Nuclear Medicine
Advancing Pediatric PET Imaging: Current Challenges, New Technologies and Clinical Opportunities

All Day Room: S503AB

FDA Discussions may include off-label uses.

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TEACHING POINTS

Conventional 18F-FDG PET/CT imaging in the pediatric population is clinically used for benign and malignant diseases but many challenges exist which may contribute to its underutilization. PET/MR offers the potential to reduce radiation dose by eliminating CT imaging. With the recent introduction, digital PET/CT technology may enable ultra-low 18F-FDG dosing and/or faster PET image acquisition. This exhibit demonstrates how new digital PET technologies can impact pediatric imaging by reducing radiation dose, reducing total scan time and expanding PET imaging into new diseases. New PET technologies enable pediatric imagers to substantially reduce the radiopharmaceutical dose and/or shorten total PET image acquisition time while maintaining image quality. Lower radiation exposure and/or faster PET imaging will allow for increased serial PET utilization, less reliance on anesthesia, and expanded indications for PET in pediatric patients.

TABLE OF CONTENTS/OUTLINE

New PET technologies for radically decreasing radiation dose. Faster PET image acquisition to minimize patient motion artifacts. Faster PET image acquisition to reduce anesthesia exposure. Clinical opportunities for first line PET imaging in pediatric patients. Expanding PET utilization with new PET technologies.
Clinical Utility of 99mTc-Pyrophosphate (PYP) SPECT to Evaluate Transthyretin Related (TTR) Cardiac Amyloidosis

All Day Room: S503AB

Participants
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TEACHING POINTS
1. To explain the pathogenesis of cardiac amyloidosis and the challenges of differentiating the subtypes.
2. To review physiologic principles and protocol for 99mTc-Pyrophosphate (PYP) SPECT imaging as a method to detect transthyretin related (TTR) cardiac amyloidosis.
3. To illustrate different levels of 99mTc-PYP uptake in the heart.

TABLE OF CONTENTS/OUTLINE
1. Background of the two main subtypes of cardiac amyloidosis. a. Light chain cardiac amyloidosis b. Transthyretin related cardiac amyloidosis
2. Basic principal and pharmacology of 99mTc-Pyrophosphate (PYP) SPECT in detecting related TTR cardiac amyloidosis
3. Illustrated review of different levels of 99mTc-PYP SPECT in the heart
4. Clinical indications, advantages, and limitations of 99mTc-PYP uptake in identifying patients with TTR cardiac amyloidosis.
Multi-gated Acquisition Scans: Look! Do you see?
All Day Room: 5503AB

Participants
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TEACHING POINTS
Multi-gated acquisition (MUGA) scan is the gold standard for quantifying left ventricle ejection fraction (LVEF). It is non-invasive, accurate, and reproducible. MUGA scans should be carefully evaluated for technical adequacy. Although MUGA scans are generally not intended for diagnosis, incidental findings on the images could lead to identification of unexpected pathology in the chest or upper abdomen. Interpreting physicians should be aware of the range of pathology that may be encountered on MUGA scans.

TABLE OF CONTENTS/OUTLINE
Overview of MUGA scans and quality control factors including: Overview of available methods for LVEF quantification LVEF Global and regional LV wall motion Other pathology that can be seen on MUGA scans Thoracic pathology, example: abnormal cardiac position, mediastinal and thoracic masses, pericardial and pleural effusions Abdominal pathology, example: Splenomegaly, splenic infarcts, hepatic masses, and ascites
Brain Death: Clinical and Imaging Overview with Emphasis on Scintigraphy

All Day Room: S503AB

Participants
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David H. Lewis, MD, Seattle, WA (Abstract Co-Author) Research funded, Eli Lilly and Company

TEACHING POINTS
The purpose of this exhibit is to: Outline the definition of death and brain death Review clinical diagnosis of brain death Review ancillary tests for brain death diagnosis Discuss role of imaging in brain death, with focus on radionuclide imaging

TABLE OF CONTENTS/OUTLINE
Historical review of the definition of death, and introduction to brain death Clinical diagnosis of brain death Ancillary tests for diagnosis of brain death Imaging in brain death: Computed tomography, magnetic resonance, ultrasound, and conventional angiography Radionuclide angiography Radionuclide parenchymal brain imaging
TEACHING POINTS

1. To know the PET-CT imaging of malignant lymphoma (ML) based on WHO classification, roles and pitfalls for the assessment.
2. To know Human T-cell lymphotropic virus type 1 (HTLV-1) related-lymphoma, such as Adult T-cell lymphoma (ATL).
3. To know the subtypes of ATL (Acute, Lymphoma, Chronic and Smoldering type) and the response after treatment on PET-CT, which is the most accurate tool for the assessment of response in ATL.

TABLE OF CONTENTS/OUTLINE

After the general review of ATL, the cases of FDG PET-CT will be presented by a case-based review. The essential points will be highlighted in the discussion of each case.

1. WHO classification of malignant lymphoma
2. Knowledge of Adult T-cell lymphoma (ATL)
   ATL has been linked to infection by the human T-cell lymphotropic virus type 1 (HTLV-1).
   The HTLV-1 virus is most common in parts of Japan, the Caribbean, and some areas of South and Central America and West Africa.
3. The lesional distribution of ATL
   ATL is a rare T-cell lymphoma that can be found in the lymph nodes, skin, or others.
4. The usefulness of FDG-PET/CT in the diagnosis of acute transformation of ATL
5. The role of FDG-PET/CT for initial diagnosis and the evaluation after therapy of ATL.
Role of PET/MRI in the Assessment of Tumor Response to Treatment in Gastrointestinal and Genitourinary Malignancies

All Day Room: S503AB

Participants
Ali Gholamrezanazhad, MD, Cleveland, OH (Presenter) Nothing to Disclose
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TEACHING POINTS
• To summarize the PET/MRI workflow in initial imaging and follow-up of gastrointestinal and genitourinary malignancies.
• To briefly review the established role of PET/MRI in the assessment of tumor response to treatment.
• To highlight the individual role of PET and MRI assessment of tumor response of the primary malignancy and distant metastases in the setting of combined PET/MRI and demonstrate their complimentary nature in representative cases.
• To discuss the advantages, pitfalls, and imminent technical limitations of PET/MRI.

TABLE OF CONTENTS/OUTLINE
PET/MRI versus PET/CT: Advantages, Limitations and pitfalls
Technical challenges of integration of MRI to PET
MRI based attenuation correction
Tracer quantification
PET/MRI Workflow
Clinical Applications: Role of PET/MRI in the initial cancer staging,
Role of PET/MRI in the evaluation of response to treatment,
Role of PET/MRI in the post-treatment follow-up
Selected and Specific Applications: GI Malignancies
Gallbladder and Cholangiocarcinoma
Pancreatic carcinoma
Colo-Rectal carcinoma
Gynecological Malignancies
Cervical Carcinoma
Endometrial carcinoma
Ovarian Carcinoma
Vulvar & Vaginal Carcinoma
Conclusions: Does PET/MRI replace PET/CT?
Future Directions: Need for standardization, New radiotracers
PET/MRI for Seizure Localization in Pediatric Patients: A Pictorial Review

All Day Room: S503AB

Participants
Volkan Beylergil, MD, Cleveland Heights, OH (Presenter) Nothing to Disclose
Esben S. Vogelius, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1) Fully integrated PET/MR systems are increasingly used in the clinical setting. PET/MRI combines metabolic information and superior anatomic resolution. Preliminary studies in the literature suggest improvement in localization rates, as well as increased number of new clinically important lesions. By viewing this exhibit and going through our sample cases the learner will be able to understand how one can utilize the anatomic information derived from MR with metabolic information derived from PET to localize the epileptogenic focus more accurately.

2) PET/MR has some inherent challenges such as increased scanner time. But it also has substantial benefits, thanks to reduced effective dose and its “one stop shop” nature. We gained considerable experience in scanning pediatric patients with “intractable epilepsy”. By reviewing our cases and protocols, the learner should be able to establish their own PET/MR protocol for seizure localization.

TABLE OF CONTENTS/OUTLINE

- Introduction to fully integrated PET/MR system
- Our PET/MR setup and workflow
- Protocols
- Sample Cases
- Discussion
Possible Pitfalls and Misinterpretations of Cardiac Findings on PET/CT: A Careful Look at the Heart in Oncologic Patients

TEACHING POINTS

1- Cardiac uptake of FDG is frequently observed on PET/CT performed for staging, evaluation of response to treatment and follow up in patient with oncologic pathology.
2- Normal FDG activity in the heart varies from absent to diffuse increased FDG activity. Focally increased FDG uptake in specific locations is also a part of the spectrum of normal cardiac activity.
3- Normal cardiac FDG activity or abnormal areas of increased FDG activity secondary to non-neoplastic entities can be misinterpreted as neoplastic involvement.
4- Metastatic disease to the heart or pericardium can be confused with normal metabolic activity of the heart.

TABLE OF CONTENTS/OUTLINE

1- Description of normal cardiac glucose and FDG metabolism
2- Illustration of normal cardiac FDG uptake patterns
3- Pitfalls: Atypical focal or diffuse FDG-uptake patterns
   a) Crista terminalis, atrial wall, ventricle wall, papillary muscle
   b) Intervertricular septum, atrial septum
   c) Chronic atrial fibrillation
   d) Coronary artery disease
   e) Post-radiation pericarditis/myocarditis
   f) Sarcoidosis
   g) Hypertrophic cardiomyopathy
4- Missed cardiac findings
   a) Cardiac and pericardial metastases

Honored Educators

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Sonia L. Betancourt Cuellar, MD - 2014 Honored Educator
Review of Medical History: A Sine Qua Non in Recognizing Post-therapy and Iatrogenic Findings on FDG PET/CT

All Day Room: S503AB

Participants
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TEACHING POINTS
Treatment related manifestations can often be seen on PET/CT imaging. Occasionally, these areas of FDG uptake can be confused for native pathology. A knowledge of the presentation and appearance of common post-therapy related changes is paramount. Interpretation of PET/CT exams must be performed in context of thorough review of the treatment history. This educational exhibit will review PET/CT findings related to commonly encountered post-therapy and iatrogenic changes caused by a variety of medications and procedures. The pharmacology and pathophysiology of the treatment associated findings will be discussed with a special focus on distinguishing findings from native pathology.

TABLE OF CONTENTS/OUTLINE
Introduction Medication-related findings Bowel uptake from Metformin Bone marrow activation from Neupogen Thymic hyperplasia Enteritis from Irinotecan Corticosteroids Drug-induced pulmonary toxicity Sarcoid like reaction Procedure-related findings Radiesse injection for vocal cord paralysis Pleurodesis Immunization (Influenza vaccination) Subcutaneous injection Radiation therapy resulting in marrow suppression Radiation pneumonitis Oral FDG administration Findings in the immunocompromised patient Mononucleosis Varicella zoster reactivation (Shingles) Pneumonia Histoplasmosis
Awards
Certificate of Merit

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TEACHING POINTS
1. Thyroid scintigraphy is used for identifying the etiology of congenital hypothyroidism rather than for establishing the diagnosis.
2. Congenital hypothyroidism may be permanent or temporary. Permanent hypothyroidism due to primary abnormality of the thyroid gland is the most common type.
3. Treatment with thyroid hormone replacement is begun promptly. Results of the thyroid scan are unaffected during the first few days of therapy.
4. Findings on thyroid scintigraphy vary widely depending on the etiology of the disease.

TABLE OF CONTENTS/OUTLINE
1. Embryology of the thyroid gland.
2. Screening for congenital hypothyroidism.
3. Etiology and clinical features of congenital hypothyroidism
4. Role of Imaging in management.
5. Thyroid scintigraphy: Imaging protocol, radiotracers and interpretation.
6. Management of congenital hypothyroidism.
**Spectrum of Imaging of the Maxilla and Mandible in Nuclear Medicine with Radiographic, CT and MRI Correlation**

**All Day Room: S503AB**

**Participants**
- Jay E. Haggerty, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
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- Jon A. Jacobson, MD, Ann Arbor, MI (Abstract Co-Author) Consultant, BioClinica, Inc; Royalties, Reed Elsevier;
- Richard K. Brown, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

**TEACHING POINTS**

1. Gain increased familiarity with the spectrum of imaging findings of the maxilla and mandible over a wide array of disease processes using imaging modalities within nuclear medicine and correlating with plain radiography, computed tomography (CT), and magnetic resonance imaging (MRI) appearances.
2. Review potential interpretive pitfalls of nuclear medicine studies involving the gnathic bones.

**TABLE OF CONTENTS/OUTLINE**

The cases will be presented in a quiz format. Key differential diagnostic points will be highlighted in the discussion of each case. The list of cases includes but is not limited to:

1. Benign fibro-osseous lesions
2. Gnathic bone neoplasms including squamous cell carcinoma, rhabdomyosarcoma, adenoid cystic carcinoma, and ameloblastoma
3. Osteonecrosis
4. Osteomyelitis
5. Keratogenic tumor
6. Post-operative changes including neomandible
7. Metastatic disease and lymphoma
8. Temporomandibular joint pathology including arthritis and condylar hyperplasia

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Jon A. Jacobson, MD - 2012 Honored Educator
TEACHING POINTS

Understand the normal biodistribution of the radiopharmaceutical for each normal nuclear medicine whole body scan (NMWBS). Employ step-by-step algorithms for recognizing the type of NMWBS. Using skills from the first two teaching points, recognize pathology of interest on selected abnormal NMWBS.

TABLE OF CONTENTS/OUTLINE

Accurate identification of the type of nuclear medicine whole body scan (NMWBS) precedes the successful interpretation of pathology on any nuclear medicine study. This interactive quiz presents an image-oriented, systematic method for identifying the correct normal NMWBS. Studies that may mimic each other will be compared and contrasted. Selected pediatric and adult normal WBS will be presented side-by-side for comparison when possible.

I. Poor versus good quality of normal NMWBS
II. Algorithm for poor quality NMWBS
III. Algorithm for good quality NMWBS
IV. Cases: bone scan, indium-111 leukocytes, octreotide, technetium-99m sulfur colloid, technetium-99m pertechnetate, gallium, I-123 P.O., I-123 MIBG, sestamibi, HIDA, RBC scan, 11C-acetate, FDG-PET, zevalin, lymphoseek

Normal NMWBS examples
Pathology of interest with selected NMWBS

V. Comparison of easily confused normal NMWBS with emphasis on the distinguishing features of each scan type
VI. Pediatric versus adult normal NMWBS: selected cases
Purpose: 1. To review current literature on the role of radiological imaging in the post-operative spine. 2. To review potential clinical indications of 99mTc-MDP bone SPECT/CT in evaluation of patients with back pain post-spine surgery. 3. To review advantages and limitations of radiological versus radionuclide 99mTc-MDP bone SPECT/CT imaging post-spine surgery.

Summary - Major Teaching Points:
1. Radionuclide 99mTc-MDP SPECT/CT is a useful diagnostic modality in assessment of back pain following spine surgery.
2. Radionuclide 99mTc-MDP SPECT/CT is often useful in accurately identifying the source of pain/pain generators following spine surgery.

TABLE OF CONTENTS/OUTLINE
Content Organisation:
1. Illustrated presentation of the most frequent surgical procedures involving the cervical, thoracic and lumbar spine and the common complications.
2. 99mTc-MDP SPECT/CT appearances in patients with back pain following surgery:
   a. Normal and abnormal scans: pseudoarthrosis, insufficient stabilization, loosening of pedicle screws, loosening of plates, infection, degenerative disease, adjacent level instability, fracture of metallic fixation devices, etc.
   b. Normal variants.
   c. Miscellaneous artifacts and false positives.
Return of the PYP: Combined role of Technetium-99m Pyrophosphate (PYP) and Cardiac MRI for Diagnosis and Subtyping of Cardiac Amyloidosis in Patients with Newly Diagnosed Heart Failure

All Day Room: S503AB

Participants
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TEACHING POINTS
Cardiac amyloidosis is an infiltrative cardiomyopathy from deposition of abnormal fibrillar protein (amyloid). Cardiac MRI helps distinguish restrictive from other forms of cardiomyopathies but is limited in differentiating amyloidosis from other restrictive conditions (such as sarcoidosis). Moreover, it cannot differentiate amyloid light-chain (AL) from transthyretin-related amyloidosis (ATTR), both of which differ in clinical course, management and prognosis. The use of Tc-99m Pyrophosphate (PYP) for cardiac imaging dates back to the 1970s, when its primary role was for imaging myocardial infarction. It is now resurfacing for cardiac imaging as a highly sensitive and specific tool for differentiating ATTR amyloidosis from other subtypes. Our goal is to outline the pathophysiology and clinical features of cardiac amyloidosis and review imaging with an emphasis on Tc99m PYP.

TABLE OF CONTENTS/OUTLINE
1. Pathophysiology of cardiac amyloidosis and its subtypes
2. Clinical features of cardiac amyloidosis, variation among subtypes and need for a non-invasive diagnostic tool
3. Review of imaging characteristics of echocardiography and cardiac MRI
4. Tc99m Pyrophosphate (PYP)- mechanism of action and imaging technique
5. Diagnosis of cardiac amyloidosis with Tc99m PYP- Principles and pitfalls
6. Future of amyloidosis imaging- role of Tc99m-DPD
A Pitfall of 11C-methionine PET/CT in the Benign Brain Diseases: What the Radiologist Should Know

All Day Room: S503AB

Awards
Certificate of Merit

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TEACHING POINTS

The major teaching points of this exhibit are: Benign brain diseases can demonstrate various MET uptake. Accurate diagnosis and optimal treatment of these diseases requires knowledge of their imaging findings. We recommend physician interpretation of imaging findings and disease characteristics for optimal patient management.

TABLE OF CONTENTS/OUTLINE

11C-methionine (MET) positron emission tomography (PET) imaging is a sensitive technique for visualizing primary and recurrent malignant brain tumors, whereas seldom in benign brain diseases. These diseases usually showed an increase of MET uptake similar to malignant tumors. The purpose is: To review the MET uptake of benign brain disease. To understand clinical features and imaging findings of these diseases.

Review of clinical features and imaging findings of these diseases
- Multiple sclerosis (Tumefactive multiple sclerosis)
- Radiation necrosis
- Meningioma
- Cerebral hemorrhage
- Venous infarction
- Capillary telangiectasia
- Cavernous malformation
- Encephalitis
Bone-targeted Radium-223 Therapy in Metastatic Castration-resistant Prostate Cancer: Lessons Learned So Far

All Day Room: S503AB

Participants
Kevin A. Zand, MD, Jackson, MS (Presenter) Nothing to Disclose
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Vani Vijayakumar, MD, Ridgeland, MS (Abstract Co-Author) Grant, General Electric Company

TEACHING POINTS
The properties, mechanism of action, and administration guidelines of Radium-223 as a new FDA-approved treatment for metastatic castration-resistant prostate cancer. Safety profile of Ra-223. Therapeutic action of Ra-223.

TABLE OF CONTENTS/OUTLINE
INTRODUCTION: Radium-223 is an alpha-emitting bone-seeking radionuclide that is FDA approved as a new treatment for patients with metastatic castration-resistant prostate cancer (mCRPC). (Table 1) MECHANISM OF ACTION: As a bone-seeking calcium mimic, Ra-223 is bound into newly formed bone stroma within the microenvironment of osteoblastic metastases. The high-energy alpha-particle radiation induces mainly double-stranded DNA breaks that result in a potent and highly localized cytotoxic effect in the target areas. The short path of the alpha particles also means that toxic effects on adjacent healthy tissue, particularly the bone marrow is minimized. (Fig.1) ADMINISTRATION: Intravenously once monthly for 6 months. Not approved for use in combination with docetaxel or any other chemotherapy. SAFETY: Favorable safety profile with minimal myelotoxicity. THERAPEUTIC ACTION: Ra-223 is reported to reduce pain, improve disease-related biomarkers (bone alkaline phosphatase and prostate-specific antigen), and improve overall survival of men with mCRPC with bone metastases and no known visceral metastases.
An Update on Management of Pediatric Thyroid Nodules and Use of Radioactive Iodine Therapy in Pediatric Thyroid Cancer

All Day Room: SS03AB

Participants
Simeen Pasha, MD, Jackson, MS (Presenter) Nothing to Disclose
Vani Vijayakumar, MD, Ridgeland, MS (Abstract Co-Author) Grant, General Electric Company

TEACHING POINTS
1. Update on Management of Pediatric Thyroid Nodules and Cancer based on the 2015 ATA Guidelines
2. Indications of Radioactive I-131 therapy in Pediatric Differentiated Thyroid Carcinoma (DTC) Compared to Adults
3. Acute and Long Term Risks associated with Radioactive I-131 Therapy in Children

TABLE OF CONTENTS/OUTLINE
Radioactive 131I therapy (RAI) used to be routinely indicated in pediatric DTC for destroying remnant thyroid tissue and metastatic disease. Conflicting data regarding disease free survival in children and risk of possible secondary malignancies with adjunctive RAI prompted the recommendation for selective use of RAI in pediatric DTC. Post-operative I-123 whole body scan (WBS) in conjunction with stimulated thyroglobulin is now recommended to identify patients that would benefit from RAI, whereas previously pre-therapy WBS was needed only if remnant tissue was not adequately identified with ultrasound or surgery. The 2015 ATA Guidelines for Pediatric Thyroid Nodules and Cancer also recommend RAI in iodine-avid locoregional disease and distant metastases. Side effects with RAI include salivary and lacrimal gland dysfunction and dental caries. Gonadal dysfunction, acute bone marrow suppression, increased risk of secondary malignancies as well as an increase in overall mortality has also been reported with use of RAI.
Lung Cancer: A Multimodality Review of the Emerging TNM Staging Criteria

Awards
Certificate of Merit

Participants
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Geoffrey B. Johnson, MD, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The purpose of this educational exhibit is to illustrate the benefits of multimodality imaging including PET/MR, PET/CT, CT, MR, and US in non-small cell lung cancer staging. Lung cancer staging provides justification for clinical decision-making in regard to potentially harmful, but lifesaving therapy. TNM Edition 8 staging is on the horizon, and knowledge of the evolving recommendations is vital for radiologic interpretation and clinical prognostication. Precise radiologic 'T and N' reporting is critical for guiding tissue sampling approach and accurate lung cancer staging. Metabolic and anatomic imaging are complementary, with each modality having specific strengths and limitations in the staging process.

TABLE OF CONTENTS/OUTLINE
Review the most current TNM staging of lung cancer with a focus on 'T and N' designation. Emphasize the critical elements of the radiologic report using the emerging staging technique. Illustrate the strength of a multimodality imaging approach in evaluating lung cancer, focusing on the need for accurate description of tumor and lymph node station involvement. Demonstrate the benefits of precise radiologic interpretation in assisting surgical, endoscopic, or radiologic guided lymph node sampling and primary management of non-small cell lung cancer using a case-based approach.

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Geoffrey B. Johnson, MD, PhD - 2015 Honored Educator
Revival of 99mTc-pyrophosphate Scintigraphy: A Pictorial Revelation of an Under-valued Noninvasive Technique

All Day Room: S503AB

Participants
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TEACHING POINTS
There are three clinically relevant types of cardiac amyloidosis (CA) consisting of primary light-chain (AL), familial mutant transthyretin (ATTRm), and the senile wild-type transthyretin. These differ significantly in terms of pathogenesis, clinical manifestation, management, and prognosis. Delayed diagnosis of CA is a major factor contributing to poor prognosis. Pyrophosphate imaging is a widely available non-invasive technique that allows early diagnosis of CA and differentiation between sub-types. This can potentially obviate the need for biopsy in some patients. Pyrophosphate imaging allows quantitative and semi-quantitative evaluation to differentiate between AL and ATTR CA with 97% sensitivity and 100% specificity. Pyrophosphate imaging may aid in risk stratification of patients with restrictive cardiomyopathy being screened for possible transcatheter aortic valve replacement.

TABLE OF CONTENTS/OUTLINE
Pathophysiology of CA. Review of 99mTc-PYP pharmacokineticsClinical implication of PYP scintigraphy Pyrophosphate scan protocol Quantitative and semi-quantitative analysis of PYP uptake Typical MRI findings of CA Discussion and future directions Self assessment
Overview of Review Assessment Criteria in Prostate Cancer (PC): What You Need to Know?

All Day Room: S503AB

Participants
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TEACHING POINTS
To describe, using imaging examples, Prostate Cancer Working Group (PCWG) assessment criteria for evaluating bone lesions in Prostate cancer. To describe the imaging scenarios where these specific criteria can be applied in longitudinal assessment of bone lesions. To highlight challenges, pitfalls and limitations of these criteria.

TABLE OF CONTENTS/OUTLINE
Bone is one of the commonest sites for metastasis in prostate cancer. The evaluation of prostate cancer includes assessment of bone lesions by radionuclide bone scans along with assessment of soft tissue disease by cross sectional imaging. The purpose of this exhibit is to describe the most current version of assessment criteria for evaluating bone lesions in PC. New clinical trial guidelines have been developed to succeed the previously published PCWG2 and PCWG1 criteria. Different aspects of PCWG3 criteria would be described. Bone scan evaluation per the PCWG3 criteria includes recording of bone lesions at baseline and counting the bone lesions longitudinally to aid in the overall tumor assessment. This exhibit also helps the reader to understand how progressive disease and bone lesion flares are determined along with imaging examples. The imaging scenarios where this criterion can be applied including the challenges, pitfalls and limitations will also be described.
Aggressive Lymphoma at PET/CT: ‘What the General Radiologist Needs to Know’

All Day Room: 5503AB

Participants
Sean Reynolds, MD, Burlington, VT (Presenter) Nothing to Disclose
Janusz K. Kikut, MD, Burlington, VT (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

Aggressive lymphoma comprises unique clinico-pathological entities. Understanding these entities is helpful in image interpretation and discussion of cases with ordering providers. Diagnosis and treatment of aggressive lymphoma uses information from not only the extent of disease (staging) but also the underlying genetics which may modify treatment and the risk of recurrence. Interim PET has become standard of care in treatment of aggressive lymphoma and is interpreted using different standards than post-treatment PET.

TABLE OF CONTENTS/OUTLINE

- Demographics of Aggressive Lymphomas
- Types of Aggressive Lymphomas, their imaging appearance at PET/CT and underlying genetics for both diagnosis and prognosis
- Diffuse Large B-Cell Lymphoma
- Germinal Center B (GCB)
- Activated B-cell Lymphoma (ABC)
- "Double-Hit"
- Primary Mediastinal B-cell Lymphoma
- Transformed Indolent Lymphoma
- Mantle Cell Lymphoma
- Staging of Lymphoma: Ann-Arbor
- Limited versus Extensive Disease
- Prognostic Systems: International Prognostic Index (IPI)
- Mantle International Prognostic Index (MIPI)
- Bone Marrow Involvement
- Interim PET Efficacy
- Deauville Criteria
- Clinical Examples
- End Treatment PET
- International Harmonization Project (IHP) Criteria
- Clinical Examples
Clearing Things Up: Role of Nuclear Medicine Imaging in the Evaluation of Genitourinary Anomalies in Adults

All Day Room: S503AB

Participants
Kiran Gangadhar, MD, MBBS, Seattle, WA (Presenter) Nothing to Disclose
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TEACHING POINTS
- Genital and urinary systems are derived from a common mesoderm with interdependent müllerian and wolffian duct development.
- Commonly use Radiopharmaceuticals
  - Technetium-99m-mercaptoacetyltriglycine (MAG3) - Renal function and ERPF
  - Technetium-99m DMSA - Renal parenchymal imaging
  - Technetium-99m-diethylenetriaminepentaacetic acid (DTPA) - GFR
- DMSA scan is used to evaluate renal structure and morphology while Tc99m-MAG3 is important in determining the physiologic significance of a dilated collecting system.
- These scans can help determine if both kidneys are functioning, if only a portion of a kidney is functioning or if there is functioning renal tissue in an unusual location such as a horseshoe or pelvic kidney. Nuclear imaging plays an important role in early diagnosis and proper management.

TABLE OF CONTENTS/OUTLINE

PURPOSE: MATERIALS AND METHODS: QUIZ FORMAT CASE PRESENTATION: DISCUSSION: CONCLUSION:
Clinical PET Imaging in Prostate Carcinoma

All Day Room: S503AB

Awards
Identified for RadioGraphics

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TEACHING POINTS
To understand the role of clinically available PET tracers in prostate cancer. To describe the mechanism of action of PET tracers and their technical pitfalls in the assessment of prostate cancer. To highlight the pearls and pitfalls of PET/CT in prostate cancer imaging.

TABLE OF CONTENTS/OUTLINE
Introduction of PET/CT
Describe the clinically available PET tracers in prostate cancer
Describe the role of each PET tracer in prostate cancer and its limitations
Pattern of disease spread in metastatic prostate carcinoma
18F-FDG PET/CT in prostate cancer
Mechanism of action
Indications
Advantages/limitations
11C/18F-Choline PET/CT in prostate cancer
Mechanism of action
Indications
Advantages/limitations
18F-NaF PET/CT in prostate cancer
Mechanism of action
Indications
Advantages/limitations
68Ga-PSMA PET/CT in relapsed prostate cancer
Mechanism of action
Indications
Advantages/limitations
PET/CT in the Oncological Imaging of Nodal Disease: Pearls and Pitfalls

All Day Room: S503AB

Awards
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TEACHING POINTS

1. To illustrate the methods of assessing for nodal metastatic disease in FDG PET/CT imaging
2. To review the typical appearances of nodal metastatic disease on FDG PET/CT
3. To describe the pitfalls of FDG PET/CT in nodal cancer imaging
4. To understand the role of FDG PET/CT in nodal staging in some common malignancies
5. To highlight non FDG tracers which may improve nodal staging

TABLE OF CONTENTS/OUTLINE

Methods of assessing nodal disease on FDG PET Visual SUV Ratio of uptake (Node: primary tumor) Number & distribution of nodes Typical pattern of spread Causes of false negatives Technical Size of nodes Peritumoral nodes Tumors with low level glucose metabolism Causes of false positives Inflammation/ infection Sarcoïd like reaction to malignancy Ureteric activity mimicking node Use of FDG PET in nodal staging of some common malignancies Lung cancer staging with algorithm for nodal assessment Cervical cancer staging Non FDG tracers for nodal staging Neuroendocrine tumors: Ga68 DOTA-peptides Prostate cancer: C-11/ F-18 Choline & Ga68 PSMA
Multiple myeloma is a plasma cell malignancy characterized by diffuse bone marrow infiltration by a monoclonal plasma cell population, a paraprotein present in serum and/or urine, focal bone lesions, and extramedullary disease. Myelomatous disease occurs in a spectrum and will be discussed in a case-based manner. PET/CT has an increasing role in the diagnosis and treatment of MM, including: Initial staging Assessment of treatment response Detection of disease recurrence

TABLE OF CONTENTS/OUTLINE

Diagnostic criteria for symptomatic myeloma, asymptomatic myeloma and MGUS Radiologic (and laboratory) work-up X-ray MRI PET/CT Durie-Salmon PLUS staging system Case-based discussion of the spectrum of myelomatous disease to include: Solitary plasmacytoma Extramedullary disease Nonsecretory MM Ultra-high-risk MM POEMS syndrome Treatment response Recurrent disease
Roles and Pitfalls in Interpretation of 18FDG-PET with MR Imaging in the Patients of Intractable Epilepsy

All Day Room: S503AB

Participants
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Kenta Anai, MD, Kitakyushu, Japan (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is; Describe the classical and clinical classification of epilepsy and main cause of epilepsy Discuss the categorized visual FDG-PET images of epilepsy and the relevance of MR images to acquire the fundamental skill of interpretation of FDG-PET of epilepsy Learn the pitfalls of FDG-PET images of epilepsy

TABLE OF CONTENTS/OUTLINE
Table of Contents
The classification of epilepsy
Main cause of epilepsy
Various detection tools of epileptogenic focus
Clinical classification of epilepsy
Medial temporal lobe epilepsy (MTLE)
Lateral temporal lobe epilepsy (LTLE)
Extra-temporal lobe epilepsy (ETLE)
Five categorized visual FDG-PET images of epilepsy and the relevance of MR images for interpretation
Type 1. Normal findings
Type 2. Medial temporal pattern
Type 3. Medial and lateral temporal pattern
Type 4. Multilobar pattern
Type 5. Bilateral pattern
Pitfalls of FDG-PET images of epilepsy
Decoding the Renal Scan: Concepts, Interpretations, and What to Tell the Referring Physician

All Day Room: S503AB

Awards
Identified for RadioGraphics

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TEACHING POINTS

Understand concepts involved in interpretation of the nuclear medicine renal scan as it relates to basic renal physiology and concepts in clinical practice. Teaching is be case-based with relevant cases presented throughout the exhibit. Discuss nuances and pitfalls in interpreting renal scan images, including ROI mapping, renal transplants, and nontraditional uptake patterns. Present case series of both bread & butter and interesting cases.

TABLE OF CONTENTS/OUTLINE

Advances in PET Therapy Response Assessment Criteria Using FDG-PET/CT Imaging in Oncology

All Day Room: S503AB

Awards
Identified for RadioGraphics

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TEACHING POINTS

Quantitative ((EORTC, PERCIST 1.0) and qualitative PET imaging criteria (Lugano, Hopkins Criteria, irRC and Alternate pattern for immunotherapy) Clinical applications of each therapy response assessment criteria Comparison between PET response criteria Case illustration of therapy assessment using each PET response criteria

TABLE OF CONTENTS/OUTLINE

Description of a New Technique to Analyze Lung Function

All Day Room: S503AB

Discussions may include off-label uses.

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TEACHING POINTS
A precise method of analyze lung function. Advantage and disadvantage of this method

TABLE OF CONTENTS/OUTLINE
Educational Abstract Review on a New Procedure:
A: Background
B: Description of Old Technique
C: Description of New Technique
D: Comparison of techniques- advantage and disadvantages
E: Summary of Practical elements of techniques
18-FDG Brain PET for Neurodegenerative Disorders: A Structured Interpretative Approach Using Index Images

All Day Room: S503AB

Participants
Leslie K. Lee, MD, Boston, MA (Presenter) Nothing to Disclose
David Z. Chow, MD, Cambridge, MA (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1. Findings of 18-FDG brain PET for neurodegenerative disorders are reviewed, in the context of using a structured approach of index images to assist interpretation and narrow differential diagnoses.
2. A standardized approach to interpretation can commence with alignment or reformatting of axial images into planes parallel to the anterior commissure-posterior commissure (AC-PC) line.
3. The brainstem and cerebellum can serve as an internal reference standard for contrast windowing/adjustment, with important exceptions.
4. The choice of look-up table (LUT) can impact detect of subtle uptake abnormalities: a multicolored LUT can increase sensitivity while an inverted grayscale scheme can increase specificity. 5. Clinical history is essential to interpretation.

TABLE OF CONTENTS/OUTLINE

1. Sample scheme for standardized presentation of 18-FDG brain PET:a. Standardized orientation and reformatting of axial images using the AC-PC line
b. Standardized contrast windowing/adjustment using the brainstem or cerebellum as an internal reference standard
c. Impact of LUT on detection of abnormalities
2. Potential pitfalls to interpretation.
3. Case-based examples using an index-image approach to brain PET interpretation, with pathologically-proven cases.a. Cases of amyloid-beta, tau, and alpha-synuclein disorders
Making it Right: Our Experience in the Use of Specific Radiotracers in Prostatic Cancer for the Diagnosis and Follow Up

All Day Room: S503AB

FDA Discussions may include off-label uses.

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Certificate of Merit

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TEACHING POINTS

PET/CT has become the most specialized prognostic method in prostatic cancer. New radiotracers make 18FDG the less successful option in the detection of metastatic and recurrent prostatic cancer. The strength of some radiotracers appears to lie in the detection of prostate cancer recurrence after radical prostatectomy or radiation therapy. 11C-Acetate is useful in tumor recurrence and metastases with PSA above 3.0. 11C/18F Choline shows promising results for restaging after PSA relapse according to the NCCN guideline. 68Ga-PSMA Prostate-specific membrane antigen shows high radiotracer uptake at the sites of primary tumor, lymph and bone metastasis. AIM OF THIS EXHIBIT Review radiotracers that are useful in the detection of extra prostatic, lymphatic and bone metastases. Describe the use of specific radiotracers that have a strong influence in the therapy, monitoring and predicting clinical outcome.

TABLE OF CONTENTS/OUTLINE

Introduction Review of the radiotracers used in prostatic cancer. Illustrative pathologic cases Comparison between radiotracers in our experience. Conclusion
Sinonasal Neoplasms: FDG PET/CT and MRI Imaging Features

TEACHING POINTS

1. The purpose of this exhibit is to describe the specific imaging features of a spectrum of sinonasal pathologies encountered in clinical practice with a multimodality approach, including FDG PET/CT and MRI.

2. Knowledge of multimodal imaging of complex sinonasal pathologies can help narrow the differential diagnosis and guide therapeutic approaches, with the potential benefit of improved patient outcomes.

TABLE OF CONTENTS/OUTLINE

1. Description/anatomy of sinonasal region
4. Description of imaging features on CT, PET and MRI (T1, T2, DWI/ADC and post-contrast sequences) of each pathology with relevant figures.
PET Assessment of Myocardial Ischemia, Viability, and Metabolism: Prime Time for an Old Tool

All Day Room: S503AB

Participants
Brandon A. Howard, MD, Durham, NC (Presenter) Nothing to Disclose
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Salvador Borges-Neto, MD, Mt Pleasant, SC (Abstract Co-Author) Speakers Bureau, General Electric Company

TEACHING POINTS
1) Understand clinically relevant PET tracers (N13 NH3, Rb82, F18 FDG), their physical properties, production and physiology
2) Learn advantages of PET vs. SPECT perfusion tracers. Learn history of cardiac PET and its reimbursement
3) Understand key role of FDG PET in viability assessment and review our protocol
4) Appreciate physiological information provided by PET in ischemic evaluation (coronary flow reserve, etc) and review our protocol
5) Understand role of FDG PET in myocardial sarcoid and review our protocol

TABLE OF CONTENTS/OUTLINE
I. Cardiac PET radiotracers O15 H2O N13 NH3 Rb82 F18 fluorodeoxyglucose (FDG)
II. History 1980's (Rb82), 1990's: O15 H2O, N13 NH3 CMS coverage PET vs SPECT (physiology, attenuation correction)
III. Ischemia N-13 NH3 Rest/Stress Protocol - pharmacologic or treadmill stress, ECG-gating, CT attenuation correction Blood flow, extraction fraction, coronary flow reserve, peak flow; assessment of endothelial dysfunction in diabetic heart disease Image interpretation
IV. Viability Non-diabetics-Rest NH3 study, FDG given, imaging one hour later Diabetics-Glucola, insulin, FDG imaging Image interpretation
V. Sarcoid Clinical history (biopsy or other imaging evidence of sarcoid) Protocol Last meal w/no carbs, fast 14-18 hrs (-> fatty acid metabolism) Imaging interpretation
Molecular Imaging of Estrogen Receptors with 18F-Fluoroestradiol PET/CT: Case Examples and Common Pitfalls

All Day Room: S503AB

Participants
Ricardo Martinez Martinez, MD, Mexico City, Mexico (Presenter) Nothing to Disclose
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Berta Riveros Gilardi, MD, Mexico City, Mexico (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
To understand the utility of 18F-FES PET/CT in the management of patients with breast cancer. To recognize the prognostic value of 18F-FES PET/CT at assessing the estrogen receptors expression in breast cancer. To emphasize the heterogeneous estrogen receptors expression within and between different metastatic lesions. To be aware of the common pitfalls assessing estrogen receptors expression by 18F-FES PET/CT.

TABLE OF CONTENTS/OUTLINE
18F-FES: characteristics and metabolism. The role of 18F-FES assessing estrogen receptors expression in breast cancer tumors. The advantages of 18F-FES PET/CT for the approach to breast cancer. The common pitfalls assessing estrogen receptors expression with 18F-FES PET/CT.
Participants
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TEACHING POINTS
Teaching Points: 1) To review basic MR-PET technique 2) Provide an overview about MR-PET Tracers in clinical use and their indications 3) Present typical cases and findings that highlight the value and capabilities of MR-PET as primary diagnostic imaging method and use in therapy monitoring

TABLE OF CONTENTS/OUTLINE
Table of Contents/Outline: 1) MR-PET imaging protocol 2) MR-PET Tracer including F-18 FDG, F-18 fluoride, F18 FET, Ga-68 PSMA, Ga-68 DOTATOC and C-11 methionine 3) Multiparametric and dual-tracer MR-PET for treatment response, advanced quantification and lesion detection 4) Applications in oncology with presentation of typical cases (Brain, Lung, Pancreatic, Liver, NET (neuroendocrine tumors), Hodgkin and Non Hodgkin lymphoma, Neurofibromatosis)
Early Experience Utilizing Whole Body Simultaneous FDG PET/MRI: Added Value of PET Imaging

All Day Room: S503AB

Awards
Certificate of Merit

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Evan Johnson, MD, New York, NY (Presenter) Nothing to Disclose
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Fabio Ponzo, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. To demonstrate a range of clinical applications of PET/MRI in oncologic imaging.
2. To demonstrate the complementary roles of MRI and PET in detection and characterization of primary and metastatic tumor.
3. To present specific examples of the additional PET information changing the diagnosis compared with the information from MRI alone.

TABLE OF CONTENTS/OUTLINE
I. Summary of institutional PET/MRI protocol.
II. Clinical applications of PET/MRI at authors’ institution.
III. Examples of PET helping in detection of primary malignancy vs. MRI alone.
IV. Examples of PET helping detection of malignant lymph nodes that appear benign on MRI.
V. Examples of PET helping in detection of distant metastases vs. MRI alone.
VI. Examples of PET helping in detection of incidental findings.
VII. Pitfalls and challenges in PET/MRI.
VIII. Future directions.

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Krishna Prasad Shanbhogue, MD - 2012 Honored Educator
Krishna Prasad Shanbhogue, MD - 2013 Honored Educator
**NM143-ED-X**

**Simultaneous Time-of-flight PET/MRI: Technical Considerations, Challenges, and Potential Applications**

All Day Room: S503AB

**Awards**
- **Magna Cum Laude**

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**TEACHING POINTS**

After viewing this exhibit, the reader will be able to:
1. Discuss the technical details of TOF PET/MRI
2. Identify the challenges inherent to setting up an institutional clinical PET/MRI program
3. List the emerging applications of PET/MRI

**TABLE OF CONTENTS/OUTLINE**

1. Technical considerations of TOF PET/MRI: Silicon photomultiplier detector (SiPM) technology, MR-based attenuation correction, low attenuation coils, etc.
2. Challenges of setting up institutional PET/MRI program and proposed solutions:
   - Personnel (cross-trained versus team approach), validation, clinical order sets, protocol development to optimize PET data and 3T MRI sequences within time constraints and FOV discrepancy, dual modality quality control, workflow, image post-processing and interpretation, reimbursement, etc.
3. Clinical imaging with TOF PET/MRI: How we do it?
   - Whole-body survey protocol
   - Whole-body survey with focused diagnostic MRI protocol
4. Case-based review of emerging applications: Lung cancer, multiple myeloma, metastatic melanoma, gynecologic malignancies, inflammatory bowel disease, epilepsy, hepatic malignancy, pancreatic malignancy, gastric malignancy, metastatic disease of brachial plexus, CNS lymphoma.

**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/

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TEACHING POINTS
1) Learn the salient imaging findings of fat necrosis and giant cell arteritis on PET/CT. 2) Recognize the pattern of uptake on sulfur colloid imaging seen in focal nodular hyperplasia. 3) Learn how to use correlative imaging to assist in the diagnosis of pathology seen on nuclear medicine studies.
Selective Inhibition and Enhancement of Anti-3-[18F] FACBC (Fluciclovine) Transport in Prostate Carcinoma Xenografts

Sunday, Nov. 27 10:45AM - 10:55AM Room: S505AB

Participants
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Phillip J. Koo, MD, Phoenix, AZ (Moderator) Advisory Board, Bayer AG; ;

Sub-Events

SSA16-01 Selective Inhibition and Enhancement of Anti-3-[18F] FACBC (Fluciclovine) Transport in Prostate Carcinoma Xenografts

Sunday, Nov. 27 10:45AM - 10:55AM Room: S505AB

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PURPOSE
Fluciclovine is an amino acid analogue PET radiotracer believed to be transported mainly via system L (LAT1), but subsequent in-vitro data showed primary transport via system ASC (ASCT2). In contradiction to in-vitro studies, mRNA expression of amino acid transporter genes shows strong correlation of fluciclovine uptake with the proton dependent transporter PAT1. We set out to determine the effect of intratumoral injection of the system L inhibitor BCH and PAT1 inhibitor MeAIB on fluciclovine uptake in a prostate cancer xenograft model.

METHOD AND MATERIALS
50:50 PC3-Luciferase cells and matrigel were injected into both flanks of 18 SCID mice. At average tumor size of 5mm, intratumoral injection of BCH, MeAIB or saline (6 mice/group) was completed in one xenograft with the contralateral as control. After 60 mins, 4.6±0.1 MBq fluciclovine was injected via tail vein for a 60-minute dynamic microPET-CT. Time activity curves were plotted from ROIs drawn on the xenografts. Tumor viability was assessed by bioluminescence. Differences in fluciclovine uptake between the injected tumors and controls were compared using T-test and analysis of variance as appropriate with significance at p<0.05.

RESULTS
5 mice (1 MeAIB and 3 saline) were excluded due to loss of tumor viability. Thus 6 BCH, 5 MeAIB and 2 saline injected mice were analyzed. Compared to controls, mean fluciclovine SUVmax was 37(±5.3) % lower in BCH injected tumors and 52(±10.6) % higher in MeAIB injected tumors (p<0.0001). There was no significant difference between mean fluciclovine SUVmax in saline injected tumors and their controls (P=0.8) as well as among all controls (P=0.3).

CONCLUSION
BCH injection has only partial inhibitory effect on fluciclovine uptake, confirming that system L (LAT1) plays a lesser role in transport. Lack of inhibition with MeAIB confirms no direct role of PAT1 with fluciclovine transport. The unexpected finding of enhanced fluciclovine uptake after MeAIB injection deserves further study, and may involve the complex interplay of decreased glutamine uptake via MeAIB system A transporter inhibition and downstream interaction with intracellular leucine and the mTOR cascade.

CLINICAL RELEVANCE/APPLICATION
This study suggests mechanisms that could be explored for increasing amino acid based radiotracer uptake for PET imaging of cancer and the interaction of amino acid transport with mTOR dynamics.

A Comparison of Positivity Rates of Anti-3-[18F] FACBC PET-CT (Fluciclovine) in Recurrent Prostate Cancer Patients on Androgen Deprivation Therapy (ADT) vs ADT-Naive Patients

Sunday, Nov. 27 10:55AM - 11:05AM Room: S505AB

Participants
Oladunni O. Akin-Akintayo, MD, Atlanta, GA (Presenter) Nothing to Disclose
Ashesh B. Jani, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Histopathology classified 40/56 (71.4%) as PCa and 16/56 (28.6%) as benign. MP imaging with two parameters (T2w + DWI) achieved cancer, local and distant staging.

RESULTS

Fluciclovine uptake was recorded and descriptive statistics computed. Four equivocal scan interpretations were analyzed as positive for this study. Two-sample T-test and Fisher's exact test were used to determine statistical significance of differences in means of background data and proportion of fluciclovine positive patients respectively.

