as measured by complete thrombosis on a follow up ultrasound, was achieved in 87.0% (127/146) of subjects. In 68% (13/19) of subjects who had not achieved complete thrombosis on follow up ultrasound, repeat thrombin injection was performed and deemed successful; 3 subjects required operative intervention and 3 subjects underwent no subsequent intervention. No imaging or procedure factor was associated with technique failure, including volume of thrombin injected (mean 476 units for complete thrombosis (CT) vs. 671 units for incomplete thrombosis (IT); p=0.105), number of pseudoaneurysm lobes (mean 1.33 for CT vs. 1.37 for IT; p=0.826) or largest size of pseudoaneurysm (mean 3.0 cm for CT vs. 3.6 cm for IT; p=0.133). No statistically significant difference in pre-procedure INR, aPTT or platelet count was found between subjects with CT and those with IT (p>0.125).

CONCLUSION

Imaging guided percutaneous thrombin injection has a high technical success rate for the treatment of iatrogenic femoral artery pseudoaneurysm. No imaging, procedure or laboratory factors are predictive of technique failure.

CLINICAL RELEVANCE/APPLICATION

Abnormal coagulation parameters do not affect technique efficacy for imaging guided percutaneous thrombin injection of iatrogenic femoral artery pseudoaneurysms.

SST11-09 Nephroprotective Imaging for Evaluation of Peripheral Arterial Occlusive Disease (PAOD): A Multi-Observer Comparison Study between Quiescent-Interval Single-Shot MR Angiography (QISS-MRA) and Invasive Angiography with Carbon Dioxide (CO2-DSA)

Friday, Dec. 1 11:50AM - 12:00PM Room: E352

Awards
Student Travel Stipend Award

Participants
Christophe Arendt, MD, Frankfurt Am Main, Germany (*Presenter*) Nothing to Disclose
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Lukas Lenga, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
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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

PURPOSE

Non-contrast QISS-MRA and CO2-DSA remain promising nephroprotective methods for accurate staging of PAOD in patients with chronic renal failure (CRF). The aim of our study was to assess the diagnostic value and subjective image quality of QISS-MRA in comparison with CO2-DSA.

METHOD AND MATERIALS

Sixteen consecutive patients (77.5±12.6 years, 64% male) with impaired renal function (eGFR 23.9±7.9 ml/min/1.73 m²) who underwent QISS-MRA at 3 Tesla and CO2-DSA within two weeks were retrospectively included. Identification of significant (>=50%) stenoses of the lower extremity arteries (21-segment-model) was evaluated by 4 independent readers with different level of experience per-segment in random order. Subjective image quality was determined using a 5-point Likert scale (1, non-diagnostic quality; 5, excellent quality or non-perceivable artifacts). CO2-DSA of an experienced interventional radiologist was considered the standard reference method.

RESULTS

115 segments were available for direct MRA-DSA comparison with a prevalence of >=50% stenoses of 27.8% (32/115). Diagnostic parameters of QISS-MRA yielded as follows: sensitivity 90.6% [95%CI: 84.2-95.1%], specificity 94.0% [95%CI: 90.9-96.3%], PPV 85.3% [95%CI: 79.1-89.9%], NPV 96.3% [95%CI: 93.8-97.8%], with an ICC of 0.89. Median values of qualitative imaging parameters for QISS-MRA were as follows: arterial signal intensity: 4 (pelvis), 4 (thigh), 5 (calf); venous overlay: 4, 4, 5; susceptibility artifacts: 5, 5, 5; motion artifacts: 4, 5, 5; ECG-related artifacts: 5, 5, 5. Values for ICC were 0.72, 0.73, 0.93, 0.69 and 0.79, respectively. Opacification of arteries at CO2-DSA was rated 3, 4, 3, with an ICC of 0.65.

CONCLUSION

Non-invasive QISS-MRA offers high diagnostic performance for the detection and ruling out of PAOD in comparison with invasive CO2-DSA. In a direct comparison, image quality of QISS-MRA was prefered by observers over CO2-DSA.

CLINICAL RELEVANCE/APPLICATION

Patients with symptomatic PAOD and CRF could undergo a non-invasive diagnostic evaluation of the lower extremities using QISS-MRA with subsequent guidance to vessels of interest for percutaneous intervention in DSA-technique.