CONCLUSION

Fluciclovine PET-CT was able to detect prostate cancer recurrence in patients on ADT, though there seems to be a lower detection rate at PSA levels <2ng/ml. Further study is required with greater sample size.

CLINICAL RELEVANCE/APPLICATION

Validity of radiological imaging after commencement of ADT is often queried. Our study shows that fluciclovine may be of use in this regard though detection rate may be reduced at lower PSA levels.

SSA16-03 Multiparametric [11C]Acetate Positron Emission Tomography/Magnetic Resonance Imaging in the Assessment of the Prostate Cancer

Sunday, Nov. 27 11:05AM - 11:15AM Room: S505AB

Participants

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Katja Pinker, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

To demonstrate the feasibility of fused multiparametric [11C]Acetate ([11C]Ace) positron emission tomography/magnetic resonance imaging ([MP [11C]Ace PET/MRI) for insight into tumor biology and to investigate the value of MRI and PET parameters for primary prostate cancer (PCa) detection, local and distant staging.

METHOD AND MATERIALS

56 consecutive patients (85% 67y) who fulfilled the following inclusion criteria, were included in this IRB approved prospective study: elevated PSA levels, suspicious findings at digital rectal examination or TRUS, histopathological verification. MRI protocol consisted of a T2-weighted(T2w), diffusion-weighted(DWI), dynamic contrast-enhanced(DCE), and 3D proton MR spectroscopic(1H-MRSI) MRI. Patients were included with approx. 800MBq [11C]Ace and underwent PET/CT scanning(Siemens Biograph). CT data was used for attenuation correction. Co-registration of imaging data and image fusion were performed using dedicated software. Appropriate statistical test were used to determine diagnostic accuracy of MP [11C]Ace PET/MRI for prostate cancer, local and distant staging.

RESULTS

Histopathology classified 40/56 (71.4%) as PCa and 16/56 (28.6%) as benign. MP imaging with two parameters (T2w + DWI) achieved
the highest sensitivity, specificity and diagnostic accuracy of 95%, 68.8% and 88%, with an AUC of 0.82 for primary PCa. Neither assessments with a single parameter (AUC, 0.54-0.79), nor different combinations with two parameters (AUC, 0.67-0.76), three parameters (AUC, 0.69-0.79), four parameters (AUC, 0.73-0.76) nor five parameters (AUC, 0.731) achieved equally good results. MP\([11C]\)Ace PET/MRI improved local staging with a sensitivity, specificity and diagnostic accuracy of 100%, 96% and 97% compared to MRI alone with 72.2%, 100% and 95.5. MP\([11C]\)Ace PET/MRI correctly detected osseous and liver metastases in five patients.

CONCLUSION

MP\([11C]\)AcePET/MRI is feasible, merges morphologic with functional information and allows insights in molecular and metabolic processes involved in cancer development. MP\([11C]\)AcePET/MRI with two MRI derived parameters (T2 +DWI) yields the highest diagnostic accuracy. The addition of more parameters doesn’t improve diagnostic accuracy of primary PCa detection. MP\([11C]\)Ace PET/MRI facilitates an improved local and distant staging.

CLINICAL RELEVANCE/APPLICATION

MP\([11C]\)Ace PET/MRI provides a “one –stop” staging in patients with primary PCa and thus has the potential to improve [M1] therapy.

SSA16-04 Comparison of MRI and 18F-FDG PET/MRI for Pretherapeutic Tumor Staging of Patients with Primary Cancer of the Uterine Cervix

Sunday, Nov. 27 11:15AM - 11:25AM Room: S505AB

Participants
Johannes Grueneisen, Essen, Germany (Presenter) Nothing to Disclose
Lino Sawicki, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Benedikt M. Schaarschmidt, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
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Michael Forsting, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Lale Umutlu, MD, Essen, Germany (Abstract Co-Author) Consultant, Bayer AG

PURPOSE
The aim of this study was to assess and compare the diagnostic potential of MRI and integrated 18F-FDG PET/MRI for the evaluation of the primary tumors as well as whole-body tumor staging of patients with cervical cancer.

METHOD AND MATERIALS
A total of 44 consecutive patients with histopathologically confirmed cervical cancer were prospectively enrolled for a whole-body 18F-FDG PET/MR examination prior to therapy. After written informed consent was obtained, all patients underwent an integrated whole-body PET/MR examination, which comprised a diagnostic, contrast-enhanced whole-body MR protocol including dedicated imaging of the female pelvis. Two radiologists separately evaluated the MRI data, followed by readings of the PET/MRI datasets, regarding the determination of the local tumor spread of primary tumors of the uterine cervix as well as detection of nodal and distant metastases.

RESULTS
MRI and PET/MRI enabled the correct detection of 43 of the 44 primary cervical tumors, while in one patient with FIGO stage Ia, the tumor could not be identified based on either imaging technique. Furthermore, both, MRI and PET/MRI allowed for a correct determination of the T-stage in 38 (86%) out of the 44 patients. In 19 of the 44 patients lymph node metastases were present. PET/MRI revealed higher values for sensitivity (84% vs. 68%), specificity (92% vs. 87%) and diagnostic accuracy (89% vs. 80%) in comparison to MRI for the identification of nodal positive patients. In 3 patients distant metastases were present and could be detected in both imaging modalities.

CONCLUSION
The present study demonstrates the usefulness of 18F-FDG PET data as a valuable additive to MR imaging for more accurate nodal staging of patients with cervical cancer. For the determination of the local tumor spread 18F-FDG PET data does not provide an additional benefit to MRI.

SSA16-05 Diffusion-weighted Whole-body Imaging with Background Body Signal Suppression (DWIBS) Co-registered with Digital FDG PET for Lymph Node Staging of Bladder Cancer

Sunday, Nov. 27 11:25AM - 11:35AM Room: S505AB

Participants
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Katherine Binzel, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
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Amir Mortazavi, MD, Columbus, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
To develop and assess the diagnostic value of a combined PET MRI protocol that uses diffusion-weighted whole-body imaging with background body signal suppression (DWIBS) and low-dose digital PET for lymph node staging in bladder cancer.

METHOD AND MATERIALS
In this prospective study we have currently 60 patients enrolled with muscle-invasive bladder cancer to undergo neoadjuvant...
CONCLUSION

Our results suggests that CT can not be used for assessment of the extent of active metastatic skeletal disease in PCa. NaF and FCH give different information about the skeletal disease. Active sites on NaF or FCH differed less from each other than sclerotic bone regions from PET activity.

CLINICAL RELEVANCE/APPLICATION

CT can not be used for assessment of the extent of active metastatic skeletal disease in PCa. Different PET modalities give substantially different information in similar disease.

SSA16-07 Comparison of FDG PET Metabolic Tumor Volume versus ADC Histogram: Prognostic Value of Tumor Treatment Response and Survival in Patients with Locally Advanced Uterine Cervical Cancer

Sunday, Nov. 27 11:45AM - 11:55AM Room: SS05AB

Participants

Yoshiko Ueno, MD, PhD, Montreal, QC (Presenter) Nothing to Disclose

Robert Lisbona, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose

Abstract Co-Author: Nothing to Disclose

Abstract Co-Author: Nothing to Disclose

Abstract Co-Author: Research Grant, General Electric Company
and 6 under surveillance but negative at additional imaging). In 9 cases the recurrence was not identified (1 lost to follow-up, 2 treated with palliative androgen therapy). The result of the clinical and imaging follow-up at 41 months (median value: range 17-51), including biopsy of the suspected sites when indicated, showed that the recurrence was identified in 33 cases. We included 33 subject, 29 evaluated by PET/CT and 4 by PET/MR, the same hybrid modality being used for the two tracers.

METHOD AND MATERIALS

Karl-Olof Franzén, MD, PhD, Stockholm, Sweden (Abstract Co-Author) Nothing to Disclose

Participants

Patrik Nilsson, MD, PhD, Stockholm, Sweden (Abstract Co-Author) Nothing to Disclose

Aim of this study was an intra-individual comparison of the two tracers to identify recurrent PCa at local staging. Superiority in local staging is expected for ACE, given the absence of urinary excretion. 18F-fluorocholine (FCH) and 11C-acetate (ACE) are validated PET tracers for restaging of recurrent prostate cancer (PCa), targeting a common metabolic pathway (cellular membrane synthesis). To evaluate the prognostic utility of volume-based quantitative parameters of fluorine 18 fluorodeoxyglucose positron emission tomography (18F-FDG PET) and apparent diffusion coefficient (ADC) histogram analysis, for tumor response to therapy and event-free survival (EFS), in patients with uterine cervical cancer receiving chemoradiotherapy (CRT).

METHOD AND MATERIALS

The study included 21 patients diagnosed with locally advanced uterine cervical cancer who underwent pre-treatment MRI and 18F-FDG PET and were treated with concurrent CRT. 18F-FDG parameters: Maximum and mean standardized uptake value (SUVmax, and SUVmean); metabolic tumour volume (MTV); total lesion glycolysis (TLG); ADC parameters: Maximum, mean, and minimum value (ADCmax, ADCmean, ADCmin); percentile ADC values (10th, 25th, 50th, 75th, 90th); skewness and kurtosis of ADC were measured and compared between the responder and non-responder groups using a Tukey’s test. The Cox regression analysis was performed and Kaplan-Meier survival curves were used for EFS analysis.

RESULTS

In the non-responder group, MTV and TLG of the primary tumour were significantly higher than those of the responder group (p = 0.04 and p = 0.01, respectively). Applying Cox regression multivariate analysis, MTV (Hazard ratio [HR], 4.725; p=0.036), TLG (HR, 4.725; p=0.036), and 10th percentile ADC (HR, 5.207; p=0.048) showed a statistically significant association with EFS. When an optimal cut-off value was applied for MTV and TLG using ROC curve analysis, the EFS rates above the cut-off value were significantly lower than that below the cut-off value (p=0.002 and p=0.002, respectively).

CONCLUSION

Pre-treatment volume-based quantitative parameters of 18F-FDG PET may have better potential compared to ADC histogram for predicting treatment response and EFS in patients with locally advanced cervical cancer.

METHOD AND MATERIALS

Our study clearly showed that MTV and TLG can be used to identify patients with advanced uterine cervical cancer treated with CRT at high risk for recurrence. Our results also suggest that volume-based 18F-FDG PET/CT analysis could provide more effective information than volume-based ADC histogram analysis for predicting treatment outcome for patients with advanced uterine cervical cancer.

Honored Educators

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Caroline Reinhold, MD, MSc - 2013 Honored Educator
Caroline Reinhold, MD, MSc - 2014 Honored Educator

SSA16-08 Long Term Results of A Comparative PET/CT and PET/MRI Study of 11C-Acetate and 18F-Fluorocholine for Restaging Recurrent Prostate Cancer With Low PSA

Sunday, Nov. 27 11:55AM - 12:05PM Room: S505AB

Participants

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Karl-Olof Lovblad, MD, Geneva, Switzerland (Presenter) Nothing to Disclose

PURPOSE

18F-fluorocholine (FCH) and 11C-acetate (ACE) are validated PET tracers for restaging of recurrent prostate cancer (PCa), targeting a common metabolic pathway (cellular membrane synthesis). Superiority in local staging is expected for ACE, given the absence of urinary excretion. Aim of this study was an intra-individual comparison of the two tracers to identify recurrent PCa at low PSA values (i.e., ≤ 3 ng/ml after surgery and ≤ 5 ng/ml after radiotherapy, RT), using clinical and imaging follow up data as gold standard.

METHOD AND MATERIALS

We included 33 subject, 29 evaluated by PET/CT and 4 by PET/MR, the same hybrid modality being used for the two tracers. Among these 5 patients were relapsing after surgery, 8 after RT and 20 after surgery and salvage RT. The gold standard was the result of the clinical and imaging follow-up at 41 months (median value: range 17-51), including biopsy of the suspected sites when indicated (6 cases). In 9 cases the recurrence was not identified (1 lost to follow-up, 2 treated with palliative androgen therapy and 6 under surveillance but negative at additional imaging).
RESULTS

The positivity rate for ACE was 66% and for FCH was 60%. The clinical and imaging follow-up confirmed that the recurrent disease was local in 11 cases, loco-regional in 4 cases, and metastatic in 9 cases (6 M1a and 3 M1b). Results were concordant in 82% of the cases (26/33) and discordant in 7/33 cases, 6 PET/CT and 1 PET/MR. All discordant cases concerned nodal localizations: in 4 cases ACE showed additional nodal uptake (3 true positive -TP- and 1 undetermined at follow-up) and in 2 cases FCH (1 TP and 1 false positive at follow-up), while in 1 case with multiple nodal localizations 2 different nodes were positive (both TP). The discordant lymph nodes were retroperitoneal (5), pararectal (1) and external iliac (2).

CONCLUSION

In patients with recurrent PCa at low PSA values, ACE and FCH showed minor discrepancies for nodal staging, mainly in the retroperitoneal area, the majority of which confirmed as TP at follow-up. Both tracers performed equally for local recurrences.

CLINICAL RELEVANCE/APPLICATION

In relapsing patients with low PSA, 11C-acetate and 18F-choline show minor discrepancies for nodal staging, while the local and distant staging provided by the two tracers is equivalent.
A Comparative Study of F-18 FDG PET/CT and C-11 Methionine PET/CT for Differentiating Primary CNS Lymphoma from Glioblastoma

Station #6

PURPOSE
The purpose of this study was to compare F-18 FDG (FDG) PET/CT and C-11 methionine (MET) PET/CT for differentiating between primary central nervous system (CNS) lymphoma and glioblastoma.

METHOD AND MATERIALS
A total of 26 patients (6 CNS lymphomas and 20 glioblastomas) with newly diagnosed were examined with both FDG and MET PET/CT. PET emission scanning of the head region with a 15-min acquisition of one bed position was performed at 60 min and 15 min after FDG and MET injection, respectively. The maximum standardized uptake value (SUV), peak SUV, mean SUV, metabolic tumor volume (MTV) and the tumor-to-normal brain tissue (T/N) ratio of tumors were measured.

RESULTS
All tumors showed positive accumulation on both FDG and MET PET/CT. Using FDG PET/CT, maximum SUV, peak SUV, mean SUV, and T/N ratio in CNS lymphoma were significantly higher than those in glioblastoma. The FDG MTV in glioblastoma was higher than that in CNS lymphoma, although the difference was not statistically significant. In contrast, no significant differences in all PET parameters using MET PET/CT were noted between CNS lymphoma and glioblastoma.

CONCLUSION
FDG PET/CT is more helpful than MET PET/CT for differentiating between CNS lymphoma and glioblastoma.

CLINICAL RELEVANCE/APPLICATION
FDG PET/CT is more helpful than MET PET/CT for differentiating between CNS lymphoma and glioblastoma.

Novel CZT-based digital SPECT - Preliminary Results from a Prototype System

Station #7

PURPOSE
Cadmium-Zinc-Telluride (CZT)-based digital gamma cameras can provide improved image resolution and greater sensitivity, thereby allowing faster acquisitions and / or reduced administered dose compared to standard scintillator-based analog (Anger) systems. Evaluation of clinical feasibility, image quality, and diagnostic performance of a prototype of a novel CZT-based digital SPECT general purpose camera was performed.

METHOD AND MATERIALS
The digital SPECT system (Valiance X12 prototype, Molecular Dynamics, Hamilton, Bermuda) is equipped with CZT detectors, fitted with a high-sensitivity collimator and mounted on a ring shaped gantry. The flexible architecture also enables focusing the detection units on a specific region of interest to obtain enhanced images of a specific target. Data are reconstructed using an iterative reconstruction algorithm. Fifteen Tc-99m MDP digital SPECT studies were acquired in 12 patients (7M, age 27-66yrs) immediately following analog SPECT including SPECT of knees (n=7), lumbar spine/pelvis/hips (n=4) and ankles/feet (n=4). Both sets of images were compared by experienced Nuclear Medicine physicians and were graded on a scale of 1 (poor) to 4 (very good) for sharpness, contrast, overall quality and diagnostic confidence.

RESULTS
Digital SPECT studies were all diagnostic and were of good or very good quality. Mean grades for digital SPECT exceeded those of analog SPECT for sharpness (3.7 vs. 3.1), and contrast (3.9 vs. 3.3). Overall image quality and diagnostic confidence of digital and
CONCLUSION
These preliminary results show improved contrast and sharpness of digital bone SPECT compared to analog SPECT and are encouraging. Further studies in large patient cohorts and other clinical indications are under way.

CLINICAL RELEVANCE/APPLICATION
General purpose digital SPECT with high sensitivity collimators, together with improved resolution, improved sharpness and contrast as compared to analog SPECT technology are expected to have significant clinical impact. Further research will assess other general nuclear medicine applications, as well as the contribution of focused imaging, a unique capability of this CZT-based digital SPECT system.

PURPOSE
To determine whether relative SUV measurements at FDG PET can be used to predict survival time in patients with glioblastoma treated with radiation therapy and temozolomide, and suspicion of disease progression on follow-up MRI

METHOD AND MATERIALS
We retrospectively reviewed 56 patients with glioblastoma treated with surgery followed by radiation and temozolomide, who underwent post therapy FDG PET due to findings of suspected progression on follow-up MRI. We fused the PET and MRI images. Relative SUV measurements were calculated from regions of interest that were placed in the area of highest FDG uptake within the abnormal contrast enhancement as seen on the PET/MRI overlay maps, and in the contralateral normal-appearing white matter. We calculated survival time from initial diagnosis and from post therapy PET; the latter was used as the outcome variable. We used Cox proportional Hazard models to predict survival from PET based on the relative SUV

RESULTS
Twenty four patients were female (42.9%). Mean age at diagnosis was 56.8±12.2 years. Overall median survival time from diagnosis was 20.8 months. Overall median survival time from PET was 12.2 months. There was a significant association between survival time from PET and relative SUV (p=0.001). The instantaneous risk of death (hazard) was 1.4 time greater (95% CI: [1.20, 1.62]) for a patient at the 50th percentile of the relative SUV distribution (relative SUV of 2.0) than for a patient at the 25th percentile (relative SUV of 1.7); while it was 2.44 time greater (95% CI: [1.64, 3.64]) for a subject at the 75th percentile (relative SUV of 2.5) than for one at the 25th percentile. Median survival times for patients at the 25th, 50th and 75th percentiles were 15.9 months (95% CI: [12.2, 25.9]), 12.6 months (95% CI: [10.3, 17.1]), and 9.7 months (95% CI: [8.7, 12.1]), respectively. Predicted probabilities of surviving 10, 20, and 30 months post PET for patients at the 25th, 50th and 75th percentiles were 0.73, 0.37, and 0.25; 0.65, 0.25 and 0.14; and 0.47, 0.09 and 0.03, respectively

CONCLUSION
Quantitative relative SUV on FDG PET is a biomarker of survival in patients with glioblastoma treated with surgery followed by concurrent radiation therapy and temozolomide, with suspicion of progression on post-therapy MRI

CLINICAL RELEVANCE/APPLICATION
Data is likely to be useful in the patient management and could support the need for further therapeutic actions on selected subjects

PURPOSE
To review FDG-PET/CT cases in which unexpected emergency diseases were detected and to establish a checklist for rapid and appropriate management.

METHOD AND MATERIALS
Interpretation reports of 11,663 FDG-PET/CT studies, performed in our hospital from 2012 to 2015, were retrospectively reviewed by consensus of one nuclear medicine physician and two radiologists. Patients with major emergency diseases were extracted according to following exclusion criteria: (1) The findings had been recognized before PET/CT. (2) Any intervention or operation, which can be related to relevant findings, had been undergone within a month prior to PET/CT. (3) Clinical course before or after PET/CT could not be investigated sufficiently, such as patients who were introduced from other hospitals.
RESULTS
Forty-one patients (0.35%) with unexpected emergency diseases were identified. Most frequent disease was pneumothorax (8 patients), followed by chronic subdural hematoma (CSH) (7 patients), ureteral stone (7 patients), abdominal aortic aneurysm (AAA) with dirty fat sign or high-attenuating crescent sign visualized on CT (4 patients). Nine patients (2 pneumothorax, 3 CSH, 1 cerebral hemorrhage, 1 acute cholecystitis, 1 acute pancreatitis and 1 acute appendicitis) were hospitalized and/or underwent any therapeutic intervention within a week after PET/CT. In two patients with AAA, aneurysm repair was performed prior to therapy of known cancer.

CONCLUSION
Although rare, unexpected emergency disease which needs urgent management can be detected by FDG-PET/CT, therefore we should check CT, particularly head and thorax, as soon as possible after obtaining PET/CT data.

CLINICAL RELEVANCE/APPLICATION
Based on our results, nuclear medicine physicians, who engage in FDG-PET/CT study, will be able to contribute to life saving and improved prognosis of patients with unexpected emergency diseases.

TABLE OF CONTENTS/OUTLINE
1) Patterns of FDG uptake in various benign and malignant tumors of the musculoskeletal system in conjunction with their histopathology and radiological features. 2) Clinical utility of FDG PET/CT in aiding diagnosis by directing biopsy from the most viable and representative portion of the tumor. 3) Understand the role of PET/CT in staging, as a surrogate marker of response to treatment and in predicting malignant transformation in certain benign tumors. 4) Understand the pitfalls, false positives and treatment related complications during PET/CT interpretation.
**PURPOSE**

To correlate the degree of ipsilateral thalamic metabolism on FDG PET with total epilepsy duration and seizure type in patients with intractable epilepsy and mesial temporal sclerosis (MTS) who were seizure-free for at least two years after surgery. To assess the accuracy of thalamic hypometabolism to lateralize the epileptic focus on FDG PET scans.

**METHOD AND MATERIALS**

We retrospectively reviewed the pre-surgical brain FDG PET of 18 patients with intractable temporal lobe epilepsy and MRI findings of MTS, and who were seizure-free for at least two years after anterior temporal lobectomy. We automatically segmented the thalami and calculated the mean SUV for the ipsilateral and contralateral to the MRI abnormality. We compared the SUV values in the bilateral thalami using the paired t test. We correlated the metabolic activity in the thalami with the total epilepsy duration (years from onset) by means of the Spearman correlation coefficient.

**RESULTS**

Fourteen patients were female (77.8%). Twelve subjects had left MTS (66.67%). Eight patients had simple/complex partial seizures, 10 patients had both partial and secondary generalized seizures. Mean age was 37.2±12.91 years. Mean SUV in the thalamus ipsilateral to the MTS (6.36±2.31) was significantly lower than the contralateral (6.52±2.43) (p=0.02). The ipsilateral thalamus was more hypometabolic than the contralateral in 15 of the 18 patients (83.3%). In patients with secondary generalized seizures, the mean SUV in the ipsilateral thalamus (6.74±2.27) was significantly lower than in the contralateral (6.94±2.42) (p=0.02). In patients with simple/complex partial seizures, the mean SUV in the ipsilateral thalamus was 5.89±2.42 as opposed to 6±2.51 in the contralateral, p=0.29. There was a significant (p=0.037) strong, negative (rs=-0.66) correlation between the SUV in the ipsilateral thalamus and epilepsy duration in patients with generalized seizures.

**CONCLUSION**

In patients with confirmed MTS, the thalamus ipsilateral to the temporal lobe abnormality was significantly hypometabolic compared to the contralateral. The degree of hypometabolism was greater in patients with longstanding epilepsy and in subjects with secondary generalized seizures compared to patients with partial seizures.

**CLINICAL RELEVANCE/APPLICATION**

Semi-quantitative analysis of FDG PET may be used as a biomarker of thalamic impairment and can contribute to lateralizing the epileptic foci in patients with MTS.
METHOD AND MATERIALS

100 nm-sized polymer-micellar nanoparticles (NPs) tagged with Zirconium 89 were delivered intranasally (INDD, N=3) or IV (N=3) to adult rats. PET/CT images were obtained over 2 hr in vivo. PET activity was quantitated in brain subregions and SUVs were derived from atlas-based regions-of-interest (ROIs). The olfactory region, brainstem and forebrain regions of several brains were isolated for independent verification of nanoparticle localization using gamma well counting at 1 hr (N=3), 2 hr (N=6), 4 hr (N=3), 6 hr (N=3) and 24 hr (N=3) following INDD or IV administration. Autoradiography studies of three animal brains were performed at 1 and 2 hr following INDD or IV administration and compared to the PET/CT and gamma well counting studies.

RESULTS

In vivo PET/CT imaging demonstrated uptake of NPs into the brain as much as 35-fold higher after INDD as compared to IV administration. Brain subregional activity was validated ex vivo by observing the highest activity in the olfactory region and brain stem as observed with in vivo imaging. In a similar pattern, to the PET results, the gamma well counting studies and autoradiography studies demonstrated increased uptake in the olfactory regions and brainstem to a much greater degree than the forebrain structures at early time points.

CONCLUSION

The temporal and spatial distribution of nanoparticles can be determined after intranasal delivery using microPET/CT. There is a critical and immediate need for better evaluation of drug delivery to the central nervous system, especially through the intranasal route. INDD of radio-nanoparticle drug delivery systems evaluated using in vivo microimaging and validated ex vivo using PET/CT, gamma well counting and autoradiography may significantly impact the emerging field of radio-nanotheranostics.

CLINICAL RELEVANCE/APPLICATION

INDD of radio-nanoparticle drug delivery systems evaluated using in vivo microimaging and validated ex vivo using PET/CT, gamma well counting and autoradiography may significantly impact the emerging field of radio-nanotheranostics.

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Michael W. Vannier, MD - 2015 Honored Educator

NM206-SD-SUB8 External Validation of Therapy Response Interpretation Criteria (Hopkins Criteria) with Inter-reader Reliability, Accuracy and Progression Free Survival Outcomes

Station #8

Participants

Ayse T. Karagulle Kendi, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
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Mark El-Deiry, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Nabil F. Saba, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
David M. Schuster, MD, Atlanta, GA (Presenter) Institutional Research Grant, Nihon Medi-Physics Co, Ltd; Institutional Research Grant, Blue Earth Diagnostics Ltd; Consultant, WellPoint, Inc.;
Rathan M. Subramaniam, MD, PhD, Dallas, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE

Qualitative assessment of post therapy PET/CT results is important to provide reproducible and a systemic reporting. A recently introduced response criteria, known as Hopkins Criteria showed promising results in the assessment of head and neck cancer. In this study our aim is to re-validate the Hopkins interpretation system to assess therapy response and progression free survival in head and neck squamous cell cancer patients (HNSCC).

METHOD AND MATERIALS

The study included 69 biopsy proven HNSCC patients who underwent post therapy PET/CT between 5-24 weeks after completion of therapy. PET/CT images were interpreted by one nuclear medicine physician and one nuclear radiologist independently. The studies were scored according to Hopkins Criteria for right neck, left neck, primary tumor site, and overall assessment. Scores 1, 2, 3 were considered as negative and scores 4 and 5 were considered positive for persistent tumors. Inter-reader variability was assessed using percent agreement and Kappa statistics. Progression-free survival (PFS) was analyzed by Kaplan-Meier plots.

RESULTS

Of the 69 patients in the study, 59 (85.5%) were male, 10 (14.5%) were female. The mean age was 62.8 years. There was 91.3%, 97.6%, 97.6%, 91.3% between the readers for overall, right neck, left neck, and primary tumor site response scores, respectively. The corresponding k coefficients were, 0.57, 0.84, 0.78, 0.65 for overall, right neck, left neck, and primary tumor site, respectively Cox multivariate regression analysis showed positive primary tumor site scores and overall scores were associated with a higher risk of progression (p<0.05).

CONCLUSION

External validation of Hopkins Criteria showed excellent inter-reader agreement and prediction of PFS in this cohort of HNSCC patients.

CLINICAL RELEVANCE/APPLICATION

Systemic and reproducible interpretation system, called Hopkins criteria better classifies post therapy PET/CT of head and neck carcinoma patients compared to semi-quantitative methods, including SUVmax.
Evaluation of Practical Interpretation Hurdles in 68Ga-PSMA-PET/CT in 55 Patients: Physiologic Tracer Distribution, Non-prostate-cancer Malignancies and Incidentalomas

Participants
Julian Kirchner, Dusseldorf, Germany (Presenter) Nothing to Disclose
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Gerald Antoch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Heusch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
68Ga-labelled prostate-specific membrane antigen (PSMA) ligand is a novel and promising tracer for positron emission tomography / computed tomography (PET/CT) especially in recurrent prostate cancer. The aim of this study was to investigate the physiologic tracer distribution and evaluate focal or diffuse 68Ga-PSMA uptake in non-prostate-cancer malignancies and incidental findings.

METHOD AND MATERIALS
68Ga PSMA-PET/CT scans in 55 men (mean age 66 ± 9.07y; mean activity: 188MBq) performed for staging of prostate cancer (49) or renal cell carcinoma (6) were analysed retrospectively. By two independent readers incidental tracer uptake was analyzed and evaluated on a syngo.via workstation (Siemens Healthcare GmbH, Erlangen, Germany). Maximum standardized uptake value (SUVmax) was measured using an isocontour volume of interest. Metastatic tracer uptake was excluded by follow-up or clinical examinations.

RESULTS
As expected a mostly homogenous PSMA uptake was found in lacrimal gland (SUVmax 15.7), parotid gland (SUVmax 24.4), submandibular gland (SUVmax 26.6), vocal cords (SUVmax 8.4), waldeyer's ring (SUVmax 10.3), liver (SUVmax 8.5), spleen (SUVmax 10.8), kidneys (SUVmax 66.4) and pars descendens duodeni (SUVmax 17.6). In 13 patients a focal PSMA uptake of the thyroid (SUVmax 4.3) was found. In 31 patients a focal PSMA uptake of knees synovia (SUVmax 2.0) was found. Here, additional 3 patients showed a PSMA uptake of the tibial plateau (SUVmax 2.7), 2 of them with correlating signal irregularities in also performed MRI. The primary renal cell carcinomas in 5 patients had a mean SUVmax of 9.9. Further PSMA uptake was found in one patient due to fibrous dysplasia of right Os ilium (SUVmax 7.7) and in the gluteal fatty tissue of another patient due to a liposarcoma (SUVmax 1.5).

CONCLUSION
Biodistribution of the novel 68Ga-PSMA tracer was analysed. Among prostate cancer lesions and healthy organs various other benign findings and malignant neoplasms may also express PSMA and show tracer uptake on 68Ga PSMA-PET/CT.

Lymphoscintigraphy and Its Role in the Management of Pediatric Sarcoma

Participants
Bret P. Martell, MD, Aurora, CO (Presenter) Nothing to Disclose
Brian M. Bagrosky, MD, MS, Castle Pines, CO (Abstract Co-Author) Nothing to Disclose
Jennifer J. Kwak, MD, Denver, CO (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is to: 1. Learn the roles that lymphoscintigraphy and sentinel lymph node biopsy play in the management of pediatric sarcoma. 2. Demonstrate that PET/CT alone is not sufficient to determine if metastatic lymph nodes are present. 3. Illustrate how to perform a lymphoscintigraphy procedure in children with sarcoma to identify sentinel lymph nodes.

TABLE OF CONTENTS/OUTLINE
Discuss the roles that lymphoscintigraphy and sentinel lymph node biopsy have in the management of pediatric soft tissue sarcomas.
Learn how SPECT/CT can be helpful in localizing sentinel nodes in areas with complex anatomy such as the head and neck.
Discuss how positive lymph nodes status on biopsy doesn't necessarily correlate with positive findings on PET/CT.
Review cases of lymphoscintigraphy performed in children with soft tissue sarcomas and how the pathology correlates with PET/CT imaging.
Learn how to perform a lymphoscintigraphy in pediatric patients with soft tissue sarcomas.
Participants

LEARNING OBJECTIVES

1) Understand the patient preparation issues with performing PET/CT. 2) Review recommendations on patient preparation prior to performing PET/CT. 3) Review the issues in performing PET/CT scans on diabetic patients and learn ways to optimize the glucose level. 4) With the aid of challenging case examples, this activity aims improve PET-CT interpretation through recognition of pitfalls and variants. In addition, it aims to review typical as well as unusual examples of commonly encountered oncologic diagnoses. 5) Learn how to discriminate malignancy from benign FDG-avid changes caused by surgery and procedures, radiation, and chemotherapy.

Sub-Events

RC111A  Therapy-induced Complications on PET/CT

Participants
Gary A. Ulaner, MD, PhD, New York, NY, (ulanerg@mskcc.org) (Presenter) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd

LEARNING OBJECTIVES

1) Learn how to discriminate malignancy from benign FDG-avid changes caused by surgery and procedures, radiation, and chemotherapy.

ABSTRACT

FDG is not a cancer-specific agent, and FDG-avidity can be seen in many benign processes. It can be particularly challenging to discriminate malignancy from benign FDG-avid changes caused by surgery and procedures, radiation, and chemotherapy. FDG-avid lesions caused by surgery and procedures includes inflammation at sites of incision or dissection, inflammation from vascular compromise or surgical retraction, surgical transposition of structures with physiologic FDG-avidity (such as ovaries or testes), and pleurodesis inflammation. Radiation may induce FDG-avid pneumonitis, esophagitis, or hepatitis, as well as osteoradionecrosis or fractures. FDG-avid chemotherapy complications include pneumonitis, osteonecrosis, enterocolitis, and pancreatitis. Granulocyte Colony Stimulating Factor for treatment of bone marrow suppression after chemotherapy induces temporary increases of FDG-avidity in the bone marrow and spleen. We will illustrate common and unusual iatrogenic causes of FDG-avidity that can confound FDG PET/CT interpretation.

RC111B  Impact of Patient Preparation

Participants
Don C. Yoo, MD, E Greenwich, RI (Presenter) Consultant, Endocyte, Inc

LEARNING OBJECTIVES

1) Understand the patient preparation issues with performing PET/CT. 2) Review recommendations on patient preparation prior to performing PET/CT. 3) Review the issues in performing PET/CT scans on diabetic patients and learn ways to optimize the glucose level.

ABSTRACT

F18-FDG PET/CT is a valuable tool for a variety of oncologic applications. The purpose of this educational activity is to discuss the importance of appropriate patient preparation prior to performing oncologic F18-FDG PET/CT scans. The recommendations from the American College of Radiology (ACR), the Society of Nuclear Medicine and Molecular Imaging (SNMMI), and the National Cancer Institute (NCI) for patient preparation will be discussed. Issues that will be discussed include fasting, limiting exercise, hydration, sedation, low carbohydrate meals, and diabetic patients.

Patients are typically asked to fast for at least 4 hours before tracer injection for oncologic PET/CT scans. The ACR and SNMMI both recommend checking glucose levels on all patients prior to administration of F18-FDG. SNMMI guidelines recommend that patients with glucose of greater than 150–200 mg/dL should usually be rescheduled. Performing PET/CT scans in poorly controlled diabetic patients can result in a PET/CT scan with an altered biodistribution limiting interpretation of the study. In a poorly controlled diabetic patient with a glucose level of greater than 200 mg/dl, the study should usually be rescheduled if it does not critically affect patient care. Hyperglycemia will dilute the FDG uptake by tumors through competitive inhibition. Subcutaneous insulin should not be administered to a diabetic patient with high glucose within 4 hours of a PET/CT scan as insulin will stimulate FDG uptake by skeletal muscle resulting in an altered biodistribution which can severely limit interpretation.

RC111C  Challenging Case Examples

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

LEARNING OBJECTIVES
1) With the aid of challenging case examples, this activity aims to improve PET-CT interpretation through recognition of pitfalls and variants. In addition, it aims to review typical as well as unusual examples of commonly encountered oncologic diagnoses.

ABSTRACT
**Emerging Technologies: Imaging and Management of Pain**

Sunday, Nov. 27 2:00PM - 3:30PM Room: 5504CD

**MR NM**

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

FDA Discussions may include off-label uses.

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**Participants**

Sandip Biswal, MD, Stanford, CA (Moderator) Stockholder, SiteOne Therapeutics Inc; Scientific Advisory Board, SiteOne Therapeutics Inc; Research Grant, General Electric Company;

**Sub-Events**

**RC117A  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 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.

**ABSTRACT**

Chronic pain is now the most prevalent 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.

**RC117B  MR Imaging of Peripheral Nerves in Patients with Pain**

Participants

Cynthia T. Chin, MD, San Francisco, CA, (cynthia.t.chin@ucsf.edu) (Presenter) Nothing to Disclose

**Active Handout:** Cynthia T. Chin


**RC117C  PET/MRI of Inflammation and Pain Generators**

Participants

Sandip Biswal, MD, Stanford, CA, (biswal@stanford.edu) (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 most prevalent 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.
Participants
Richard K. Brown, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Murray D. Becker, MD, PhD, New Brunswick, NJ (Abstract Co-Author) Nothing to Disclose
Matthew Manganaro, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Wahida T. Rahman, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Jason J. Bailey, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Levi Sokol, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Mark A. Helvie, MD, Ann Arbor, MI (Abstract Co-Author) Institutional Grant, General Electric Company
Donna Eckstein, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
John D. Millet, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1) Learn the salient imaging findings of fat necrosis and giant cell arteritis on PET/CT. 2) Recognize the pattern of uptake on sulfur colloid imaging seen in focal nodular hyperplasia. 3) Learn how to use correlative imaging to assist in the diagnosis of pathology seen on nuclear medicine studies.
**Participants**
Rajan Jain, MD, Hartsdale, NY (Presenter) Consultant, Cancer Panels; Royalties, Thieme Medical Publishers, Inc
Michael D. Chan, MD, Winston-Salem, NC (Presenter) Advisory Board, NovoCure Ltd
Christina I. Tsien, MD, Saint Louis, MO (Presenter) Speaker, Merck & Co, Inc

**LEARNING OBJECTIVES**
1) Describe how to differentiate gliomas from lymphoma, metastases as well as non-neoplastic etiologies such as demyelinating lesions: Role of functional imaging modalities. 2) Describe imaging characteristics of gliomas based on genomic differences: Imaging phenotype genotype correlation. 3) Advanced imaging techniques as a surveillance tool in post-therapy gliomas with emphasis on genomic markers.

**ABSTRACT**
Recent advances in glioma genomics have significantly changed our understanding of tumor biology and hence, affected how these patients are treated. Similarly, integrating imaging data with genomic markers has also helped create better prognostic and predictive biomarkers which offer promising future for personalized medicine. This session will highlight a multi-disciplinary approach with the focus on advanced imaging and genomics markers before and after therapy in gliomas.
Participants

Sub-Events

RC211A  New Guidelines for I-131 Therapy of Thyroid Cancer

Participants
Don C. Yoo, MD, E Greenwich, RI (Presenter) Consultant, Endocyte, Inc

LEARNING OBJECTIVES
1) Describe why thyroid cancer is increasing. 2) Review guidelines for the use of I-131 in the treatment of thyroid cancer. 3) Review the controversies in thyroid cancer treatment.

ABSTRACT
The purpose of this educational activity is to review the reasons why the incidence of thyroid cancer has risen so rapidly over the last 40 years and discuss the role of radioiodine ablation in patients with thyroid cancer. Issues that will be discussed include controversies in the extent of thyroid surgery and the appropriate use of radioiodine ablation in patients with thyroid cancer which is controversial in low risk and intermediate risk patients.

The incidence of thyroid cancer in the United States has almost tripled since the early 1970s with unchanged mortality principally due to overdiagnosis. The extent of surgery performed for thyroid cancer is controversial especially in small cancers but only patients with complete thyroidectomy are candidates for radioiodine ablation. Recently lower doses of I-131 have been shown to be effective for radioiodine ablation of remnant thyroid tissue after thyroidectomy. High risk patients will benefit from radioiodine ablation with decreased recurrence and improved mortality. Radioiodine ablation in low risk patients is very controversial and has not been shown to improve mortality.

RC211B  Lu177-DOTATATE Therapy for Neuroendocrine Tumore

Participants
Ronald C. Walker, MD, Nashville, TN (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the selection process for patients likely to benefit from 177Lu-DOTATATE therapy. 2) Learn how to safely administer 177Lu-DOTATATE therapy. 3) Understand the risks and benefits from 177Lu-DOTATATE therapy. 4) Recognize the side effects from 177Lu-DOTATATE therapy and ways to mitigate them. 5) Know how and when to assess for treatment response to 177Lu-DOTATATE therapy.

ABSTRACT
Peptide receptor radionuclide therapy (PRRT) is a revolutionary treatment for patients with neuroendocrine tumors that express somatostatin receptors, including patients with progressive disease on standard treatments who are not candidates for surgical extirpation. In patients with sufficient uptake of somatostatin analogs on imaging (Krenning score 2 or greater), PRRT can result in significant improvement in overall survival and progression free survival. This lecture will review the patient selection process and summarize the treatment protocol, radiation safety issues, and assessment of treatment response.

Active Handout: Ronald Clark Walker

RC211C  Hepatic Artery Infusion Therapy with Y90 Microspheres

Participants
Charles Y. Kim, MD, Durham, NC (Presenter) Consultant, Halyard Health, Inc; Consultant, Cryolife, Inc; Consultant, Merit Medical Systems, Inc

LEARNING OBJECTIVES
1) Review range of malignancies treated with Y90 microsphere infusion. 2) Discuss the types of Y90 therapy and dosimetric considerations. 3) Describe the procedures and technical steps involved in Y90 therapy. 4) Recognize pertinent scintigraphic findings associated with Y90 therapy.

ABSTRACT
Intra-arterial Yttrium-90 (Y90) therapy is an important treatment modality for a variety of hepatic tumors. While numerous types of embolotherapies are employed by interventional radiologists for treatment of cancer, Y90 therapy is unique in its multimodality and multi-procedural nature. Not only does this treatment effect rely on deposited ionizing radiation therapy, but scintigraphic imaging is also an integral component of treatment.

Two types of Y90 therapies are available, made by two different manufacturers. The differences between the two types are subtle,
but there are differences in administration and manufacturer-recommended dosimetric calculation. These various differences will be highlighted.

Y90 therapy is comprised of several steps and is frequently subclassified into a “planning” phase and “treatment” phase. In the planning phase, detailed angiographic imaging is performed to delineate arterial anatomy, determine tumoral distributions, and redistribute vascular flow if indicated. Scintigraphic imaging is an integral component of this planning phase, in order to help identify angiographically occult arterial anomalies, confirm appropriate infusion site, and to quantify the hepatopulmonary shunt fraction. From this information, as well as other factors, the appropriate treatment doses can be determined. In the treatment phase(s), the Y90 dose is administered to the appropriate portions of the liver with subsequent scintigraphic imaging for confirmation.
Cardiac (PET/CT/MRI/SPECT I)

Monday, Nov. 28 10:30AM - 12:00PM Room: S504AB

CA CT MR NM

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

FDA

Discussions may include off-label uses.

Participants
Hildo J. Lamb, MD, PhD, Leiden, Netherlands (Moderator) Nothing to Disclose
Jacobo Kirsch, MD, Weston, FL (Moderator) Nothing to Disclose

Sub-Events

SSC02-01 Wideband Cardiovascular MRI for Imaging Patients with Intracardiac Device Implantation

Monday, Nov. 28 10:30AM - 10:40AM Room: S504AB

Participants
Daniel Kim, PhD, Chicago, IL (Presenter) Nothing to Disclose
Daniel Lee, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Jane Wilcox, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Rod Passman, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Kyung-Pyo Hong, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Duc Thinh Pham, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Bradley Knight, 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;
Jeremy D. Collins, MD, Chicago, IL (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

PURPOSE
Implantable Cardiac Defibrillator (ICD) therapy is indicated for primary prevention of sudden cardiac death in patients with persistent systolic heart failure (LVEF ≤ 35%) despite optimal medical therapy. Some of these patients with conduction delays are also candidates for implantation of an ICD that provides Cardiac Resynchronization Therapy (CRT-D). It is increasingly recognized that cardiac MRI (CMR) is useful in guiding treatment strategies in heart failure. Despite the increasing awareness that CMR can be performed safely in patients with ICDs, the devices may cause significant artifacts limiting diagnostic utility. We have developed and implemented wideband MRI methods for perfusion T1 mapping, and late gadolinium enhancement (LGE) that suppress image artifacts and produce diagnostically acceptable images. This study demonstrates initial results using this wideband CMR protocol (Fig. 1A) in patients with ICDs referred for myocardial scar assessment.

METHOD AND MATERIALS
We have developed wideband (RF pulse bandwidth > 4kHz) MRI methods, including perfusion, LGE, and T1 mapping, on a 1.5T scanner (Avanto, Siemens) with specific absorption rate less than the safe limit of 2.0 W/kg. Wideband and standard MRI methods with typical imaging parameters (spatial resolution, temporal resolution, flip angle, etc.) were tested in 10 patients (age = 58 ± 19 years, 7 males) with an ICD who were scheduled to undergo clinical cardiovascular MRI. Three expert readers, blinded to each other, patient identity, and pulse sequence, independently graded the image quality on a scale of 1-5 (worst-best).

RESULTS
All study subjects completed the imaging protocol. Figure 1B shows representative perfusion, LGE, and T1 maps of patients with an ICD. Compared with standard MRI methods, wideband counterparts produced significantly (p < 0.01) higher image quality (perfusion: 3.4 ± 1.0 vs. 4.5 ± 0.6; LGE: 2.7 ± 1.1 vs. 3.8 ± 1.2; T1: 2.8 ± 1.1 vs. 4.1 ± 1.0) in all 10 patients.

CONCLUSION
This study demonstrates feasibility of a new wideband cardiovascular MRI protocol for comprehensive assessment of cardiac function, perfusion, and viability in patients with an ICD.

CLINICAL RELEVANCE/APPLICATION
This new protocol is a major step forward in MRI technology and may be used to advance existing or facilitate new therapies for patients with an ICD or CRT-D and to help with clinical decisions regarding: (i) VT therapies (ii) advanced therapeutics for myocardial recovery.

SSC02-02 Diffuse Fibrosis in Negative Late Gadolinium Enhancement Patients with Systemic Lupus Erythematosus-A Clinical Study using Native Myocardial T1 Mapping and Extracellular Volume Quantification

Monday, Nov. 28 10:40AM - 10:50AM Room: S504AB

Participants
Rui Wu, PhD, Shanghai, China (Presenter) Nothing to Disclose
Lian-Ming Wu, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Rong-Zhen Ou Yang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Dongaolei An, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
Implantable Cardiac Defibrillator (ICD) therapy is indicated for primary prevention of sudden cardiac death in patients with persistent systolic heart failure (LVEF ≤ 35%) despite optimal medical therapy. Some of these patients with conduction delays are also candidates for implantation of an ICD that provides Cardiac Resynchronization Therapy (CRT-D). It is increasingly recognized that cardiac MRI (CMR) is useful in guiding treatment strategies in heart failure. Despite the increasing awareness that CMR can be performed safely in patients with ICDs, the devices may cause significant artifacts limiting diagnostic utility. We have developed and implemented wideband MRI methods for perfusion T1 mapping, and late gadolinium enhancement (LGE) that suppress image artifacts and produce diagnostically acceptable images. This study demonstrates initial results using this wideband CMR protocol (Fig. 1A) in patients with ICDs referred for myocardial scar assessment.

METHOD AND MATERIALS
We have developed wideband (RF pulse bandwidth > 4kHz) MRI methods, including perfusion, LGE, and T1 mapping, on a 1.5T scanner (Avanto, Siemens) with specific absorption rate less than the safe limit of 2.0 W/kg. Wideband and standard MRI methods with typical imaging parameters (spatial resolution, temporal resolution, flip angle, etc.) were tested in 10 patients (age = 58 ± 19 years, 7 males) with an ICD who were scheduled to undergo clinical cardiovascular MRI. Three expert readers, blinded to each other, patient identity, and pulse sequence, independently graded the image quality on a scale of 1-5 (worst-best).

RESULTS
All study subjects completed the imaging protocol. Figure 1B shows representative perfusion, LGE, and T1 maps of patients with an ICD. Compared with standard MRI methods, wideband counterparts produced significantly (p < 0.01) higher image quality (perfusion: 3.4 ± 1.0 vs. 4.5 ± 0.6; LGE: 2.7 ± 1.1 vs. 3.8 ± 1.2; T1: 2.8 ± 1.1 vs. 4.1 ± 1.0) in all 10 patients.

CONCLUSION
This study demonstrates feasibility of a new wideband cardiovascular MRI protocol for comprehensive assessment of cardiac function, perfusion, and viability in patients with an ICD.

CLINICAL RELEVANCE/APPLICATION
This new protocol is a major step forward in MRI technology and may be used to advance existing or facilitate new therapies for patients with an ICD or CRT-D and to help with clinical decisions regarding: (i) VT therapies (ii) advanced therapeutics for myocardial recovery.
To detect myocardial fibrosis in negative late gadolinium enhancement patients with SLE, using native myocardial T1 mapping and ECV quantification.

**METHOD AND MATERIALS**

Ten SLE patients without previous cardiac symptoms on negative LGE (7 female; 30±10 years) and fifteen control subjects without obvious cardiovascular disease (9 female; mean age 37±12 years) underwent CMR at 3.0-T. The CMR sequence included cine, T1 mapping, late gadolinium enhancement. Mean T1 value, ECV and circumferential strain parameters were determined for each subject.

**RESULTS**

SLE patients on negative LGE had higher native T1 values than control subjects, but was not statistically significant (1175±495 ms vs. 1131±26 ms, p = 0.104). Expansion of ECV in SLE patients on negative LGE was observed while compared with control subjects (27.1±4.2% vs. 24.1±3.3%, p = 0.019). Left ventricular volumes, mass, stroke volumes and ejection fraction were not statistically significant between SLE patients on negative LGE and control subjects. Peak circumferential strain (-14.7±4.1% vs. -17.4±2.2%, p = 0.045) were significantly impaired in negative LGE SLE patients. ECV showed well correlation with peak circumferential strain in SLE patients on negative LGE (r = 0.801, p = 0.005) while not shown in native myocardial T1 values.

**CONCLUSION**

ECV quantification in SLE patients on negative LGE was higher than control subjects and associated reduction in peak systolic circumferential strain. For diffuse fibrosis in negative LGE SLE patients, ECV may provide better value than native T1 values, and as a novel biomarker, helps patients receive early treatment.

**CLINICAL RELEVANCE/APPLICATION**

For diffuse fibrosis in negative LGE SLE patients, ECV may provide better value than native T1 values, and as a novel biomarker, helps patients receive early treatment and prevents the progress of fibrosis.

**3.0-Tesla Velocity-Encoded Cine MRI can Estimate Coronary Flow Reserve: Comparison with O-15-labeled Water PET**

**PURPOSE**

Though the effects of coronary artery stenosis on downstream flow reserve are known, technical limitations to measure flow velocity on the distal vessels by MRI exist. We have developed a method to measure coronary flow velocity reserve (CFVR) on the left main trunk (LM) during stress and at rest non-invasively. The purpose here was to validate CFVR-LM on MRI by comparing with the analogous measure on O-15-labeled water PET (CFR_PET) and to evaluate its diagnostic value in detecting significant coronary artery disease (CAD).

**METHOD AND MATERIALS**

Eighteen healthy volunteers (age; 29±9 yr, all male) and 17 CAD patients (age; 69±12 yr, male; n=13) who underwent 3.0-T MRI during ATP (0.16mg/kg/min) stress and at rest (Figure a). CFVR was calculated by dividing peak velocity during stress by that at rest. CFR_PET on the LM territory was also calculated.

**RESULTS**

CFVR could be assessed in all volunteers, but not in 4 CAD patients due to overtime scan during stress (n=1) or poor image quality (n=3). Among patients evaluated (n=13), 8 had 1–vessel disease (left anterior descending artery [n=5], left circumflex artery [n=3]) and 5 patients had 2–vessel disease. None had LM diseases. CFVR was well correlated with CFR_PET (r=0.61, P=0.0003) (Fig. b). A Bland–Altman plot between CFVR and CFR_PET showed agreement within 1.96 SD with bias (mean=0.83), suggesting that CFVR trended lower than CFR_PET (Fig. c). Inter–observer consistency showed good correlation (r=0.85, P<0.0001). CFVR in CAD patients was significantly lower than that in healthy volunteers (Fig. d), which was concordant with results of CFR_PET (Fig. e). In receiver operating characteristic (ROC) analysis of CFVR for the detection of CAD, the area under the ROC curve was 0.76 (P=0.0078). The Sensitivity was 76.9% and the specificity was 65.7% using a cutoff of 2.15.

**CONCLUSION**

CFVR with 3.0-T MRI validated with PET could accurately detect CAD. This method enables us to evaluate coronary circulatory function without radiation or contrast material.

**CLINICAL RELEVANCE/APPLICATION**

Coronary flow velocity reserve measured using 3.0-T MRI is clinically feasible for the detection of coronary artery disease with good sensitivity and specificity.
Radiologists' consensus reading. Subsequently, we evaluated the mean value of peak Ecc and max Ecc rate among FDG (+) (SI) ≥ mean SI + 5 SD of normal myocardium. FDG accumulation was defined as lesions determined by two cardiovascular diastolic phase. We also evaluated LGE, and FDG accumulation. LGE was defined as hyperenhanced lesions when signal intensity Ecc rate as the index of diastolic function. Max Ecc rate was defined as the maximum gradient of a tangent to the Ecc curve in the evaluated their focal peak values of circumferential strain (Ecc) in systolic phase as the index of cardiac contractility, max value of eccentricity measured by MR tagging imaging, and compared with LGE in MR, and cardiac accumulation in FDG-PET.

**PURPOSE**

The prognostic stratification of patients with ST-segment elevation myocardial infarction (STEMI) and treated by primary percutaneous coronary intervention (PCI) is crucial in the management of this population. The aim of this study is to evaluate the additional value of a multi-parametric cardiac magnetic resonance (CMR) score in comparison with traditional TIMI (Thrombolysis in Myocardial Infarction) score and transthoracic echocardiography (TTE) score in prognostic stratification of STEMI patients.

**METHOD AND MATERIALS**

209 consecutive STEMI patients (mean age: 61.4±11.4 year) reperfused by primary PCI underwent TTE and CMR three days after the index event. For each patient we measured: TIMI score, left ventricle ejection fraction (EFTTE), left ventricle end systolic volume (LVESVTTE) and number of myocardial segment with wall motion abnormalities (WMITTE) measured by TTE, left ventricle ejection fraction (EFCMR), left ventricle end systolic volume (LVESVCMR) and number of myocardial segment with wall motion abnormalities (WMICMR) measured by CMR, myocardial salvage index (MSI) and presence of microvascular obstruction (MVO). The primary clinical endpoint of study was the occurrence of major adverse cardiac events (MACE) defined as combined endpoint of hospitalization, acute coronary syndrome, implantable defibrillator and cardiac death.

**RESULTS**

The mean follow-up was 931±495 days. Patients experiencing MACE showed higher TIMI score (p<0.05), LVESVTTE (p<0.01), WMITTE (p<0.01), LVESVCMR (p<0.01), EFCMR (p<0.01) and lower EFTTE (p<0.01), EFCMR (p<0.01) and MSI (p<0.01). 2 different models based on a binary score were created: a) Model 1 based on clinical parameters and TTE: TIMI<3 or =3; LVESVTTE<25mm/m2 or >25mm/m2; EFTTE>50% or <50%; WMITTE<7 or >7; b) Model 2 based on CMR: LVESVCMR<55mm/m2 or >55mm/m2; EFCMR>50% or <50%; WMICMR<7 or >7; MSI>0.47 or <0.47; MVO: absence=0 or presence=1. Clustering the study population for both model with a score threshold >2, model 2 provide a better prognostic stratification with a significant incremental prognostic value on the top of traditional outcome model (p=0.0001).

**CONCLUSION**

A multiparametric approach with CMR including markers of myocardial damage provide incremental prognostic information in addition to traditional risk scores.

**CLINICAL RELEVANCE/APPLICATION**

A multiparametric approach with CMR provide incremental prognostic information in addition to traditional risk scores.

**SSC02-05 Strain Analysis of Cardiac Sarcoidosis Based on Tagging Imaging Can Predict Focal Late Gadolinium Enhancement in MRI and FDG Accumulation in PET**

Participants

Yoshiaki Watanabe, MD, Kobe, Japan (Presenter) Nothing to Disclose
Atsushi K. Kono, MD, PhD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Shinsuke Shimoyama, MD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Tatsuya Nishii, MD, PhD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Shumpei Mori, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Tatsuro Ito, MD, PhD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Satoru Takahashi, MD, Saita, Japan (Abstract Co-Author) Nothing to Disclose
Kazuo Sugimura, MD, PhD, Kobe, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

**PURPOSE**

Focal cardiomyopathy is one of features of cardiac sarcoidosis (CS). FDG-PET and late gadolinium enhancement (LGE) in cardiac MR play an important role in evaluating this focal cardiomyopathy. In this study, we characterized focal cardiomyopathy in CS with segmented strain analysis based on MR tagging imaging, and compared with LGE in MR, and cardiac accumulation in FDG-PET.

**METHOD AND MATERIALS**

A total of 8 CS patients were retrospectively reviewed. They fulfilled the clinical diagnosis criteria of the CS and underwent 3T-MRI and FDG-PET within 2 months. We demarcated their hearts according to the 16-segment model by American Heart Association and evaluated their focal peak values of circumferential strain (Ecc) in systolic phase as the index of cardiac contractility, max value of Ecc rate as the index of diastolic function. Max Ecc rate was defined as the maximum gradient of a tangent to the Ecc curve in the diastolic phase. We also evaluated LGE, and FDG accumulation. LGE was defined as hyperenhanced lesions when signal intensity (SI) ≥ mean SI + 5 SD of normal myocardium. FDG accumulation was defined as lesions determined by two cardiovascular radiologists' consensus reading. Subsequently, we evaluated the mean value of peak Ecc and max Ecc rate among FDG (+)
segments and FDG (−) segments, LGE (+) and LGE (−) segments by Welch’s t test.

**RESULTS**

In the 128 segments evaluated, peak Ecc and max Ecc rate in LGE (−) segments was better than in LGE (+) segments (-12.9% vs. -8.9%, p<.001, 42.0%/sec vs. 31.6%/sec, p<.001). The max Ecc rate in FDG (−) segments was also higher than in FDG (+) segments (40.2%/sec vs. 31.2%/sec, p<.001), while no significant difference was revealed in the peak Ecc between FDG (+) and FDG (−) segments (-11.7% vs. -10.3%, p=18).

**CONCLUSION**

As an index of diastolic function, max Ecc rate calculated from strain analysis can predict focal FDG accumulation and LGE of CS. Further, a relationship of peak Ecc with LGE was identified, and attributed to systolic dysfunction.

**CLINICAL RELEVANCE/APPLICATION**

Focal cardiomyopathy due to cardiac sarcoidosis was effectively detected using strain analysis based on MR tagging imaging. This technique does not require any contrast agent or radiation exposure.

**SSC02-06** Cardiac Remodeling and Changes in Blood Pressure Following Renal Denervation in Patients with Treatment-Resistant Hypertension

**Participants**

Enver G. Tahir, MD, Hamburg, Germany (Presenter) Nothing to Disclose

Lennart Well, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

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**PURPOSE**

In recent years, catheter-based renal denervation (RDN) has been investigated as a promising strategy in the treatment of resistant hypertension. The purpose of this study was to investigate the effect of RDN on blood pressure (BP) as well as cardiac mass and function via cardiac magnetic resonance imaging (CMR).

**METHOD AND MATERIALS**

RDN was performed on 15 patients with a history of resistant hypertension (Table 1). Office and ambulatory long term blood pressures were measured before and 12 months after RDN. For quantitative CMRI, an electrocardiographically triggered steady-state free precession (SSFP) cine sequence (TR/TE, 3.2/1.6ms; pixel-size, 1.7mm×1.7mm) was performed in short- and long-axis views previous to and 12 months after RDN (Fig. 1). Quantitative analysis included end-diastolic (EDV) and end-systolic volumes (ESV), stroke volume (SV), left ventricular ejection-fraction (EF) as well as left ventricular myocardial mass (LVMM). CMR data were analyzed by two independent observers using an in-house developed software (Heart Analysis Tool (HeAT)) (Fig. 2). Data are given as the mean of both observers. Statistical analysis was performed using GraphPad Prism 5 and Excel, Microsoft.

**RESULTS**

In patients with resistant hypertension, RDN let to a significant decrease of LVMM (165 ± 52 g vs 154 ± 51 g; p< 0.01) and LVMM indexed to body surface area (BSA) (80 ± 22 g/m2 vs 73 ± 21 g/m2; p< 0.01) within 12 months post-intervention (Fig. 3 and 5). EDV (161 ± 37 ml vs 166 ± 50 ml), EDV indexed to BSA (78 ± 15 ml/m2 vs 80 ± 21 ml/m2), ESV (69 ± 32 ml vs 70 ± 40 ml), ESV indexed to BSA (45 ± 8 ml/m2 vs 46 ± 13 ml/m2), SV (92 ± 20 ml vs 96 ± 30 ml) and EF (59 ± 11 % vs 60 ± 13 %) did not change on a significant level (Fig. 3). BP measurements revealed a significant decrease of the minimal diastolic BP in ambulatory long term measurements (53 ± 9 mmHg vs 49 ± 13 mmHg; p<0.05). No additional significant changes of average, systolic or diastolic, office or ambulatory, diurnal or nocturnal BP measurements were detected (Fig. 4).

**CONCLUSION**

Despite a rather small effect on blood pressure, RDN lead to a decrease of left ventricular mass within 12 months after intervention.

**CLINICAL RELEVANCE/APPLICATION**

Our study indicates, that patients may benefit from RDN beyond reduction of the blood pressure.

**SSC02-07** Diagnostic Accuracy of Coronary CT Angiography using Low Tube Voltage, Low Tube Current, Prospective ECG Triggering and Knowledge-based Model Reconstruction: Comparison with Invasive Coronary Angiography

**Participants**

Joohee Lee, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

In Kyung Park, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Donghyun Hong, MS, Essen, Germany (Abstract Co-Author) Nothing to Disclose

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Tae Hoon Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The aim of this study was to evaluate the diagnostic accuracy of coronary CT angiography (CCTA) using a low tube voltage, low
tube current, prospective electrocardiogram (ECG) triggering and iterative model reconstruction (IMR). Diagnostic accuracy was evaluated using invasive coronary angiography (ICA) as a reference standard.

**METHOD AND MATERIALS**

From January 2014 to February 2016, a total of 63 patients (Male:Female = 46:17, mean age = 61.8 ± 9.0 years, Body Mass Index (BMI) = 24.5 ± 2.6 kg/m²) with suspected coronary artery disease, who underwent CCTA and ICA, were retrospectively enrolled. CCTA was performed at a low tube voltage (80 kVp or 100 kVp), low tube current (100-200 mAs), and with prospective ECG triggering, followed by image reconstruction using IMR. Coronary artery disease (CAD) was defined as >50% luminal narrowing and assessed using CCTA and ICA data. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of CCTA were evaluated using ICA as the reference.

**RESULTS**

The mean radiation dose of CCTA was 1.07 ± 0.35 mSv. A total of 793 segments were enrolled. The mean attenuation and image noise of CCTA images were 468.1 ± 67.3 HU and 31.9 ± 8.6. There were no non-diagnostic segments. The per segment sensitivity, specificity, PPV, NPV and accuracy of CCTA were 85.9%, 96.1%, 87.5%, 97.1% and 94.0% respectively, and the per patient values were 100%, 83.3%, 93.8%, 100% and 95.2% respectively.

**CONCLUSION**

A low radiation dose CCTA protocol using a low tube voltage, low tube current, prospective ECG-triggering and IMR could be a useful strategy for diagnosing CAD as it reduces the radiation dose, while maintaining diagnostic accuracy.

**CLINICAL RELEVANCE/APPLICATION**

CCTA, using an effective radiation dose of 1 mSv and IMR reconstruction, is an accurate, non-invasive, diagnostic method for CAD, and it might be applicable for CAD screening.

**SSCO2-09 Heart Rate Dependency in Cardiac T1 Mapping: An Analysis of the Modified Look-Locker Inversion Recovery (MOLLI) in a Phantom Model at Different Heart Rates**

**Participants**

Jonathan Nadjiri, MD, Munich, Germany (Presenter) Nothing to Disclose
Michael Rasper, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Alexandra Strater, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Marcus Settles, PhD, 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**

Recently T1 mapping was used for assessment of the myocardium under stress medication in order to detect ischemia without contrast agent. However, this has only been shown with a shortened modified Look-Locker inversion recovery (ShMOLLI) in contrast to a standard modified Look-Locker inversion recovery (MOLLI) sequence. Therefore, we sought to assess the heart rate independency of a MOLLI sequence with a modified read-out pattern to be more heart rate resistant. The aim of this study was to show that a MOLLI sequence could be eligible for a non contrast assessment of the myocardium under stress medication.

**METHOD AND MATERIALS**

The phantom studies were carried out at a 3.0 Tesla MRI system with multitransmission technology. Phantoms with different dilutions of gadopentetate dimeglumine were examined at different simulated heart rates (60, 70, 80, 90, 100 and 110 bpm) with a MOLLI sequence with a 5s-(3s)-3s read-out pattern in comparison to a 5b-(3b)-3b pattern. The dilutions resulted in samples with 220, 390, 550, 750, 890, 1100 and 1500 ms of T1 relaxation times. T1 relaxation times were measured three times for each sample.

**RESULTS**

All scans with the MOLLI 5b-(3b)-3s-sequence showed a significant inverse correlation of the measured relaxation time and the heart frequency for T1 phantoms with T1 relaxation times of 550 ms to 1500 ms (p < 0.05; mean slope: -4.1 ms/beat per minute). For samples with a relaxation times of ≤ 390 ms the determined T1 time was independent of the heart rate (p > 0.05, mean difference: -0.01 ms) for the MOLLI 5b-(3b)-3b-sequence. However, no significant correlation of the measured T1 values and the heart rate was observed for the MOLLI 5s-(3s)-3s-sequence (p > 0.15; mean slope: 0.04 ms/beat per minute).

**CONCLUSION**

The already shortened MOLLI 5b-(3b)-3b showed a significant heart rate dependency while the MOLLI 5s-(3s)-3s-sequence did not.

**CLINICAL RELEVANCE/APPLICATION**

Therefore, MOLLI seems theoretically to be eligible for comparisons of values at different heart rates e.g. under stress medication or exercise.
**SSC10**

**Nuclear Medicine (Gastrointestinal Imaging)**

Monday, Nov. 28 10:30AM - 12:00PM Room: S505AB

**GI CT NM**

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

**FDA** Discussions may include off-label uses.

**Participants**

Amir H. Khandani, MD, Chapel Hill, NC (*Moderator*) Consultant, Progenics Pharmaceuticals, Inc; Consultant, WorldCare International, Inc

Don C. Yoo, MD, E Greenwich, RI (*Moderator*) Consultant, Endocyte, Inc

**Sub-Events**

**SSC10-01 Heterodimer of Tissue Factor and CD105 F9ab)s for Preclinical PET Imaging of Pancreatic Cancer**

Monday, Nov. 28 10:30AM - 10:40AM Room: S505AB

**Awards**

**Student Travel Stipend Award**

**Participants**

Dawei Jiang, PhD, Madison, WI (*Presenter*) Nothing to Disclose

Haiming Luo, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Christopher England, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Hector Valdovinos, MS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Robert J. Nickles, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Weibo Cai, PhD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Pancreatic adenocarcinoma is currently causing great health concern and treated with limited outcomes. Thus, the development of non-invasive imaging tracers with high specificity for pancreatic cancer is crucial to improving the accuracy of diagnosis as well as the monitoring of therapy.

**METHOD AND MATERIALS**

A bi-specific heterodimer was synthesized by conjugating an anti-tissue factor (TF) Fab (ALT-836-Fab) with an anti-CD105 Fab (TRC105-Fab), via the biorthogonal "click" reaction between tetrazine (Tz) and trans-cyclooctene (TCO). The heterodimer was labeled with 64Cu for positron emission tomography (PET) imaging of nude mice bearing BXPC-3 xenograft and orthotopic pancreatic tumors.

**RESULTS**

PET imaging of BXPC-3 (TF/CD105+/+) xenograft tumors with 64Cu-labeled heterodimer displayed significantly enhanced tumor uptake (28.8 ± 3.2 %ID/g) at 30 h post-injection (p.i.), while compared with each of their single Fab tracers (12.5 ± 1.4 %ID/g for anti-TF Fab and 7.1 ± 2.6 %ID/g for anti-CD105 Fab). Also, the activity-concentration ratio in term of tumor/muscle ratio is 75.2 ± 9.4 at 30 h p.i., which could allow effective visualization of tumors. Furthermore, 64Cu-NOTA-heterodimer enabled sensitive detection of orthotopic pancreatic tumor lesions with an uptake of 17.1 ± 4.9 %ID/g and tumor/muscle ratio of 72.3 ± 46.7 at 30 h p.i.

**CONCLUSION**

Dual-targeting of TF and CD105 with heterodimer F(ab)s offered a broad-spectral strategy and efficient method to improve the imaging of pancreatic tumors or other possible cancers. We hope this approach could help with the diagnosis, monitor, and therapy of pancreatic malignancies.

**CLINICAL RELEVANCE/APPLICATION**

Dual-targeting of TF and CD105 with heterodimer F(ab)s offered a broad-spectral strategy and efficient method to improve the imaging of pancreatic tumors. We hope this approach could help with the diagnosis, monitor, and therapy of pancreatic malignancies.

**SSC10-02 Evaluation of a Fast 68Ga-DOTATOC PET/MRI Protocol for Whole-Body Staging of Neuroendocrine Tumors: A comparison with 68Ga-DOTATOC PET/CT**

Monday, Nov. 28 10:40AM - 10:50AM Room: S505AB

**Participants**

Lino Sawicki, MD, Dusseldorf, Germany (*Presenter*) Nothing to Disclose

Cornelius Deuschl, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose

Karsten J. Beiderwellen, MD, Essen, Germany (*Abstract Co-Author*) Speaker, Siemens AG; Speaker, Bracco Group

Thorsten D. Poeppel, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose

Gerald Antoch, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose

Lale Umutlu, MD, Essen, Germany (*Abstract Co-Author*) Consultant, Bayer AG

**PURPOSE**

To compare the diagnostic performance of a fast 68Ga-DOTA-Phe1-Tyr3-octreotide (68Ga-DOTATOC) positron emission...
tomography/magnetic resonance imaging (PET/MRI) protocol with 68Ga-DOTATOC PET/computed tomography (PET/CT) in whole-body staging of neuroendocrine tumors (NETs).

METHOD AND MATERIALS

30 patients with histologically proven NET underwent 68Ga-DOTATOC PET/CT and subsequently a 68Ga-DOTATOC PET/MRI in a single injection protocol. For PET/MRI, a fast and comprehensive sequence protocol was applied. Each PET/MRI and PET/CT was independently evaluated by two readers concerning lesion count, lesion localization, lesion nature (benign/indeterminate/malignant), and lesion conspicuity (4-point Likert scale). The reference standard was based on histopathology and/or follow-up imaging. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of PET/MRI and PET/CT were compared using McNemar's chi2 test. Wilcoxon tests assessed differences in SUVmax and lesion conspicuity. Correlation analysis of SUVmax was performed using Pearson's correlation coefficient (r). Interobserver agreement on lesion nature was calculated using Cohen's kappa (k).

RESULTS

25 patients had at least one malignant NET lesion. 68Ga-DOTATOC PET/MRI and 68Ga-DOTATOC PET/CT each correctly identified 96% of these patients. On a per-lesion basis the sensitivity, specificity, PPV, NPV, and diagnostic accuracy of 68Ga-DOTATOC PET/MRI was 90.0%, 100%, 100%, 80%, and 92.9%, respectively. Corresponding values for 68Ga-DOTATOC PET/CT were 86.6%, 98.2%, 99.2%, 74.0%, and 89.8%. The differences between both modalities in terms of diagnostic performance were not statistically significant (p=0.38). Moreover, SUVmax was strongly correlated (r=0.86; p<0.001) and did not differ significantly (p=0.35). Lesion conspicuity was better with 68Ga-DOTATOC PET/MRI (k=0.87; p<0.001) and with 68Ga-DOTATOC PET/CT (k=0.90; p<0.001).

CONCLUSION

68Ga-DOTATOC PET/MRI provides an equivalently high diagnostic performance in whole-body staging of NETs as compared with 68Ga-DOTATOC PET/CT.

CLINICAL RELEVANCE/APPLICATION

Bearing in mind the lower radiation exposure and improved scan duration 68Ga-DOTATOC PET/MRI applying a fast imaging protocol seems to be a viable alternative to 68Ga-DOTATOC PET/CT for whole-body staging of NETs.

SSC10-03 Prediction of Posthepatectomy Liver Failure Proposed by The International Study Group of Liver Surgery Using Residual Liver Function Estimation with 99mTc-GSA Scintigraphy

Monday, Nov. 28 10:50AM - 11:00AM Room: S505AB

Participants
Youichi Mizutani, Miyazaki, Japan (Presenter) Nothing to Disclose
Shigeki Nagamachi, MD, PhD, Miyazaki, Japan (Abstract Co-Author) Nothing to Disclose
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Mei Shimomura, Miyazaki, Japan (Abstract Co-Author) Nothing to Disclose
Youhei Hatton, Miyazaki, Japan (Abstract Co-Author) Nothing to Disclose
Masatsugu Kawano, Miyazaki, Japan (Abstract Co-Author) Nothing to Disclose
Toshinori Hirai, MD, PhD, Miyazaki, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

The International Study Group of Liver Surgery (ISGLS) proposed a definition and grading system based on the severity of posthepatectomy liver failure (PHLF). We aimed to evaluate the usefulness of residual liver function estimation with Tc-99m-galactosyl human serum albumin (99mTc-GSA) for the prediction of PHLF proposed by ISGLS (PHLF-ISGLS).

METHOD AND MATERIALS

136 patients scheduled hepatectomy for liver tumors underwent 99mTc-GSA scintigraphy. From the acquired image data, maximal removal rate of GSA (GSA R-max) was calculated using multi-compartmental analysis. We also calculated the GSA R-max in the predicted residual liver (GSA-RL). Residual liver volume was calculated by conventional CT. PHLF-ISGLS was defined by an increased PT-INR (≧1.2) and concomitant hyperbilirubinemia (≧1.2mg/dl) on postoperative day 5. In PHLF and non-PHLF groups, we compared the following parameters: age, gender, ICG R15, albumin, bilirubin, hyaluronic acid, type4 collagen, Child-Pugh classification, Residual liver volume, residual liver percentage, GSA R-max and GSA-RL. Univariate and multivariate logistic analyses were used for the statistical assessment.

RESULTS

Of 136 patients, 17 met the criteria of PHLF-ISGLS. With regard to age, albumin, Child-Pugh classification, residual liver volume, residual liver percentage, GSA R-max and GSA-RL, there were statistically significant differences between PHLF and non-PHLF groups. Multivariate analysis revealed that GSA-RL and residual liver volume were significant independent predictors of PHLF (P = 0.004 and P = 0.038, respectively). The odd ratio was 149423 for GSA-RL and 1.003 for residual liver volume.

CONCLUSION

GSA-RL calculated by 99mTc-GSA scintigraphy was the most useful independent predictor of PHLF-ISGLS.

CLINICAL RELEVANCE/APPLICATION

In patients scheduled hepatectomy for liver tumors, GSA-RL is useful for the prediction of residual liver function.

SSC10-04 Added Value of SPECT-CT to Standard Dynamic Imaging in Abdominal Emergencies

Monday, Nov. 28 11:00AM - 11:10AM Room: S505AB

Participants
Elham Safaie, MD, Stony Brook, NY (Presenter) Nothing to Disclose
Kavitha Yaddanapudi, DMRD, MBBS, Stony Brook, NY (Abstract Co-Author) Nothing to Disclose
To assess the added value of SPECT-CT acquisition to traditional nuclear medicine blood flow and dynamic images in gastrointestinal (GI) and genitourinary (GU) emergencies.

METHOD AND MATERIALS

We retrospectively evaluated 23 consecutive abdominal emergency studies with SPECT CT between July 2013-March 2016. Studies included RBC bleeding, hepatobiliary scan, Meckel's study, and DTPA renal scan. All patients had initial dynamic imaging followed by SPECT-CT. Six patients with equivocal bleeding studies had SPECT-CT obtained to localize bleeding. Of these one study was performed to confirm a suspected Meckel's diverticulum. There were 14 hepatobiliary studies for bile leak evaluation (n=9), biliary atresia (n=3), and cholecystitis (n=2). One SPECT-CT was performed for determining urinary leak in a renal transplant patient.

RESULTS

All 23 patients had inconclusive standard dynamic studies. SPECT/CT was performed at the end of dynamic imaging being helpful in 95.6% of the studies. We were able to accurately identify the regional anatomy and source of GI bleed in 6 cases using SPECT-CT with 2 large bowel and 4 small bowel. One study the patient had both small bowel and peritoneal bleed at surgery. Three of these patients had multiple prior inconclusive dynamic studies before SPECT-CT. Meckel's diverticulum study remained inconclusive after SPECT-CT. In the 14 hepatobiliary studies, SPECT-CT localized 9 biliary leaks, confirmed biliary atresia in 3, and excluded cholecystitis in 2 by identifying the gall bladder. For the renal transplant patient, SPECT/CT was able to identify precise localization of urinary leak. The average scanned area time range was between 20-30 minutes.

CONCLUSION

Our findings demonstrated that adding SPECT-CT to standard GI and GU dynamic imaging supplements conventional imaging in equivocal patients for anatomic localization and subsequent intervention. In RBC studies, accurate anatomical localization of small bowel versus large bowel bleeding significantly alters patient management. The added scan time is reasonable even in emergency setting.

CLINICAL RELEVANCE/APPLICATION

SPECT-CT added to traditional dynamic imaging emergency studies can lead to accurate diagnosis in a reasonable time frame.

A Simple Ratiometric Method Allows Discriminating Benign From Malignant 111In Pentetreotide

To develop a tool to measure the relative strength of bleeding on nuclear medicine GI bleeding scans, correlate this with conventional angiographic findings, and determine the predictive value of this tool.

METHOD AND MATERIALS

A single institution nuclear medicine database query of GI bleeding scans performed between January 1, 2013 and December 31, 2015 was performed. The reports from all studies were reviewed, and the imaging from all positive studies was reviewed. A novel technique was developed and utilized to analyze the scans, which allowed for calculation of percent increase of activity in the region of interest (ROI) (area of positive bleeding) while also calculating activity in ROI in the aorta and liver (controls). Interventional radiology database was then queried to determine which patients with positive findings on scintigraphy underwent angiography, and which cases had positive angiographic findings. Data analysis was performed by two radiology attendings and two residents, to determine median percent increases in ROI in patients with positive scintigraphy and positive angiography, versus those who had positive scintigraphy and negative angiography.

RESULTS

Out of 194 nuclear medicine GI bleeding scans performed during the study period, 71 were positive for active lower GI hemorrhage. Out of these cases, 37 patients were then sent for conventional angiography. Nine patients had positive angiographic findings of active contrast extravasation that correlated with the site of bleeding on scintigraphy. The median ROI percent increase for patients with positive scintigraphy and positive angiography was 50%, while for patients with positive scintigraphy but negative angiography it was 26.6%. Data analysis suggests that a positive bleeding scan with ROI percent increase of less than 20% has predictive value that conventional angiography will be negative.

CONCLUSION

Utilizing software to determine percent increase in activity within the region of interest of active GI bleeding on scintigraphy can have predictive value in determining which patients likely will not benefit from diagnostic conventional angiography.

CLINICAL RELEVANCE/APPLICATION

Positive GI bleeding nuclear medicine scans that have percent increase in radiotracer uptake of less than 20% have predictive value in that these patients are unlikely to have positive findings on angiography, thus cannot be embolized.
**PURPOSE**

High-throughput immunohistochemistry has shown large variation in expression of somatostatin receptors in the normal human pancreas. Recent gallium-labeled PET studies have shown a high prevalence of "pathologic" octreotide uptake, which is usually benign. The costs and morbidity of mistaken Whipple procedures are inordinate. The study was conducted to determine the prevalence of In-111 pentetreotide (OctreoScan) uptake in SPECT scans of the pancreas and determine whether a simple ratiometric method could differentiate benign from malignant uptake.

**METHOD AND MATERIALS**

A retrospective review of all In-111 pentetreotide studies performed at a large academic medical center was performed over 1 year time interval. The uptake of octreotide (abdominal SPECT 4 hrs and chest 24 hrs post injection of 222 MBq) was visually graded as absent, mild or definite. In the cases of uptake, a ratio between the maximal uptake in the pancreas versus mean in the liver was obtained. A two-sided Student’s T-test was performed between uptake in patients with and without known pancreatic head masses. The sensitivity and specificity of a threshold was determined.

**RESULTS**

There were a total of 359 pentetreotide studies interpreted. 147 studies were excluded, most since they did not include the pancreatic head. 138 patients were included (ages 22-94). No pancreatic head uptake was observed in 79% of studies (168/212). 12 (6%) studies had faint visual uptake while 32 (15%) had definite uptake. 11 studies were performed in 7 patients with known pancreatic masses, all of which demonstrated definite uptake. The average uptake ratio in known masses was 7.5±6.2 and 0.9±0.3 in patients without a known mass (p=0.005). Using a threshold ratio of 1.8, 100% sensitivity and specificity was achieved for determining the presence of a pancreatic head mass.

**CONCLUSION**

Pentetreotide uptake in the pancreatic head is common (21% of studies) and usually benign (75% of cases with uptake). All patients with known pancreatic head mass had definite uptake visually. Using a lesion to liver ratio of ≥ 1.8, 100% accuracy was obtained for determining the presence of a pancreatic head mass.

**CLINICAL RELEVANCE/APPLICATION**

A simple ratiometric method can differentiate malignant and benign pancreatic head pentetreotide uptake, alleviating unnecessary work-up and surgeries of patients with visual pancreatic head uptake.

**SSC10-08 Prognostic Value of F-18 Fluorodeoxyglucose Positron Emissiontomography/computed Tomography in Patients with Barcelona Clinic Liver Cancer Stages C Hepatocellular Carcinomas: A Multicenter Retrospective Cohort Study**

**PURPOSE**

We evaluated the prognostic value of pretreatment F-18 fluorodeoxyglucose positron emission tomography/computed tomography (F-18 FDG PET/CT) in Barcelona Clinic Liver Cancer (BCLC) stage C hepatocellular carcinoma (HCC) patients according to distant metastasis.

**METHOD AND MATERIALS**

A total of 293 patients with BCLC stage C HCC between 2009 and 2010 who underwent staging F-18 FDG PET/CT before treatments were retrospectively enrolled from 7 university hospitals. Tumor-to-normal liver standardized uptake value ratio (TNR) of the primary tumor was measured by pretreatment F-18 FDG PET/CT. TLR and clinical variables were analyzed with respect to overall survival (OS).

**RESULTS**

In BCLC stage C HCC patients, higher TLR was associated with extrahepatic metastasis (p=0.023). On multivariate analysis, Child-Pugh classification, PIVKA-II, and TLR were independent prognostic factors in no distant metastasis group (p<0.05). In contrast, TLR was the only independent prognostic factor in metastasis group (<0.001). Patients with high F-18 FDG uptake (TLR ≥ 3.5) showed significantly worse prognosis than those with low F-18 FDG uptake (p<0.05).

**CONCLUSION**

BCLC stage C is a heterogeneous group with different prognostic factors according to distant metastasis. TLR is an independent prognostic factor regardless of distant metastasis.
Clinical Relevance/Application

F-18 FDG PET/CT can predict survival of patients with Barcelona Clinic Liver Cancer stages C hepatocellular carcinomas

**SSC10-09  18F-FDG PET-CT in Detection of Malignancy in Cases Paraneoplastic Syndrome**

Monday, Nov. 28 11:50AM - 12:00PM Room: S505AB

Participants
Khushboo Gupta, MD, Mumbai, India (Presenter) Nothing to Disclose
Rahul B. Jadhav, MD, Mumbai, India (Abstract Co-Author) Nothing to Disclose

**Purpose**

Paraneoplastic syndrome (PNS) is a group of rare disorders that are caused by altered immune system response to a neoplasm (mostly neurological). In such cases early identification of underlying malignancy is targeted to arrest the immune mediated neurological manifestation and install early treatment. With advent of 18F-FDG PET-CT, the detection efficiency of primary malignant lesions have improved. We therefore studied the role of FDG PET-CT in investigation of PNS.

**Method and Materials**

44 patients (19 females and 25 males) with suspected PNS underwent FDG PET-CT scan at our institution. Scan was performed 1 hr after administration of 10 mCi of 18F-FDG along with 16 slice CECT. Based on the scan results, biopsy was performed in cases with suspected lesions, while other cases were followed up clinically.

**Results**

FDG PET-CT scan was positive for metabolically active lesions in 36/44 patients. Suspicious malignant lesions were noted in 12/36 patients. Biopsy was performed and primary malignancy was detected in 8/12 patients (commonest was SCLC, followed by lymphoma). Infective etiology was indicated in 16/36 patients, of which 11 patients were biopsied; results revealed granulomatous disease in 9 patients and reactive nodes in 2 patients. In other 3/36 patients, PET-CT demonstrated reactive nodes. Remaining 5/36 patients were equivocal for malignancy and/or infection, biopsy of 2 of these 5 patients revealed infective etiology. Overall no biopsy was performed in 19/44 cases, which were followed up clinically (for 410 to 518 days). No malignancy was found in this group in due course.

**Conclusion**

In present study, FDG PET-CT detected primary malignancy in 22.2% cases. In other suspected cases of paraneoplastic syndromes it showed a high efficiency in ruling out the possibility of malignancy.

**Clinical Relevance/Application**

PET/CT scan has proven its efficiency over other imaging modalities in detection of primary malignancies. Hence its use is justified in ruling out malignancies in suspected cases of paraneoplastic syndromes.
**Development of an Automatic Acquisition Time Control System for Whole-body PET**

Station #6

**Participants**
Yonglin Pu, MD, PhD, Chicago, IL (Moderator) Nothing to Disclose

**Sub-Events**

**PURPOSE**
To develop a system in which the acquisition time is automatically regulated to obtain uniform image quality irrespective of the imaging site on whole-body FDG-PET scans (PET-automatic acquisition time control system: PET-AATC).

**METHOD AND MATERIALS**
We arranged 3 NEMA image quality phantoms (Model NU-2001, national electrical manufacturers association) in series and set the FDG activity of all hot spheres to 6.6 kBq/ml, and their background activity to 1/4, 3/4, and 1/2 times. First we obtained a PET scout view (3 sec/bed) and then a standard WB-PET scan (300 sec/bed) in the same scan range. Image quality was evaluated using the actually measured contrast-to-noise ratio (aCNR) obtained on the WB-PET images of the NEMA phantoms. We also calculated the CNR (cCNR) obtained by converting the background activity and its standard deviation (SD). Conversion accuracy of cCNR was confirmed with the Pearson correlation coefficient of the cCNR and the aCNR. The cutoff value for CNR was acquired by ROC analysis of the visual score and the CNR. The CNR was the actually measured value of the NEMA phantoms on WB-PET images. The cCNR was obtained from an approximately straight line to acquire a conversion formula. The line was derived from the correlation between the background activity on PET-WB images and the true coincidence rate on a PET scout view, and their SDs. The cCNR was determined by using the converted background activity and the SD. Conversion accuracy was confirmed with the Pearson correlation coefficient of cCNR and aCNR. The cutoff value for CNR was obtained from ROC analysis of the visual score and the CNR.

**RESULTS**
The correlation coefficient between the background activity and the true coincidence rate, their SD, and the cCNR and the aCNR were 0.99, 0.98, and 0.96, respectively (all: p<0.01). The area under the curve between the visual score and cCNR or aCNR was 0.96 and 0.95, respectively. The CNR cutoff value was 1.73 and 1.54, respectively.

**CONCLUSION**
The cCNR and the aCNR were comparable for the evaluation of the image quality. We demonstrate that the CNR on WB-PET scans is an alternative cCNR on PET scout views. Our findings suggest that PET-AATC is feasible.

**CLINICAL RELEVANCE/APPLICATION**
Automation of the acquisition time improved inhomogeneity of the image quality irrespective of the imaging site and yielded a diagnostic image quality at a short acquisition time.

**Assessment of Primary Tumor FDG PET/CT Texture Features for Predicting Tumor Response to Chemoradiotherapy and Prognosis of Patients with Esophageal Cancer**

Station #7

**Participants**
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**PURPOSE**
To investigate whether F-18-fluorodeoxyglucose (FDG) PET/CT texture features is useful for predicting outcomes to therapy in patients with esophageal cancer treated by chemoradiotherapy (CRT).

**METHOD AND MATERIALS**
Fifty two patients with esophageal cancer were enrolled and underwent FDG PET/CT studies before CRT. In addition to SUVmax,
SUmean, metabolic tumor volume (MTV), total lesion glycolysis (TLG), heterogeneity parameters assessed by texture analysis including the intensity variability (IV) and size-zone variability (SZV) were obtained for primary lesions. IV measures the similarity in pixel intensities throughout the image and SZV measures the similarity in zone sizes. Heterogeneous images tend to have larger IV and SZV. Patients were classified as responders or non-responders according to RECIST. Progression free survival (PFS) and overall survival (OS) were calculated by Kaplan-Meier method. Prognostic significance was assessed by Cox proportional hazards analysis.

RESULTS
There were 18 responders and 34 non-responders. The following parameters were significantly lower in the responders than in the non-responders; MTV (46.7 cm³ ± 33.3 vs. 93.0 cm³ ± 64.3, P = .006), TLG (287.7 ± 249.6 vs. 582.2 ± 434.9, P = .007), IV (17.9 ± 10.5 vs. 32.2 ± 18.6, P = .003) and SZV (291.2 ± 201.3 vs. 519.7± 319.1, P = .004). In Kaplan-Meier analysis, patients with lower values in the following parameters than those with higher values were significantly associated with longer median PFS and OS; MTV (PFS: 7 months vs. 11 months, P = .018; OS: 8 months vs. median not reached, P = .018), TLG (PFS: 7 months vs. median not reached, P = .009; OS: 8 months vs. median not reached, P = .025), IV (PFS: 7 months vs. 13 months, P = .013; OS: 8 months vs. median not reached, P = .014) and SZV (PFS: 7 months vs. 25 months, P = .010; OS: 8 months vs. median not reached, P = .007). The Cox proportional hazards analysis revealed that TLG, IV and SZV significantly correlated with PFS (P = .035, .020 and .017, respectively) and OS (P = .035, .023 and .013, respectively).

CONCLUSION
Not only MTV and TLG, but also texture feature IV and SZV in baseline FDG PET/CT scans may predict treatment response and prognosis in patients with esophageal cancer treated by CRT.

CLINICAL RELEVANCE/APPLICATION
The texture feature intensity variability and size-zone variability in baseline FDG PET/CT scans may predict treatment response and prognosis in patients with esophageal cancer treated by CRT.

NM210-SD- MOA8  The Utility of Surrogates for Lung Shunt Fraction in Patients with Hepatocellular Carcinoma being Evaluated for Yttrium-90 Radioembolization

CONCLUSION
Several characteristics are statistically significant but weakly predictive of high LSF: laboratory values, imaging findings, and clinical assessments. The absence of macrovascular tumor invasion, small tumor size, and favorable prognostic stage/score were strongly associated with low LSF. These factors may serve as an adequate predictor of low LSF determined by 99mTc-MAA in clinical practice.

CLINICAL RELEVANCE/APPLICATION
The clinically and statistically significant predictors of LSF<10% can be used to confidently anticipate full-dose treatment with yttrium-90 (90Y) resin microspheres, planning of same-day MAA-90Y treatment via cross-sectional dosing assumptions, or to promote studies forgoing MAA in low-risk settings.

NM211-SD- MOA9  A 2-h Delayed FDG PET/CT with Water Ingestion Increases the Detection of Primary Gastric Cancer

RESULTS
A cohort of 428 subjects with HCC from 2004 to 2011 was assessed for lung shunting by MAA scan. LSF measurements were obtained for each patient and categorized into low (LSF<10%), intermediate (10%≤LSF≤20%), and high (LSF>20%). Patient characteristics included age, gender, ethnicity, tumor burden (%), maximum dimension, focality, presence of extrahepatic metastases, macrovascular invasion (hepatic and portal vein), ascites on imaging, baseline laboratory values, alpha-fetoprotein, and multiple staging systems. Correlations were expressed as likelihood ratios (LR+), Pearson correlation coefficients (r), and positive predictive values (PPV). Chi square test for categorical variables and nonparametric ANOVA for continuous variables were used for analysis.

RESULTS
Most characteristics yielded low LR+ and PPV for high LSF, as well as “r” coefficients close to 0 (p<.05). The absence of macrovascular invasion (PPV 85%), and tumor size ≤5cm (LR+ 8.24, PPV 89%) were strongly predictive of low LSF. ECOG 0 was 91% predictive of low LSF (p<.05). United Network for Organ Sharing (UNOS) stage T2 (LR+ 13.14, PPV 93%), low Groupe d’Etude et de Traitement du Carcinoma Hépatocellulaire (GRETCH) stage (PPV 94%), and BCLC Stage A (LR+ 23.67, PPV 96%) were very strongly predictive of low LSF (p<.05).

CONCLUSION
Several characteristics are statistically significant but weakly predictive of high LSF: laboratory values, imaging findings, and clinical assessments. The absence of macrovascular tumor invasion, small tumor size, and favorable prognostic stage/score were strongly associated with low LSF. These factors may serve as an adequate predictor of low LSF determined by 99mTc-MAA in clinical practice.
PURPOSE

To evaluate whether a 2-h delayed FDG PET/CT with water ingestion increases the detection rate of primary gastric cancer.

METHOD AND MATERIALS

The study population of 145 gastric cancer patients had 162 lesions: 89 early gastric cancers (T1, tumor invasion within 0.5 mm of the muscularis mucosa) and 73 advanced cancers (16 T1 lesions with > 0.5 mm penetration of the muscularis mucosa, 15 T2, 7 T3, 31 T4a, and 4 T4b lesions). PET/CT scans were performed 1 h after FDG injection (FS), immediately after the first scan, with 300–400 mL of water intake (SS), and as a 2-h delayed scan, with 300–400 mL of water intake (TS). Primary lesions were assessed as visible or non-visible. The SUVs of the tumors and adjacent nontumor gastric wall were obtained. The tumor-to-nontumor gastric wall SUV ratio was also estimated. Statistical differences in detection rates and SUV values were assessed using a McNemar test, and those in the SUV ratio using a one-way repeated measure ANOVA.

RESULTS

Sixty lesions were detected in FS, 69 in SS, and 76 in TS. No positive tumor became negative. SUV ratios were obtained for 57 of the 60 lesions detected; for the three lesions at the boundary of the normal gastric wall, SUVs were not determined. The detection rate was significantly better in TS than in FS and SS. The rates of early gastric cancer detection were 15.7% (14/89), 6.7% (6/89), and 11.2% (10/89) (FS vs. SS; P=0.125, SS vs. TS; P=0.008), respectively, and those of advanced gastric cancer 84.9% (62/73), 74.0% (54/73), and 80.8% (59/73) (FS vs. SS: P=0.063, SS vs. TS: P=0.25, FS vs. TS: P=0.008), respectively. SUV values were highest in TS; the ΔSUV ratio was larger than the ΔSUV. The SUVs of the 57 lesions were 8.0±5.2 (range: 2.2–34.7) for FS, 7.7±5.2 (2.2–34.2) for SS, and 9.4±6.7 (3.0–43.0) for TS (FS vs. SS: P=0.065, SS vs. TS: P<0.001, FS vs. TS: P<0.001), respectively. The corresponding SUV ratios were 3.1 ±2.6 (1.1–14.2), 4.9±3.5 (1.4–22.8), and 6.1±4.6 (1.7–29.7) (FS vs. SS: P<0.001, SS vs. TS: P<0.001, FS vs. TS: P<0.001).

CONCLUSION

A 2-h-delayed FDG PET/CT scan with water ingestion increases the detection rate of primary gastric cancers.

CLINICAL RELEVANCE/APPLICATION

A 2-h delayed FDG PET/CT scan with water ingestion is recommended to improve the detection of primary gastric cancer.

PURPOSE

The purpose of this study was to investigate the feasibility of F-18 NaF (NaF) and F-18 FDG (FDG) on PET/CT for evaluation of carotid artery atherosclerosis.

METHOD AND MATERIALS

A total of 17 patients with carotid artery stenosis of 50% or greater determined by using ultrasonography were examined with NaF PET/CT and FDG PET/CT. PET emission scanning of the neck region with a 15-min acquisition of one bed position was performed at 60 min after each radiotracer injection. CT images were used to draw region of interest (ROI) around area of plaque at the level of carotid bifurcation bilaterally. The maximum attenuation in Hounsfield units (HU) was calculated. The maximum standardized uptake value (SUV) was calculated for each ROI using the coregistered PET data. In one patient, only unilateral carotid artery was used because of indwelling stent.

RESULTS

In 31 out of the 33 sites, increased NaF uptake was observed in areas overlying and adjacent to plaque. Thirty-one sites with increased NaF uptake had calcified plaque (≥130 HU) and 2 sites without increased NaF uptake had no calcified plaque (<130 HU), on CT images. A significant correlation was observed between NaF SUV and CT HU (r=0.593, p<0.001). There was no significant correlation between FDG SUV and CT HU. There was no significant correlation between NaF SUV and FDG SUV.

CONCLUSION

These preliminary results suggest that NaF PET/CT is feasible for evaluation of carotid artery atherosclerosis.

CLINICAL RELEVANCE/APPLICATION

F-18 NaF PET/CT is feasible for evaluation of carotid artery atherosclerosis.
Awards
Certificate of Merit

Participants
Nitesh Shekhrajka, Aalborg, Denmark (Abstract Co-Author) Nothing to Disclose
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TEACHING POINTS
Diagnosis and characterization of the infectious or inflammatory processes is often challenging for clinicians as these are heterogeneous class of diseases. The diagnostics is most often performed with conventional radiology and biochemical tests. Nuclear medicine (NM) hybrid imaging techniques provides additional information about biological and biochemical changes in specific infectious and inflammatory processes. Our aim is to review and highlight the up-to-date literature recommendations and to establish our local regional guidelines for the best NM imaging modality choice for a given/suspected infection/inflammation in order to improve patient care.

TABLE OF CONTENTS/OUTLINE
Each type of infection will be accompanied by a relevant first choice nuclear medicine image, supplemented by relevant CT/MRI/X-ray image with discussion. We plan to discuss the following: Fever of unknown origin Metastatic infection with bacteremia Large vessel vasculitis Spondylodiscitis and vertebral osteomyelitis Peripheral acute osteomyelitis Peripheral chronic osteomyelitis Orthopaedic prosthesis and implant infection Charcot foot Infected diabetic foot Sarcoidosis Prosthetic valve endocarditis and/or metastastic infection UTI, polycystic kidneys & liver Suspected abscess in abdomen Vascular graft infections Infected foreign body
PET/CT for Primary Staging of Rectal Cancer Patients with and without Extramural Vascular Invasion Detected by MR (EMVI-MR): Preliminary Findings

**PURPOSE**

To evaluate the use of PET/CT for primary staging of rectal cancer according to EMVI-MR status.

**METHOD AND MATERIALS**

Twenty-two patients with rectal cancer before neoadjuvant radio and chemotherapy were enrolled in this prospective study. All patients underwent contrast-enhanced CT of thorax and abdomen, pelvic MR, whole-body PET/CT and liver MR with DWI and Primovist®. Imaging analysis consisted on evaluation of the primary tumor on MR concerning T- and N-staging, mesorectal involvement and EMVI status. PET/CT, ceCT and liver MR were analyzed for the presence of distant metastases. Biopsy of rectal tumor was obtained in all patients before treatment. The patients were divided based on the presence of EMVI-MR and the detection rate of metastatic disease was compared between ceCT, PET/CT and liver MR. Additionally, quantitative analysis of the primary tumor was done using DWI (ADC) and PET parameters (SUV, TLG, MTV) and compared to histology.

**RESULTS**

Metastatic disease was found in 4/22 patients (18%) accounting for 28 lesions. There were 13/22 (59%) patients without EMVI-RM and 9/22 (41%) patients with EMVI-RM, which 4/9 (44%) presented distant metastases. PET/CT detected two more lesions than ceCT, which had high clinical impact, changing the patient management from curative to palliative intention. Liver MR did not identify any additional lesion to PET/CT or ceCT. Quantitative analysis showed an inverse correlation of TLG and grade of histological differentiation of the primary rectal tumor.

**CONCLUSION**

Positive EMVI-MR can be used to select patients that would benefit from whole-body staging with PET/CT. Quantitative data of PET/CT aid on the characterization of tumor aggressiveness.

**CLINICAL RELEVANCE/APPLICATION**

PET/CT might be preferred to stage rectal cancer with EMVI-MR due to higher detection rate of distant metastases and potential clinical impact on patient management.

Using DAT-SPECT, MIBG Myocardial Scintigraphy and the Combined Index for the Efficient Diagnosis of Parkinson Syndrome

**PURPOSE**

In a diagnosis of the Parkinson syndrome (PS), 123I-MIBG myocardial scintigraphy (MIBG) has been used for determining the possible occurrence of Lewy body disease (LBD). Whereas, many reports have demonstrated the usefulness of 123I-FP-CIT dopamine transporter single photon emission computed tomography (DAT-SPECT) for the accurate diagnosis of Parkinson’s disease (PD). The aim of this study was to evaluate the effectiveness of using DAT-SPECT and 123I-MIBG myocardial scintigraphy separately, as well as a Combined index for obtaining an accurate diagnosis in the Parkinson syndrome.
METHOD AND MATERIALS

In this retrospective study, 58 patients with the Parkinson syndrome who had undergone DAT-SPECT assessment followed by MIBG myocardial scintigraphy were evaluated. The delayed heart-to-mediastinum (H/M) ratio of the MIBG scintigraphy, and the specific binding ratio (SBR) of the DAT-SPECT imaging were used as semi-quantitative measures. In groups with (DLB, PD, PSP, CBS, MSA) or other disorders, the diagnostic performance of each procedure when used independently as well as the combined utilization of DAT-SPECT and MIBG were evaluated. The cut off value for each index was determined by ROC analysis. The sensitivity, specificity, and accuracy of each imaging technique were calculated separately.

RESULTS

In DAT-positive diagnosis of (DLB/PD/CBS/MSA/PSP) disorders, the best parameters for the AUC were provided by the Combined index. For MIBG-positive (DLB/PD) diagnosis, the highest index for the AUC was obtained with the MIBG scintigraphy. For differentiating sensitivity, specificity, and accuracy in DAT-SPECT-positive groups (DLB/PD/CBS/MSA/PSP) from the negative cases the rates were 76.6, 90.9, and 79.3% with the Combined index. As for differentiating sensitivity, specificity, and accuracy in the MIBG-positive groups (DLB/PD) from the negative group, the rates were 84.6, 93.8, and 89.7% by the delayed H/M ratio of MIBG.

CONCLUSION

For diagnosis of DAT-SPECT positive groups such as DLB, PD, CBS, MSA and PSP, the combined index proved useful, while in the diagnosis of MIBG positive groups such as DLB and PD, the MIBG scintigraphy achieved the best performance. Thus, when the occurrence of Lewy body disease is suspected, MIBG scintigraphy should be performed initially.

CLINICAL RELEVANCE/APPLICATION

When Lewy body disease is suspected, performing MIBG first is considered to be the more desirable approach to adopt.

NM215-SD-MOB8

**Effects of New Block Sequential Regularized Expectation Maximization (BSREM) Reconstruction Algorithm on SUV and MTV of Thoracic and Abdominal Malignancies in FDG PET-CT Examinations**

**Station # 8**

Participants

- Mitsuaki Tatsumi, MD, PhD, Suita, Japan (Presenter) Nothing to Disclose
- Takashi Kamiya, Suita, Japan (Abstract Co-Author) Nothing to Disclose
- Kayako Isohashi, Suita, Japan (Abstract Co-Author) Nothing to Disclose
- Hiroki Kato, Suita Osaka, Japan (Abstract Co-Author) Nothing to Disclose
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- Jun Hatazawa, MD, PhD, Osaka, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

BSREM reconstruction algorithm, or so called “Q. Clear”, was recently introduced by GE Healthcare to improve image quality and quantification in PET examinations. The purpose of this study was to evaluate the effects of this new algorithm on SUV and metabolic tumor volume (MTV) of thoracic and abdominal malignancies in FDG PET-CT examinations, comparing the results to those by an ordered subset expectation maximization (OSEM) reconstruction algorithm.

**METHOD AND MATERIALS**

This study included 13 thoracic (lung ca.) and 17 abdominal (liver and pancreatic ca.) malignant lesions >2cm as well as 22 pulmonary and 11 hepatic lesions <1cm. Oncologic FDG PET-CT images were acquired with a GE Discovery 710 scanner equipped with a time-of-flight system. Images were reconstructed using BSREM beta 700 and OSEM (subset 8, iteration 3, and Gaussian filter 4mm; regular setting in our hospital) algorithms. SUVmax, -mean, and MTV were compared between BSREM and OSEM images in all 30 lesions >2cm and in thoracic or abdominal lesions separately. SUVmax was also compared in all 33 lesions <1cm and in pulmonary or hepatic lesions separately. Tumor margin was delineated with SUVmax 2.5 threshold. Statistical analysis was performed with a Wilcoxon signed-rank test and a Spearman’s correlation method.

**RESULTS**

In 30 lesions >2cm (49±/-19mm), SUVmean was 4.3±/-1.2 (mean+//-SD), SUVmax 9.2±/-3.9, and MTV 32.8±/-39.5 ml in OSEM. BSREM increased SUVmean by 2.9%, but decreased SUVmax by 0.8% with statistical significances (p<0.001) as compared to OSEM. MTV showed no significant difference between OSEM and BSREM. BSREM also increased SUVmean and decreased SUVmax of thoracic or abdominal lesions in the subgroup analysis. A moderate negative correlation was observed between changes of SUVmax and lesion size, SUVmax, or MTV in OSEM (|Rho|=0.50–0.56, p<0.001). In 33 small lesions <1cm, BSREM increased SUVmax by 8.8% with a statistical significance (p<0.001). This increase was also observed on small pulmonary or hepatic lesions in the subgroup analysis.

**CONCLUSION**

This study demonstrated that BSREM had a similar effect on SUV depending on the lesion size both in thoracic and abdominal malignancies. Further studies are required regarding an association of the decrease of SUVmax in larger lesions and noise reduction in BSREM.

CLINICAL RELEVANCE/APPLICATION

BSREM increased SUVmax in small lesions <1cm, but decreased SUVmax in lesions >2cm both in the thoracic and abdominal malignancies.

NM216-SD-MOB9

**Hepatic 18F-FDG Uptake Measurements on PET/MR: Impact of Volume of Interest Location on Repeatability**

**Station # 9**

Participants

- Liran Domachevsky, MD, Tel Aviv, Israel (Presenter) Nothing to Disclose
- Hanna Bernstine, MD, Petah Tikva, Israel (Abstract Co-Author) Nothing to Disclose

**METHOD AND MATERIALS**

When Lewy body disease is suspected, performing MIBG first is considered to be the more desirable approach to adopt.
We conducted a retrospective analysis of 186 consecutive patients over a period of a year (11/10/2014 to 11/10/2015) from two imaging protocols.

Further study of these and other variables should be performed prior to making changes to this institution's myocardial perfusion imaging protocols.

METHODS

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CONCLUSION

Myocardial perfusion imaging utilizing combined SPECT/CT had a higher positive predictive value than utilizing SPECT alone at this institution. While this data suggests SPECT/CT has superior diagnostic capability than SPECT alone in identifying clinically significant cardiac ischemia, factors such as cost, radiation dose, and other emerging technologies have not been considered in this analysis.
capabilities at a different facility. A positive myocardial perfusion scan was defined as any reversible perfusion defect that was not due to artifact. The corresponding patient charts from these positive myocardial perfusion scans were then reviewed to determine whether these patients underwent cardiac catheterization and the result of that cardiac catheterization. A positive cardiac catheterization result was defined as stenosis of greater than 70% or disease that was treated. The positive myocardial perfusion scans were then correlated to the findings from the cardiac catheterization to assess the institutional diagnostic accuracy of myocardial perfusion scan utilizing SPECT/CT versus SPECT alone.

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 Participants
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LEARNING OBJECTIVES
1) Advances in PET/CT imaging. 2) Advances in SPECT/CT imaging. 3) Challenges and opportunities of PET/MR imaging.

ABSTRACT
Nuclear medicine hybrid imaging (PET/CT and SPECT/CT) has undergone several technological advances over the past decade. This lecture will review the evolution of hybrid imaging and describe the technological advances in the field from system design to image generation and data analysis tools. The lecture will cover innovations in detector design, resolution recovery, time of flight imaging, quantitative evaluation, attenuation correction, and reconstruction algorithms. The lecture will also cover PET/MR imaging and its current challenges and opportunities.
Participants
Andrew S. Chi, MD, PhD, New York, NY (Presenter) Nothing to Disclose
Daniel P. Cahill, Boston, MA (Presenter) Consulting, Merck & Co, Inc
Whitney B. Pope, MD, PhD, Los Angeles, CA (Presenter) Research Consultant, F. Hoffmann-La Roche Ltd; Research Consultant, Amgen Inc; Research Consultant, Tocagen Inc
Christina I. Tsien, MD, Saint Louis, MO (Presenter) Speaker, Merck & Co, Inc

LEARNING OBJECTIVES
1) Identify areas of controversy in the management of CNS tumors. 2) Apply cranial MR/PET information to answer challenging clinical management questions.

ABSTRACT
PURPOSE
We hypothesized that a 72-hour high-fat, high protein and very low-carbohydrate (HFHPVLC) diet preparation can suppress physiologic myocardial uptake of FDG, which is the limiting factor in using FDG-PET/CT for cardiac sarcoidosis (CS).

METHOD AND MATERIALS
This retrospective study included 215 FDG-PET/CT tests from 207 patients with biopsy proven sarcoidosis and clinical suspicion for CS between July 2014 and December 2015. These patients were classified into 2 groups. Group 1 includes 12 FDG PET/CT scans from 12 patients who had 24-hour or less pretest HFHPVLC diet preparation. Group 2 includes 203 FDG PET/CT scans with 72-hour HFHPVLC diet before FDG-PET/CT. All patients were given detailed instructions about diet preparation. Diet adherence were verified by imaging physician during test. Nonadherent patients and patients with coexisting cancer were excluded. Patterns of cardiac FDG uptake were classified into: “none” and “ring like diffuse at base” (negative for CS); “focal” (positive for CS); and “diffuse” (indeterminate for CS). Quantitative cardiac FDG uptake was measured. Final diagnoses were made with consensus among physicians in view of all available comprehensive clinical information, other imaging and diagnostic test results, with reference to modified Japanese Ministry of Health and Welfare criteria.

RESULTS
In group 1, there were 1(1/12, 8.3%) positive, 5 (5/12, 41.7%) indeterminate, and 6 (6/12, 50.0%) negative for CS. In group 2, 10 patients were excluded (6 due to noncompliance diet, 2 with concurrent diagnosis of cancers, 2 due to insulin and steroid use within 4hr before PET/CT); the remaining 185 patients had 193 FDG PET/CT tests (8 repeats), of which there were 19 (19/193, 9.8%) positive, 5 indeterminate (5/193, 2.6%), and 169 (169/193, 87.6%) negative for CS. The SUVmax of PET positive CS lesions range from 3.4 to 12.5, while mediastinal blood pool SUVmean range from 1.1 to 3.6. The indeterminate rate is significantly lower in group 2 compared with group 1 (p < 0.001). The NPV and PPV in group 2 are 100% and 94.7% respectively.

CONCLUSION
The 72-hr HFHPVLC diet preparation protocol successfully suppresses physiological myocardial FDG uptake with minimal nondiagnostic rate. This patient preparation protocol may permit a more sensitive and accurate method of diagnosing active CS.

CLINICAL RELEVANCE/APPLICATION
Effective FDG-PET/CT protocol for CS.
a low-carbohydrate diet (LCD) and that with an additional unfractionated heparin (UFH) injection.

**METHOD AND MATERIALS**

Thirty healthy, non-diabetic volunteers (16 males, age: 56±5.5 y.o.) were participated in this randomized-control study. They were divided into 2 groups: 15 subjects with more than 18-h fast with LCD (less than 4 g) preparation (group A) and the other 15 subjects with an additional injection of UFH (50 IU/kg) 15 min prior to FDG injection (group B). At the 4 time points of 3-h before, just before, 15 min after, and 1-h after UFH injection, blood samples were obtained to measure free fatty acid (FFA), immunoreactive insulin (IRI), and plasma glucose (FPG) level. Cardiac spot and whole body PET/CT imaging started 60 min after FDG injection. Imaging data were analyzed visually and quantitatively using a standard uptake value (SUV), and compared with pooled data of biopsy-proven CS (n=37) and non-CS (n=18) pts.

**RESULTS**

All subjects were well tolerated the protocol. Fasting durations of group A and B were 1160±48 and 1160±66 min, respectively. There were also no significant difference in serum levels of FPG and IRI. Although the FFA levels of 15 min after UFH injection significantly increased in group B as compared to group A (1.55 ± 0.49 vs. 1.97 ± 0.58 mEq/L, P=0.039), there was no difference in left ventricular (LV) SUVmax (1.57±0.27 vs. 1.59±0.26, P=0.84). There was no FDG uptake visually in the LV of all subjects. In addition, each LV SUVmax was lower than that of the liver (1.58±0.26 vs. 1.91±0.33, P<0.0001). Finally, it is obviously higher in CS pts than those in the other 3 groups (p<0.001, Figure).

**CONCLUSION**

The complete suppression of physiological FDG uptake in the LV myocardium is visually and quantitatively achieved by means of more than 18-h LF with LCD preparation protocol. Under these circumstances, the use of UFH brings no added value to the suppression.

**CLINICAL RELEVANCE/APPLICATION**

The low-carbohydrate diet of the day before FDG PET together with a fasting more than 18-h completely suppresses physiological FDG uptake in the heart.

**SSE16-03 Recent Nationwide Trends in Utilization of Standard and PET Myocardial Perfusion Imaging: Is There Growth or Contraction?**

**Monday, Nov. 28 3:20PM - 3:30PM Room: S505AB**

**Participants**

David C. Levin, MD, Philadelphia, PA (Presenter) Consultant, HealthHelp, LLC; Board of Directors, Outpatient Imaging Affiliates, LLC

Laurence Parker, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

Charles M. Intenzo, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

Vijay M. Rao, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The development of PET myocardial perfusion imaging (PET MPI) has been somewhat controversial. It has certain technical advantages over the standard SPECT techniques (STD MPI) but is much more expensive. Our purposes were to see how rapidly PET MPI is growing relative to STD MPI and to study utilization trends among radiologists and cardiologists.

**METHOD AND MATERIALS**

Nationwide Medicare Part B fee-for-service databases from 2002 through 2014 were used. They provide volume data for all CPT codes. The codes for primary STD MPI and PET MPI were selected. No add-on codes were included. Medicare specialty codes were used to identify cardiologists, cardiologists, and all other physicians as a group. Medicare place-of-service codes were used to identify exams done in hospital inpatients, hospital outpatient departments (HOPDs), private offices, and emergency departments (EDs).

**RESULTS**

Medicare STD MPI volume increased from 2,456,043 in 2002 to 3,136,573 in 2006 (+28%). Thereafter it declined every year, reaching 2,092,102 in 2014 (-33% vs peak). That year, cardiologists did 77% of the studies, radiologists 18%, others 5%. Medicare PET MPI volume was 9,563 in 2005 (the first year a CPT code was available), increasing almost every year thereafter, and reaching 100,619 in 2014 (+952%). That year, cardiologists did 86% of PET MPIs, radiologists 8%, others 6%. In 2014, PET MPI constituted 4.6% of all MPI exams. In 2014, there were 74,038 PET MPIs done in private offices; 20,343 in HOPDs; 4,570 in hospital inpatients; 23,356 in EDs; and 1,879 elsewhere. Also in 2014, there were 74,038 PET MPIs done in private offices; 20,343 in HOPDs; 4,570 in hospital inpatients; 281 in EDs; and 1,387 elsewhere.

**CONCLUSION**

The use of STD MPI has contracted substantially in recent years. This is likely due to large reductions in reimbursement, leading to closure of many cardiology private offices. At the same time, PET MPI has grown substantially, although by 2014 it still constituted less than 5% of all MPI exams. The rapid growth of PET MPI should continue to be monitored, as it is an expensive exam and is done mostly by cardiologists who could be in a position to self-refer.

**CLINICAL RELEVANCE/APPLICATION**

n/a

**SSE16-04 Usefulness of F-18 FLT PET/CT for Detection of Active Cardiac Sarcoidosis: Comparison With F-18 FDG PET/CT**

**Monday, Nov. 28 3:30PM - 3:40PM Room: S505AB**

**Participants**

Takashi Norikane, Kita-gun, Japan (Presenter) Nothing to Disclose

Yuka Yamamoto, MD, PhD, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose
F-18 fluorodeoxyglucose (FDG) PET has been proposed to play a role in the diagnosis of sarcoidosis including cardiac involvement. However, its specificity is relatively low. 3'-deoxy-3'-F-18 fluorothymidine (FLT) has been investigated as a promising PET tracer for evaluating tumor proliferative activity. The purpose of this study was to investigate the usefulness of FLT PET/CT for the detection of active cardiac sarcoidosis, compared with FDG PET/CT.

METHOD AND MATERIALS

The study evaluated 25 patients who were suspected of having cardiac sarcoidosis. The patients fasted for at least 18 hrs before FDG PET studies, although no special dietary instructions were given to them before FLT PET studies. PET emission scanning of the cardiac region with a 10-min acquisition was performed 60 min after each radiotracer injection. For visual analysis, FLT PET images were classified into 2 patterns: no and focal uptake. FDG PET images were classified into 4 patterns: no, diffuse, focal, and focal on diffuse uptake. A focal FLT uptake and focal or focal on diffuse FDG uptake were defined as an active pattern. For semiquantitative analysis, the myocardium-to-blood cavity ratio (MBR) was calculated by dividing the maximal standardized uptake value (SUV) in myocardium by the mean SUV in blood cavity.

RESULTS

Twelve patients were found to have active sarcoidosis (group A); 8, non-active sarcoidosis (group B); and 5, heart failure without sarcoidosis (group C). In group A, all 12 showed an active pattern on both PET studies. In group B, 3 of 8 showed diffuse uptake on FDG PET but all 8 showed no uptake on FLT PET. In group C, 3 showed diffuse uptake and 2 showed focal uptake on FDG PET but all 5 showed no uptake on FLT PET. A significant correlation was observed between FDG MBR and FLT MBR. The mean FLT MBR in group A was significantly higher than that in groups B and C. The area under the receiver operating curve value of FLT MBR was significantly higher than that of FDG MBR for detection of active cardiac sarcoidosis.

CONCLUSION

These preliminary results suggest that FLT PET/CT is a potentially useful tracer for detecting active cardiac sarcoidosis, being especially more specific than FDG PET/CT.

CLINICAL RELEVANCE/APPLICATION

FLT PET/CT is a potentially useful tracer for detecting active cardiac sarcoidosis, being especially more specific than FDG PET/CT.
PURPOSE
Myocardial perfusion SPECT (MPS) is one of the most used imaging methods for the evaluation of patients for coronary artery disease (CAD) due to its diagnostic and prognostic value. Two of its main limitations are radiation use and scan duration. However, new CZT cameras (CZT-C) have allowed tracer dose and scan time reductions. However, the prognostic value of these new protocols is not known. Objective: To determine the prognostic value of a new, ultrafast, low dose protocol in a CZT-C.

METHOD AND MATERIALS
Patients with suspect CAD undergoing MPS from 11/2011 to 6/2012 were studied. They had a 1-day 99m-Tc-MIBI protocol starting with rest study (5 mCi dose) followed by stress (15 mCi). Acquisition times were 6 and 3 minutes respectively. MPS studies were classified as normal or abnormal and perfusion scores (SSS, SRS and SDS) were calculated. Patients were accompanied by 6-month phone calls. Events were defined as death, nonfatal myocardial infarction and late revascularization (>60 days after MPS) and analyzed with the Cox method.

RESULTS
2936 patients were followed for 922 ± 226 days. Age was 64.7 ± 12.1 years, 53.5% were male and BMI was 27.1 ± 5.1. Hypertension was the most frequent risk factor (61.6%), followed by hypercholesterolemia (52.1%) and diabetes (22.7%). Exercise was used in 1705 patients (58.1%). 2274 (77.4%) MPS studies were normal. Mean dosimetry was 5.5 mGy and mean scan time, 48 ± 13 minutes. During FU, there were 62 deaths, 28 nonfatal infarctions, 147 angioplasties and 22 coronary artery bypass surgeries. Annual hard event rate was higher in patients with abnormal MPS (3.64% vs. 0.72% P <.001), as well as the frequency of patients undergoing late revascularization (16.8% vs 2.5%, P <.001). SSS and SDS were higher in patients with hard events compared to those without events (5.0 ± 6.3 vs 2.6 ± 5.0, p<0.001; 1.7 ±3.4 vs 0.7 ±1.9, P <.001) and among revascularized patients compared to non-revascularized (SSS: 6.05±6.83 vs 2.45±4.74 , p<0.001/ SDS: 2.57±3.75 vs 0.57±1.71, p<0.001). Hard events and revascularization occurred 2 and 5.5 times more in patients with extensive ischemia.

CONCLUSION
A new MPS protocol in a CZT-C allowed faster, lower radiation studies without compromising the prognostic ability of this imaging method.

CLINICAL RELEVANCE/APPLICATION
This new protocol for Cardiac SPECT in new CZT cameras demonstrated an excellent prognostic value using half of the radiation dose and ultrafast acquisition lasting <1 hour.
Feasibility of 18F-FDG Dose Reduction in Dynamic PET using A Next Generation Digital PET/CT

**PURPOSE**
To explore the feasibility of low dose dynamic PET imaging using a next generation digital PET/CT while achieving accurate quantification designed for response assessment studies at multiple time points.

**METHOD AND MATERIALS**
30min dynamic FDG PET scans were acquired on a digital PET/CT system (Vereos) in continuous list mode. Dynamic PET data were reconstructed (3i15s) using 3 techniques (Time-of-Flight, TOF + Point Spread Function (PSF), and TOF + PSF + Gaussian Filter (GF)), and following a 30-frame (fr) protocol (60s×30fr), a 30s×60fr and 15s×120fr to simulate based on full tracer dose of 450MBq FDG, 1/2 and 1/4 tracer doses. Maximum activity concentrations (Bq/mL) of lesions and arteries were obtained by 3D VOI placement. The average lesion uptake value (L_Ave) and the standard deviation (SD) of lesion uptake (L_SD) were calculated. Kinetic parameters were estimated using in-house developed software with 2-tissue compartment model (2TCM) (k1, k2, k3 and Ki; k4 was set to be 0) and Patlak model (Ki). The 60s×30fr with TOF data were taken as reference. L_Ave values and kinetic parameters generated with different doses and reconstruction techniques were compared to gold standard using Student’s t-test with statistical significance being set at p<0.05.

**RESULTS**
High-quality dynamic 18F-FDG PET images could be generated and all lesions were readily identifiable even when FDG dose was decreased by 75%. The addition of PSF alone seemed to slightly increase PET image noise, especially with lower doses. PET with both 50% and 25% doses could still accurately quantify SUVmax values. Kinetic parameters k1, k2 and k3 calculated by 2TCM did not show significant difference with 50% dose regardless of reconstruction technique. PET with 25% dose could generate accurate k3, however, it caused significant differences in k1 and k2 (p<0.05). Ki values calculated either by Patlak analysis or 2TCM remained consistent with full as well as lower doses.

**CONCLUSION**
Even with a 75% FDG dose reduction to the current 13mCi standard, dynamic PET images of high-quality and quantitative accuracy can be obtained using a next generation digital PET system.

**CLINICAL RELEVANCE/APPLICATION**
This study demonstrates the feasibility of dynamic PET even with very low tracer doses using a next generation digital PET without impacting image quality or quantification.
blood flow was calculated from first pass count curves using a 2-compartment model, with coronary vascular resistance (CVR) computed as mean arterial pressure ÷ flow. Gender-specific Rb-82 normal limits for relative perfusion were applied to compute summed stress score (SSS). Emory Cardiac Toolbox algorithms computed ejection fraction (EF) & quantified regional asynchrony as contraction phase histogram bandwidth. ROC analysis determined parameter thresholds of discrimination of MVD by maximizing accuracy, i.e., area under ROC curves.

RESULTS
Of the 70 pts, 14 (20%) had MVD & 56 (80%) did not. For each category of parameter studied, stress values exhibited higher correlation with angiography than either rest values or change values. Highest ROC areas were observed for SSS, EF, bandwidth, & CVR (accuracy = 84%, 79%, 76% & 75%, respectively). For each parameter, stress values were significantly different for pts with & without MVD (SSS = 21±47 versus 10±49, p = 0.0002; EF = 39±19% versus 61±15%, p < 0.0001; bandwidth = 150±699 versus 79±549, p = 0.0001; CVR = 104±42 versus 68±39 mm Hg/ml/g/min, p = 0.004). Optimal discrimination between pts with & without MVD was the combination of SSS > 12 & stress EF < 50% (accuracy = 87%, sensitivity = 71% & specificity = 91%).

CONCLUSION
Rb-82 rest/regadenoson-stress PET/CT computations agree well with arteriographic findings of multi-vessel disease.

CLINICAL RELEVANCE/APPLICATION
Rb-82 PET is a reasonable alternative in detecting multi-vessel disease when arteriography is not possible.

SSE22-03 Longitudinal Variability of PET SUVs in the NCI Quantitative Imaging Network (QIN)

Monday, Nov. 28 3:20PM - 3:30PM Room: S403B

Participants
Paul E. Kinahan, PhD, Seattle, WA (Presenter) Research Grant, General Electric Company; Co-founder, PET/X LLC
Darrin W. Byrd, MS, Seattle, WA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Clinical oncology trials that utilize PET measurements to assess change in response to therapy may suffer from reduced study power if biases in the standardized uptake value (SUV) are not consistent between sites or across time. Bias instability due to instrument calibration has not been previously characterized except in studies having limited repeat measurements over short time periods. We evaluated the variability in SUVs over roughly 8 months in a multicenter network.

METHOD AND MATERIALS
We used cross-calibration 'kits' with two long-lived sealed PET sources of 68-Ge in epoxy. The first source is a NIST-traceable dose calibrator reference standard while the second is implicitly NIST-traceable (i.e. made by the same process) 4.5 cm diam. uniform cylinder source for PET scanners. These were distributed to 9 cancer centers that were part of the NCI Quantitative Imaging Network (QIN), with a total of 19 PET/CT scanners and 16 dose calibrators. The number of scans per scanner ranged from 3 to 43 (average of 13) and the duration over which scans were performed ranged from 39 to 412 days (average of 232). A total of 161 dose calibrator measurements were made with an average separation of 24 days between measurements. SUV bias was estimated from the scanner and dose calibrator biases.

RESULTS
Scanner bias was higher than expected, probably due to attenuation and scatter corrections for the epoxy used in the source. However, neither scanner or dose calibrator signal recoveries were stable in time. Scanner bias varied by approximately 10% on average over the course of measurements. Dose calibrator recovery variability was approximately 5%. Fluctuations in recovery of scanners and dose calibrators were uncorrelated, thus SUV variability was not smaller than scanner or dose calibrator variability.

CONCLUSION
Scanner and dose calibrator bias variations are potentially significant contributors to SUV variability both in networks of hospitals and at single sites. Biases from dose calibrators and PET scanners do not cancel out in SUV calculations. Sites conducting clinical trials should employ long-lived sources as part of quality control for PET scanner calibration monitoring.

CLINICAL RELEVANCE/APPLICATION
Sites conducting clinical trials should employ long-lived sources as part of quality control for PET scanner calibration monitoring. Submitted on behalf of the QIN Data Acquisition Working Group.

SSE22-04 A Multi-Method, Multi-Center Study of PET/MRI Brain Attenuation Correction on A Large Cohort of [18F]-FDG Patients: Ready for Clinical Implementation

Monday, Nov. 28 3:30PM - 3:40PM Room: S403B

Participants
Claes N. Ladeoged, MSc, Copenhagen, Denmark (Presenter) Nothing to Disclose
Ian Law, MD, PhD, Copenhagen, Denmark (Abstract Co-Author) Nothing to Disclose
Udunna Anazodo, London, ON (Abstract Co-Author) Nothing to Disclose
David Izquierdo-Garcia, Charlestown, MA (Abstract Co-Author) Nothing to Disclose
Ninon Burgos, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Ines Merida, Lyon, France (Abstract Co-Author) Support, Siemens AG
Didier Benoit, Brest, France (Abstract Co-Author) Nothing to Disclose
Meher R. Juttukonda, PhD, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
Jorge Cabello, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Matthias Fenchel, Erlangen, Germany (Abstract Co-Author) Employee, Siemens AG
Bjoern Jakoby, Knoxville, TN (Abstract Co-Author) Employee, Siemens AG
Lisalette Hoegaard, Copenhagen, Denmark (Abstract Co-Author) Nothing to Disclose
Adam E. Hansen, PhD, Copenhagen, Denmark (Abstract Co-Author) Nothing to Disclose
Flemming L. Andersen, MSc, PhD, Copenhagen, Denmark (Abstract Co-Author) Nothing to Disclose

PURPOSE
A Multi-Method,Multi-Center Study of PET/MRI Brain Attenuation Correction (BAC) in [18F]-FDG brain PET imaging, with a large cohort of MRI patients across 19 centers.

METHOD AND MATERIALS
The study included a total of 103 patients in 19 centers with 18 PET/MRI scanners and 17 BAC methods. The cohort included patients with brain tumors, stroke, and traumatic brain injury. The BAC methods were divided into two categories: model-based BAC (MB-BAC) and model-free BAC (MF-BAC). For each method, the accuracy of BAC was assessed using the difference between the attenuation-corrected and uncorrected images, and the resulting SUVs were compared.

RESULTS
The results showed that both MB-BAC and MF-BAC methods were effective in improving the accuracy of PET images. The accuracy of BAC was highest for MB-BAC methods, with a mean difference of 0.08 SUV units. For MF-BAC methods, the mean difference was 0.15 SUV units.

CONCLUSION
The results of this study suggest that MB-BAC methods are more accurate than MF-BAC methods in improving the accuracy of PET images. The study also demonstrated the feasibility of a multi-method, multi-center study of PET/MRI BAC in [18F]-FDG brain PET imaging.
PURPOSE
In order to improve the current vendor-implemented MR attenuation correction (AC) methods for achieving more accurate quantifiable radioactivity concentration measured by PET, a number of AC methods have been proposed in the literature. The aim of this study was to evaluate a selection of novel methods, and identify the ones suitable for clinical use by applying a unified quantitative evaluation with identical metrics, subject cohort, and common CT-based reference.

METHOD AND MATERIALS
In total, eleven MRAC methods were evaluated on 204 [18F]-FDG subjects, and compared to attenuation correction based on CT. Methods were: two vendor-implemented (Dixon (Martinez-Moller et al., 2009) and UTE (Keereman et al., 2010)), five based on template/atlas information (SEGBONE (Koesters et al., 2016), ONTARIO (Anazodo et al., 2014), BOSTON (Izquierdo-Garcia et al., 2014), UCL (Burgos et al., 2014), and LYON (Merida et al., 2015)), one based on simultaneous reconstruction of attenuation and emission (MLAA (Benoit et al., 2015)), and three based on image-segmentation (MUNICH (Cabello et al., 2015), CAR-RiDR (Juttukonda et al., 2015), and RESOLUTE (Ladefoged et al., 2015)). Evaluation was performed both globally and regionally, with a special focus on robustness and outlier analysis (Ladefoged et al., 2015).

RESULTS
The average global performance in PET tracer uptake was for each method (mean ± SD)%: Dixon (-11.3±3.5)%; UTE (-5.7±2.0)%; SEGBONE (-1.7±3.6)%; ONTARIO (-4.3±3.6)%; BOSTON (-0.3±1.8)%; UCL (0.7±1.2)%; LYON (-0.4±1.6)%; MLAA (-1.9±2.6)%; MUNICH (3.7±4.1)%; CAR-RiDR (-0.4±1.9)%; and RESOLUTE (0.3±1.7)%. The best performing methods showed regional average errors within ±3% of PET with CT (BOSTON, UCL, LYON, RESOLUTE). Five methods (BOSTON, UCL, LYON, RESOLUTE, CAR-RiDR) showed that for 95% of the patients, 95% of brain voxels had an uptake that deviated by less than 15% from the reference.

CONCLUSION
All novel methods showed great performance on average. The main difference among the methods has to be found in the robustness, clinical feasibility, and number of outliers. It may be concluded that the problem of MRAC in the brain has been solved to an acceptable degree.

CLINICAL RELEVANCE/APPLICATION
This study compares a selection of novel MR attenuation correction methods, and attempts to identify the ones suitable for clinical use.

SSE22-05 PET/MR Imaging of the ACR Phantom Using Adapted MRAC Techniques

Monday, Nov. 28 3:40PM - 3:50PM Room: S403B

Participants
Joseph Meier, Houston, TX (Abstract Co-Author) Nothing to Disclose
Timothy Deller, Waukesha, WI (Abstract Co-Author) Nothing to Disclose
Yiqiang Jian, Waukesha, WI (Abstract Co-Author) Nothing to Disclose
Ken-Pin Hwang, MS, PhD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Osama R. Mawlawi, PhD, Houston, TX (Presenter) Research Grant, General Electric Company; Research Grant, Siemens AG

CONCLUSION
The proposed modifications of the MRAC allows accurate PET SUV quantification in all regions of the ACR phantom with the exception of the Teflon insert. These modifications allow the use/evaluation of the same MRAC pulse sequence on both patients and phantom studies without resorting to CTAC templates.

Background
The GE SIGNA PET/MR utilizes a LAVA FLEX pulse sequence to separate fat and water to create PseudoCts(PCT) for attenuation correction(AC) of PET data. This results in large biases in phantom imaging primarily due to lack of fat in PET phantoms and lack of signal from the phantom shell and its solid internal structures when using standard MR pulse sequences. Our objective was to develop novel techniques to generate PCT of the ACR phantom while still using the LAVA FLEX sequence that will result in no bias in the corresponding PET image quantification.

Evaluation
A PET ACR phantom filled with an activity concentration equivalent to 370 MBq of injected activity was scanned on a GE 710 PET/CT and a GE MR 750. Two acquisitions were acquired on each scanner, one with a 300 ml bottle of vegetable oil affixed to the side of the phantom and one without. PET images were reconstructed using CTAC, LAVA FLEX MRAC (PCT_Clin) without oil bottle, and a modified MRAC (PCT_mod) which included: oil bottle to enable fat/water separation, slice to volume normalization, removal of vertebral mask to allow for air pockets, rescaled MRAC Houndsfield Units(HU) from soft tissue(42) to water(0) and fat(-104) to oil(-115), and acrylic shell from HU of -1000 to 120 which was digitally inserted into the phantom. Image analysis was performed according to ACR specifications and compared to CTAC which was considered as the gold standard.

Discussion
There was no appreciable visual difference in uniformity and resolution in the reconstructions. The percent error of the PCT_clin and PCT_mod with respect to CTAC was: Background SUVmean(-31%, -2%), 25mm Hot Cylinder(-30%, -3%), Air SUVmean(174%, -1%), Teflon SUVmean(-67%, -84%), Cold Water SUVmean(-31%, -5%).

SSE22-06 PET/MR Headphone Attenuation Estimation using MLAA

Monday, Nov. 28 3:50PM - 4:00PM Room: S403B

Participants
Thorsten Heusser, Dipl Phys, Heidelberg, Germany (Presenter) Nothing to Disclose
Christopher M. Rank, MSc, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Martin T. Freitag, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Marc Kachelriess, PhD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
This study compares a selection of novel MR attenuation correction methods, and attempts to identify the ones suitable for clinical use.

RESULTS
The average global performance in PET tracer uptake was for each method (mean ± SD)%: Dixon (-11.3±3.5)%; UTE (-5.7±2.0)%; SEGBONE (-1.7±3.6)%; ONTARIO (-4.3±3.6)%; BOSTON (-0.3±1.8)%; UCL (0.7±1.2)%; LYON (-0.4±1.6)%; MLAA (-1.9±2.6)%; MUNICH (3.7±4.1)%; CAR-RiDR (-0.4±1.9)%; and RESOLUTE (0.3±1.7)%. The best performing methods showed regional average errors within ±3% of PET with CT (BOSTON, UCL, LYON, RESOLUTE). Five methods (BOSTON, UCL, LYON, RESOLUTE, CAR-RiDR) showed that for 95% of the patients, 95% of brain voxels had an uptake that deviated by less than 15% from the reference.

CONCLUSION
All novel methods showed great performance on average. The main difference among the methods has to be found in the robustness, clinical feasibility, and number of outliers. It may be concluded that the problem of MRAC in the brain has been solved to an acceptable degree.

CLINICAL RELEVANCE/APPLICATION
This study compares a selection of novel MR attenuation correction methods, and attempts to identify the ones suitable for clinical use.

SSE22-05 PET/MR Imaging of the ACR Phantom Using Adapted MRAC Techniques

Monday, Nov. 28 3:40PM - 3:50PM Room: S403B

Participants
Joseph Meier, Houston, TX (Abstract Co-Author) Nothing to Disclose
Timothy Deller, Waukesha, WI (Abstract Co-Author) Nothing to Disclose
Yiqiang Jian, Waukesha, WI (Abstract Co-Author) Nothing to Disclose
Ken-Pin Hwang, MS, PhD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Osama R. Mawlawi, PhD, Houston, TX (Presenter) Research Grant, General Electric Company; Research Grant, Siemens AG

CONCLUSION
The proposed modifications of the MRAC allows accurate PET SUV quantification in all regions of the ACR phantom with the exception of the Teflon insert. These modifications allow the use/evaluation of the same MRAC pulse sequence on both patients and phantom studies without resorting to CTAC templates.

Background
The GE SIGNA PET/MR utilizes a LAVA FLEX pulse sequence to separate fat and water to create PseudoCts(PCT) for attenuation correction(AC) of PET data. This results in large biases in phantom imaging primarily due to lack of fat in PET phantoms and lack of signal from the phantom shell and its solid internal structures when using standard MR pulse sequences. Our objective was to develop novel techniques to generate PCT of the ACR phantom while still using the LAVA FLEX sequence that will result in no bias in the corresponding PET image quantification.

Evaluation
A PET ACR phantom filled with an activity concentration equivalent to 370 MBq of injected activity was scanned on a GE 710 PET/CT and a GE MR 750. Two acquisitions were acquired on each scanner, one with a 300 ml bottle of vegetable oil affixed to the side of the phantom and one without. PET images were reconstructed using CTAC, LAVA FLEX MRAC (PCT_Clin) without oil bottle, and a modified MRAC (PCT_mod) which included: oil bottle to enable fat/water separation, slice to volume normalization, removal of vertebral mask to allow for air pockets, rescaled MRAC Houndsfield Units(HU) from soft tissue(42) to water(0) and fat(-104) to oil(-115), and acrylic shell from HU of -1000 to 120 which was digitally inserted into the phantom. Image analysis was performed according to ACR specifications and compared to CTAC which was considered as the gold standard.

Discussion
There was no appreciable visual difference in uniformity and resolution in the reconstructions. The percent error of the PCT_clin and PCT_mod with respect to CTAC was: Background SUVmean(-31%, -2%), 25mm Hot Cylinder(-30%, -3%), Air SUVmean(174%, -1%), Teflon SUVmean(-67%, -84%), Cold Water SUVmean(-31%, -5%).

SSE22-06 PET/MR Headphone Attenuation Estimation using MLAA

Monday, Nov. 28 3:50PM - 4:00PM Room: S403B

Participants
Thorsten Heusser, Dipl Phys, Heidelberg, Germany (Presenter) Nothing to Disclose
Christopher M. Rank, MSc, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Martin T. Freitag, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Marc Kachelriess, PhD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
PURPOSE
To estimate headphone attenuation in hybrid PET/MR imaging using maximum likelihood reconstruction of attenuation and activity (MLAA).

METHOD AND MATERIALS
Attenuation correction of flexible hardware components such as MR body coils or headphones is still a major challenge in hybrid PET/MR imaging. While stationary components (e.g., patient table and head coils) can be added to the MR-derived patient attenuation map in a straightforward way using CT-derived templates, attenuation of flexible components is neglected in clinical routine. Ignoring headphone attenuation has been shown to result in local brain SUV underestimation values of up to 15%. We propose to employ the MLAA algorithm to simultaneously estimate attenuation and activity distributions outside the patient body outline to obtain an estimate of the headphone attenuation. Due to cross-talk effects, MLAA cannot recover the true attenuation coefficients of the headphones. However, the outline of the headphones can be segmented and pre-defined attenuation coefficients can be applied. The average headphone attenuation coefficients were empirically derived performing phantom measurements and chosen such that the SUV underestimation when ignoring headphone attenuation could be compensated for. For clinical evaluation, we investigated the proposed headphone attenuation estimation for six PET/MR patient data sets acquired with a Siemens Biograph mMR.

RESULTS
For the headphones used in our mMR system, it turned out that an average attenuation coefficient of $\mu = 0.007$ 1/mm was required to compensate for the SUV underestimation in the phantom measurements, reducing the average and maximum underestimation from 5.3% to 1.6%, and 12.7% to 2.1%, respectively. Ignoring headphone attenuation resulted in an average SUV underestimation across the six patient data sets of 3.9% evaluated in the full brain and 8.6% evaluated in the cerebellum, compared to compensating for headphone attenuation using the proposed method.

CONCLUSION
We propose a method to estimate PET/MR headphone attenuation making use of the MLAA algorithm. The proposed method was shown to significantly reduce SUV underestimation in both phantom and patient data.

CLINICAL RELEVANCE/APPLICATION
MLAA-based estimation of headphone attenuation has the potential to improve PET quantification in brain PET/MR. The proposed method can, potentially, be readily included into clinical workflow.
Participants
Richard K. Brown, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Murray D. Becker, MD, PhD, New Brunswick, NJ (Abstract Co-Author) Nothing to Disclose
Matthew Manganaro, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Wahida T. Rahman, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Jason J. Bailey, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Levi Sokol, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Mark A. Helvie, MD, Ann Arbor, MI (Abstract Co-Author) Institutional Grant, General Electric Company
Donna Eckstein, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
John D. Millet, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Shivam Shah, MD, North Brunswick, NJ (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1) Learn the salient imaging findings of fat necrosis and giant cell arteritis on PET/CT. 2) Recognize the pattern of uptake on sulfur colloid imaging seen in focal nodular hyperplasia. 3) Learn how to use correlative imaging to assist in the diagnosis of pathology seen on nuclear medicine studies.
Case-based Review of Nuclear Medicine: PET/CT Workshop-Head and Neck Cancers (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Nov. 29 8:30AM - 10:00AM Room: S406A

Participants
Janis P. O'Malley, MD, Birmingham, AL, (jomalley@uabmc.edu) (Moderator) Nothing to Disclose
Jonathan E. McConathy, MD, PhD, Birmingham, AL (Presenter) Research Consultant, Eli Lilly and Company; Research Consultant, Blue Earth Diagnostics Ltd; Research Consultant, Siemens AG; Research Consultant, General Electric Company;

LEARNING OBJECTIVES
1) Participants will use FDG-PET/CT and FDG-PET/MRI more effectively in their clinical practice through better understanding of the anatomy, clinical scenarios, and differential diagnoses relevant to the diagnostic imaging of head and neck cancers.

ABSTRACT
LEARNING OBJECTIVES


ABSTRACT

Participants
Haesun Choi, MD, Houston, TX, (hchoi@mdanderson.org) (Moderator) Nothing to Disclose

Purpose
While it is standard practice to determine the blood glucose level at the time of FDG PET imaging, no current assessment reports on trends and observations and changes exist. We utilized access to the clinical trial data of the National Clinical Trial Network to develop a 10 year perspective.

METHOD AND MATERIALS

Patient blood glucose levels (BGL) are routinely determined as point of care testing to insure eligibility as most FDG PET protocols require a confirmation that the level is not above 200 mg/dl. Within the quality assurance assessment we perform for clinical trials within the NCI cooperative groups (NCTN), we record and assess the BGL. We developed query tools and pivot tables to assess the distribution and changes over time for BGL. We analyzed a portfolio of 5 clinical trials that include FDG PET within the last 10 years and evaluated more than 2000 examinations.

RESULTS

The distribution of fasting BGLs for each study included in our analysis were fairly similar. In general, BGLs were found to be within the limit of 200 mg/dL required for compliance within each clinical trial protocol. We found trends that point to population differences in regard to disease state and therapeutic status. Consistently, more than 90% of subjects had a BGL less than 150 at the time of injection. A representative trial including 411 FDG PET examinations found an average BGL at 107 ± 24 mg/dL, range was between 59 and 212 mg/dL. The majority of subjects had a BGL below 110 at the time of injection, less than one third of subjects had a BGL above 110, and only 8% had a BGL above 150. Overall, only 0.5% of studies had BGL above the threshold level. There were no significant trends founds relating BGL to recorded fasting time.

CONCLUSION

On average, blood glucose levels of patients enrolled in these clinical trials were below 110 mg/dL at the time of injection. Overall protocol compliance is exceptional, however stricter BGL limits could be achieved with a reduced threshold at 150 mg/dL without greatly impacting recruitment if reduced glycolytic status variability would be desired especially for quantitative assessments.

CLINICAL RELEVANCE/APPLICATION

Compliance to blood glucose thresholds is clinical trial and practice is high. Opportunity exists to refine guidelines if more
Results: In HL median PFS 17 months, 86% overall survival. In DLBCL median PFS 15 months, 93% overall survival. At baseline
SUVmax in all pts was 15.0 +/- 5.2, (HL12.9 +/- 4.6 vs DLBCL 18.0 +/- 4.7; t-test p 0.003). Using cut off thresholds for intP to predict CR at cSUV <=2.0, cDSC <=2.0 and DELT >=80%, In HL: for cSUV- PPV 67%, NPV 95%; for DELT of cSUV PPV 100%, NPV 95%; for cDSC- PPV 30%, NPV 100%. In DLBCL: for cSUV- PPV 25%, NPV 100%; for DELT of cSUV PPV 33%, NPV 100%; for cDSC- PPV 50%, NPV 100%.

CONCLUSION

Conclusion: The results from our series suggest that intP has a promising role in managing HL as well as DLBCL. As opposed to recent work from other groups, in our modest cohort a negative intP in DLBCL had a NPV of 100% across cSUV, cDSC and DELT, with regards to CR Vs progressive disease; it appears that if intP is –ve then end of RxP is not mandated. In the results for HL subset, the role of intP parallels the emerging results from other groups. Our results need to be validated in a larger series, and alternate different management strategies.

CLINICAL RELEVANCE/APPLICATION

Clinical relevance: If our results in DLBCL are corroborated in larger series by other groups, a neg. intP would suffice and potentially preclude/defer end of therapy PET.

Learning Objectives

1) Compare and contrast prognostic, predictive, and pharmacodynamic biomarkers. 2) Understand the difference between integrated and integral biomarkers in clinical trials. 3) Discuss advantages and limitations of imaging biomarkers.

Abstract

Serum, pathological, and imaging biomarkers are becoming increasingly important to define potential biological targets, select which patients may benefit from a particular targeted agent, and to follow patients during and following therapy. Traditionally, imaging has not been formally recognized as a biomarker, and standardization of quantitative imaging techniques remains a major challenge. However, functional and quantitative imaging techniques are now being used routinely to evaluate early response to therapy. Unlike conventional cytotoxic chemotherapy, targeted therapy can be cytostatic and selects only susceptible populations of cells. Imaging response criteria is therefore often different from standard anatomic (RECIST, WHO) criteria, and the response may be heterogeneous. In the future, both serum and imaging biomarkers will have an increasingly important role in managing patients undergoing conventional and targeted therapy.

Purpose

NaF PET/CT is suggested as a potential valuable tool in the assessment of MM. The aim of this study was to assess the combined use of the radiotracers FDG and NaF in treatment response evaluation of a group of multiple myeloma (MM) patients undergoing high-dose chemotherapy (HDT) followed by autologous stem cell transplantation (ASCT) by means of static (whole-body) and dynamic PET/CT (dPET/CT).

Method and Materials

35 patients with primary, previously untreated MM were enrolled in the study. All patients underwent PET/CT scanning with FDG and NaF before and after therapy. Treatment response by means of FDG PET/CT was assessed according to the EORTC 1999 criteria. NaF PET/CT therapy response assessment was based on visual evaluation of the patients’ scans. Clinical criteria served as gold standard.

Results

5 MM patients had a negative baseline FDG PET/CT scan and were excluded from the statistical analysis. Of the remaining 30 patients, 4 demonstrated complete response (CR) and 26 demonstrated non-CR (13 patients near complete response-nCR, 4 patients very good partial response-VGPR, 9 patients partial response-PR). After treatment, FDG PET/CT was negative in 15/30 patients and positive in 15/30 patients, showing a sensitivity of 57.7% and a specificity of 100%, in comparison to clinical criteria. Regarding NaF PET/CT, 5/30 pts (16.7%) had a negative baseline scan, thus failed to depict MM. NaF PET/CT depicted 56/129 18F-
FDG positive lesions (43%). Follow-up NaF PET/CT showed persistence of 81.5% of the baseline 18F-NaF positive MM lesions after treatment, despite the fact that 64.7% of them had turned to 18F-FDG negative. Dynamic FDG and NaF PET/CT studies showed that SUVaverage, SUVmax, as well as the kinetic parameters K1, influx and FD from reference bone marrow and skeleton responded to therapy with a significant decrease (p<0.001).

CONCLUSION
FDG PET/CT demonstrated satisfactory results in treatment response evaluation of MM. On the other hand, NaF PET/CT does not seem to aid significantly in treatment response evaluation of MM patients undergoing HDT and ASCT, at least in an early phase.

CLINICAL RELEVANCE/APPLICATION
Our study confirms the role of FDG PET/CT and at the same time stresses the limitations of NaF PET/CT in treatment response evaluation of MM patients.

RC311-08 Investigation of Quantitative [I-123] MIBG SPECT/CT in a Pediatric Population with Neuroblastoma
Tuesday, Nov. 29 10:20AM - 10:30AM Room: S505AB

Participants
Samuel L. Brady, MS, PhD, Memphis, TN (Presenter) Nothing to Disclose
Barry L. Shulkin, MD, MBA, Memphis, TN (Abstract Co-Author) Nothing to Disclose

PURPOSE
SPECT has traditionally been regarded as a non-quantitative imaging modality. With recent advances in reconstruction and attenuation correction algorithms, quantitation in SPECT/CT is available. In this study a manufacturer-independent quantitative SPECT/CT reconstruction algorithm was investigated.

METHOD AND MATERIALS
Our institutional IRB deemed this study to be exempt from informed consent. All data were managed in compliance with HIPPA. 106 [I-123] MIBG SPECT/CT examinations were retrospectively reconstructed using SUV SPECT® (HERMES Medical Solutions Inc., Montreal Quebec), where 43 examinations were imaged using a GE Infinia Hawkeye 4, and 63 were imaged using a Siemens Symbia Intevo. Inter-scanner SUV analysis of nine regions of normal [I-123] MIBG tissue uptake (left/right parotids, left/right submandibular gland, left ventricle of the heart, liver, left/right adrenal glands, and the bladder) was conducted. Intra-patient SUVmean variability was calculated by measuring normal liver uptake within patients scanned on both scanners. Additionally, neoplastic tissue present in the examination data was quantified using SUVmax and trended with time.

RESULTS
A total of 44 patients (22 male) with median age of 3.9 years (range 0.8-17.4 years) were analyzed. Inter-scanner SUV variability measured no statistical difference (average p-value of 0.38) among the nine normal tissues analyzed. Intra-patient liver SUVmean varied by no more than 14% as calculated for 25 patients (87 examinations) scanned on both scanners. In one clinical example a posterior thoracic tumor was evaluated over eight time points (2/2015-2/2016) and demonstrated a 74% (3.1/12.0) reduction in SUVmax with treatment.

CONCLUSION
The results demonstrate low intra-patient measurement variability for scanner-independent quantitative SPECT/CT SUV analysis in a pediatric population with neuroblastoma. Furthermore, quantitative SPECT/CT may offer the opportunity for objective analysis of tumor response using the conventional single photon emitting agent [I-123] MIBG, by normalizing the uptake to injected dose, patient weight, and injection to imaging interval as is done for PET.

CLINICAL RELEVANCE/APPLICATION
Quantitative SPECT/CT may assist inter-institutional trials that require tumor response measurement using single photon emitting radionuclides and facilitate evaluation using radionomic techniques.

RC311-09 Imaging of Osteosarcoma using Bone Scintigraphy, Sodium Fluoride-18-PET/CT and Fluoro-18-Deoxyglucose PET/CT - Evaluation of Treatment Response in a Phase I Trial with Radium-223 Therapy
Tuesday, Nov. 29 10:30AM - 10:40AM Room: S505AB

Participants
Kalevi J. Kairemo, MD,PhD, Houston, TX (Presenter) Nothing to Disclose
Eric M. Rohren, MD, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Gregory C. Navizzini, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Arvind Rao, Houston, TX (Abstract Co-Author) Nothing to Disclose
Homer A. Macapinlac, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Vivek Subbiah, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
The aim was to investigate the role of different imaging modalities in a phase I clinical trial of radium-223 (223RaCl2) in the treatment of patients (N=18) with high-risk relapsed bone-forming osteosarcoma (NCT01833520).

METHOD AND MATERIALS
Patients received 1–6 cycles of 223RaCl2, doses varied from 6.84 MBq to 57.81 MBq. Bone scintigraphy, FDG-PET or sodium fluoride-18 (NaF) PET was used to characterize the disease. All 18 patients had multiple lesions. Bone scintigraphy and FDG-PET or NaF-PET studies could be compared in 10 patients at two time points. lesion number, locations, and volumes were analyzed using FDG-PET and NaF-PET. We also developed a measure in analogue to PERCIST analyze response in NaF-PET, called NAFCIST.

RESULTS
Of the 18 patients, 12 had bone lesions in at least one of the bone lesions with multiple lesions involved in one patient. PET images showed a good correlation with the bone scintigraphy images.
Of the 18 patients, 17 had bone lesions. In four of the seven patients with multiple skeletal lesions (>5), FDG-PET and NaF-PET studies could be compared. The skeletal tumor locations varied in our patient population: two patients lesions in the skull, seven in the extremities, 10 patients in pelvis, 12 in the spine, and nine patients in the ribs. The FDG-PET and NaF-PET studies could be compared in all four patients who had multiple lung lesions (>5): the lung volume, calcified lung nodules, and pathologic NaF and FDG volumes varied substantially. Most of the patients (14/18) had soft-tissue metastases, and at least some of the metastases were calcified in all 14 patients. Soft-tissue lesions were found in lungs, brain, liver and lymph nodes. In many patients, the soft-tissue lesions were extensions of bone tumors. Overall response was seen in only one patient, but 4 patients experienced mixed responses, in which most often the bone lesion decreased in intensity, and the surrounding soft tissues increased in intensity. The NaF-PET response criteria (NAFCIST change) demonstrated a correlation with changes in alkaline phosphatases, and with cumulative administered activity.

CONCLUSION

NAFCIST may be a new tool for high-risk osteosarcoma response evaluation, because NaF demonstrates also soft tissue metastases in osteosarcoma (lung, liver, brain, lymph node), and 5 lesions in multiple organs can be found. Our results indicate that NaF-PET is an essential part of osteosarcoma staging and NaF PET and FDG PET are complementary in osteosarcoma.

CLINICAL RELEVANCE/APPLICATION

We have developed new criteria for osteosarcoma response evaluation based on fluoride-PET.

Honoried 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/

Eric M. Rohren, MD, PhD - 2015 Honored Educator

RC311-10 Question and Answer

Tuesday, Nov. 29 10:40AM - 10:50AM Room: S505AB

Participants

RC311-11 Challenges of Solid Tumor Measurements and Techniques to Address This

Tuesday, Nov. 29 10:50AM - 11:20AM Room: S505AB

Participants

Haesun Choi, MD, Houston, TX, (hchoi@mdanderson.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES


ABSTRACT

LEARNING OBJECTIVES


ABSTRACT

RC311-12 Comparison of Novel Multi-level Otsu and Conventional PET Segmentation Methods for Measuring FDG Metabolic Tumor Volume in Patients with Soft Tissue Sarcoma

Tuesday, Nov. 29 11:20AM - 11:30AM Room: S505AB

Participants

Inki Lee, MD, Madison, WI (Presenter) Nothing to Disclose
Hyung-Jun Im, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Meiyappan Solaiyappan, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Steve Cho, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose

PURPOSE

There are various strategies that may be used for PET tumor segmentation. We have developed a novel and highly consistent segmentation algorithm using a multi-level Otsu PET method (MO-PET) (JNM 2015 May 1;56(supplement 3):452). We evaluated the reliability of MO-PET compared to conventional PET segmentation methods for measuring FDG PET metabolic tumor volume (MTV) in patients with soft tissue sarcoma (STS).

METHOD AND MATERIALS

Clinical and imaging data were obtained from the NCI Cancer Imaging Archive (http://dx.doi.org/10.7937/K9/TCIA.2015.7G02GSKS). Forty-eight STS patients with FDG PET/CT and MR prior to therapy were analyzed. MTV of the tumor using MO-PET was compared to other conventional methods (absolute SUV threshold values of 2.0, 2.5 or 3.0, and percentage of SUVmax values of 30%, 40%, 50% or 60%). The reference volume was defined as an MR based gross tumor volume (GTV), which was contoured on T2-weighted fat-suppression images. Intra-class analysis and Bland-Altman analysis were performed to evaluate the correlation and agreement of MTV to GTV.

RESULTS

MTVs obtained using each parameter including SUV 30%, 2.0, 2.5, 3.0, and MO-PET were highly correlated with the GTV in intra-
class correlation analysis (all p<0.01 except for SUV 30% p<0.05). MO-PET had the highest correlation of MTV to GTV with a correlation coefficient of 0.93. The highest correlation coefficient using absolute and percent SUV threshold was 2.0 and 30% (correlation coefficients: 0.79 and 0.42, respectively). The Bland-Altman bias results showed highest agreement for MTV using MO-PET with GTV (26.0 ± 489.6 cm³) compared to other methods (SUV 2.0 with -69.3 ± 765.8 cm³ and SUV 30% with -255.0 ± 876.6 cm³).

CONCLUSION

PET MTV segmented with MO-PET method showed higher correlation and agreement with MRI-based GTV in comparison to conventional percent and absolute SUV-based PET segmentation methods. MO-PET is a reliable and consistent method for measuring tumor MTV.

CLINICAL RELEVANCE/APPLICATION

Quantitation of tumor metabolic burden using the MO-PET segmentation method shows promise for future clinical applications.

PURPOSE

4'-[Methyl-11C] Thiothymidine (4DST) PET-CT provides DNA synthesis imaging, which represented higher correlation with proliferation of advanced non small cell lung cancer (NSCLC) compared to FDG. The aim of this prospective study is to evaluate the potential of 4DST for early therapy monitoring of advanced NSCLC, and comparing the result to the assessments with CT and FDG PET-CT.

METHOD AND MATERIALS

The patients pathologically diagnosed with advanced NSCLC scheduled to receive platinum-doublet chemotherapy (PDC) were eligible. 4DST and FDG PET-CT scan, and CT were performed at baseline and after 2 cycles of PDC. Patients were evaluated after 2 cycles of PDC by RECIST 1.1 (response evaluation criteria in solid tumors) based on CT measurements, EORTC (European Organization for Research and Treatment of Cancer criteria) and PERCIST 1.0 (PET Response Criteria in Solid Tumors) based on PET-CT measurements. 4DST PET-CT was evaluated according to modified EORTC criteria (difference of SUVmax as -35% > was regarded as inadequate therapeutic response). The reference standard for the assessment of patient’s prognosis was based on the medical records and the follow-up radiographic assessments.

RESULTS

A total of 20 patients were included in this study. Three patient showed PD before early interim PET, finally 17 patients (male: 13, female 4, mean age: 72 ± 7, range: 56-84) were used for the analysis. The results of prognosis for patients after following up of average four months were 12 patients of recurrence and five patients without disease progression. 4DST had a significantly higher PPV (75%, p < 0.001) to predict disease progression than RECIST (50%), EORTC (25%) and PERCIST (33%). No difference in NPV was found between 4DST (80%) and RECIST (100%), EORTC (100%), and PERCIST (100%).

CONCLUSION

4DST PET/CT had a potential for early therapy monitoring of advanced NSCLC.

CLINICAL RELEVANCE/APPLICATION

4DST PET/CT had a potential for early therapy monitoring of advanced NSCLC.
Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (Moderator) Nothing to Disclose

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.

Participants
Georges El Fakhri, PhD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review common current applications for abdominopelvic oncologic PET/MRI, including hepatic malignancies, rectal cancer, and cervical cancer. 2) Understand the role of novel tracers in prostate cancer (PSMA PET) and neuroendocrine tumors (somatostatin receptor PET). 3) Present the current limitations and future advances in PET/MRI that will help increase the clinical acceptance and applicability of body PET/MRI.

Participants
Pamela K. Woodard, MD, Saint Louis, MO, (woodardp@mri.wustl.edu) (Presenter) Research Grant, Astellas Group; Research Grant, Bayer AG; Research agreement, Siemens AG; ; ; ;

LEARNING OBJECTIVES
1) Discuss clinical cardiac PET/MR imaging applications, including myocardial perfusion and viability, nonischemic cardiomyopathy, and tumor assessment.

Participants
Thomas A. Hope, MD, San Francisco, CA, (thomas.hope@ucsf.edu) (Presenter) Research Grant, Consultant, GE Healthcare

LEARNING OBJECTIVES
1) Review common current applications for abdominopelvic oncologic PET/MRI, including hepatic malignancies, rectal cancer, and cervical cancer. 2) Understand the role of novel tracers in prostate cancer (PSMA PET) and neuroendocrine tumors (somatostatin receptor PET). 3) Present the current limitations and future advances in PET/MRI that will help increase the clinical acceptance and applicability of body PET/MRI.

ABSTRACT

RC317A PET/MRI: The Evolving Imaging Field of Structure and Function

RC317B PET/MRI Physics: The Opportunities and Challenges

RC317C PET/MRI Clinical Applications: Brain and Head and Neck

RC317D PET/MRI Clinical Applications: Body

RC317E PET/MRI Clinical Applications: Cardiac
**Molecular Imaging Mini-Course: Basics of Molecular Imaging**

Tuesday, Nov. 29 8:30AM - 10:00AM Room: S403B

**Participants**

**Sub-Events**

**RC323A Developing Molecular Imaging Agents**

Participants
Julie L. Sutcliffe, PhD, Sacramento, CA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the ideal properties of a molecular imaging agent and molecular target. 2) Describe the in vitro and in vivo validation of the molecular imaging agent. 3) Describe specific examples of successful molecular imaging agents.

**ABSTRACT**

**RC323B Instrumentation (PET and CT) and Image Reconstruction**

Participants
John Sunderland, PhD, Iowa City, IA (john-sunderland@uiowa.edu) (Presenter) Research Grant, Siemens AG

**LEARNING OBJECTIVES**

1) Identify the primary design components of a modern PET/CT system. 2) Design and implement a PET/CT quality control program to assure high quality and quantitatively accurate clinical imaging. 3) Describe commonly used PET reconstruction algorithms and the practical impact of reconstruction parameters upon image quality and quantitation.

**ABSTRACT**

**RC323C Basic Clinical Applications**

Participants
Hubert J. Vesselle, MD, PhD, Seattle, WA (Presenter) Consultant, MIM Software Inc

**ABSTRACT**
Case-based Review of Nuclear Medicine: PET/CT Workshop-Chest Cancers (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Nov. 29 10:30AM - 12:00PM Room: S406A

Participants
Janis P. O'Malley, MD, Birmingham, AL, (jomalley@uabmc.edu) (Moderator) Nothing to Disclose
Ciaran J. Johnston, MD, Dublin, Ireland, (cjohnston@stjames.ie) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1. Discuss the strengths and limitations of PET-CT of the chest with reference to staging the common cancers (lung, breast, esophageal).
2. Discuss confounding factors in chest PET-CT including non-neoplastic hypermetabolic lesions and conversely tumours that demonstrate little or no FDG avidity.
3. Demonstrate the importance of CT correlation, particularly in suspected lung cancer.
4) Describe the role of PET CT in assessing patient response to radiation therapy and chemotherapy, including early assessment and PET influenced treatment strategies.
PURPOSE
This study aims to demonstrate the diagnostic performance of PET-CT in patients with PUO.

METHOD AND MATERIALS
141 consecutive patients with criteria of PUO (78 male, mean age 52±18) were retrospectively evaluated using PET-CT after inconclusive conventional imaging. FDG PET-CT was done after injecting the FDG contrast and scan done after 60 minutes. The varied uptake on FDG was evaluated based on SUV max values. Final diagnosis was based on biopsy, laboratory tests, and imaging follow-up.

RESULTS
The cause of PUO was identified in cases were diagnosed as 41 infection, 37 malignancy, 41 non-infectious inflammatory diseases and 21 other causes. The patients had PET-CT scan at day 11 (±5 days) of hospital admission. Results Table:

| True Positive in 49/141:                          |
| 16 infection, 16 malignancy, 17 inflammation.    |
| False Positive lesions in 9/141, due to reactive nodes confirmed with subsequent CT. True Negative lesions in 9/141, clinically self-limiting conditions with full spontaneous recovery. Such spontaneous recovery took 14 days (±18 days) after hospital admission. False Negative lesions in 15/141: 3 infection, 5 malignancy, 6 inflammation, 1 others. PET-CT appears to miss some of the connective tissue diseases, non-FDG-avid malignancy and poorly-FDG-avid malignancy or infection within the organs of normal physiological FDG-uptake such as brain and liver. The PPV, NPV and accuracy of PET-CT were 84%, 73% and 79% respectively. On multivariate analysis, none of the inflammatory markers (white cell counts, ESR and CRP) statistically satisfied as independent predictor of PET-positivity.

CONCLUSION
Thus 18F-FDG PET-CT correctly diagnosed a cause of PUO in 89% of patients. A negative PET-CT with no spontaneous recovery still requires further investigations in order to exclude various causes such as myeloma and FDG-avid small gastrointestinal/renal/pancreatic malignancies.

CLINICAL RELEVANCE/APPLICATION
Thus FDG PET-CT helps in evaluation of PUO cases.
with preTx SUV- nor MTV-related parameters, but showed strong correlations with postTx SUV- and MTV-related parameters (Rho=0.82-0.88, p<0.001). DSS also showed moderate (Rho=0.47-0.52) and strong (Rho=0.86) correlations with changes of SUV- and MTV-related parameters, respectively. Recurrence within 2 years exhibited strong correlations with postTx SUV-, MTV-, and changes of MTV-related parameters as well as with DSS (Rho=0.59-0.66). ROC analysis revealed negative interpretation with Scores 1-2 (area under the curve: 0.79, sen.68%, spe.96%, acc.82%) better than Scores 1-3 as negative in predicting recurrence in this study. Although ROC AUC 0.87 of postTx SUVmax was the greatest, it did not differ statistically from the AUC of DSS.

CONCLUSION

This study demonstrated DSS had correlations with postTx SUV- and MTV-related parameters as well as changes of SUV- and MTV-related parameters after Tx in FL. DSS provided comparable results to those parameters in predicting recurrence of FL.

**CLINICAL RELEVANCE/APPLICATION**

Deauville visual 5-point scale on FDG PET after treatment was demonstrated to provide comparable results to SUV- and MTV-related parameters in predicting recurrence of follicular lymphoma.

**NM220-5D**

**Density-threshold for FDG-PET/CT-based N-staging in Lung Cancer Patients**

**Station #8**

Participants
Paul G. Flechsig, Heidelberg, Germany (Presenter) Nothing to Disclose
Clemens Kratochwil, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Hans-Ulrich Kauczor, MD, Heidelberg, Germany (Abstract Co-Author) Research Grant, Siemens AG Research Grant, Bayer AG
Boehringer Ingelheim GmbH Speakers Bureau, Siemens AG Speakers Bureau, Novartis AG Speakers Bureau, GlaxoSmithKline plc Speakers Bureau, Almirall SA
Lawrence H. Schwartz, MD, New York, NY (Abstract Co-Author) Committee member, Celgene Corporation Committee member, Novartis AG Committee member, ICON plc Committee member, BioClinica, Inc
Uwe Haberkorn, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Frederik L. Giesel, MD, MBA, Heidelberg, Germany (Abstract Co-Author) Patent application for F18-PSMA-1007

**PURPOSE**

Mediastinal N staging done by integrated 18F-FDG-PET/CT in lung cancer patients is not always accurate. In order to reduce the need for invasive staging procedures, additional surrogate parameters for the detection of malignant lymph node infiltration would be helpful. The purpose of this study was to evaluate if semi-automated density measurements in mediastinal lymph nodes can improve pre-clinical N-staging, irrespective of the specific lung cancer entity.

**METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board. 248 histologically proven lymph nodes in 122 lung cancer patients were investigated. Non-contrast enhanced 18F-FDG-PET/CT was performed before surgery/biopsy. Lymph nodes analyses were performed on the basis of FDG-uptake and volumetric CT histogram analysis for metric lymph node sampling.

**RESULTS**

Of the 248 lymph nodes, 118 were benign, 130 malignant. Malignant lymph nodes had a significantly higher median CT density (>30HU) compared to benign lymph nodes (9.3 HU, p < 0.05), irrespective of the histological subtype. The discrimination between different malignant tumour subtypes by means of volumetric density analysis failed. Irrespective of the malignant subtype, a possible cut off value of 20HU may help differentiate between benign and malignant lymph nodes.

**CONCLUSION**

Density measurements in unclear mediastinal and hilar lymph nodes with equivocal FDG uptake in PET might serve as a possible surrogate parameter for N-staging in lung cancer patients, irrespective of the specific lung cancer subtype. This could also help to find possible high yield targets in cases where invasive lymph node staging is necessary.

**CLINICAL RELEVANCE/APPLICATION**

Semi-automated density measurement in lymph nodes in lung cancer patients might create a promising imaging surrogate for N-staging, irrespective of malignant tumour subtype, which is of clinical relevance in patients with unclear PET findings in PET/CT, prior to invasive lymph node sampling.

**NM221-5D**

**Differential Diagnostic Value of 18F-FDG PET/CT in Osteolytic Lesions**

**Station #9**

Participants
Xiaomeng Li, MD, Beijing, China (Presenter) Nothing to Disclose
Ning Wu, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the differential diagnostic value of 18F-FDG PET/CT in osteolytic lesions.

**METHOD AND MATERIALS**

This retrospective study spanned 8 years and included 344 newly diagnosed patients with osteolytic lesions. They all underwent both FDG PET/CT and biopsy/surgery because of the suspicion of malignancy. Both FDG uptake and morphologic changes such as soft tissue mass formation were compared with pathological results.

**RESULTS**

A total of 8896 osteolytic lesions were evaluated. The SUVmax of MM osteolytic lesions is significantly lower than bone metastases (1.6±0.7 vs. 5.5±2.7, P=0.000). The best cutoff value of SUVmax in the differentiation of MM and bone metastasis is 2.65 (sensitivity 86.1% and specificity 94.7%, P=0.000). Bone lesions with soft tissue mass have higher SUVmax than pure osteolytic
lesions (both \( P=0.000 \)). SUVmax of bone metastases showed significant correlation with those of primary tumors (\( r=0.532, P=0.000 \)). Furthermore, the formation of soft tissue mass is more common in bone metastases than in MM (7% vs. 2%).

**CONCLUSION**

FDG PET/CT is a valuable tool in the differential diagnosis of osteolytic lesions.

**CLINICAL RELEVANCE/APPLICATION**

In osteolytic lesions, the best cutoff value of SUVmax in the differentiation of multiple myeloma and bone metastasis is 2.65. For patients with metastatic bone cancer of unknown primary origin, our results can help to detect primary tumors.

**NM222-SD-TUA10**

FDG PET/MR Uptake Measurements of Tumor and Normal Structures in Cancer Patients: Same Day Assessment of Reproducibility with PET/CT and PET/MR Test-retest Repeatability

**Participants**

Liran Domachevsky, MD, Tel Aviv, Israel (Presenter) Nothing to Disclose
Hanna Bernstine, MD, Petah Tikva, Israel (Abstract Co-Author) Nothing to Disclose
Dorit Stern, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Natasha Goldberg, MD, Petah Tikva, Israel (Abstract Co-Author) Nothing to Disclose
Meital Nidam, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Dan Stein, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Itai Abadi-Koren, PhD, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
David Groshar, MD, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To determine PET/CT and PET/MR reproducibility and test-retest PET/MR repeatability of measurements of fluorine 18 fluorodeoxyglucose (FDG) uptake in normal structures and in tumor lesions, obtained by PET/CT and by two sequential PET/MR examinations performed on the same day in patients with cancer.

**METHOD AND MATERIALS**

This prospective observational study was IRB approved and written informed consent was obtained. Between October 2015 and February 2016, consecutive patients performing FDG PET/CT and two sequential non-enhanced whole-body FDG PET/MR were included. Studies order was random. A total of 34 patients with no visible tumor lesion (20 women and 14 men, mean age 54.9±11.2 years) and 33 patients (19 women and 14 men, mean age 53.1±12.1) with visible tumor lesions (a total of 63) were enrolled. Maximal, peak and mean standardized uptake value normalized for body weight (SUV’s) and lean body mass (SUL’s) were obtained for normal structures (aorta, liver, spleen, vertebra, iliac bone and subcutaneous fat) in PET/CT and PET/MR using a spherical volume of interest (VOI). For lesions an isocontour VOI with a threshold of 40% of maximal SUV/L was placed and SUV/L’s and metabolic tumor volume (MTV) were calculated. A sphere VOI was placed in the liver and the tumor to liver ratio (T/L) calculated. Coefficient of variation, intraclass correlation coefficient and repeatability coefficient were used to estimate the measurements reliability.

**RESULTS**

There was a high lesional reproducibility and repeatability with an almost perfect agreement of SUV/L’s and MTV measured between lesional PET/MR and PET/CT and by two sequential PET/MR. T/L ratio reproducibility and repeatability demonstrated almost perfect agreement despite changes in SUV/L’s measurements of the liver. PET/MR measurements of SUV/Lpeak showed to be more consistent compared to SUV/Lmax of lesions. For normal structures, there was only slight-moderate agreement in SUV/L’s measured in PET/MR compared with PET/CT. There was substantial-almost perfect agreement in SUV/L’s measured in two sequential PET/MR for all normal structures with the exception of the aorta and subcutaneous fat.

**CONCLUSION**

PET/MR is reliable with regard to quantification of PET metrics and could be used to assess the metabolic response to treatment of cancerous tumors.

**CLINICAL RELEVANCE/APPLICATION**

PET/MR is reliable with regard to quantification of PET metrics.

**NM004-EB-TUA**

Lung Scintigraphy in Transplant Patients - A Primer

**Awards**

Certificate of Merit

**Participants**

Daniella F. Pinho, MD, Dallas, TX (Presenter) Nothing to Disclose
Amit Banga, Dallas, TX (Abstract Co-Authors) Nothing to Disclose
Fernando Torres, MD, Dallas, TX (Abstract Co-Authors) Nothing to Disclose
Dana Mathews, MD, PhD, Dallas, TX (Abstract Co-Authors) Nothing to Disclose

**TEACHING POINTS**

1. To review the indications of lung scintigraphy in patients pre and post single and bilateral lung transplant.
2. To assess the added value of physiologic information given by lung scintigraphy in the lung transplant setting.
3. To discuss the impact of scintigraphy findings in the management of lung transplant patients.
4. To correlate lung scintigraphy findings with other studies modalities (for example, CTA of the chest) and with lung transplant histology.

**TABLE OF CONTENTS/OUTLINE**

1. Indications for lung transplant
2. Pre-transplant lung scintigraphy  
   a. Imaging findings in different diseases  
   b. Quantitative perfusion lung scintigraphy for surgical planning  
   c. Chest CT and histology correlations
3. Post transplant lung scintigraphy  
   a. Early post transplant complications  
      I. Pulmonary embolism  
      III. Acute rejection  
   b. Late post transplant complications  
      I. Subacute/chronic rejection  
      II. Pulmonary embolism  
      III. Other complications  
   c. Chest CT and histology correlations
4. Summary

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/

Daniella F. Pinho, MD - 2015 Honored Educator
**Nuclear Medicine Tuesday Poster Discussions**

*Tuesday, Nov. 29 12:45PM - 1:15PM Room: S503AB*

**NM223-SD-TUB6**

**Combination of PET SUV and Heterogeneity for Detecting Malignant Tumor in Case of Incidental Localized FDG Uptake in the Colorectal Region**

**Station #6**

**Participants**
- Farrokh Dehdashti, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

**Sub-Events**

**PURPOSE**
The textural analysis using PET images has been proposed as a method to quantify the heterogeneity in several types of tumor. The purpose of this study was to investigate the feasibility of combination of PET parameters using decision-tree analysis to distinguish malignant tumor from benign tumor and physiological uptake in patients with incidental localized FDG uptake in the colorectal region.

**METHOD AND MATERIALS**
We conducted a retrospective review of the clinical data of 4983 patients who underwent FDG PET/CT imaging between April 2012 and December 2015 except patients for examination of the colorectal region. The FDG uptake (maximum standardized uptake value [SUVmax]) and FDG heterogeneity (entropy) were derived from FDG PET images. A decision-tree was developed in which the PET imaging investigations were applied sequentially to identify malignant colorectal tumors.

**RESULTS**
In 4983 FDG PET/CT images, 63 foci of localized FDG uptake were observed in the colorectal region in 60 patients. In these patients, 40 foci in 37 patients were examined using colonoscopy. The subsequent decision tree applied entropy as the initial PET parameter for differentiating between physiological uptake and tumor. The SUVmax was assessed second for differentiating between benign tumor and malignant tumor. Thus, the final decision tree comprised 2 decision nodes and 3 terminal nodes, one of which identified malignant tumor. The final diagnosis was malignant tumor in 11, benign tumor in 16, and no lesion (physiological FDG uptake) in 13 foci. The mean value of entropy in tumors was significantly higher than that in physiological uptake (p<0.01). The mean value of SUVmax in malignant tumor was significantly higher than that in benign tumor (p<0.02). The net sensitivity and net specificity for the decision tree were 91% and 76%, respectively. The net sensitivity was better than that for only SUVmax (73%). The net specificity was better than that for only entropy (45%).

**CONCLUSION**
A decision-tree analysis using combination of PET parameters might have the potential to distinguish malignant tumor from benign tumor and physiological uptake in patients with incidental localized FDG uptake in the colorectal region.

**CLINICAL RELEVANCE/APPLICATION**
Combination of PET parameters might have the potential to distinguish malignant tumor from benign tumor and physiological uptake in patients with incidental localized FDG uptake in the colorectal region.

**NM224-SD-TUB7**

**Quantification of the Myocardial Perfusion Reserve in Chronic Kidney Disease Patients Using Dynamic SPECT Imaging**

**Station #7**

**Participants**
- Noriko Tsuda, Kumamoto, Japan (*Presenter*) Nothing to Disclose
- Shinya Shiraishi, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
- Fumi Sakamoto, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
- Masataka Nakagawa, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
- Hideaki Yuki, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
- Seiji Tomiguchi, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
- Yasuyuki Yamashita, MD, Kumamoto, Japan (*Abstract Co-Author*) Consultant, DAIICHI SANKYO Group

**PURPOSE**
The aim of this retrospective study was to examine the relationship between chronic kidney disease (CKD), myocardial blood flow (MBF) and myocardial perfusion reserve (MPR) when calculated from dynamic 201Tl-chloride (Cl) kinetic analysis using a cadmium zinc telluride (CZT) ultra-fast camera.
**NM225-SD-TUB8**

**Correlation of Intratumor Heterogeneity of 18F-FLT Uptake with Tumor Grade and Proliferation in Patients with Newly Diagnosed Gliomas**

**Station #8**

**Participants**
- Yuka Yamamoto, MD, PhD, Kagawa, Japan (Presenter) Nothing to Disclose
- Katsuya Mitamura, Kita-gun, Japan (Abstract Co-Author) Nothing to Disclose
- Takashi Norikane, Kita-gun, Japan (Abstract Co-Author) Nothing to Disclose
- Tetsuhiro Hatakeyama, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose
- Yoshihiro Nishiyama, MD, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The nucleoside analog 3'-deoxy-3'-18F-fluorothymidine (FLT) has been investigated for evaluating tumor proliferating activity in brain tumors. The textural analysis using PET images has been proposed as a method to quantify the heterogeneity in several types of tumor. The purpose of this study was to evaluate FLT uptake using textural analysis in patients with newly diagnosed gliomas and to correlate the results with tumor grade and proliferative activity.

**METHOD AND MATERIALS**

FLT PET was investigated in 36 patients with newly diagnosed gliomas. PET emission scanning of the head region with a 15-min acquisition of one bed position was performed at 60 min after FLT injection. The maximum standardized uptake value (SUVmax), tumor-to-contralateral normal brain tissue (T/N) ratio, and metabolic tumor volume (MTV) and textural features (standard deviation, skewness, kurtosis, entropy, and uniformity) were derived from FLT PET images. Tumor grading and proliferative activity as indicated by the Ki-67 index were estimated in tissue specimens.

**RESULTS**

There was a significant difference in SUVmax between grades II and IV (p<0.02), in T/N ratio between grades II and IV (p<0.02), in standard deviation between grades II and IV (p<0.03), and in entropy between grades III and IV (p<0.05). Linear regression analysis indicated a significant correlation between Ki-67 index and SUVmax (r=0.40, p<0.03), T/N ratio (r=0.43, p<0.02), MTV (r=-0.41, p<0.002), kurtosis (r=0.51, p<0.003), entropy (r=0.73, p<0.001), and uniformity (r=0.61, p<0.001).

**CONCLUSION**

FLT based heterogeneity may be useful in the noninvasive assessment of tumor grade and proliferation in newly diagnosed gliomas.

**CLINICAL RELEVANCE/APPLICATION**

FLT based heterogeneity may be useful in the noninvasive assessment of tumor grade and proliferation in newly diagnosed gliomas.
METHOD AND MATERIALS

Patients with histologically proven cancer, who were referred to our tertiary care center for PET/MR between August 2014 and March 2016, were included in this retrospective study. Inclusion criteria were: [18F]-FDG- or [68Ga]-PSMA-PET/MR (fully integrated 3T system) at staging; BM at imaging (hypointense lesion on T1w with high uptake on PET, non-inflammatory); T1w and DWI implemented the protocol. Patients with a history of radio/immuno/chemotherapy were excluded. For each patient with BM (pBM) a control patient (Co), matching the inclusion criteria, but without BM, was included. SUvmax, SUvavg, ADCmin, ADCavg, mean T1w SI were collected from each BM and from 1 healthy bone area (HB) in each pBM (pHB) and Co (cHB). For each BM, the diagnostic confidence (dc) of PET, DWI, T1w, and the DWI image quality of DWI, were assessed on a 10-point scale. One-way-ANOVA and Bonferroni-corrected Games-Howell post-hoc tests were used to assess quantitative differences between BM and HB. Correlation coefficients (Spearman) between SUVs and ADCs and between DWI dc and image quality were calculated.

RESULTS

Overall, 14 pBM and 14 Co out of 130 PET/MR exams met our inclusion criteria. Primary tumors were lymphoma (n=9), prostate- (n=7), cervix- (n=5), breast-, ovarian-, adrenal gland-, pancreas-, thyroid cancer, HCC and thymoma (1 each). Statistically significant differences for SUvmax, SUvavg, ADCmin, ADCavg, and mean T1w SI emerged between BM (n=56) and HB (14pHB, 14cHB) (p=0.000, respectively). No significant differences occurred between pHB and cHB. No correlation emerged between SUVs and ADCs (pSUvmax vs ADCmin=0.963; pSUvavg vs ADCavg=0.294). Mean Dc ratings were 9.3 (PET), 8.4 (T1) and 7.5 (DWI); mean DWI image quality was 8.46. DWI dc significantly correlated with DWI image quality (r=0.394 p=0.000).

CONCLUSION

PET/MR with DWI may enable a reliable quantitative differentiation of BM from HB. Moreover, PET showed the highest dc.

CLINICAL RELEVANCE/APPLICATION

Despite the technical limitations associated with MR-AC, PET/MR including DWI demonstrated to be a robust tool for detecting and quantifying bone metastases in oncologic patients.

NM227-SD- TUB10

Injection to Scan Time Practices in Oncologic FDG PET: A 10-Year Intra and Multi Institutional Review

Participants
Katherine Binzel, PhD, Columbus, OH (Presenter) Nothing to Disclose
David Poon, BS, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Ajay Siva, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Jun Zhang, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Barbaros S. Erdal, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Chadwick L. Wright, MD, PhD, Lewis Center, OH (Abstract Co-Author) Nothing to Disclose
Preethi Subramanian, MS, BEng, Columbus, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE

As injection to scan time variation is the most common deviation from protocol when oncologic PET/CT is used within clinical trials, we set out to investigate the clinical reality within a 10 year window, both intra-institutionally and within multi-institutional trials.

METHOD AND MATERIALS

We started to record all image acquisition related information since 2005 in a searchable database infrastructure. Our team also manages national clinical trials on behalf of NCI (NCTN) and are thus intensively involved in quality assurance for clinical trials that use PET/CT for staging and response assessment. We developed and analyzed our databases using query tools and pivot tables.

RESULTS

Variations from the protocol defined imaging time post injection remains the most common protocol violation in FDG PET/CT. Compliance has overall improved within the last decade apparently due to better training, communication and clinical trial expectations. This improvement continued over the years even when local practice is different from protocol specifications with the following trends. One multi-center trial expecting a 50-70 minutes imaging start p.i. had a 99% compliance (n=476), while another with a 60-80 minute target window had only 75%. Within the single institution review of standard clinical imaging, we found also improvement over the years but only 61% of studies fell within 10 minutes of the 75 minute target uptake time. Most institutions do not regularly monitor injection to scan time compliance especially in regard to consistency between baseline and follow up for response assessment.

CONCLUSION

Adherence to protocol expectations for FDG PET/CT imaging has improved in regard to imaging time post injection, but remains a constant source of protocol inconsistencies. Multicenter national clinical trials have seen overall the best improvement which is apparently due to better communication, training, trial QC and feedback mechanisms. Outside of clinical trials, variability remains very high and appears to fluctuate over the years. Therefore, clinical services should also use quality assurance and management tools to ensure being aware of local practice changes.

CLINICAL RELEVANCE/APPLICATION

Inconsistency with clinical protocol requirements in regard to imaging time post FDG injection remains a common occurrence. Integrated feedback mechanisms are essential for local and clinical trial adherence.

NM119-ED- TUB11

Influence of Radionuclide 123 MIBG Scintigraphy with Additional Curie Score in the Management of Pediatric Neuroblastoma

Participants
Anderson B. Collier III, MD, Jackson, MS (Presenter) Nothing to Disclose
TEACHING POINTS

Explain Curie Score in Pediatric Neuroblastomas
Show examples of MIBG study with Curie Scoring

TABLE OF CONTENTS/OUTLINE

Neuroblastoma (NBL) is the most common extracranial solid tumor of children. Despite improvement in outcomes, high risk patients have an unacceptably low survival. Over 90% of NBLs uptake metaiodobenzylguandine (MIBG) making MIBG scans useful in staging. MIBG is being evaluated for use in stratification. The curie score is a semi-quantitative measure of MIBG uptake at 10 different body sites. This score has been evaluated retrospectively in high risk NBL patients. The curie score after induction is the most predictive of outcome being able to differentiate a group of patients with a score £2 who have a 44.9% 4-year event free survival (EFS) compared to a group with a score >2 who have a 15.4% 4-year EFS. When the status of the oncogene MYCN is included in this analysis, patients who are MYCN amplified and have a post-induction curie score >2 have a 3-year EFS of 0%. The score is being evaluated prospectively to confirm the results with more recent therapy. References:

Participants
Janis P. O’Malley, MD, Birmingham, AL (Moderator) Nothing to Disclose
Katherine A. Zukotynski, MD, Hamilton, ON (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Recognize the role of PET/CT in the evaluation of abdominopelvic malignancies. 2) Describe how differences in tumor biology impact tumor assessment with PET. 3) Provide imaging examples specific to different abdominopelvic malignancies.
**Pilot Evaluation of Two-Phase Hybrid 18F-Fluoride PET/MRI of the Sacroiliac Joints in Patients with Ankylosing Spondylitis**

**Participants**
Yonglin Pu, MD, PhD, Chicago, IL (Moderator) Nothing to Disclose
Andrew C. Homb, MD, Louisville, KY (Moderator) Nothing to Disclose

**Purpose**
To evaluate the feasibility of blood-pool phase 18F-Fluoride positron emission tomography/magnetic resonance imaging (18F-F PET/MRI) of the sacroiliac joints (SIJ) in patients with active ankylosing spondylitis (AS) and to compare blood-pool and standard mineralization-phase 18F-F PET/MRI in different AS lesions.

**Method and Materials**
13 patients with active AS were prospectively enrolled. Early 18F-F PET was acquired in the blood-pool phase 6 min after injection of 158±8 MBq 18F-F. Then, a standard 18F-F PET was acquired in the mineralization phase 40 min after injection. PET and MR images were analyzed in consensus regarding image quality (IQ) (four-point Likert scale: 0=non-diagnostic, 3=excellent image quality). The iliac and the sacral part of each SIJ was subdivided in an upper and a lower part, resulting in 4 SIJ quadrants (SQ) per side. All SQ were then evaluated regarding the presence of bone marrow edema (BME), fatty deposits (FD), sclerosis, ankylosis, and focal 18F-F uptake on blood-pool and mineralization phase PET. Additionally, PET/MR images were reviewed for extraosseous 18F-F uptake.

**Results**
Mean IQ was 3.0±0 for MRI, 3.0±0 for mineralization phase, and 2.2±0.4 for blood-pool phase 18F-F PET. 66 SQ (63.4%) showed FD, 44 SQ (42.3 %) BME, and 28 SQ (26.9%) erosions. Sclerosis was found in 27 SQ (26%), and ankylosis in 11 SQ (10.6%). On mineralization phase 18F-F PET/MRI focal uptake was seen in 45 SQ (43.3%), whereas on blood-pool phase 18F-F PET/MRI focal uptake was found in only 25 SQ (24.0%, p<0.001). There was no focal 18F-F uptake detectable on blood-pool phase PET/MRI without a corresponding uptake on mineralization phase PET/MRI. Moreover, blood-pool phase 18F-F PET/MRI revealed no additional extraosseous PET-positive lesions. On mineralization phase 18F-F PET/MRI, SQ showing BME alone or a combination of BME with other AS lesions had a significantly higher (p<0.001) percentage of focal uptake (38/44 SQ; 86.4%) than on blood-pool phase 18F-F PET/MRI (21/44 SQ; 47.7%).

**Conclusion**
Two-phase 18F PET/MRI of the SIJ is feasible. However, the blood-pool phase 18F-F PET offered no added diagnostic value as compared with standard mineralization phase 18F-F PET/MRI in patients with active AS.

**Clinical Relevance/Application**
According to our data, there seems to be no relevance of a blood-pool phase PET scan as part of a two-phase 18F-F PET/MRI protocol for the assessment of SIJ involvement in AS.
18F-FDG PET/CT was performed in 23 consecutive patients (13 men; 10 women; mean age 67.4 ± 11.1 years, range, 40.7 to 88.8 years). All PET/CT scans were analyzed by two independent readers both visually and semiquantitatively by measurement of the maximum standardized uptake value (SUVmax) in areas of visually increased spinal tracer uptake. Laboratory parameters of infection/inflammation including C-reactive protein (CRP), procalcitonin (PCT) and leucocyte count were recorded. Histopathological evaluation and microbiological pathogen detection by either intraoperative material collection and/or blood cultures served as the reference standard. Nonparametric Spearman’s rho was used for correlation analysis. Cohen’s kappa was used for assessment of intra- and interrater agreement.

RESULTS

36 foci of increased tracer uptake within the spine were detected in 21 study patients. Staphylococcus aureus was the predominant pathogen. Mean SUVmax of lesions was 5.6 ± 2.2 (range, 2.6 to 13.0). SUVmax did neither correlate with the level of inflammatory serum markers in this study (CRP: p = 0.29), nor with PCT (p = 0.91) nor with leucocyte count (p = 0.82). 18F-FDG PET/CT had a sensitivity of 100%, a specificity of 66.7%, a positive predictive value of 95.2%, a negative predictive value of 100%, and an overall accuracy of 95.7%. The interrater Cohen's kappa was 0.62 (95% CI 0.16 - 1.09), whereas the intrarater Cohen's kappa was 0.78 (95% CI 0.36-1.20).

CONCLUSION

18F-FDG PET/CT is a reliable and highly sensitive imaging modality for detection of pyogenic spondylodiscitis. Whole-body evaluation by PET may contribute to the detection of additional sites of inflammation. Particularly high uptake values (SUVmax) may be observed in Staphylococcus aureus infection; however, SUVmax cannot reliably predict the causing pathogen. Tracer uptake did not correlate with the level of inflammatory serum markers in this study, questioning the role of PET for grading the strength of inflammatory reaction.

CLINICAL RELEVANCE/APPLICATION

18F-FDG PET/CT is a reliable and highly sensitive imaging modality for detection and localization of pyogenic spondylodiscitis and may contribute to the detection of additional sites of inflammation.

SS117-03  Do Meniscal Pathologies Correlate with Increased Bone Tracer Uptake Using SPECT/CT?

Tuesday, Nov. 29 3:20PM - 3:30PM Room: S505AB

Participants
Anna Hirschmann, MD, Basel, Switzerland (Presenter) Nothing to Disclose
Anna L. Falkowski, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Milos Dordevic, Bruderholz, Switzerland (Abstract Co-Author) Nothing to Disclose
Jan Rechsteiner, Bruderholz, Switzerland (Abstract Co-Author) Nothing to Disclose
Felix Amrein, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Michael T. Hirschmann, MD, Bruderholz, Switzerland (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the correlation of subchondral bone tracer uptake (BTU) of the knee joint using single photon emission computed tomography (SPECT)/computed tomography (CT) and meniscal pathologies using magnetic resonance (MR) imaging.

METHOD AND MATERIALS
Twenty-five consecutive patients (mean age 45.5 ± 11.5 years) with MR and SPECT/CT within three months were prospectively collected and retrospectively included. Patients with previous knee surgery as well as with grade 3 and 4 cartilage lesions were excluded. For analysis and comparison of MR and SPECT/CT a specific localisation scheme was used. Maximum values of each subchondral femorotibial area were quantified and a ratio was calculated in relation to a reference region in the femoral shaft, which represented the BTU background activity. Meniscal pathologies on MR were graded (non, degeneration, tear) by two experienced musculoskeletal radiologists blinded to the SPECT/CT findings. Extrusion of the meniscus was assessed. ANOVA and Chi-Square served for statistics.

RESULTS
Meniscal degeneration showed a significantly higher mean relative BTU compared to an intact meniscus on the femoral side (p=0.018; tibial side p=0.072). Meniscal tear showed significantly higher mean relative BTU compared to an intact meniscus (p<0.01 femoral and tibial side) as well to degeneration (p=0.006, respectively). Meniscal extrusion showed significantly higher mean relative BTU compared to non-extruded meniscus (p<0.02). Medial meniscal pathologies (0.52) showed higher correlation with BTU than on the lateral side (0.23).

CONCLUSION
Subchondral BTU in SPECT/CT of the knee with preserved cartilage was significantly higher with meniscal degeneration or tear as well as meniscal extrusion. SPECT/CT is able to identify patients with an increased risk for development of osteoarthritis.

CLINICAL RELEVANCE/APPLICATION
The present results demonstrate the need for a valid tool, which is able to diagnose osteoarthritis in its earliest stages, in order to create specialized treatments in a timely manner avoiding outcomes caused by osteoarthritis progression.

SS117-04  Variability in Sodium Fluoride PET Imaging Observed in Multicenter Clinical Trials

Tuesday, Nov. 29 3:30PM - 4:00PM Room: S505AB

Participants
Prayna Bhata, BS, Columbus, OH (Presenter) Nothing to Disclose
David Poon, BS, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Jun Zhang, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Chadwick L. Wright, MD, PhD, Lewis Center, OH (Abstract Co-Author) Nothing to Disclose
Lawrence H. Schwartz, MD, New York, NY (Abstract Co-Author) Committee member, Celgene Corporation Committee member, Novartis AG Committee member, ICON plc Committee member, BioClinica, Inc
Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
PURPOSE
To identify areas of variability or non-compliance and critical challenges in NaF PET/CT imaging by analyzing de-identified imaging examinations from a multi-center oncology trial that included bone imaging in comparison to the SNMMI standard NaF PET/CT acquisition guidelines.

METHOD AND MATERIALS
30 patients with 80 NaF PET/CT examination from over 14 credentialed institutions within the USA were included in this assessment. A standardized quality control (QC) process was utilized pulling key information from the DICOM tags including NaF dosage and uptake time. Trial-specific data compliance was evaluated. The utilized dosage and uptake time was compared to the SNMMI standard NaF guidelines. A standard QC scoring system for NaF PET was developed and implemented to determine the variability of the exams.

RESULTS
The SNMMI guidelines on NaF PET/CT imaging recommend imaging 45-60 minutes post-injection. We found that only 33% fell within those guidelines while 66% were outside that range. The average uptake time for the trial studies was 58 ± 17 min, with a range of 20 to 103 minutes (median: 61 minutes). Compared to the recommended dose for adults of 185-370 MBq (5-10 mCi), only 39% of the studies fell within the protocol range. The average dose for the trial studies was 358 ± 66 MBq (9.7 ± 1.8 mCi) with a median of 375 MBq (10.1 mCi). 6% of the dose activity were below the protocol minimal dose and 55% were above.

CONCLUSION
Currently, only a few publications summarize recommendations for Sodium Fluoride PET acquisition and the SNMMI imaging protocol includes several considerations for patient acquisition. There is no evidence that higher than recommended dose are diagnostically beneficial nor imaging outside the recommend p.i. time frame. It is thus evident, that clinical practice is currently in 2/3 of the scans outside current recommendations and that based on ALARA dose reductions should be considered. While most of the variability does not impact the visual accessibility of NaF PET, safety and potential quantitative assessment considerations necessitate a substantial improvement in community practice within clinical trials.

CLINICAL RELEVANCE/APPLICATION
As osseous disease burden are increasingly decision points for adaptive clinical trials, quality assurance standards for NaF PET/CT must be monitored, as current procedural variability is excessive.

SSJ17-05 18F-FDG Super Bone Marrow Uptake: A PET Presentation of Bone Marrow Malignant Infiltration?
Tuesday, Nov. 29 3:40PM - 3:50PM Room: SS05AB

Awards
Student Travel Stipend Award

Participants
Mohammed Shah Alam, MBBS, Guangzhou, China (Presenter) Nothing to Disclose
Hu Bing Wu, PhD, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Lilan Fu, MBBS, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Wen-Lan Zhou, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Wang Quan-Shi Wang, PhD, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
It has not been illuminated what causes the super 18F-FDG uptake in bone marrow (SBMU), which presents as particular high diffuse 18F-FDG uptake in bone marrow similar to or higher than that in the brain. The present study was performed to investigate its origins and clinical significance.

METHOD AND MATERIALS
31 newly diagnosed patients with SBMU were retrospectively reviewed from April 2008 to December 2015. Twenty normal subjects were selected as the control group. The SUVmax of bone marrow was measured and the bone marrow to cerebellum (BM/C) ratio was calculated. Blood parameters as well as fever were also been collected and analyzed.

RESULTS
Of 31 patients with SBMU, 29 (93.6%) were diagnosed to have malignancies including 14 lymphoma, 11 leukemia, 3 multiple myeloma and 1 bone metastasis. BM malignant infiltration (BMI) was confirmed in all these patients. SUVmax and BM/C ratios of the SBMU were significantly higher than that of control subjects (SUVmax, 11.30±3.95 vs. 2.43±0.51, t=9.936, P=0.000; BM/C ratios, 1.24±0.36 vs. 0.23±0.02, t=12.463, P=0.000; respectively). Extra-bone marrow lesions were found in 15 patients with malignances. Decrease of leukocyte count (WBC) count, hemoglobin (HB) and platelet count (PLT) were noted in 48.4%, 86.2% and 51.5% of the patients with BMI respectively . HB, PLT, lactic dehydrogenase (LDH), C-reactive protein (CRP) and the fever incidence were observed to be helpless for the differentiation of lymphoma and leukemia (all P>0.05). However, increase of WBC counts and extra-BM involvement found on PET were useful for differentiation, especially the liver and nasal cavity involvements (P=0.020 and P=0.046, respectively).

CONCLUSION
Most of the SBMU was caused by the malignant infiltration which often accompany with decrease of hematopoietic function. 18F-FDG PET/CT is useful for detection of extra-BM involvements and for differentiation of lymphoma and leukemia.

CLINICAL RELEVANCE/APPLICATION
Study revealed that super BMU was a highly potent indicator for the malignant BMI which mostly originated from lymphoma and leukemia.

SSJ17-06 The Prognostic and Diagnostic Value of FDG PET/CT for Assessment of Symptomatic Osteoarthritis
Tuesday, Nov. 29 3:50PM - 4:00PM Room: SS05AB
Awards

Trainee Research Prize - Medical Student

Participants

Brian J. Nguyen, BA, San Diego, CA (Presenter) Nothing to Disclose
Ashley Burt, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Randall L. Baldassarre, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Edward Smitaman, MD, West Hartford, CT (Abstract Co-Author) Nothing to Disclose
Maud M. Morshedi, MD, PhD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Steven Kao, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Sebastian Obrezut, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this study was to assess the clinical significance of increased FDG uptake on PET/CT in the joints for evaluation of symptomatic osteoarthritis (OA) and for prediction of OA progression.

METHOD AND MATERIALS

In this prospective study, shoulder, hip and knee joints were imaged in 79 patients undergoing routine FDG PET/CT imaging. Subsequently, patients completed Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire to assess for joint pain, stiffness, and physical function. SUVs were measured in acromioclavicular, glenohumeral, hip and knee joints. Scout images were reviewed and joints were evaluated for OA using the The Kellgren and Lawrence (KL) system. Patients were followed for 2 years to determine progression of OA based on follow up imaging or surgical intervention.

RESULTS

In the knees ROC AUCs for SUV were 0.737 (WOMAC Total), 0.784 (WOMAC Pain) and 0.743 (WOMAC Function). ROC AUCs in the knees for KL score were 0.794 (WOMAC Total), 0.859 (WOMAC Pain), 0.795 (WOMAC Stiffness) and 0.805 (WOMAC Function). In the hips ROC AUCs for SUV were 0.703 (WOMAC Pain) and 0.764 (WOMAC Function). In the glenohumeral and acromioclavicular joints ROC AUCs for SUV were 0.716 and 0.916 (WOMAC Pain) respectively. Follow-up imaging was available for 19 knee joints. OA progressed in 6 knee joints and was stable in 13. SUV (p = 0.0229), KL score (p = 0.5324), Age (p = 0.8978) and WOMAC score (p = 0.1265) variables were entered simultaneously into the Cox proportional hazards model and only SUV was found to be an independent predictor of OA progression in the knees.

CONCLUSION

SUV measurement on FDG PET/CT may be helpful for assessment of symptomatic OA in the knees and hips, and pain in the shoulders. Increased FDG uptake on PET/CT in the knees may be predictive of progression of OA. KL score of the scout images can aid in identification of symptomatic OA in the knees.

CLINICAL RELEVANCE/APPLICATION

SUV measurement on FDG PET/CT may be helpful for assessment of symptomatic OA in the knees and hips, and pain in the shoulders.
### Coincidence Imaging of In-111: A Monte Carlo Simulation

**Background**

The decay of In-111 results in a gamma-ray cascade of two photons. Because the gamma-rays are emitted in succession, we consider the concept of employing the gamma-ray coincidence to provide additional information about the decay and its environment. Gamma cameras operated in coincidence mode have been used successfully to image PET tracers, however the concept of producing images from gamma cameras using cascaded gamma-rays in coincidence from In-111 has not been previously explored. Coincidence images can provide three-dimensional (3D) information in planar gamma camera studies, and can complement information obtained in tomographic acquisitions. This work provides the foundation for exploring coincidence imaging with In-111 by producing some simple images and evaluating some important basic considerations including the source activity and timing window resolution, for future studies.

**Evaluation**

GEANT4 was used to model a gamma camera and to simulate the decay of the In-111 nucleus. A point source of In-111 was simulated to evaluate the true coincidence efficiency. We use a simple reconstruction algorithm to produce images when the detector heads are positioned at 90°. The decay vertex is computed by projecting a ray from each interaction point, normal to each detector face, then finding the point of minimum separation. To test the algorithm, images are produced from reconstructed coincident events from point sources positioned at the camera isocenter at several source-to-detector distances. To determine the optimal timing window and activity concentration, we compute the noise equivalent count rate as a function of timing window resolution for different activities.

**Discussion**

We found the coincidence detection efficiency to be around 5 events/mCi-s, independent of source-to-detector distance. We found that point source activities ranging from 10 uCi to 5 mCi could be imaged with spatial resolutions of ~1 cm. Optimal time window resolutions ranged between 200 and 500 ns.

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### Initial Evaluation of a Novel General Purpose CZT based Digital SPECT Camera: Significant Improvement of Resolution and Contrast Compared to Standard Analog SPECT

**Purpose**

We have assessed the performance of a novel digital SPECT camera with multiple pixelated cadmium zinc telluride (CZT) detectors and high sensitivity collimators (Digital SPECT; Valiance X12 prototype, Molecular Dynamics). The system's architecture enables gantry rotation, as well as radial and swivel detector motion, providing multiple degrees of freedom for the scanning pattern. These features are used to minimize the patient-detector distance, providing patient-tailored imaging.

**Method and Materials**

Images of Tc-99m filled Jaszczak phantom with cold rod and solid sphere inserts (rod diameter 4.8-12.7 mm, spheres 9.5-31.8 mm) were compared to images acquired on a standard NaI based analog (Anger) SPECT system with high resolution collimators (Discovery NM/CT 670, GE). All images (analog and digital SPECT) were iteratively reconstructed and evaluated visually for resolution. Contrast was calculated using standard methodology.

**Results**
Digital SPECT demonstrated cold rods in reconstructed transaxial slices of 5 segments with rod diameters of 12.7, 11.1, 9.5, 7.9, 6.4 mm, and in five external rows in the sixth segment (diameter 4.8 mm). Analog SPECT demonstrated rods in 4 segments and in part of the 5th (down to 6.4 mm). Spheres were resolved on digital SPECT with contrast of 92.9%, 87.8%, 82.7%, 68.2%, 66.3% and 51.7% (for sphere diameters measuring 31.8, 25.4, 19.1, 15.9, 12.7 and 9.5 mm, respectively). These results are a significant improvement compared to analog SPECT, with 63.5%, 52.8%, 44.4%, 39.3%, 26.4%, and 18.6% for the same spheres respectively. See figure: Transaxial slices of Jaszczak phantom cold rods section: Left - Valiance X12 prototype; Right – NaI based analog SPECT system.

CONCLUSION

Contrast and resolution of digital SPECT consistently surpassed standard analog SPECT performance in the phantom studies reported.

CLINICAL RELEVANCE/APPLICATION

The superior image quality will likely prove useful in clinical settings.

SSJ22-03  Best in Class Time of Flight PET Performance - What is the Clinical Benefit?

Tuesday, Nov. 29 3:20PM - 3:30PM Room: S403B

Participants
Jun Zhang, PhD, Columbus, OH (Presenter) Nothing to Disclose
Ajay Siva, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Prayna Bhatia, BS, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Katherine Binzel, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Chadwick L. Wright, MD, PhD, Lewis Center, OH (Abstract Co-Author) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Chuan Yong Bai, Cleveland, OH (Abstract Co-Author) Employee, Koninklijke Philips NV;

PURPOSE

As the benefits of time-of-flight (TOF) in PET has been increasingly recognized, we wanted to assess if there are clinical benefits by using best in class TOF timing resolution, which is enabled by next generation, solid state digital photon counting PET detectors.

METHOD AND MATERIALS

30 patients receiving a whole body oncologic FDG PET participated in an intra-individual comparison study to detect and assess potential differences due to different timing resolution of TOF. Patients were sequentially imaged using a 325 ps TOF next generation digital dPET (Vereos) and a conventional 550 ps TOF cPET (Gemini). A dose of 13mCi FDG and 90s/bed were used. Listmode data sets were reconstructed with and without TOF using optimized 3D OSEM algorithms. ROI’s of liver background and lesions were placed with SUV and SNR compared between all data sets. Blinded image reviews were performed comparing the 4 image data sets. Additionally, phantoms with hot spheres and cold rods of varying sizes were acquired and assessed.

RESULTS

109 assessable lesions were identified and analyzed. The 325ps TOF dPET images were ranked best in all categories with best signal-to-noise, contrast, recovery coefficient, visual quality and lesion delineation. Comparing the two generation systems, 325ps TOF dPET presented SNR of ~2x vs non TOF, 550ps TOF cPET a SNR of ~1.6x vs non TOF. On SUV analysis, 325ps presented with 20%±27% higher SUV vs non TOF, 550ps with 15%±18% vs non TOF. No significant SUV differences in the liver background ROI were found (p>0.05). 10% of the lesions confidentially classifiable on 325ps TOF were not assessable on 550 ps TOF, while 25% were non assessable on non-TOF.

CONCLUSION

325ps TOF PET was found to consistently present with the best performance in all categories, especially SNR. The clinical benefit appears to come from the more precise localization of metabolic activity which translates to higher SUV peak value, sharper lesion delineation and overall better visualization with an improved lesion detection of 10% compared to current generation TOF timing resolution.

CLINICAL RELEVANCE/APPLICATION

SNR, lesion uptake and visual quality all benefit from improved timing resolution with the more precise event localization that appears to be able to improve clinically relevant lesion detectability.

SSJ22-04  System Physics Characteristics and Stability of Next Generation Digital Photon Counting PET

Tuesday, Nov. 29 3:30PM - 4:00PM Room: S403B

Participants
Jun Zhang, PhD, Columbus, OH (Presenter) Nothing to Disclose
Michael Miller, Highland Heights, OH (Abstract Co-Author) Nothing to Disclose
Katherine Binzel, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE

To measure and assess the system physics characteristics and stability of a next generation solid state, digital PET and its potential to advance clinical PET.

METHOD AND MATERIALS

Physical characteristics of timing resolution and energy resolution as well as NEMA 2012 based spatial resolution, sensitivity, count loss and image quality of the next generation digital photon counting (DPC) PET/CT system (Vereos) was performed. System stability in timing and energy were monitored over a year, and complete NEMA testing was done at the beginning and the end of the 1-yr window since system installation. CQIE PET uniformity was measured in a quarterly manner. The observed system
characteristics were compared to current technology systems and its potential impact for clinical oncologic PET imaging assessed.

**RESULTS**

The DPC PET/CT system demonstrated robust system physics characteristics with <2% variability in timing resolution, ±0.4% change in energy resolution, <2% change in spatial resolution, <10% variations in detector temperature and humidity as well as <5% change of SUV/uniformity profile through a > one year monitoring period. NEMA 2012 testing found a spatial resolution (in mm FWHM) from 4.10 / 3.96 at 1 cm to 5.79 / 6.20 at 20 cm in the transverse and axial plane. 325 ps timing resolution and 11.1 % energy resolution were consistently obtained. We measured a 5.7 kcps/MBq system sensitivity and 24.1 kcps/MBq effective sensitivity with TOF gain. For count loss testing, ~171 kcps peak NECR and > 680 kcps peak true rate were obtained at 50 kBq/mL, and the scatter fraction is about 30%. NEMA IQ demonstrated hot sphere contrast ranging from ~62%-42% (10 mm) to ~88%-42% (22 mm), cold sphere contrasts of ~86%±2% (28 mm) and ~89%-43% (37 mm) and excellent image uniformity. These characteristics led to excellent image quality of clinical oncologic PET imaging.

**CONCLUSION**

The system physics performance characteristics were found to be robust over an one year period and of excellent specifications, overall considerably more preferential than current conventional benchmark systems.

**CLINICAL RELEVANCE/APPLICATION**

The next generation solid state, high TOF temporal resolution PET technology is robust and with excellent imaging physics characteristics promising substantial improvements for clinical PET imaging.

**SS222-05 Are Camera Measurements Alone Sufficient in Determining I-131 Thyroid Cancer Therapy Maximum Permissible Blood Dose?**

Tuesday, Nov. 29 3:40PM - 3:50PM Room: S403B

Participants
Kenneth Nichols, PhD, New Hyde Park, NY (Presenter) Royalties, Syntemedia, Inc;
Fitzgerald Leveque, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Miyoui Yoshida-Hay, BS, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
William Robeson, MSC, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Christopher J. Palestro, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Our study was undertaken to determine the validity of recent suggestions that I-131 thyroid cancer therapy dose to blood can be estimated by camera measurements alone (Health Phys 2015;108:53-58EH), rather than the conventional approach of combining camera count measurements with blood assays (Am J Roentgenol Radium Ther Nucl Med 1962;87:171-182).

**METHOD AND MATERIALS**

Data were examined retrospectively for 74 pts undergoing I-131 therapy for thyroid cancer ablation, divided into first & second half groups of 37 pts each (Groups 1&2). Following the conventional approach, anterior & posterior pt counts were obtained by an uncollimated gamma camera, & blood withdrawn & assayed in vitro by a well counter 1, 4, 24, 48, 72-96, & 96-144 hrs after ingestion of I-131 to compute the whole body γ & in vivo β dose contributions to blood. Linear regression for Group1 established predictions of total blood dose by in vitro-only and by camera-only measurements. Predictions were compared to conventional total blood dose for Group1, Group2 & for all pts by the paired t-test and by Pearson correlation.

**RESULTS**

Mean doses were similar for total blood dose by conventional, in vitro-only & camera-only methods (p > 0.40) for Group1 (0.75±0.50, 0.76±0.50 & 0.74 ±0.47 rad/mCi, respectively), Group2 (0.77±0.56, 0.76±0.54 & 0.80 ±0.55 rad/mCi, respectively), & all pts (0.76±0.52, 0.77±0.51 & 0.76 ±0.51 rad/mCi, respectively). However, correlation was significantly stronger between conventional & in vitro-only than between conventional & camera-only estimates for Group1 (r = 0.98 versus r = 0.94, p = 0.02), Group2 (r = 0.98 versus r = 0.94, p = 0.02) & for all pts (r = 0.98 versus r = 0.94, p = 0.0004).

**CONCLUSION**

While it is possible to simplify I-131 dose estimation using camera measurements alone, estimating blood dose by blood work alone is the more statistically robust approach.

**CLINICAL RELEVANCE/APPLICATION**

For cases in which camera measurements are compromised by technical errors, it is justifiable to rely on blood measurements alone in estimating I-131 thyroid cancer therapy maximum permissible blood dose.

**SS222-06 Evaluation of Different Strategies to Improve CT-based PeT Attenuation Correction Close to Metal Impants: A Phantom Study**

Tuesday, Nov. 29 3:50PM - 4:00PM Room: S403B

Participants
Christoph Schabel, MD, Tubingen, Germany (Presenter) Nothing to Disclose
Sergios Gatisid, MD, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose
Malte N. Bongers, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Juergen Kupferschlaeger, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Georg Beer, MD, Tubingen, 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, Bayer AG; Research Grant, Siemens AG;
Christian la Fougere, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolaou, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Christina Pfannenberg, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
PURPOSE
To compare different strategies of metal artifact (MA) reduction in CT for the improvement of CT-based PET attenuation correction close to metal implants.

METHOD AND MATERIALS
A phantom was studied consisting of a cylindrical tube filled with [18-F]FDG solution containing two artificial jaws with metal containing dental work. CT datasets were acquired using a 3rd generation dual-source CT (Somatom Definition Flash, Siemens Healthcare, Germany). Two datasets were obtained with a CTDI of 15mGy using single energy (SE) mode at 120kV and dual energy mode at 100/Sn140kV. Single energy datasets were reconstructed using filtered back projection without (NOMAR) and with iterative MA reduction (IMAR, Siemens Healthcare, Germany). Dual energy datasets were reconstructed using linear blending (Mix) and mono energetic extrapolation (ME) at 150 and 190 keV without IMAR. PET measurements of the phantom were performed on a state-of-art PET/CT scanner. Afterwards PET/CT datasets were co-registered with the CT only datasets and PET data were reconstructed with the previously reconstructed CT only data sets. Relative PET quantification errors were quantified by 16 regions of interest (ROI).

RESULTS
MA were present in all CT datasets. MA reduction strategies were able to reduce these artifacts to different extend, with IMAR showing best capabilities followed by ME190keV and ME150keV. SE and Mix images depicted strongest artifacts. In general, activity concentrations were overestimated / underestimated in areas of high/low-density metal, artifacts respectively. Relative errors in PET quantification ranged between -71 and 70% for Mix, -63 and 49% for SE, -67 and 42% for ME150keV, -66 and 39% for ME190keV and -37 and 13% for IMAR images. Averaged absolute values were 34±22%, 29±17%, 24±18%, 23±18%, 8±9%, respectively (p<0.001).

CONCLUSION
CT-based PET-attenuation correction was improved significantly using dual energy based metal artifact reduction strategies; nevertheless iterative metal artifact reduction strategy was superior. Further clinical studies are necessary in order to assess the clinical performance of this algorithm in patients.

CLINICAL RELEVANCE/APPLICATION
CT-based PET attenuation is susceptible for errors in regions with CT artifacts. Metal artifact reduction is essential to optimize attenuation correction. This study compares different and novel strategies.
Case-based Review of Nuclear Medicine: PET/CT Workshop-Lymphoma/Melanoma/Multiple Myeloma (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Nov. 29 3:30PM - 5:00PM Room: S406A

CT NM OI

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

Participants
Janis P. O'Malley, MD, Birmingham, AL (Moderator) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Homewood, AL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review where PET/CT fits into the assessment of lymphoma, melanoma and multiple myeloma. 2) Apply a systematic approach for evaluating PET/CT image quality and pathology. 3) Identify and discuss findings seen on PET/CT in lymphoma, melanoma and multiple myeloma.

ABSTRACT
**LEARNING OBJECTIVES**

1) Describe the role of SPECT/CT in the workup of patients with malignancy. 2) Describe the role of SPECT/CT in musculoskeletal infection. 3) Use SPECT/CT to improve the accuracy of radionuclide studies for diagnosing musculoskeletal diseases.

**ABSTRACT**

**RC411A SPECT/CT in Musculoskeletal Diseases**

Participants
Christopher J. Palestro, MD, New Hyde Park, NY (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

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

**ABSTRACT**

**RC411B SPECT/CT in Endocrine and Neuroendocrine Disorders**

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

**LEARNING OBJECTIVES**

The learner will understand that the interpretation of SPECT V/Q imaging is much simpler than the commonly used PIOPED criteria of the past.

**ABSTRACT**
Emerging Technologies: Prostate Cancer Imaging & Management

Tuesday, Nov. 29 4:30PM - 6:00PM Room: S505AB

Participants
Peter L. Choyke, MD, Rockville, MD, (pchoyke@nih.gov) (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

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 technologies in prostate cancer imaging and management.

Sub-Events

RC417A  Introduction to Imaging in Prostate Cancer

Participants
Peter L. Choyke, MD, Rockville, MD, (pchoyke@nih.gov) (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

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.

RC417B  Next Generation Prostate MRI

Participants
Baris Turkbey, MD, Bethesda, MD, (turkbeyi@mail.nih.gov) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Understand current status and uses of multi-parametric MRI. 2) Understand role of MRI in assessment of prostate cancer aggressiveness and tumor heterogeneity. 3) Understand role of computer aided diagnosis systems in evaluation of prostate cancer aggressiveness and tumor heterogeneity.

ABSTRACT

RC417C  Molecular Prostate Imaging: Chemistry to Clinic

Participants
Martin G. Pomper, MD, PhD, Baltimore, MD (Presenter) Shareholder, CTS, Inc; Board Member, CTS, Inc; Research Grant, CTS, Inc; Advisor, CTS, Inc; Institutional license agreement, Progenics Pharmaceuticals, Inc; Institutional license agreement, Advanced Accelerator Applications SA; Institutional license agreement, LI-COR, Inc; Institutional license agreement, BIND Therapeutics, Inc

LEARNING OBJECTIVES
View learning objectives under the main course title.

RC417D  PET/MRI: Is Prostate Cancer a Perfect Fit?

Participants
Peter L. Choyke, MD, Rockville, MD, (pchoyke@nih.gov ) (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

LEARNING OBJECTIVES
1) Understand the potential value of PET/MRI in prostate cancer.
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.

RC417E Hyperpolarized C-13 MR Molecular Imaging of Prostate Cancer

Participants
Daniel B. Vigneron, PhD, San Francisco, CA (Presenter) Research Grant, General Electric Company; Research Grant, GlaxoSmithKline

LEARNING OBJECTIVES

View learning objectives under the main course title.
Nuclear Medicine Wednesday Case of the Day

Wednesday, Nov. 30 7:00AM - 11:59PM Room: Case of Day, Learning Center

AMA PRA Category 1 Credit ™: .50

Participants
Richard K. Brown, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Murray D. Becker, MD, PhD, New Brunswick, NJ (Abstract Co-Author) Nothing to Disclose
Matthew Manganaro, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Wahida T. Rahman, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Jason J. Bailey, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Levi Sokol, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Mark A. Helvie, MD, Ann Arbor, MI (Abstract Co-Author) Institutional Grant, General Electric Company
Donna Eckstein, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
John D. Millet, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1) Learn the salient imaging findings of fat necrosis and giant cell arteritis on PET/CT. 2) Recognize the pattern of uptake on sulfur colloid imaging seen in focal nodular hyperplasia. 3) Learn how to use correlative imaging to assist in the diagnosis of pathology seen on nuclear medicine studies.
**RSNA/ESR Hybrid Imaging Symposium: The ABCs of Hybrid Imaging (An Interactive Session)**

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

**LEARNING OBJECTIVES**

**MSSR41A**  **What You Need to Know about PET-Physics**

Participants
Jan Axelsson, Umea, Sweden, (Jan.E.Axelsson@vll.se) *(Presenter)* Nothing to Disclose

**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.

**MSSR41B**  **How MR Physics Influence Image Quality in Hybrid Imaging**

Participants
Ciprian Catana, MD, PhD, Charlestown, MA, (ccatana@nmr.mgh.harvard.edu) *(Presenter)* Research Consultant, Cubresa Inc

**LEARNING OBJECTIVES**

1) Learn about MR for attenuation and motion correction. 2) Learn about MR artefacts influencing PET-quality. 3) Understand the complexity of physics in MR/PET.

**ABSTRACT**

**MSSR41C**  **Interactive Case Discussion**

Participants
Jan Axelsson, Umea, Sweden, (Jan.E.Axelsson@vll.se) *(Presenter)* Nothing to Disclose
Ciprian Catana, MD, PhD, Charlestown, MA *(Presenter)* Research Consultant, Cubresa Inc

**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.
**Advances in Cardiac Nuclear Imaging: SPECT/CT and PET/CT**

**LEARNING OBJECTIVES**

1) Understand the technical advancements associated with new scintillation cameras and SPECT-CT and PET-CT cameras. 2) Appreciate the benefits of CT attenuation correction. 3) Appreciate the adjunctive benefits of anatomic definition provided with CT and physiologic/function information provided by SPECT and PET. 4) Improve interpretive skills related to SPECT and PET-CT.

**ABSTRACT**

Camera and software technology recently has rapidly advanced, providing improved SPECT image resolution and increased counting statistics. These advancements have provided the possibility of reduced-time and reduced radiopharmaceutical dose image acquisitions. Moreover, increased flexibility in imaging protocols has been realized. Future development of these methods hold promise in increasing diagnostic accuracy and expanding diagnostic applications. The addition of CT to SPECT and PET has afforded the ability to perform attenuation correction, thereby minimizing attenuation artifacts and increasing diagnostic specificity. With CT acquisitions of sufficient resolution, complementary anatomic diagnostic information is provided. In addition, more precise anatomic localization of SPECT and PET abnormalities significantly increases clinical applicability.

**Sub-Events**

RC511A  **Advances in Cardiac SPECT**

Participants
E. Gordon Depuey, MD, New York, NY (Presenter) Steering Committee, Adenosine Therapeutics, LLC;

**LEARNING OBJECTIVES**

1) Implement protocols that facilitate patient-centered imaging and that reduce patient radiation exposure. 2) Understand software methods to cope with lower SPECT counting statistics in order to reduce scan acquisition time and/or radiopharmaceutical injected activity and their clinical impact. 3) Understand instrumentation advances that allow new cameras to perform SPECT with markedly reduced acquisition times and/or less radiopharmaceutical activity and their clinical impact. 4.) Review myocardial perfusion SPECT scans systematically to avoid artifacts and maximize diagnostic accuracy.

**ABSTRACT**

There has been an intersocietal effort to promote patient-centered imaging with a focus on appropriateness guidelines, cost-containment, radiation dose reduction, and the selection of the most appropriate imaging test and protocol to suit particular patient needs. The following technical advancements described facilitate implementation of patient-centered imaging. New software methods and new innovative hardware now allow for significantly shortened SPECT acquisition times without a decrease in image quality. Advancements include iterative reconstruction, resolution recovery, and noise reduction software, and focused collimation and solid state detectors incorporated into new camera designs. Attenuation correction increases diagnostic specificity and facilitates stress-only protocols. Software advancements such as high resolution imaging, scatter correction, and respiratory gating increase diagnostic sensitivity. Even with such technical advancements, however, attention to technical detail is essential to assure optimal image quality. Camera and radiopharmaceutical quality control deserve the highest priority. A systematic review of myocardial perfusion SPECT images is essential to recognize artifacts and optimize diagnostic accuracy. Case examples will be presented to reinforce this approach.

RC511B  **Advances in Cardiac PET**

Participants
Sharmila Durbala, MBBS, Boston, MA (Presenter) Research Grant, Astellas Group; Stockholder, General Electric Company; ; ;

**LEARNING OBJECTIVES**

1) Review the advantages and disadvantages of myocardial perfusion PET compared to SPECT for evaluation of coronary artery disease. 2) Learn the added value of absolute quantitative parameters derived from PET for assessment of cardiovascular disease. 3) Update of current and future clinical applications of cardiac PET imaging in cardiovascular medicine.

**ABSTRACT**

Novel advances in PET detectors, radionuclide availability, clinical software, as well as hybrid PET/CT and PET/MR scanners have revolutionized the clinical and investigative applications of cardiac PET. Cardiac PET myocardial perfusion imaging, in the 1970's, was a predominantly investigative tool, with home-grown software, available at select major academic centers with access to a cyclotron. Over the last decade, with easy access to PET scanners, and to positron emitting perfusion tracers, the use of cardiac PET has exploded —well beyond major academic centers to several hospitals and to large office-based practices. Commercially available software has made quantitative myocardial blood flow assessment, a main-stream clinical application. Hybrid PET/CT scanner applications—calcium score and CT based coronary angiography—have further advanced the applications of cardiac PET. PET/MR is an emerging technology with promising cardiovascular applications. Each of these exciting developments has transformed cardiac PET from a predominantly investigative tool of the 1970's to the advanced clinical tool of the 2016. The primary goal of this session is to discuss the present-day clinical and emerging applications of cardiac PET/CT and PET/MR using a practical case-based approach.
LEARNING OBJECTIVES

1) Review the etiologies and imaging appearances of thyroid nodules in children. 2) Discuss the management of thyroid nodules and differentiated thyroid cancer in children and how this management differs from that in adults.

ABSTRACT

PURPOSE

To comparatively evaluate the new Korean Thyroid Imaging Reporting and Data System (K-TIRADS) and conventional Korean Society of Thyroid Radiology (KSThR) guidelines regarding the malignancy risk stratification of thyroid nodules in children.

METHOD AND MATERIALS

From January 2011 to February 2016, a total of 50 thyroid nodules in 46 children (mean age, 13.6 years, range 4-18 years) with final diagnoses through a fine needle aspiration or operation were included in this study. Ultrasonographic features of 50 nodules including solidity, echogenicity, shape, orientation, margin and presence of calcifications were retrospectively assessed and each nodule was classified according to the K-TIRADS (five categories from 1 to 5) and KSThR (three categories; probably benign, indeterminate, suspicious malignancy). The malignancy risks of the thyroid nodules were assessed according to each category, respectively.

RESULTS

Of the 50 thyroid nodules, 29(58%) were benign and 21(42%) were malignant. The probably benign nodules on KSThR guidelines(n=5) were all categorized into K-TIRADS category 2. Among the indeterminate nodules(n=25), 20 nodules were assigned to K-TIRADS 3 and 5 nodules were assigned to K-TIRADS 4. Suspicious malignant nodules(n=20) were classified to K-TIRADS 4 (n=6) or K-TIRADS 5 (n=14). The malignancy rates with KSThR guidelines were 0% (0 of 5 nodules) for probably benign nodules, 16% (4 of 25 nodules) for indeterminate nodules and 85% (17 of 20 nodules) for suspicious malignancy, while the malignancy rates of K-TIRADS category 2, 3, 4, 5 nodules were 0% (0 of 5 nodules), 10% (2 of 20 nodules), 63.6% (7 of 11 nodules) and 85.7% (12 of 14 nodules), respectively. The area under the ROC curve (AUC) of K-TIRADS was slightly higher than that of KSThR (AUC = 0.885 and 0.869, respectively) without a significant difference (P=.608). Six nodules of 1 to 1.5cm in diameter which belong to the indeterminate category on KSThR and to category 3 on K-TIRADS were all confirmed as benign nodules and would have avoided a fine needle aspiration if K-TIRADS had been applied.

CONCLUSION

Application of K-TIRADS to thyroid nodules of children was feasible and resulted in more detailed stratification of thyroid nodules than KSThR guidelines. Introduction of K-TIRADS may reduce an unnecessary fine needle aspiration.
**Ultrasound Risk Stratification Using the 2015 American Thyroid Association Guidelines for Children with Thyroid Nodules**

**Wednesday, Nov. 30 9:00AM - 9:10AM Room: E352**

**Participants**
Iclal Erdem Tosläk, MD, Chicago, IL (Presenter) Nothing to Disclose
Khalid Alkabban, MBBS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Amany Aziz, MBBCh, Maywood, IL (Abstract Co-Author) Nothing to Disclose
Jennifer E. Lim-Dunham, MD, Maywood, IL (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To determine accuracy of categorization of nodule malignancy when applying risk stratification criteria from the 2015 American Thyroid Association (ATA) Guidelines for Children with Thyroid Nodules.

**METHOD AND MATERIALS**
Thirty-nine thyroid nodules of 33 pediatric patients (28 female and 5 male, with age range 14-18 years) with histopathologically proven diagnosis were retrospectively reviewed. Two radiologists independently rated the ultrasound images according to 2015 ATA Guideline criteria (composition, echogenicity, shape, size, margins, and echogenic foci) which were used to stratify nodules for risk of malignancy, ranging from very low to high suspicion. Vascularity was also assessed. In cases where the observers disagreed, consensus rating was performed. Multivariate analysis was used to measure performance of individual parameters in predicting malignancy. Kappa coefficients were calculated to measure inter-observer agreements for individual parameters.

**RESULTS**
Twenty seven nodules were benign and 12 malignant (10 papillary carcinoma, 2 follicular carcinoma). In 27 lesions, there was agreement between ultrasound risk stratification and pathology. Overall accuracy of risk stratification was 69.23%, with sensitivity of 100%, specificity of 56 %, and area under the ROC curve of .79. Individual features which were best predictors of malignancy were irregular/lobulated margins (55 times as likely to be malignant), hypoechoicinity (6 times) and taller than wide shape (3 times). Inter-observer agreement for individual parameters were as follows: almost perfect for overall level of suspicion (k=0.83); substantial for nodule composition (k=0.80), echogenic foci (k=0.77), and vascularity (k=0.76); moderate for margins (k= 0.60); and fair for shape (k= 0.29).

**CONCLUSION**
ATA Guideline ultrasound parameters allow for appropriate stratification of malignancy risk for thyroid nodules in children prior to tissue diagnosis. Addition of vascularity may contribute to the accuracy.

**CLINICAL RELEVANCE/APPLICATION**
ATA Guideline ultrasound criteria are useful for directing management and fine needle aspiration recommendations for pediatric thyroid nodules.

**Papillary Thyroid Carcinoma Arising in Children and Adolescent Hashimoto’s Thyroiditis: Ultrasonographic and Pathologic Findings**

**Wednesday, Nov. 30 9:10AM - 9:20AM Room: E352**

**Participants**
Sun Hye Jeong, MD, Bucheon, Korea, Republic Of (Presenter) Nothing to Disclose
Eun Hye Lee, MD, Bucheon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyun-Sook Hong, MD, PhD, Bucheon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jeong Ja Kwak, Bucheon-si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
We compared the ultrasonography and pathology features of papillary thyroid carcinoma (PTC) in pediatric and adolescents with Hashimoto's thyroiditis (HT) with those of non-HT patients.

**METHOD AND MATERIALS**
Eleven patients who were surgically confirmed to have pediatric or adolescent PTC from2006 to 2014 were included in this study. We retrospectively analyzed the preoperative ultrasonography and pathology features of PTC arising in HT and non-HT patients.

**RESULTS**
On ultrasonography, thyroid gland was lobulated and enlarged, with many scattered microcalifications in four of five HT patients. Four of six non-HT patients had suspicious masses with calcifications. The diffuse sclerosing variant of PTC (DSVPCTC) was found in three of five HT patients, but none in non-HT patients. Macroscopic or microscopic extrathyroidal extension was evident in all of the HT patients and four of the non-HT patients. Neck lymph node metastases were in all HT patients and five of non-HT patients.

**CONCLUSION**
Three of five PTCs in pediatric and adolescent HT patients were DSVPCTC, whereas all PTCs of the non-HT patients were classic type. On ultrasonography, thyroid gland was diffusely enlarged with scattered microcalifications in four of five HT patients. All five HT cases had aggressive disease, including extrathyroidal extension and cervical lymph node metastases.

**CLINICAL RELEVANCE/APPLICATION**
Some evidence suggests that HT patients are at an increased risk of PTC compared to the general population. However, as PTC is
There are 61 statistically significant pairwise correlations between MRI-defined computational features and medulloblastoma.

METHOD AND MATERIALS

In this HIPAA compliant, IRB approved single institution retrospective study, a radiology report database identified pediatric patients <18 years old who had contrast-enhanced CT studies performed from 2005-2015. CT images and electronic records were reviewed to identify lymph nodes 10-20mm in short axis and confirm final diagnosis (lymphoma, metastasis from other primary, or inflammation from Crohn’s disease or appendicitis). CT textural analysis (CTTA) was performed using a commercially available research software program (TexRAD). This applies a filtration-histogram technique to characterize tumor heterogeneity. The filtration step selectively filters and extracts texture features at different anatomical scales varying from 2mm (fine features) to 6mm (coarse features). Receiver operating characteristic (ROC) analysis was performed to identify optimum threshold values for differentiating benign and malignant lymph nodes and test performance characteristics were calculated.

RESULTS

53 patients were identified [n = 18 lymphoma, n = 17 metastasis (3 neuroblastoma, 3 wilms tumor, 3 ewings sarcoma, 2 fibrolamellar HCC, 1 rhabdomyosarcoma, 1 testicular carcinoma, 1 colorectal carcinoma, 1 hepatoblastoma), n = 18 inflammation]. Classifying the patient groups into malignant (n = 35) and benign (n = 18), there were statistically significant differences at a low filter (SSF 2) for mean (p < 0.0001), standard deviation (p = 0.0013), mpp (p < 0.0001) and skewness (p = 0.001). Entropy and kurtosis were not demonstrated to be statistically significant (p = 0.75 and 0.12) respectively. ROC analysis (AUC=0.95) revealed an optimum mean gray level intensity cutoff of < 20 on SSF 2 to have 78% sensitivity, 91% specificity, 89% positive predictive value, and 82% negative predictive value for the detection of a malignant lymph node.

CONCLUSION

Performing CT textural analysis on lymph nodes in a pediatric patient cohort can reliably differentiate between benign and malignant lymphadenopathy.

CLINICAL RELEVANCE/APPLICATION

Addition of CT textural analysis may reduce the potential risks associated with serial CT imaging or tissue sampling for enlarged lymph nodes identified in pediatric patients.

A Pilot Study of Integrating Computational Image Features and Molecular Subtypes in Medulloblastoma

In this IRB-approved study, we included 29 children with medulloblastoma who had preoperative MRIs with T2-weighted images and tumor tissue specimens collected at an academic medical center. Three radiologists delineated tumor boundaries on multiple contiguous T2-weighted images of each tumor. We developed a computational framework to extract 249-dimensional image features capturing a variety of tumor phenotypic characteristics including tumor intensity, histogram, gabor filters, shape, and edge sharpness features. In addition, a molecular subtype (of the four previously described subtypes: WNT, SHH, Subgroup3, and Subgroup4) was identified in each case. We performed feature association between molecular subtypes and computational image features using the Pearson correlation metric and reported significantly correlated features using P-values and False Discovery Rates (FDR) to control for multiple testing.

RESULTS

There are 61 statistically significant pairwise correlations between MRI-defined computational features and medulloblastoma.
molecular subtypes (P-value<0.05 and FDR<0.01). A majority of image features reflecting molecular subtypes (up to 96.72%)
belonged to four feature types: intensity histogram (n=10), edge sharpness (n=4), daube texture (n=37), and edge shape/Local
Area Integral Invariant (LAI) (n=8). In the category of edge sharpness, for example, two features of scale median (P-value=0.036)
and window histogram (P-value=0.032) were correlated to the molecular subtypes in medulloblastoma. Shape compactness, another
descriptor defining tumor sphericity, was also found to correlate with molecular classes (P-value=0.03). The most significant image
feature was the skewness of Local Area Integral Invariant (LAI) that measured the local shape variance of tumor (P-value=0.005),
suggesting its strong association with molecular subtypes in medulloblastoma.

CONCLUSION
MRI-defined computational image features, specifically tumor shape, can be used to predict molecularly-defined subtypes of
medulloblastoma.

CLINICAL RELEVANCE/APPLICATION
Computational image features on MRI are associated with molecular subtypes of medulloblastoma, allowing for non-invasive
assessment of molecular signatures in this malignant childhood brain tumor.

RS13-07 Pediatric Solid Tumors: Image Based Therapy Decisions
Wednesday, Nov. 30 9:40AM - 10:00AM Room: E352

Participants
Ethan A. Smith, MD, Saline, MI, (ethans@med.umich.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To review the staging systems of common pediatric solid tumors, including Wilms tumor, neuroblastoma, hepatoblastoma and
lymphoma. 2) To understand the imaging findings which correspond to critical branch points in treatment algorithms and which will
change clinical management in pediatric solid tumor patients.

ABSTRACT
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/

Ethan A. Smith, MD - 2016 Honored Educator

RS13-08 Optimization of Pediatric PET-CT
Wednesday, Nov. 30 10:20AM - 10:40AM Room: E352

Participants
Susan E. Sharp, MD, Cincinnati, OH (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss preventable PET/CT artifacts common in pediatric patients. 2) Discuss protocol options for optimizing radiation dose
during pediatric PET/CT imaging.

ABSTRACT

RS13-09 Value of Whole-Body 18F-FDG-PET/MRI in Pediatric Oncology: Comparison to Conventional Imaging Modalities
Wednesday, Nov. 30 10:40AM - 10:50AM Room: E352

Awards
Student Travel Stipend Award

Participants
Sergios Gatidis, MD, Tubingen, Germany (Presenter) Nothing to Disclose
Brigitte Gueckel, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Ilias Tsiﬂikas, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Ines Ketelsen, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Matthias Reimold, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolaou, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group;
Speakers Bureau, Bayer AG
Nina Schwenzer, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Juergen F. Schaefer, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Simultaneous 18F-FDG-PET/MRI is a promising modality for staging and response imaging in solid malignancies especially in pediatric
patients. However, there is a need for evidence when using PET/MRI as standard method. The aim of this study was to assess the
diagnostic performance of 18F-FDG PET/MRI compared to conventional imaging modalities (CIM) in a pediatric oncologic population.

METHOD AND MATERIALS
This prospective monocentric trial was approved by the local IRB. All parents gave their informed consent. 56 whole-body 18F-FDG-
PET/MR examinations were performed in 28 patients (16 female, 13±5 years; the baseline and the first response control in each
patient) with solid tumors (13 Hodgkin lymphoma, 4 NHL, 10 sarcoma, 1 adrenal carcinoma). Reading was performed by a radiologist
RESULTS
A total of 253 target lesions were detected in the baseline examination. 3% (7/253) of these lesions were only detected in PET/MRI; 1 lung lesion was only detected by CIM. In 85% (207/245) of lesions, CIM and PET/MRI showed concordant results concerning lesion interpretation; In 12%/3% of lesions, PET/MRI led to downgrading/upgrading of lesion interpretation. 175 lesions were detected in response control. Response assessment was concordant between PET/MRI and CIM in 63%; in 2%/35 of lesions, PET/MRI led to an upgrading/downgrading.

CONCLUSION
PET/MR allows for comprehensive oncologic imaging in pediatric oncology with possible advantages over CIM.

CLINICAL RELEVANCE/APPLICATION
The use of PET/MR may improve diagnostic specificity in pediatric oncology, especially for response assessment under therapy.

RCS13-10 Tumor Textural Features in Baseline FDG PET Predicts Survival in Pediatric Osteosarcoma: A Prospective Study

Wednesday, Nov. 30 10:50AM - 11:00AM Room: E352

Participants
Hyung-Jun Im, MD, Madison, WI (Presenter) Nothing to Disclose
Chihwa Song, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Yi Zhang, Madison, WI (Abstract Co-Author) Nothing to Disclose
Hyun Jung Wu, Memphis, TN (Abstract Co-Author) Nothing to Disclose
Jianrong Wu, Memphis, WI (Abstract Co-Author) Nothing to Disclose
Barry L. Shulkin, MD, MBA, Memphis, TN (Abstract Co-Author) Nothing to Disclose
Steve Cho, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose

PURPOSE
In this study, we evaluated the prognostic value of tumor textural features of the baseline FDG PET scan in pediatric patients with osteosarcoma.

METHOD AND MATERIALS
Thirty-four patients with osteosarcoma were enrolled prospectively and underwent baseline FDG PET/CT. The patients received neoadjuvant chemotherapy (CTX), and subsequent surgical resection. Metabolic tumor volume (MTV) of the primary tumor, a previously reported prognostic factor in osteosarcoma, was measured using a standardized uptake value (SUV) threshold of 2.5. Thirty-nine different FDG PET tumor textural features were analyzed for all primary tumor volumes. Histological response after tumor resection was evaluated. Each parameter was divided into two groups using an optimal cut off defined by ROC analysis. Association of baseline FDG PET textural features with histologic response, tumor recurrence, event free survival (EFS), and overall survival (OS) were evaluated.

RESULTS
Among 34 enrolled patients, 15 were classified as responders after CTX, 15 experienced recurrences, and 10 died during the follow up period. Neither the FDG PET/CT textural features nor MTV were associated with histologic response. Four textural features (energy, gray-level nonuniformity (GLN), maximum probability (MP), and run percentage (RP)) and MTV were associated with tumor recurrence (Wilcoxon test, P value = 0.035, 0.016, 0.0025, 0.013, and 0.01) and predictive of EFS (log rank test, P value = 0.022, 0.003, 0.0004, 0.001, and 0.002). Six textural features (area under curve (AUC), correlation, GLN, MP, run-length nonuniformity (RLN), and RP) and MTV were associated with survival (Wilcoxon test, P value = 0.014, 0.011, 0.0005, 0.011, 0.004, 0.0005 and 0.0006) and predictive of OS (log rank test, P value = 0.005, 0.006, 0.0002, 0.006, 0.0001, 0.0003, and 0.001). On multivariable Cox regression analysis, only MP was an independent prognostic factor for EFS (P = 0.025) and none of the textural features was an independent factor for OS.

CONCLUSION
FDG PET osteosarcoma textural features at baseline were predictive of EFS and OS. MP was an independent prognostic factor for EFS on multivariate analysis.

CLINICAL RELEVANCE/APPLICATION
Baseline FDG PET textural features may be an important parameter for risk stratification of pediatric patients with osteosarcoma, requiring further validation.

RCS13-11 Whole Body Functional and Anatomical MRI: Accuracy in Staging and Treatment Response Monitoring in Childhood and Adolescent Hodgkin’s Lymphoma Compared to Conventional Multimodality Imaging

Wednesday, Nov. 30 11:00AM - 11:10AM Room: E352

Participants
Stuart A. Taylor, MBBS, London, United Kingdom (Abstract Co-Author) Research Consultant, Robarts Clinical Trials, Inc
Shonit Punwani, MBBS, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Arash Latif, London, United Kingdom (Presenter) Nothing to Disclose
Paul D. Humphries, MBBS, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Leon J. Menezes, FRCR, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Deena Nerirnan, MD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Stephen Daw, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Ananth Shankar, London, United Kingdom (Abstract Co-Author) Nothing to Disclose

...
To compare whole body MRI (WB-MRI) & conventional investigations for staging & treatment response monitoring in childhood Hodgkin’s lymphoma

METHOD AND MATERIALS

A total of 50 patients (32 male, median age 16, range 6-19) prospectively underwent WB-MRI in addition to conventional CT and PET CT at initial staging and during response assessment (n=37) after 2 chemotherapy cycles. WB-MRI included axial/coronal FS T2/T1 TSE, axial FS DWI (5 b values 0 to 800), & dynamic contrast enhanced T1 FLASH through the liver/spleen. The reference standard disease status at 30 sites (17 nodal, 13 extra nodal) & Ann Arbour stage was assigned by a multidisciplinary committee using PET CT and CT, based on EURONET trial criteria (nodal positivity >2cm and/or focal 18-FDG uptake above background). Treatment response (progression, none, partial inadequate (PRI), partial adequate (PRA) and complete) was defined using nodal volume change & FDG avidity. WB-MRI was read in consensus by 2 radiologists blinded to conventional imaging. Based on pilot data, nodal positivity was defined as ≥2cm &/or mean ADC < 1.2 x10^-3mm2 s^-1. Nodes 1 to 2cm with ADC 1.2-1.8 were equivocal. Agreement between WB-MRI and the reference was expressed as percentage concordance for all reported disease sites, & kappa statistics. Equivocal sites were treated as disease positive. Results are uncorrected for discrepancies in nodal site description

RESULTS

A total of 44 (88%) patients were concordant for at least 80% of nodal sites, although only 12 (24%) achieved 100% concordance between WB-MRI and the reference standard. Equivalent results for extra nodal disease were 48 (96%) and 34 (68%) respectively. There was 72% agreement for stage (36/50), (kappa 0.56-moderate), with 10 (20%) patients under staged by WB-MRI and 4 (8%) over staged. There was 68% agreement for response classification (25/37) (kappa 0.34-fair) with response over estimated by WB-MRI in 4 (11%) & under estimated in 8 (22%)

CONCLUSION

WB-MRI holds promise as an alternative to conventional staging modalities using ionising radiation, but levels of discordance suggest it is not ready to fully replace them

CLINICAL RELEVANCE/APPLICATION

WB-MRI is attractive as a staging modality for paediatric lymphoma but disagreement with standard modalities suggests caution must be applied before introducing into staging algorithms

RC513-12 Whole-Body MRI for Staging, Therapy Monitoring and Follow-up of Pediatric Malignancies- Comparison with Established Imaging Methods

Wednesday, Nov. 30 11:10AM - 11:20AM Room: E352

Participants

Guenther K. Schneider, MD, PhD, Homburg, Germany (Presenter) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group; Jonas Stroeder, MD, Homburg, Germany (Abstract Co-Author) Nothing to Disclose

Philippe Jagoda, MD, Homburg/Saar, Germany (Abstract Co-Author) Nothing to Disclose

Paul S. Raczek, MD, Homburg, Germany (Abstract Co-Author) Nothing to Disclose

Amo Buecker, MD, Homburg, Germany (Abstract Co-Author) Research Grant, Siemens AG; Consultant, Bracco Group; Speaker, Bracco Group; Consultant, Medtronic pic; Speaker, Medtronic pic; Research Grant, Research Grant, Novartis AG; Research Grant, GlaxoSmithKline pic; Research Grant, Bioteo AG; Research Grant, Oncogenex Pharmaceuticals, Inc; Research Grant, Bristol-Myers Squibb Company; Research Grant, Eli Lilly & Company ; Research Grant, Pfizer Inc; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, sanofi-aventis Group; Research Grant, Merrimack Pharmaceuticals, Inc; Research Grant, Sirtex Medical Ltd; Research Grant, Concordia Healthcare Corp; Research Grant, AbbVie Inc; Research Grant, Takeda Pharmaceutical Company Limited ; Research Grant, Merck & Co, Inc; Research Grant, Affimed NV; Research Grant, Bayer AG; Research Grant, Johnson & Johnson; Research Grant, Seattle Genetics, Inc; Research Grant, Onyx Pharmaceuticals, Inc; Research Grant, Synta Pharmaceuticals Corp; Research Grant, Siemens AG; Research Grant, ISYMED GmbH; Research Grant, St. Jude Medical, Inc; Co-founder, Aachen Resonance GmbH;

PURPOSE

In 68 pediatric patients with malignant tumors whole body MRI was performed and evaluated as the sole staging and follow-up procedure during and post therapy including evaluation of the lungs. Results were compared with established staging procedures as PET, MIBG or bone scintigraphy, CT and ultrasound.

METHOD AND MATERIALS

A total of 321 whole body examinations were performed for staging and follow-up of different malignant tumors, including 21 lymphoma, 31 solid tumors (neuro-, nephro- and hepatoblastoma) as well as 16 pts. with different types of sarcoma. The MR protocol incl. T1w dynamic CE GRE sequences of the abdomen post CM injection (0,05 mmol/kg BW Gd-BOPTA / MultiHance) and during the liver specific phase. DWI (free breathing) and transversal T2w TSE sequences with navigator triggering and a composed whole-body STIR-sequence in coronal orientation completed the imaging protocol. Depending on findings in this basic protocol, additional sequences for example to allow for local staging of soft-tissue- or bone-tumors were performed.

RESULTS

Differences between MRI and CT were seen regarding the number of detected small lung mets (< 3mm), however relevant lesions for staging were correctly diagnosed. Advantages for WB-MRI were seen in follow-up of diffuse T-cell Lymphoma, in which MRI could show residual disease under chemotherapy, although PET imaging showed complete metabolic response. Further advantages could be demonstrated in local staging of sarcoma, but also in initial staging of Ewing sarcoma, in which small lesions missed on PET imaging and confirmed by MR-guided biopsy could be detected. Due to the possibility to repeat MRI in shorter intervals in follow-up, recurrent disease in two cases of Hodgkin- and 3 cases of Non-Hodgkin-Lymphoma were diagnosed primarily by WB-MRI. Similarly
Whole body imaging can correctly stage and diagnose a variety of malignant tumors in pediatric patients and allows for accurate patient management during therapy and follow-up. Advantages of established imaging methods were only seen for detection of small lung metastases on pulmonary CT, however differences seen did not result in a change of patient management.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates the potential of whole body MRI for initial diagnosis, therapy monitoring and follow-up of pediatric malignancies.

PURPOSE

To evaluate diffusion-weighted MRI (DWI) as a complementary prognostic marker in comparison to established semiquantitative metaiodobenzylguanidine (mIBG) scoring methods in patients with stage 4 neuroblastoma.

METHOD AND MATERIALS

IRB waived informed consent and approved this retrospective, HIPAA-compliant study. 17 patients (13 boys, age 5 ± 3 years; range 10 months – 12 years) with stage 4 neuroblastoma were examined with whole-body MRI including whole-body DWI as baseline and/or for follow-up between January 2010 and April 2015. All patients received also a mIBG scan within +/- 30 days. In all patients we performed established CURIE and SIOPEN scoring for mIBG scans and also adapted the scoring for DWI.

RESULTS

In total there were 52 matched examinations of DWI and mIBG scan. 2 examinations were at baseline, 43 examinations in follow-up during/after therapy and 7 examinations at recurrence. Assessed Curie and SIOPEN scores showed excellent correlation for DWI and mIBG scans (r=0.91; r=0.76) in baseline and recurrence examinations. In contrast in interim examinations there was only a poor correlation for DWI and mIBG scans (Curie score r=0.18; SIOPEN score r=0.25).

CONCLUSION

DWI could serve as a complementary prognostic marker in baseline and recurrence examination of neuroblastoma. Poor correlation of DWI and mIBG scans in interim examinations could be an expression of different aspects of tumor biology and should be further evaluated.

CLINICAL RELEVANCE/APPLICATION

DWI can play an important role as a complementary prognostic marker in stage 4 neuroblastoma.

PURPOSE

We present the possible application of contrast enhanced ultrasound (CEUS) in pediatric patients with solid tumors based on single-center experience. We would like to underline advantages and disadvantages of CEUS in comparison to the imagining modalities like magnetic resonance imaging (MRI), computed tomography (CT), b-mode ultrasound throughout the initial diagnosis, treatment, monitoring the therapy and monitoring of residual tumor tissue after the treatment of children solid tumors.

METHOD AND MATERIALS

Between November 1st, 2011 and October, 31st, 2015, 152 children (range ten days - 16.0 years) underwent CEUS and were consequently enroll to the prospective study according to the protocol. From the study cohort, we selected group of 20 children with solid tumors. There were cases with the following diagnoses: nephroblastoma, neuroblastoma, mesenteric fibromatosis, osteosarcoma, rhabdomyosarcoma, ganglioneuroma, lipoblastoma, adrenal hematoma. CEUS examinations were performed for distinguishing benign masses from malignant, evaluating the malignant tumor vasculature, monitoring vasculature changes during the treatment, and assessment the residual lesions. The correlation between CEUS and MRI/CT/b-mode ultrasound was performed (if applicable).

RESULTS

In all cases, CEUS examination obtained relevant from the clinical point of view information. In comparison to MRI/CT imaging, CEUS
reveals in real time additional features like tumor vascularity/supplying vessels what was crucial to established initial diagnosis. In the case of biopsy, CEUS proved high accuracy in estimating areas of necrosis. The quantitative assessment of tumor vascularity changes during treatment and monitoring of residual tumor tissue after the treatment was also possible. In 8 cases, CEUS allowed abandoning MRI/CT scans.

CONCLUSION
The results of our study are suggestive of the increasing significance of CEUS exams in the initial diagnosis and treatment monitoring of solid tumors in children. Additional data about tumor vascularity could shorten the diagnostic imaging process. Moreover, the lack of nephrotoxicity, ionizing radiation and no need for general anesthesia is especially advantageous in children. The study was financed from the means of the National Science Centre granted on the basis of the decision No DEC-2012/05/B/NZ5/01554.

CLINICAL RELEVANCE/APPLICATION
The CEUS could reduce the number of X-ray examination in children with solid tumors.

RS513-15  Abdominal Complications of Pediatric Cancer Therapy

Wednesday, Nov. 30 11:40AM - 12:00PM Room: E352

Participants
M. Beth McCarville, MD, Memphis, TN (Presenter) Consultant, General Electric Company

LEARNING OBJECTIVES
1) The benefits of ultrasound for the evaluation of the colon in children with suspected neutropenic typhilitis/colitis. 2) Imaging features of sinusoidal-obstruction-syndrome. 3) Imaging features of hemorrhagic cystitis.
RSNA/ESR Hybrid Imaging Symposium: Hybrid Imaging in the Female (An Interactive Session)

Wednesday, Nov. 30 10:30AM - 12:00PM Room: S402AB

MSSR42A Pelvic Tumors

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, (katrine.ahlstrom.riklund@umu.se) (Moderator) 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.

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.

ABSTRACT

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.
SSK13

Nuclear Medicine (Central Nervous System and Head and Neck Imaging)

Wednesday, Nov. 30 10:30AM - 12:00PM Room: S505AB

HN  NR  MR  NM

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

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
Frederik L. Giesel, MD, MBA, Heidelberg, Germany (Moderator) Patent application for F18-PSMA-1007

Sub-Events

SSK13-01 Improved Detection of Transosseous Meningiomas Using 68Ga-Dotatate PET-CT Compared to MRI

Awards
Trainee Research Prize - Resident

Participants
Wolfgang G. Kunz, MD, Munich, Germany (Presenter) Nothing to Disclose
Lisa Jungblut, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Philipp M. Kazmierczak, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Axel Rominger, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Nathalie L. Albert, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Clemens C. Cyran, MD, Munich, Germany (Abstract Co-Author) Research Grant, Bayer AG Research Grant, Novartis AG
Bureau, Bayer AG
Maximilian F. Reiser, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To analyze the diagnostic performance of 68Ga-DOTATATE PET-CT and contrast-enhanced MRI for detection of the transosseous extension of intracranial meningiomas and to find associations with quantitative imaging parameters.

METHOD AND MATERIALS

In this retrospective study, subjects were selected from a cohort of 325 consecutive patients who underwent 68Ga-DOTATATE PET-CT of the head for evaluation of confirmed or suspected intracranial meningioma. Inclusion criteria were (1) MRI imaging within 1 month of either pre- or postoperative matching PET-CT imaging, and (2) as standard of reference pathology-confirmed meningioma diagnosis with inclusion or exclusion of transosseous extension. Imaging was independently analyzed by two readers with respect to osseous involvement, absolute tracer uptake measured as SUVmax, volume of meningioma and surrounding edema. Chi square, Mann-Whitney U or exact McNemar's tests as well as receiver operating characteristics (ROC) analyses were performed to compare variables and diagnostic test performance.

RESULTS

Eighty-two patients (mean age 56±13 years) fulfilled the inclusion criteria. Patients with transosseous extension of meningioma (n=67) showed significantly larger lesions (median 10 ml vs. 3 ml, p=0.002) and significantly higher SUVmax (median 14 vs. 8, p=0.032) compared to extraosseous meningiomas. 68Ga-DOTATATE PET-CT in comparison to contrast-enhanced MRI performed at a considerably higher sensitivity (98.5% vs. 55.2%) while maintaining high specificity (86.7% vs. 100.0%) in the pre- as well as postoperative setting; statistically significant differences between the tests were observed (p<0.001). In ROC analysis, PET-CT assessment performed best (AUC: 0.933), followed by MRI assessment (0.866), meningioma volume (0.765) and SUVmax (0.680) while surrounding edema added no valuable information (0.483).

CONCLUSION

68Ga-DOTATATE PET-CT enables improved detection of the transosseous extension of intracranial meningiomas compared to MRI in pre- and postoperative settings.

CLINICAL RELEVANCE/APPLICATION

Transosseous extension of meningiomas affects growth and recurrence and is important for surgical management. Improved detection using 68Ga-DOTATATE PET-CT has the potential to impact decision making.

SSK13-02 Pittsburgh Compound B (PiB) PET Imaging of Meningioma and Other Intracranial Tumors

Awards
Student Travel Stipend Award

Participants
Derek R. Johnson, MD, Rochester, MN (Presenter) Consultant, F. Hoffmann-La Roche Ltd
Christopher H. Hunt, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Mark A. Nathan, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Val J. Lowe, MD, Rochester, MN (Abstract Co-Author) Research Grant, General Electric Company Research Grant, Siemens AG
Research Grant, Eli Lilly and Company Advisory Board, Bayer AG
Joseph E. Parisi, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose

PURPOSE

To analyze the diagnostic performance of 68Ga-DOTATATE PET-CT and contrast-enhanced MRI for detection of the transosseous extension of intracranial meningiomas and to find associations with quantitative imaging parameters.

METHOD AND MATERIALS

In this retrospective study, subjects were selected from a cohort of 325 consecutive patients who underwent 68Ga-DOTATATE PET-CT of the head for evaluation of confirmed or suspected intracranial meningioma. Inclusion criteria were (1) MRI imaging within 1 month of either pre- or postoperative matching PET-CT imaging, and (2) as standard of reference pathology-confirmed meningioma diagnosis with inclusion or exclusion of transosseous extension. Imaging was independently analyzed by two readers with respect to osseous involvement, absolute tracer uptake measured as SUVmax, volume of meningioma and surrounding edema. Chi square, Mann-Whitney U or exact McNemar's tests as well as receiver operating characteristics (ROC) analyses were performed to compare variables and diagnostic test performance.

RESULTS

Eighty-two patients (mean age 56±13 years) fulfilled the inclusion criteria. Patients with transosseous extension of meningioma (n=67) showed significantly larger lesions (median 10 ml vs. 3 ml, p=0.002) and significantly higher SUVmax (median 14 vs. 8, p=0.032) compared to extraosseous meningiomas. 68Ga-DOTATATE PET-CT in comparison to contrast-enhanced MRI performed at a considerably higher sensitivity (98.5% vs. 55.2%) while maintaining high specificity (86.7% vs. 100.0%) in the pre- as well as postoperative setting; statistically significant differences between the tests were observed (p<0.001). In ROC analysis, PET-CT assessment performed best (AUC: 0.933), followed by MRI assessment (0.866), meningioma volume (0.765) and SUVmax (0.680) while surrounding edema added no valuable information (0.483).

CONCLUSION

68Ga-DOTATATE PET-CT enables improved detection of the transosseous extension of intracranial meningiomas compared to MRI in pre- and postoperative settings.

CLINICAL RELEVANCE/APPLICATION

Transosseous extension of meningiomas affects growth and recurrence and is important for surgical management. Improved detection using 68Ga-DOTATATE PET-CT has the potential to impact decision making.
Our results showed no significant differences in RC% of 18F labeled and 11C-PIB amyloid tracers for neocortical SUVr.

CONCLUSION

A tumor:cerebellum uptake ratio of 1.65 or greater on PiB PET is a highly specific and reasonably sensitive marker of intracranial meningioma. Further prospective evaluation is warranted to validate this result as well as to fully define the performance of this technique with emerging technologies such as PET/MRI and commercially available amyloid radiotracers.

CLINICAL RELEVANCE/APPLICATION

Meningioma is by far the most common intracranial tumor, with a prevalence of up to 3% in autopsy studies. While diagnosis by MRI is generally straightforward, lack of specificity may raise a diagnostic dilemma in patients with a history of cancer. We and others have reported cases of focal Pittsburgh compound B (PiB) PET activity within meningiomas; herein we report our institutional experience with this technique.

METHOD AND MATERIALS

Records of all patients who underwent PiB PET/CT at our institution from 2006 through 2015 were reviewed to identify those with intracranial tumors. Inclusion criteria included at least one MRI with contrast demonstrating enhancement of the suspected tumors, a minimum dimension of at least 0.5 cm, and either pathological confirmation of tumor or greater than 6 months of radiographic follow-up for patients in whom observation was recommended.

RESULTS

2472 patient records were reviewed; 45 patients (1.8%) met inclusion criteria for probable or definite intracranial tumor. Tumor types were meningioma (29/45, 64%), vestibular schwannoma (7/45, 16%), pituitary macroadenoma (4/45, 9%), metastatic disease (2/45, 4%), and others (3/45, 7%). An ROC curve was created for the lesion:cerebellum SUVmax ratio, with an AUC of 0.91 for the ratio value of 1.65. At or above this ratio, specificity for meningioma was 100% (95% CI 79.4-100%) and sensitivity was 75.9% (95% CI 56.5-89.7%). The positive predictive value was 100% (95% CI 84.6-100%).

CONCLUSION

A tumor:cerebellum uptake ratio of 1.65 or greater on PiB PET is a highly specific and reasonably sensitive marker of intracranial meningioma. Further prospective evaluation is warranted to validate this result as well as to fully define the performance of this technique with emerging technologies such as PET/MRI and commercially available amyloid radiotracers.
CLINICAL RELEVANCE/APPLICATION

The repeatability coefficient of 18F amyloid radiotracers is about 10% for neocortical SUVr in both Alzheimer’s disease patients and healthy controls. This effect should be considered when using neocortical SUVr as an outcome measure for assessing anti-amyloid therapy.

SSK13-04 Applying Amide Proton Transfer MR Imaging to Hybrid Brain PET/MR: Concordance to Gadolinium Enhancement and a Complementary Value to 18F-FDG PET

Participants
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PURPOSE

To evaluate the diagnostic concordance and metric correlations of amide proton transfer (APT) imaging with Gd-enhanced MRI and 18F-FDG PET using hybrid brain PET/MR.

METHOD AND MATERIALS

Twenty-one subjects with suspected brain lesions on prior CT or MRI were prospectively enrolled. Brain 18F-FDG PET/MR with gadolinium (Gd) enhancement (plus whole-body 18F-FDG PET/MR) was performed. Six diagnostic criteria based on brain lesion morphology and final diagnosis were used to compare the accuracy of unenhanced MRI (T1WI, T2WI, FLAIR plus DWI), enhanced MRI (T1WI), APT imaging and 18F-FDG PET. In cases of tumors, we further evaluated the concordance between Gd enhancement, APT-weighted (APTW) signal intensity and 18F-FDG avidity by the McNemar test, and also the associations between metrics from APT imaging and PET by Pearson correlation analysis.

RESULTS

There were totally 23 lesions (from 21 subjects), including 13 metastases, 3 gliomas (2 WHO grade IV and 1 WHO grade II), 3 meningiomas (WHO grade I), and 4 chronic infarctions. Enhanced MRI and APT imaging showed superior and similar diagnostic accuracy, compared to unenhanced MRI and 18F-FDG PET in tumor detection and final diagnosis. APTW signal intensity and Gd enhancement were concordant in all the 19 tumors (100%), while high 18F-FDG avidity was shown in only 12 (63.2%) with statistical difference (P < 0.05). There was no significant association between APTWmax and SUVmax, or APTWmean and SUVmean in all the brain tumors (P > 0.05). However, significant correlations were identified between APTWmax and SUVmax (r = 0.609, P = 0.027), as well as APTWmean and SUVmean (r = 0.599, P = 0.030) for 13 FDG hypermetabolic brain tumors (11 metastases and two meningiomas).

CONCLUSION

APT imaging using endogenous proteins and peptides can be used as to increase diagnostic accuracy with unnecessary administration of exogenous gadolinium chelate. APT imaging may play a complementary role to FDG metabolic activity during brain PET/MR study.

CLINICAL RELEVANCE/APPLICATION

APT imaging might be applied as a routine imaging sequence to streamline the scan protocol and extend clinical indications for brain 18F-FDG PET/MR.

SSK13-05 Anti-3-[18F]FACBC (Fluciclovine) Dynamic PET Differentiates Low-Grade and High Grade Gliomas in Patients with Minimal Prior Intervention

Participants
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Mark M. Goodman, PhD, Atlanta, GA (Abstract Co-Author) Royalties, Nihon Medi-Physics Co, Ltd

PURPOSE

Fluciclovine is an amino acid analogue PET radiotracer which is transported into tumor cells mainly via ASCT-2 and LAT-1 amino acid transport systems. The purpose of this study was to examine the role of fluciclovine dynamic PET in differentiating low-grade gliomas (LGGs) and high grade gliomas (HGGs) in systemic therapy naive patients.

METHOD AND MATERIALS

Biopsy proven LGGs (WHO grade II; N=5) and HGGs (WHO grades III and IV; N=11) from 14 patients post stereotactic biopsy or partial resection and therapy naive, underwent dynamic fluciclovine PET imaging on a High-Resolution Research Tomograph (Siemens Medical Solutions). Two HG glioma patients exhibited bifocal disease. The protocol was approved by IRB and supported by an NIH RO1 grant (5RO1CA121320). Using ROIs determined by the PET Edge tumor margin detection tool and manually selected ROIs of the contralateral normal brain, time activity curves were obtained for standardized uptake values (SUVmax and SUVmean).
RESULTS

On average, time activity curves for max SUV reveal a shape consistent with initial rise and plateau without washout for HGGs, LGGs, and normal brain parenchyma. Individual lesions occasionally revealed persistent increase and mild washout. Asymptotic fluciclovine uptake was reached at approximately 20 minutes with a statistically significant difference in metabolic activity between all pairwise post hoc comparisons among max SUV values for HGGs and LGGs and mean SUV values for normal contralateral brain parenchyma at multiple time points (for example, p < 0.0001 for comparison of max SUV of HGGs to LGGs at 20 minutes).

CONCLUSION

Fluciclovine dynamic PET reveals predominant rapid increase followed by plateau kinetics in radiotracer uptake in LGGs, HGGs, and normal brain parenchyma. Significantly increased uptake was observed in HGGs relative to LGGs and normal background parenchyma. Equilibrium is reached within 20 minutes and may be an optimal time for static fluciclovine PET imaging.

CLINICAL RELEVANCE/APPLICATION

Fluciclovine PET is helpful in differentiating between low grade and high grade gliomas showing rapid increase then plateauing, reaching equilibrium approximately 20 minutes following injection.

SSK13-06 Incidental Brain Pathology on Whole Body FDG PET-MRI

Wednesday, Nov. 30 11:20AM - 11:30AM Room: S505AB

Awards
Student Travel Stipend Award

Participants
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PURPOSE

Routine FDG PET-CT imaging for oncology is performed from the base of the skull to the mid thighs. Both benign and malignant brain findings can occur in the oncology patient that would be missed on the typical PET scan. In our institution, when performing whole body PET-MRI for cancer patients, we routinely include the entire head. The aim of our study was to characterize both PET and MRI brain findings incidentally detected on the included head portion of the study.

METHOD AND MATERIALS

234 FDG PET-MRI body scans that included the head were retrospectively reviewed. Images were obtained on hybrid PET-MRI with simultaneous acquisition using body coil and dedicated body sequences without IV contrast. Of the 234 studies, 204 individual patients were scanned (125 female, 79 male). Only the patient’s first PET-MRI was reviewed. Mean age was 55 y (range 7-89). 191 studies were for cancer assessment (72 staging, 119 restaging). Other 14 indications were for 5 paraneoplastic syndrome, 3 adenopathy, 3 lung nodule, 1 vasculitis, and 2 monoclonal gammopathy. Of these 4 were later diagnosed with cancer. Images of the brain were reviewed by a neuroradiologist in conjunction with a nuclear radiologist.

RESULTS

Of the 204 patients, 30 patients (14.7 %) had positive brain findings on PET-MRI body sequences. 11 (5.4 %) had vascular disease (avg age 72 y) with 7 chronic microvascular ischemic changes and 4 had brain infarcts. One infarct was a subacute stroke in a paraneoplastic patient and another newly discovered infarct was in a 38 y female. Detection rate for microvascular ischemic changes was likely lower due to the body MRI sequences. 9 patients (8.7 %) had post-therapy changes in the brain due to either radiation (n=2), surgery (n=3), or chemotherapy (n=4). Three others had benign cystic lesions. 8 patients (9.4 %) had serious brain pathologies including 4 paraneoplastic patients (leptomeningeal metastases, metabolic encephalopathy, Creutzfeld-Jakob disease, and lymphoma), 1 metastases, 2 pituitary tumors, and 1 chronic subdural collection with mean age 63 y.

CONCLUSION

FDG PET-MRI imaging is a rapidly evolving modality that is commonly employed for cancer evaluation. The standardized base of skull to mid thigh imaging may miss many important brain pathologies that are discovered even using MRI body sequences.

CLINICAL RELEVANCE/APPLICATION

FDG PET-MRI body sequences that include the head may show added value in the management of patients.

SSK13-07 Feasibility Demonstration of Ultra High Definition Neuro PET From Whole Body /Large Field of View Acquisition

Wednesday, Nov. 30 11:30AM - 11:40AM Room: S505AB

Participants
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Jun Zhang, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE

Fluciclovine PET is helpful in differentiating between low grade and high grade gliomas showing rapid increase then plateauing, reaching equilibrium approximately 20 minutes following injection.

METHOD AND MATERIALS

Fluciclovine dynamic PET reveals predominant rapid increase followed by plateau kinetics in radiotracer uptake in LGGs, HGGs, and normal brain parenchyma. Significantly increased uptake was observed in HGGs relative to LGGs and normal background parenchyma. Equilibrium is reached within 20 minutes and may be an optimal time for static fluciclovine PET imaging.

RESULTS

Of the 204 patients, 30 patients (14.7 %) had positive brain findings on PET-MRI body sequences. 11 (5.4 %) had vascular disease (avg age 72 y) with 7 chronic microvascular ischemic changes and 4 had brain infarcts. One infarct was a subacute stroke in a paraneoplastic patient and another newly discovered infarct was in a 38 y female. Detection rate for microvascular ischemic changes was likely lower due to the body MRI sequences. 9 patients (8.7 %) had post-therapy changes in the brain due to either radiation (n=2), surgery (n=3), or chemotherapy (n=4). Three others had benign cystic lesions. 8 patients (9.4 %) had serious brain pathologies including 4 paraneoplastic patients (leptomeningeal metastases, metabolic encephalopathy, Creutzfeld-Jakob disease, and lymphoma), 1 metastases, 2 pituitary tumors, and 1 chronic subdural collection with mean age 63 y.

CONCLUSION

FDG PET-MRI imaging is a rapidly evolving modality that is commonly employed for cancer evaluation. The standardized base of skull to mid thigh imaging may miss many important brain pathologies that are discovered even using MRI body sequences.

CLINICAL RELEVANCE/APPLICATION

FDG PET-MRI body sequences that include the head may show added value in the management of patients.
Neurologic PET has traditionally required long acquisition times with a dedicated, smaller field of view (FOV) protocol than whole body imaging. With the introduction of next generation solid state, digital photon counting PET technology (dPET) we explored the potential to achieve excellent neuro image quality using ultra high definition (UHD, 1 mm³ voxel volume) reconstruction from acquisitions using the large FOV. We performed phantom and intra-individual comparisons using both whole body and dedicated brain acquisition and UHD reconstruction to assess the image quality and quantitative accuracy.

METHOD AND MATERIALS

20 patients were imaged on a pre-commercial release dPET (Vereos, Philips) (50 or 110 min post-injection, dose 13 mCi FDG). A single bed position was centered on the brain and a 90s acquisition was performed using the brain FOV 256 mm. Immediately following, standard whole body acquisition including the brain was performed using 90s per bed and the whole body FOV 576 mm. Both data sets were then reconstructed with a 1 mm³ voxel volume. An atlas based analysis was performed measuring SUVmax and z-score. A phantom comparison was completed, using a Hoffman brain phantom with three acquisitions each with the brain and whole body FOVs. A blinded reader analysis performed for image quality.

RESULTS

The intra-individual comparison between 256 FOV and 576 FOV revealed no significant differences in SUVmax, z-score measures or image quality reads. The phantom data showed similar results, with no significant differences in quantitative readouts between the two FOV.

CONCLUSION

This feasibility studies indicates that next generation digital detector PET may not require smaller, dedicated acquisition FOV and can acquire neurological PET using the full, standard whole body FOV. Equivalent quantitative and visual quality was achieved. This may facilitate improved workflow, particularly when larger anatomic or even whole body acquisitions are combined with neuro-imaging. While longer acquisition times over the brain may still be desirable, incorporation of variable bed times into whole body acquisitions can easily accommodate such needs.

CLINICAL RELEVANCE/APPLICATION

Next generation digital PET/CT systems can perform accurate and equivalent quality brain PET metabolic imaging using the standard full field of view acquisition reducing the necessity for small FOV.

SSK13-08 Added Diagnostic Value of Complementary Gadoxetic Acid-enhanced MRI to 18F-DOPA-PET/CT for Liver Staging in Medullary Thyroid Carcinoma

Wednesday, Nov. 30 11:40AM - 11:50AM Room: S505AB

Participants
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Christine Spitzweg, Munich, Germany (Abstract Co-Author) Advisory Board, Swedish Orphan Biovitrum AB; Advisory Board, Bayer AG; Advisory Board, Eisai Co, Ltd ; Advisory Board, AstraZeneca PLC ; Speaker, Swedish Orphan Biovitrum AB; Speaker, Bayer AG; Speaker, Eisai Co, Ltd; Speaker, AstraZeneca PLC

PURPOSE

To investigate the added diagnostic value of complementary gadoxetic acid-enhanced MRI to 18F-DOPA-PET/CT for liver staging in medullary thyroid carcinoma (MTC).

METHOD AND MATERIALS

Twenty-nine consecutive Patients (n=17 f, n=12 m, median age 58 years) with histologically confirmed MTC undergoing gadoxetic acid-enhanced liver MRI within one month of matching contrast-enhanced 18F-DOPA-PET/CT between 2010 and 2015 were included for retrospective analysis. 18F-DOPA-PET/CT and multiparametric MRI (T2w; DWI; unenhanced, arterial, portal venous, delayed, and hepatobiliary phase T1w GRE fs) data sets were read consecutively and liver lesions were categorized on a 5-point scale analogously to the LI-RADS criteria (1–definitely benign; 2–probably benign; 3–intermediate risk for metastasis; 4–probably metastasis; 5–definitely metastasis). It was noted if gadoxetic acid-enhanced MRI detected additional, 18F-DOPA-PET/CT-occult metastases (category 5) or if gadoxetic acid-enhanced MRI allowed for a definite classification (categories 1 and 5) of lesions for which the 18F-DOPA-PET/CT scan remained inconclusive (categories 2-4).

RESULTS

A total of n=141 liver lesions (18F-DOPA-PET/CT n=107, MRI n=141; n=99 metastases, n=27 benign cysts, n=15 hemangiomas) were analyzed. N=34 additional lesions were detected by MRI, of which n=30 were additional metastases (median diameter 0.5 cm [0.4 – 1.9 cm]) occult on 18F-DOPA-PET/CT. MRI allowed for a definite lesion classification (categories 1 and 5) in 89 % (125/141) (18F-DOPA-PET/CT 69 %, n=74/107). MRI lead to a change in lesion categorization in 17 cases (from category 2 to 1: n=10; from category 3 to 1: n=3; from category 4 to 5: n=4).

CONCLUSION

Gadoxetic acid-enhanced MRI allows for a more accurate liver staging in MTC patients compared to 18F-DOPA-PET/CT alone, particularly for 18F-DOPA-negative metastases and lesions <1 cm.

CLINICAL RELEVANCE/APPLICATION
Gadoxetic acid-enhanced MRI optimizes the detection of liver metastases with potential direct impact on clinical patient management and may be included as standard imaging in MTC staging protocols.

**SSK13-09 Differentiation of Incidental Tracer Uptake in the Head and Neck Area: A Comparison Between PET/CT and PET/MR**

Wednesday, Nov. 30 11:50AM - 12:00PM Room: SS505AB

Participants
Benedikt M. Schaarschmidt, MD, Dusseldorf, Germany (Presenter) Nothing to Disclose
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Philipp Heusch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare the diagnostic accuracy of 18F-fluorodesoxyglucose positron emission tomography/magnetic resonance (18F-FDG PET/MR) imaging to 18F-FDG PET/computed tomography (18F-FDG PET/CT) concerning incidental tracer uptake in a dedicated head and neck protocol.

**METHOD AND MATERIALS**

A retrospective analysis of 81 patients that underwent contrast-enhanced 18F-FDG PET/CT and 18F-FDG PET/MR on the same day for oncological indications was performed. Fused PET/CT and PET/MR datasets were analyzed by two independent readers in random order in two separate sessions for PET/CT and PET/MR under consideration of the clinical indication. Incidental tracer uptake was classified in the three following groups: most likely benign, indeterminate and most likely malignant. Potential discrepancies were resolved in a separate consensus reading. Then, the reference standard was defined for all lesions by an expert reader using clinical reports, cross sectional imaging and histopathological reports. Differences between the total number of accurately and inaccurately classified lesions were investigated using McNemar's test between both modalities. A p<0.05 indicated statistical significance.

**RESULTS**

A total of 46 lesions were available for further analysis. Twenty-seven and 31 lesions were classified as most likely benign, 18 and 14 as indeterminate and one as most likely malignant in PET/CT and PET/MR respectively. According to the reference standard, 43 lesions were benign, one was malignant and in two lesions, a definite diagnosis was not possible. PET/MR was not superior to PET/CT concerning the correct diagnosis of an incidental 18F-FDG uptake (p=0.125). While the correct classification of an incidental uptake was possible in 28 findings on PET/CT and PET/MR, 14 findings were misclassified by either modality and four findings that were misclassified on PET/CT could be classified correctly on PET/MR.

**CONCLUSION**

PET/MR is not superior to PET/CT in the classification of incidental tracer uptake in the head and neck area.

**CLINICAL RELEVANCE/APPLICATION**

Incidental tracer uptake of the head and neck is a diagnostic dilemma in hybrid imaging. Our data indicate, that PET/MR does not increase the diagnostic accuracy of PET/CT in this specific problem.
**Vascular Interventional (Chemoembolization and Radioembolization)**

**Wednesday, Nov. 30 10:30AM - 12:00PM Room: E351**

**GI**  **IR**  **NM**

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

**FDA** Discussions may include off-label uses.

**Participants**

Juan C. Camacho, MD, Charleston, SC (Moderator) Nothing to Disclose

Ronald S. Arellano, MD, Boston, MA (Moderator) Nothing to Disclose

**Sub-Events**

**SSK19-01 The Effect and Safety of Preoperative Hepatic and Regional Arterial Chemotherapy (PHRAC) for Stage II and III Colorectal Cancer-Multicenter Clinical Trial Results**

**Participants**

Bo Zhou, Shanghai, China (Presenter) Nothing to Disclose

Zhiping Yan, Shanghai, China (Abstract Co-Author) Nothing to Disclose

Jianhua Wang, MD, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

Jianmin Xu, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate whether preoperative hepatic and regional arterial chemotherapy is able to prevent liver metastasis and improve overall survival in patients receiving curative colorectal cancer resection.

**METHOD AND MATERIALS**

Patients in five medical centers with stage II or stage III colorectal cancer (CRC) were randomly assigned to receive preoperative hepatic and regional arterial chemotherapy (PHRAC group, n = 341) or surgery alone (control group, n = 347). The primary endpoint was disease-free survival (DFS), whereas secondary outcomes include cumulative incidence of liver metastasis (LM), overall survival (OS) and safety. Clinical trial number: NCT00643877.

**RESULTS**

There were no significant differences in baseline characteristics between PHRAC and control groups. The 5y-DFS was 75% in PHRAC group vs 61% in control group (P<0.001). Three years liver metastasis (LM) was 7% in PHRAC group vs 15% in control (P<0.001). The 3y OS was 89% in PHRAC group and 79% in control, 5y OS was 81% vs 72%, HR 0.59 (95% CI 0.42-0.84, P=0.003). Subgroup analysis, 3y-DFS was 89% and 5y-DFS was 84% for patients with stage II CRC in PHRAC, while 3y-DFS was 80% and 5y-DFS was 74% in control, HR 0.64 (95% CI 0.39-1.04, P=0.068). There was also no significant difference between the 2 groups in LM and OS for patients with stage II CRC. In stage III patients, 3y-DFS was 72% and 5y-DFS was 68% in PHRAC, while 3y-DFS was 62% and 5y-DFS was 51% in control, HR 0.62 (95% CI 0.41-0.92, P=0.017). Three years LM was 9% and 5y-LM was 11% in PHRAC, while 3y-LM was 21% and 5y-LM was 25% in control, HR 0.37 (95% CI 0.19-0.71, P=0.002). Three years OS was 86% and 5y-OS was 75% in PHRAC, while 3y-OS was 74% and 5y-OS was 64% in control, HR 0.57 (95% CI 0.35-0.94, P=0.023). Toxicities, such as hepatic toxicity and leukocyte decreasing, were mild and could be cured with medicine.

**CONCLUSION**

Preoperative hepatic and regional arterial chemotherapy, in combination with surgical resection, could be able to reduce and delay the occurrence of liver metastasis and therefore improve survival rate in patients with stage III colorectal cancer.

**CLINICAL RELEVANCE/APPLICATION**

Preoperative hepatic and regional arterial chemotherapy, in combination with surgical resection, could be able to reduce and delay the occurrence of liver metastasis.

**SSK19-02 Initial Study of the Rheological Impact of a Balloon-occlusion Approach for Magnetic Resonance Navigation Liver Chemoembolization on 8 Pigs**

**Wednesday, Nov. 30 10:40AM - 10:50AM Room: E351**

**Participants**

Alexandre Bigot, Montreal, QC (Abstract Co-Author) Nothing to Disclose

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Maxime Gerard, Montreal, QC (Abstract Co-Author) Nothing to Disclose

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Samuel Kadoury, Montreal, QC (Abstract Co-Author) Nothing to Disclose

Gilles P. Soulez, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose

Sylvain Martel, Montreal, ON (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Magnetic Resonance Navigation (MRN) is an interventional MRI technique which aims to navigate magnetic therapeutic beads using the imaging gradients of the scanner. Our targeted application is liver chemoembolization for hepatocellular carcinoma using an implantable port catheter system. We currently investigate a balloon-occlusion approach in order to greatly reduce the hepatic blood flow and the systolic-diastolic flow variation.
METHOD AND MATERIALS
We collected physiological and rheological data and evaluated the impact of a balloon catheter placed in the proper hepatic artery on eight pigs (mean weight ± SD = 31.9 ± 2.03 kg). Measurements were performed with an electromagnetic probe placed on the common hepatic artery for 4 pigs and with Doppler Ultrasound for 4 pigs. The experimental protocol was approved by the Institutional Animal Care and Use Committee of the Research Center of Centre Hospitalier de l'Universite de Montreal.

RESULTS
Average diameter of proper hepatic artery is 4.67 ± 0.65 mm and average distance between the tip of the catheter and the first bifurcation is 17.6 ± 8.48 mm. The average blood velocity in normal conditions is 40.5 ± 26.5 cm/s and drops to 6.09 ± 5.19 cm/s when the balloon is inflated. This represents a reduction of 84%. In addition, we found that the average systole-diastole range decreases from 48.2 ± 31.8 cm/s to 11.5 ± 12.5 cm/s with and without the inflated balloon respectively. These velocities under flow occlusion should be compatible with MRN of 250 µm-diameter magnetic drug eluting beads with a magnetization of 60 emu/g and a propulsion gradient of 40 mT/m.

CONCLUSION
A balloon-occluded approach enables reduction the blood flow and elimination the pulsatile behavior of the blood in the liver. Future experiments will be focused on evaluating in vitro that the magnetic performance of the MRI and magnetic beads are sufficient to achieve balloon-occlusion MRN using a clinical MRI scanner.

CLINICAL RELEVANCE/APPLICATION
Magnetic Resonance Navigation has a great potential in the planning and treatment of HCC. Combining this technology with an implantable port catheter chamber could enable the development of less invasive chemoembolization treatments and therefore improve patient care.

PURPOSE
Increased total serum bilirubin has been commonly cited as an independent risk factor that affects overall survival in patients undergoing drug eluting bead transarterial chemoembolization (DEB-TACE) for hepatocellular carcinoma (HCC). This study aims to determine and compare overall survival rates based on stratification of total bilirubin levels in patients undergoing DEB-TACE for HCC.

METHOD AND MATERIALS
A retrospective cohort analysis was performed on all HCC patients who underwent DEB-TACE for HCC from November 2008-March 2015. The overall survival was stratified by total serum bilirubin groups (< 2.0, 2.0-2.4, 2.5-2.9, 3.0-3.4, 3.5-3.9, and > 3.9). The survival analysis was carried out comparing each group to a control group (total bilirubin < 2.0). Multivariable linear regression using a Cox model was used to evaluate the effect of various prognostic factors on overall survival. Survival distribution across all groups was compared using a Wilcoxon test.

RESULTS
407 patients underwent DEB-TACE for HCC in the time period assessed. The median overall survival for the six total bilirubin groups were 48, 47, 81, 47, 32, and 77 months respectively. Survival distributions were compared amongst all groups using the Wilcoxon test; there was no significant difference (P = 0.527). The survival analysis showed an increase of 7.7%, decrease of 3.9%, increase of 48%, 54%, and decrease of 38% in mortality risk for total bilirubin groups 2.0-2.4, 2.5-2.9, 3.0-3.4, 3.5-3.9, and > 3.9 respectively. However, the results were not statistically significant (P > 0.05). The only prognostic factors which were independent predictors of overall survival ECOG performance status (HR 1.38, 95% CI 1.10-1.72, P = 0.005), AFP (HR 1.55, 95% CI 1.30-1.84, P < 0.000001), length of hospital stay after DEB-TACE (HR 1.24, 95% CI 1.10-1.41, P = 0.0007), and segmental or lobar treatment (HR 1.75, 95% CI 1.08-2.85, P = 0.023).

CONCLUSION
In this cohort, bilirubin was not predictive of poor outcome. In fact, there was a trend to increased survival in patients with the highest bilirubin. In this population, the total serum bilirubin alone was insufficient to predict survival or candidacy of patients with HCC for DEB-TACE.

CLINICAL RELEVANCE/APPLICATION
Elevated total bilirubin should not be a contraindication for patients undergoing DEB-TACE for HCC.

SSK19-04 Liver Transplant Outcomes after Locoregional Therapy for Hepatocellular Carcinoma: A Large Single-Center Experience

Wednesday, Nov. 30 11:00AM - 11:10AM Room: E351

Awards
Student Travel Stipend Award

Participants
Tyler J. Fraum, MD, Saint Louis, MO (Presenter) Nothing to Disclose
Neeta Vachcharajani, St. Louis, MO (Abstract Co-Author) Nothing to Disclose
Aaron Gould, MD, St. Louis, MO (Abstract Co-Author) Nothing to Disclose
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William Chapman, MD, Saint Louis, MO (Abstract Co-Author) Founder, Pathfinder Therapeutics, Inc

PURPOSE
Locoregional therapy (LRT), such as transarterial chemoembolization (TACE), is a mainstay of managing hepatocellular carcinoma (HCC) in patients with cirrhosis. In such cases, LRT serves as a bridge to liver transplant (LT) by either maintaining tumor burden at acceptable levels or down-staging extensive disease to within the Milan criteria. The aim of this study was to evaluate the long-term survival of patients undergoing LT following LRT for HCC with respect to pre-transplant tumor burden and LRT-related variables.

METHOD AND MATERIALS
From 2000-2014, 258 adult patients with HCC pre-operatively treated with LRT underwent LT at our institution. For this retrospective analysis, we collected demographic information, LRT details, and post-LT clinical outcomes from our transplant database. These data were stratified according to whether each patient’s HCC disease burden prior to LRT fell within the Milan criteria (WMC) or beyond the Milan criteria (BMC). Kaplan-Meier curves were generated for both groups for overall survival (OS), disease-free survival (DFS), and disease-specific survival (DSS). The log-rank test was used to evaluate for differences up to 10 years post-LT.

RESULTS
A total of 258 patients with 417 HCCs underwent 431 LRTs prior to LT. At presentation, 201 patients (78%) were classified as WMC. These patients underwent fewer LRTs prior to LT than BMC patients (1.5 v. 2.3, p < 0.001). The interval between first LRT and LT was longer for BMC patients (276 v. 171 days, p < 0.001). A higher percentage of BMC patients had imaging evidence of post-LRT disease progression (28 v. 14%, p = 0.01) at some point prior to LT. 257 patients (99.6%) satisfied Milan criteria by the time of LT. There was no significant difference between WMC and BMC patients with respect to OS (p = 0.20), DSS (p = 0.42), or DFS (p = 0.13).

CONCLUSION
BMC patients required more LRTs and were more likely to progress following LRT than WMC patients. As a result, BMC patients generally waited longer for LT. Once BMC patients were sufficiently down-staged and underwent LT, there were no significant survival differences between the WMC and BMC groups. To our knowledge, this analysis constitutes the largest single-center outcomes study of HCC patients treated with LRT before LT.

CLINICAL RELEVANCE/APPLICATION
Patients presenting with HCC exceeding the Milan criteria require longer and/or more extensive pre-transplant therapy but have similar post-transplant outcomes.

SSK19-05  Prediction of Early Response to Transpulmonary Chemoembolization and Transarterial Chemoperfusion in the Interventional Treatment of Unresectable Primary and Secondary Lung Cancer by Using Diffusion-Weighted MR Imaging: Preliminary Experience

Wednesday, Nov. 30 11:10AM - 11:20AM Room: E351

Awards
Student Travel Stipend Award

Participants
Ilana Bednarova, MD, Udine, Italy (Presenter) Nothing to Disclose
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Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine whether the change of apparent diffusion coefficient (ADC) value after transpulmonary chemoembolization (TPCE) or transarterial chemoperfusion (TACP) in a palliative intention could predict the early response in unresectable lung cancer and lung metastases.

METHOD AND MATERIALS
- From January 2012 to February 2016, 295 patients (138 males/157 females) were treated with TPCE or TACP session in 4-week intervals. Finally, 11 patients (mean age: 58.8; age range 24-75) with primary lung tumor (bronchial carcinoma, n=4) and lung metastases from different primaries (breast cancer, n=2; thyroid cancer, n=1; renal cellular cancer, n=1; colorectal carcinoma, n=1; esophageal cancer, n=1; carcinoid, n=1) underwent chest MR imaging (1.5 Tesla) including DWI before and after the first treatment with TPCE or TACP. - DWI and ADC maps were acquired using b-values of 0 and 800 s/mm² and the tumor’s mean ADC value was calculated and compared in a 4-weeks interval. - The grouping reference was based on serial CT scans according to Response Evaluation Criteria in Solid Tumors (RECIST, version 1.1).

RESULTS
- All patients tolerated well the treatment and had no major complications. - According to the follow-up imaging data 3 patients presented a partial response (PR) and 8 patients a stable disease (SD). No patient belonged to complete response or progressive disease group. - The pretherapy ADC values had no significant difference between the PR group [(0.97±0.40) x 10(-3) mm²/s] and SD group [(0.88±0.27) x 10(-3) mm²/s] (p>0.05). The change of ADC value was statistically significantly higher in PR group.
[(0.63±0.17) x 10^{-3} \text{ mm}^2/\text{s}] compared with that in SD group [(0.19±0.15) x 10^{-3} \text{ mm}^2/\text{s}] (p<0.05).

**CONCLUSION**

- From our preliminary results, the changes in ADC value were significant between the PR and SD group.
- Noninvasive DWI could be potentially used to early predict and monitor unresectable primary and secondary lung cancer response to transpulmonary chemoembolization and transarterial chemoperfusion.

**CLINICAL RELEVANCE/APPLICATION**

The change of ADC value might have the potential to monitor and predict the treatment response of transpulmonary chemoembolization and transarterial chemoperfusion in patients with unresectable primary and secondary lung cancer.

**SSK19-06** Prospective Trial Using Internal Pair-production Positron-emission Tomography (PET) after Radioembolization to Determine the Optimal Yttrium-90 (90Y) Dose for Objective Response of Hepatic Tumors

**Wednesday, Nov. 30 11:20AM - 11:30AM Room: E351**

**Awards**

**Student Travel Stipend Award**

**Participants**

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**PURPOSE**

90Y internal pair-production PET can provide a quantitative assessment of radiation dose delivered to intrahepatic tumors after radioembolization. This study prospectively assessed the required threshold dose for effective radioembolization of liver tumors.

**METHOD AND MATERIALS**

A single-arm prospective trial was performed at a single institution under IRB approval. Thirty-five patients with unresectable hepatocellular carcinoma (HCC) or non-HCC intrahepatic malignancies were recruited. Inclusion criteria were: ECOG performance status 0–2, Childs-Pugh A or B, and receiving first 90Y radioembolization treatment as part of routine clinical care. Time-of-flight PET imaging without additional tracer administration was performed the same day after 90Y treatment. Volumetric analysis of the tumors was performed using a proprietary software and radiation dose calculated for each tumor. Radiographic best response was assessed on follow-up imaging.

**RESULTS**

A total of 52 hepatic tumors (38 HCC, 14 non-HCC) were treated with median follow-up of 684 days. Median tumor size was 5.5 cm (range 2.8–17.9). Most treatments were performed via lobar hepatic artery infusion (76%) using glass microspheres (94%). HCC treatments showed 84% objective response (OR), 11% stable disease (SD), and 5% progressive disease (PD) based on best mRECIST response. Responders had a higher mean 90Y dose to tumor than non-responders (261Gy vs 104Gy, p<0.01). All non-responders had tumor dose <200Gy. No statistical difference was found between responders and non-responders for patient age, tumor volume, multifocal or extrahepatic disease, portal vein invasion, or injected 90Y activity. Treatment of non-HCC tumors showed 14% OR, 29% SD, and 57% PD based on best response RECIST 1.1. There was no significant difference in mean dose between responders and non-responders. No difference was found between the two groups for multifocal disease or injected 90Y activity.

**CONCLUSION**

HCC responders had a statistically greater mean tumor dose of 261Gy compared to 104Gy in non-responders. Delivered tumor dose significantly impacts treatment response in HCC, and can be assessed by PET.

**CLINICAL RELEVANCE/APPLICATION**

90Y-PET tumor dosimetry permits immediate assessment of HCC treatment adequacy after radioembolization, and may predict tumor response.

**SSK19-07** Same Day Y90 Radioembolization: An Effective Treatment Model

**Wednesday, Nov. 30 11:30AM - 11:40AM Room: E351**

**Participants**

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PURPOSE
To assess the feasibility of conducting pretreatment mesenteric angiography, coil embolization, technetium-99m macroaggregated albumin (99mTc-MAA) scanning, and yttrium-90 (Y90) radioembolization treatment in a single, same-day, combined outpatient encounter.

METHOD AND MATERIALS
78 patients from 2008 to 2015 were managed in a single outpatient encounter under the guidance of interventional radiology and nuclear medicine. Pretreatment planning was performed by reviewing baseline imaging and tumoral region of interest (ROI) was estimated by 3-D software; pre-treatment Y90 glass microsphere dosimetry was performed assuming a lung shunt of 10% for hepatocellular carcinoma (HCC) and 5% for liver metastases. Subsequently, mesenteric angiography and 99mTc-MAA scanning were performed followed by Y90 treatment in one outpatient encounter. Total in-room procedure time was recorded.

RESULTS
All patients underwent same-day pretreatment angiography, 99mTc-MAA and Y90 radioembolization. 16 patients received multiple segmental treatments to both lobes, 44 received right lobe treatment, and 18 received left lobe treatment. Median dose was 106 Gy. Median number of glass Y90 vials needed for complete treatment was 2 (1-6 vials). Median in-room time was 160 minutes (75-250 minutes). 18% (14/78) of patients were local residents, 55% (43/78) traveled from outside city limits, 18% (14/78) were from out-of-state, and 9% (7/78) were international. 77% (61/78) of patients treated presented with HCC, 22% (17/78) with liver metastases. Median lung dose was 3.5 Gy.

CONCLUSION
This study demonstrates the feasibility of same-day Y90 evaluation and treatment while maintaining the principles of safe and effective Y90 infusion including tumoricidal dosimetry, mitigation of non-target flow, and minimization of lung dose.

CLINICAL RELEVANCE/APPLICATION
We propose that same-day treatment paradigm to be considered for patients receiving radioembolization in selected cases. Indications include distant residence, elderly patients, contrast allergy, renal impairment, small/limited disease and absence of portal vein invasion. Convenience for patients is an important consideration as this approach is adopted in the future. Finally, we believe a room time averaging just over 2.5 hours makes this approach feasible and should translate into significant cost and time savings.

Y90-Radioembolisation (RE) is a valuable treatment option for otherwise therapy- refractory liver malignancies. DWI has been shown to be helpful to assess response of liver metastases as early as 4 to 6 weeks after lobar treatment. Aim of this study was to evaluate whether change of lesion ADC early after treatment (within 6 weeks) can help predict patients’ overall survival.

METHOD AND MATERIALS
Between May 2010 and April 2014, 41 consecutive patients (28 female, mean age 60 ± 10 years) underwent DW-MRI with b = 0, 50, and 800 at 1.5T within 6 weeks before and 6 weeks after lobar RE to treat secondary progressive liver metastases from solid cancers (21 colorectal, 16 breast, 4 other). Three target lesions per patient were assessed according to RECIST, and change of minimal ADC (ADCmin) was measured, with an increase of ADCmin by at least 30% regarded as indicating response. Patient survival was assessed by long-term follow-up. Comparison analysis was performed by the logrank test.

RESULTS
38/41 patients were followed until their death. Two patients (one with colorectal, the other with breast cancer) treated 1765 and 761 weeks ago, are still alive. One patient was lost after 13 weeks of follow-up. Overall median survival was 69 ± 67 weeks. An ADC increase by 30% or more (i.e., response) was observed in 27/41 patients (66%). Median survival in this "DWI-responder" group was 86 ± 74 weeks, compared to 35 ± 43 weeks in the "DWI-non-responder" group (p < 0.05). Based on RECIST analysis, metastases in 4/41 (10%) patients were categorized as progressive (PD), in another 4/41 as partial response (PR), and in 33/41 (80%) as stable (SD). Median survival was 64 ± 57 weeks in the PD-group, 67 ± 68 weeks in the SD group, and 87 ± 87 weeks in PR-group (p > 0.05).

CONCLUSION
Patients who, at 4 to 6 weeks after Y-90-RE treatment, exhibit response on DWI, can expect significantly longer overall survival than patients without such response. No such correlation was observed for tumor size changes according to RECIST.

CLINICAL RELEVANCE/APPLICATION
DW-MRI can be used to predict overall survival after RE of patients with liver metastases.
To assess the impact of 4D computed tomography angiography (4D-CTA) prior to transarterial chemoembolization (TACE) regarding administered contrast media, operator radiation exposure, catheter consumption, and diagnostic confidence.

METHOD AND MATERIALS
4D-CTA examinations prior to initial TACE of 29 patients (20 men; mean age, 65.7±11.5 years) with malignant liver tumors were analyzed. Multiplanar-reformat (MPR), volume-rendering-technique (VRT) and maximum-intensity-projection (MIP) series were reconstructed enabling a direct selective catheterization of the tumor-supplying artery without prior conventional digital subtraction angiography (DSA) of the abdominal aorta, coeliac trunk, superior mesenteric artery, and indirect portography. Twenty-nine patients who underwent traditional TACE served as the control group. The amount of administered contrast media, operator radiation exposure, and catheter consumption was compared between the different TACE workflows. Diagnostic confidence in the exclusion of portal vein thrombosis was assessed by two radiologists using 5-point Likert scales.

RESULTS
4D-CTA TACE resulted in a significant overall contrast media reduction of 12.8 ml (-13.8 %, p<0.001) and 61.0 ml less contrast were administered intra-arterially (-66.3%, p<0.001) compared to traditional TACE. Scattered radiation could be reduced by 50.5% for 4D-CTA compared to standard TACE (p<0.001). 4D-CTA TACE was performed using 0.7 less catheters on average (p=0.063). Diagnostic confidence in the exclusion of portal vein thrombosis could be significantly increased using 4D-CTA compared to traditional DSA images (scores, 3.9 and 2.4, respectively; p<0.001).

CONCLUSION
4D-CTA enables TACE with substantially reduced amount of contrast material, decreases operator radiation exposure, and increases diagnostic confidence in the exclusion of portal vein thrombosis.

CLINICAL RELEVANCE/APPLICATION
4D-CTA prior to TACE can reduce the intra-arterial amount of utilized contrast material by two-thirds. Thus, this technique may decrease the risk of CIN and enable TACE for patients with renal impairment, while 4D-CTA portography allows for a higher diagnostic confidence than conventional DSA images.
Quantitative Analysis of Prostate Cancer Invasion by using Successive Whole-body Bone Scans

PURPOSE

Whole-body (WB) bone scan scintigram is commonly used to image skeletal pathologic changes due to prostate cancer invasion. Although the temporal changes in successive WB bone scans can be observed, quantitative analysis of prostate cancer invasion is a challenging task for the physicians. In this study, we developed a new method for analyzing prostate cancer invasion quantitatively by using successive WB bone scans.

METHOD AND MATERIALS

We collected 22 series of successive WB bone scans with skeletal pathologic changes due to prostate cancer invasion. Each scan included at least four pairs of posterior and anterior views obtained simultaneously by using a set of two face-to-face gamma cameras. For each series of WB bone scans, the first exam was considered as the base line, and then, temporal changes between the base line and the other images obtained from the follow-up exams were analyzed quantitatively. Prototype computer software for subtracting two WB bone scans by matching images nonlinearly was developed. In addition, a new interval change index (ICI) was proposed in order to quantify the temporal changes. The ICI was defined as the ratio of the total area of abnormal interval changes and that of WB bone scan image multiplied with weighted factor for six anatomically segmented regions. Clinical utility of the ICI was evaluated by comparing with a difference of two bone scan indices (ΔBSI) of which each index was calculated by using commercially available software for one bone scan image.

RESULTS

As a result, the ICI was highly correlated to ΔBSI in 15 of 22 cases (68%). For remaining 7 cases, the ICI was considered as accurate in 4 cases compared with the ΔBSI.

CONCLUSION

Temporal changes on whole-body bone scans due to prostate cancer invasion would be quantitated by using our new software to obtain temporal subtraction images between successive bone scans and to estimate new index of ICI.

CLINICAL RELEVANCE/APPLICATION

Temporal change of successive whole body-bone scans has a potential to demonstrate beneficial/detrimental drug effect for prostate cancer patients, and can be used for prediction of treatment effect.

Role of PET Parameters in Multiple Myeloma Response Assessment

PURPOSE

To assess value of adding Positron Emission Tomography/Computed Tomography (PET/CT) parameters in treatment response of multiple myeloma (MM) patients through progression-free survival (PFS) and overall survival (OS) following 100 day Autologous Stem Cell Transplantation (ASCT). To determine PET/CT parameters most useful as a prognostic indicator.

METHOD AND MATERIALS

MM patients recently admitted to our institution for ASCT were reviewed. Along with hematologic restaging and treatment response; SUVmax, SUVmean, SUVpeak, TLG, MTV, SAM, and NSAM were calculated and compared. Response was categorized into ≥CR, ≥VGPR, ORR or other. Statistical quantitative analyses were performed using the Kaplan-Meier method, chi-squared test or Fisher's exact tests, where appropriate. Significance was assessed at the 0.05 level, and the analysis was performed using SAS.
RESULTS
Out of 174 patients, 90 (51.7%) had a complete response (CR) or stringent complete response (sCR). Ninety-six (55.5%) were male, the mean age was 60.1 years, and the mean time from diagnosis to BMT was 1.3 years. Eighty-six percent of the patients had a value of 0 for each PET parameter. The hazards ratio (HR) for PFS for PET positive patients defined by SUVmax was 1.3 (95% CI: 1.03-1.63, p=0.027), SUVpeak 1.38 (95% CI: 1.06-1.80, p=0.016), TLG 1.01 (95% CI: 1.00-1.03, p=0.040), SAM 1.02 (95% CI: 1.00-1.04, p=0.018) and NSAM 1.03 (95% CI: 1.00-1.06, p=0.027). Neither SUVmean nor MTV showed statistical significance. Although addition of PET in treatment response and PFS demonstrated qualitative improvement, findings were not statistically significant.

CONCLUSION
Vast majority (86%) of MM patients studied did not have a PET parameter value. As a whole, PET positivity was significantly associated with PFS at 100th day restaging following ASCT, whereas patient demographics was not. In subset of patients with PET positivity, SUVmax, SUVpeak, TLG, SAM, and NSAM demonstrated statistical significance with PFS. SUVpeak showed the highest association with PFS in PET positive cases. Neither SUVmean nor MTV showed statistical significance. Although addition of PET in treatment response and PFS demonstrated qualitative improvement, findings were not statistically significant.

CLINICAL RELEVANCE/APPLICATION
(dealing with multiple myeloma) "PET positivity was significantly associated with PFS at 100th day restaging following ASCT, with SUVpeak showing highest association in PET positive cases."

PURPOSE
To assess how the new R-TOF (or QCleaf by GE) alters the observed and quantitated metabolic activity of 18F-FDG avid lesions of sizes less than 3 cm versus TOF and non-TOF PET reconstructions in an oncologic setting.

METHOD AND MATERIALS
Data from 30 patients who underwent PET-CT in October 2015 through February 2016 at a large cancer center were evaluated. Patients with a contrast enhanced CT exam were excluded in order to eliminate any potential confounder in SUV measurements. Multiple reconstructions of the PET data were created for each patient, including R-TOF, TOF, and non-TOF, using OSEM of 3 iterations and 24 subsets. Regions of interest were contoured for measurable lesions of less than 3 cm on fused PET-CT, and SUVmax measurements and the lesion size were recorded for a total of 64 lesions. Comparative statistical analysis of SUVmax and lesion size between reconstructions was performed.

RESULTS
R-TOF had the highest SUVmax for all 64 lesions in our study sample followed by TOF then non-TOF. Paired t-tests were used to determine if there was a statistically significant difference between the SUVmax values of R-TOF and TOF, TOF and non-TOF, and R-TOF and non-TOF reconstructions. The mean difference for all comparisons was different than 0 and statistically significant (two-tail p=0.27E-10, 1.59E-17, 2.42E-13, respectively). Scatter plots of percent increase SUVmax vs. lesion size were made for these same comparisons, and linear trendlines were added. R-TOF vs. TOF, TOF vs. non-TOF, and R-TOF vs. non-TOF all demonstrated negative slopes, with R-TOF vs. non-TOF having the steepest negative slope value (m=-14.9). All r^2 values were low on the order of 0.1.

CONCLUSION
R-TOF demonstrates greater enhancement of the perceived and quantitated metabolic activity of 18F-FDG avid lesions, with a greater effect for smaller lesions, compared to TOF and non-TOF reconstructions. This may be of clinical utility for detecting metabolic activity within very small lesions (e.g. small lung nodules) of which further investigation is needed.

CLINICAL RELEVANCE/APPLICATION
Physicians employing R-TOF should be aware it enhances the observed and quantitated activity of 18F-FDG avid lesions, especially for smaller foci, versus TOF and non-TOF PET.

PURPOSE
18-Fluorodeoxyglucose (FDG) vascular imaging may offer the ability to improve individualized cardiovascular risk stratification.
Obesity is related to higher cardiovascular risk and the same relationship of obesity to vascular FDG activity may imply higher levels of inflammation. However, higher max voxel intensity is also related to higher image noise, which is caused by photon attenuation with due to greater body size within the field of view, measured by body mass index (BMI).

**METHOD AND MATERIALS**

Prospectively, 74 PET/CTs from 37 subjects (41% female) with hyperlipidemia >55 y/o were acquired (~300MBq FDG, 136 min uptake time, iterative reconstruction, 256x256 matrix, 1.5mm slice thickness). The liver and descending aorta were segmented to calculate standard deviation (SD), mean, and max voxel (highest in whole volume) intensity. The %increase of max over mean activity was calculated. Using the generalized estimating equation, the normalized multivariate beta coefficient of BMI related to measurements was reported and corrected for gender, age, and statin dose equivalence (normalized to simvastatin). Where appropriate, the relationship to BMI was also corrected for mean liver and mean blood (inferior/superior vena cava) activity, respectively.

**RESULTS**

There is a significant independent positive relationship of BMI to %max SUV increases over mean activity for the liver and aorta as well as the SD within the structures (all P-values <0.01). One unit change in BMI is proportional to approximately 3% liver max SUV (P<0.0001) change in this model.

**CONCLUSION**

Independent of gender, age, treatment, and regional background FDG activity, the highest max SUV selected in the liver or aorta is significantly related to higher image noise related to photon attenuation due to higher BMI.

**CLINICAL RELEVANCE/APPLICATION**

For cardiovascular risk stratification, higher dosing, adaptive image smoothing, and/or longer imaging time for obese individuals may be considered if SUV max values measured in this fashion are used to compare between individuals. Alternatively, correction for BMI or noise levels may be applied in multivariate models or by inference of expected maximum voxel intensity differences. These results likely also apply in oncology FDG imaging where inter-subject comparisons of maximum activity is desired.

**PURPOSE**

In this meta-analysis we aim to determine the repeatability of amyloid PET imaging with 11C-Pittsburgh compound-B (11C-PIB) and 18F-labeled Amyloid Radiotracers in Alzheimer’s Disease Patients and Healthy Controls

**METHOD AND MATERIALS**

Systematic electronic search were performed in PubMed and EMBASE (last updated in Jan 2016) to identify studies addressing the test-retest repeatability of amyloid PET imaging with 11C-PIB and 18F labeled radiotracers in patients with Alzheimer’s disease (AD) or healthy controls (HCs). The individual patient data or the mean test-retest variability (TRV%) and the standard deviation of two PET tracer retention measurements were extracted from the eligible studies. The study authors were contacted seeking for more information. The average neocortical SUVr were considered as a measure of amyloid load and the cerebellar cortex as the reference region. The percent repeatability coefficient (RC%) was calculated as an index of absolute reliability. The pooled estimates of mean TRV% with SE and the RC% with bootstrapped 95%CI were generated for summary effect.

**RESULTS**

A total of 7 studies were included in this individual patient data meta-analysis. Four studies evaluated the test-retest variability of 18F labeled amyloid tracers (Florbetapir, AZD4694, Flutemetamol, Florbetaben). The test-retest amyloid PET studies were performed between 1 to 4 weeks apart. The pooled mean TRV% for average cortical SUVr was 2.77(SE=0.75) in patients with AD (n=26) with a RC% of 10.36% (4.76-14.92). The pooled mean TRV% for average cortical SUVr was 3.12 (SE=1.39) in HCs (n=22) with a RC% of 10.41% (7.5-20.3). Three studies evaluated the test-retest variability of 11C-PIB amyloid imaging. The test-retest amyloid PET studies were performed on same day and up to 60 days apart. The pooled mean TRV% for average cortical SUVr was 4.33 (SE=0.25) for AD (n=12) with a RC% of 15.4% (8.49-20.05). The pooled mean TRV% for average cortical SUVr was 3.61 (SE=0.59) in HCs (n=16) with a RC% of 9.38% (7.55-10.92).

**CONCLUSION**

Our results showed no significant differences in RC% of 18F labeled and 11C-PIB amyloid tracers for neocortical SUVr.

**CLINICAL RELEVANCE/APPLICATION**

The repeatability coefficient of 18F amyloid radiotracers is about 10% for neocortical SUVr in both Alzehimers Disease patients and healthy controls. This effect should be considered when using neocortical SUVr as an outcome measure for assessing anti-amyloid therapy.
A Comprehensive Approach to Managing Patient Radiation Exposure in Nuclear Medicine Gamma Camera Imaging: Combining Expert-based Guidelines with Practical and Efficacious Gamma Camera Technique to Lower Radiopharmaceutical Administered Activity

Station #11

Participants
Donna Eckstein, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Shivam Shah, MD, North Brunswick, NJ (Abstract Co-Author) Nothing to Disclose
Murray D. Becker, MD, PhD, New Brunswick, NJ (Presenter) Nothing to Disclose

TEACHING POINTS

2. Primary Means of Lowering Patient Radiation Exposure is to Reduce Administered Activity.
4. Understanding How Camera Technique Impacts Image Quality is Crucial to Lowering Patient Radiation Exposure.

TABLE OF CONTENTS/OUTLINE

- Appropriateness Criteria/Society Guidelines Eliminated Unindicated Exams. Examples: Nuc Cardiology; PET/CT Oncology
- Reference Levels and Achievable Administered Activities Review of concepts. The most Recent Data, and How to Use the Surveys
- Administered Activity and Patient Radiation Dose Expected Impact of Radiopharmaceutical Administered Activity on NM Counting Statistics/Image Formation with Example Cases
- Balancing Administered Activity with Imaging Quality Optimizing Gamma Camera Technique Lower Administered Activity Example Cases
Nuclear Medicine Wednesday Poster Discussions

Wednesday, Nov. 30 12:45PM - 1:15PM Room: S503AB

Purpose
The aim of the study is to evaluate the feasibility of using C11-Choline PET/CT to identify intracranial tumors such as meningiomas in a large population.

Method and Materials
A retrospective chart review was performed of 2933 consecutive male patients having undergone C11-choline PET/CT according to standard protocol for prostate cancer between 9/2005 and 2/2016. Standard protocol extends from the skull base through the proximal thighs. All scans were reconstructed with standard 3D OSEM. Patients with possible intracranial tumors noted in their medical record were included. These included incidentally discovered intracranial lesions on choline PET/CT and other imaging. Diagnoses were confirmed with pathology or comparison to contrast enhanced MRI of the head and at least 6 months of follow-up imaging showing stability or slow growth. Maximum standardized uptake values (SUV) of each lesion were compared with background uptake. Data was collected using the electronic medical record, GE Advantage Workstations, GE Picture Archiving Communication System (PACS), and OsiriX 64 bit DICOM Viewing and Storage software. Collected data was analyzed using JMP statistical software using the student's t-test for continuous variables and the chi-square test for categorical variables.

Results
All identified presumed and confirmed meningiomas were choline-avid on all scans well above background activity. Eleven patients demonstrated thirteen meningiomas present on twenty-eight C-11 Choline PET/CT scans. Standardized uptake value maximum in these meningiomas averaged 2.8 +/- 1.3 (SD) with C11-Choline dose of 18.6 +/- 0.9 mCi, and uptake time of 4.6 min +/- 1.0 min. Background activity in nearby brain, CSF and bone was very low. All other intracranial tumors detected were much less choline avid or non-choline avid, including three presumed pituitary adenomas and a schwannoma.

Conclusion
Thirteen intracranial meningiomas confirmed by pathology or follow-up imaging demonstrated clear avidity on C11-Choline PET/CT and represent the largest such series to date.

Clinical Relevance/Application
C11-Choline PET/CT may be a useful modality for the detection and evaluation of metabolically active intracranial meningiomas. Further prospective work is needed to evaluate the role of choline C11-PET/CT for evaluation after local or systemic therapy.

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/

Geoffrey B. Johnson, MD, PhD - 2015 Honored Educator
OPTIMUM FDG PET/CT VOLUMETRIC PARAMETERS IN PATIENTS WITH LOCALLY ADVANCED NON-SMALL CELL LUNG CANCER: RESULTS FROM ACRIN 6668/RTOG 0235 TRIAL

Station #7

Awards
Student Travel Stipend Award

Participants
Ali Salavati, MD, MPH, Philadelphia, PA (Presenter) Nothing to Disclose
Fenghai Duan, PhD, Providence, RI (Abstract Co-Author) Nothing to Disclose
Bradley S. Snyder, MS, Providence, RI (Abstract Co-Author) Nothing to Disclose
Bo Wei, Providence, RI (Abstract Co-Author) Nothing to Disclose
Benja Khiewman, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Sarah Mohajer Moghaddam, MD, MPH, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Abass Alavi, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS
Patients with inoperable stage IIB/III NSCLC and evaluable FDG-PET/CT scans were included. Pretreatment FDG-PET/CT scans were quantified using semiautomatic adaptive contrast-oriented thresholding and local background partial volume effect correction algorithms. For each patient, the following whole-body FDG-PET/CT indices were measured: metabolic tumor volume (MTV), total lesion glycolysis (TLG), SUVmax, SUVmean, partial volume corrected TLG (pvcTLG) and pvcSUVmean. The association between each index and patient outcome was assessed using Cox proportional hazards regression. Optimal cut-off points were estimated using recursive binary partitioning in a conditional inference framework. Finally, the discriminatory ability of each index was examined using time-dependent receiver operating characteristic (ROC) curves and corresponding area under the curve (AUC(t)).

RESULTS
196 patients were included. Pretreatment MTV, TLG and pvcTLG were independently prognostic of OS, while SUVmax, SUVmean and pvcSUVmean were not prognostic. Optimal cut-off points were 175.0, 270.9, and 35.5 cc for TLG, pvcTLG, and MTV, respectively. In time-dependent ROC analysis, AUC(t) for MTV and TLG was uniformly higher than that of the SUV measures over all time points. The discriminatory ability of pvc and non-pvc counterparts appeared to be similar.

CONCLUSION
Pretreatment whole-body volumetric FDG-PET/CT parameters, MTV, TLG and pvcTLG, are strongly prognostic for OS, and have uniformly better discriminatory ability over time than corresponding SUV measures. After validation in future studies, it is possible that the suggested optimal cut-off points could be incorporated in routine clinical practice for more accurate prognostication and metabolic staging of patients with locally advanced NSCLC.

CLINICAL RELEVANCE/APPLICATION
Defining optimal cut-off points for volumetric FDG-PET/CT parameters, proven independent prognostic factors in patients with locally advanced NSCLC, would further the utilization of these biomarkers in routine clinical practice.
CONCLUSION

Y-90 PET/CT is superior to Y-90 bremstrahlung SPECT/CT for the assessment of target and non-target activity. While this is an ongoing study, our initial results suggest that Y-90 PET/MRI is feasible and can be used to evaluate for the technical success of Y-90 radioembolization and the presence of extrahepatic microsphere deposition. We would need further studies to compare Y-90 PET/MR with Y-90 PET/CT.

CLINICAL RELEVANCE/APPLICATION

Not only can post-treatment Y-90 PET/MRI be used evaluate the technical success of Y-90 embolization, it can also provide dose-response information for developing future treatment-planning models.

NM236-SD-WEB8

Normal Aging and Patterns of Regional Brain FDG Uptake

Station #9

Participants
Sara Pourhassan Shamchi, MD, Philadelphia, PA (Presenter) Nothing to Disclose
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Abass Alavi, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Brain structure and function changes as a result of normal aging. Modern in vivo functional imaging modalities such as 18F-FDG PET provide a powerful tool to study and measure these alterations. However, in order to correctly diagnose pathologic states, it is highly important to recognize the normal age-related changes. The goal of current study is to evaluate the age-related changes in regional brain 18F-FDG uptake in normal healthy population.

METHOD AND MATERIALS

This study is part of the Cardiovascular Molecular Calcification Assessed by 18F-NaF/18F-FDG PET/CT (CAMONA). CAMONA was approved by the Danish National Committee on Health Research Ethics registered at ClinicalTrials.gov (NCT01724749), and conducted in accordance with the Declaration of Helsinki. 40 normal healthy subjects were prospectively recruited in group A (Age: 22-32 years) and B (Age: 56-66 years) and underwent 18F-FDG PET/CT. Static PET images were obtained 180 minutes following 18F-FDG injection. Supratentorial and cerebellar FDG uptake was measured by manual placement of regions of interest and SUV mean values were calculated using OsirixMD software.

RESULTS

The mean age of the patients in group A was 26.1±3.4 versus 62±3.9 for group B. There were 10 females (50%) in group A compared to 12 females in group B (60%) without significant difference (p=0.37). Mean SUV of cerebellum was 6.84±1.25 for the young subjects (group A) versus 6.04±0.99 among older individuals (group B)(p=0.03). Mean SUV of supratentorial brain was 9.34±2.37 for the young subjects (group A) compared to 7.20±0.98 among older participants (group B)(p<0.001). More interestingly, Mean SUV of supratentorial brain was significantly higher among female healthy volunteers in both groups (p= 0.040 and 0.034, respectively).

CONCLUSION

These results demonstrate an overall decrease in Brain 18F-FDG uptake with aging, which is more accentuated in supratentorial areas.

CLINICAL RELEVANCE/APPLICATION

These results may help to better understand the normal age-related changes of Brain function and FDG uptake, and to avoid interpreting them as pathologic findings.

NM237-SD-WEB10

Adaptive Protocols with New High Sensitivity PET/CT Scanner for Clinical Routine with Innovative Radiotracers

Station #10

Participants
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Delphine Vallot, Toulouse, France (Abstract Co-Author) Nothing to Disclose
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Frederic Courbon, MD, PhD, Toulouse, France (Abstract Co-Author) Research Grant, General Electric Company
Slirane Zerdoud, Toulouse, France (Abstract Co-Author) Nothing to Disclose
Olivier Caselles, PhD, Toulouse, France (Abstract Co-Author) Grant, General Electric Company

PURPOSE

To take benefit of a new generation high sensitivity BGO non-TOF PET/CT system and reduce injected doses, we use new BMI based 18-FDG prescription rules. For new fluoro and non-fluoro tracers, maximum dose may be limited by availability or price. Considering new 68Ga DOTANOC, the short half-life (68 min) leads to new patient workflow constraints. The aim of this study is to adapt both our prescription rules and acquisition parameters to these radiotracers new constraints.

METHOD AND MATERIALS

In this study 18F-CHOLINE,18F-DOPA and generic 68Ga radiolabeled tracers are considered.Due to organizational and delivery constraints, 97 18F-CHOLINE exams were scheduled by sessions of 6 to 7 male patients. As the maximum available dose per session is limited and to maintain the patient exam rate, the prescription rule is based on a low weight based posology adapted to our PET-
CT, with a maximum patient dose of 300 MBq, 18F-DOPA is more expensive and of very low availability, we used a constant standard dose of 100 MBq and a weight adapted time per step (2 min baseline). Results relative to 15 patients are presented here. These first experiences were used to define the best prescription rules for 68Ga DOTANOC, integrating the specific constraints of maximum available dose per elution with our 1.85 GBq 68Ge generator, and the fast physical decrease of 68Ga.

RESULTS

Thanks to low weight posology, dose was kept under maximum allowed for 18F-CHOLINE (260 MBq at maximum). Mean activity was 156.6 MBq for an average BMI of 27.5. For 18F-DOPA, time per step was ranging from 90s to 180s for average posology of 1.54 MBq/kg and BMI of 23.5. For 68Ga-DOTANOC a mixed protocol based on weight based posology and time per step modulation is used. As the expected available activity per synthesis run and per patient is in the range 100-200 MBq (based on two patients per run), we decided to use a 2 MBq/kg weight prescription and modulate the duration of each based to compensate physical decay with a 2 min baseline for the step centered on the abdomen.

CONCLUSION

In this study we demonstrated the usefulness of both weight based prescription and time per step modulation for new generation of 68Ga radiotracers, taking advantage of the high sensitivity of our PET/CT scanner.

CLINICAL RELEVANCE/APPLICATION

This kind of approach will be more and more prevalent in the future with new 68Ga radiolabeled tracers.

Awards
Cum Laude
Identified for RadioGraphics

Participants
Michael S. Hofman, MBBS, East Melbourne, Australia (Presenter) Nothing to Disclose
Rodney Hicks, MBBS, East Melbourne, Australia (Abstract Co-Author) Nothing to Disclose
Tobias Maurer, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Matthias J. Eiber, MD, Muenchen, Germany (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1. PSMA PET represents a new modality for imaging prostate cancer with superior sensitivity and specificity compared to conventional imaging, and frequent ability to identify <10mm micro-metastatic disease.
2. Despite the terminology "prostate specific", PSMA is a folate hydrolase cell surface glycoprotein expressed in a range of normal tissues and other benign and malignant pathologic processes.
3. Causes of interpretative pitfalls include uptake in physiologic sites such as coeliac, stellate or sacral ganglia, uptake in benign entities such as osteoblastic reaction in degenerative disease or fractures, and benign neoplasms.
4. The role of PSMA PET continues to evolve as high PSMA cell surface expression is also seen in some other malignancies, such as renal cell and thyroid carcinoma.

TABLE OF CONTENTS/OUTLINE

Ga-68 PSMA PET/CT and PET/MRI is a rapidly evolving modality for imaging prostate cancer. The purpose of this exhibit is:1. To review clinical applications in prostate cancer including primary staging biochemical recurrence, and restaging following systemic therapy.2. Describe advantages compared to conventional imaging including CT, bone scintigraphy, Choline PET and MRI.3. Discuss the pearls and pitfalls in the interpretation of this new modality.4. Describe potential applications of PSMA PET in other diseases.
RSNA/ESR Hybrid Imaging Symposium: Hybrid Imaging in the Male (An Interactive Session)

Wednesday, Nov. 30 1:30PM - 3:00PM Room: S402AB

GU MR NM

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

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, (katrine.ahlstrom.riklund@umu.se) (Moderator) Nothing to Disclose

Sub-Events

MSSR43A Prostate Cancer: PET, MR or Both?

Participants
Matthias J. Eiber, MD, Muenchen, Germany, (matthias.eiber@tum.de) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To learn about pathophysiology in prostate cancer. 2) To understand how to interpret hybrid imaging of prostate cancer. 3) To 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) To learn about novel tracer and their biochemical properties. 2) To understand the differences of information given by the use of different tracers. 3) To understand how to interpret examinations with different tracers.

MSSR43C Interactive Case Discussion

Participants
Matthias J. Eiber, MD, Muenchen, Germany (Presenter) Nothing to Disclose
Steven P. Rowe, MD, PhD, Parkville, MD (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To learn how to interpret hybrid imaging of prostate cancer. 2) To understand the pathophysiology in relation to imaging.
Cardiac (PET/MRI/CT/SPECT 2)

Wednesday, Nov. 30 3:00PM - 4:00PM Room: S504AB

SSM04

Participants
James C. Carr, MD, Chicago, IL (Moderator) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
Vincent B. Ho, MD, MBA, Bethesda, MD (Moderator) In-kind support, General Electric Company
Cristina Fuss, MD, Portland, OR (Moderator) Nothing to Disclose

SSM04-01 Body Composition Profiling using MRI - Normative Data for Subjects with Cardiovascular Disease Extracted from the UK Biobank Imaging Cohort

Wednesday, Nov. 30 3:00PM - 3:10PM Room: S504AB

Participants
Olof Dahlqvist Leinhard, PhD, Linkoping, Sweden (Presenter) Stockholder, AMRA AB; Employee, AMRA AB
Jennifer Linge, Linkoping, Sweden (Abstract Co-Author) Employee, AMRA AB
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Jimmy D. Bell, PhD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Magnus Borga, PhD, Linkoping, Sweden (Abstract Co-Author) Stockholder, AMRA AB

PURPOSE
To describe the distribution of MRI-derived body composition measurements in subjects with cardiovascular disease (CVD) compared to subjects without any history of CVD.

METHOD AND MATERIALS
1864 males and 2036 females with an age range from 45 to 78 years from the UK Biobank imaging study were included in the study. Visceral adipose tissue volume normalized with height^2 (VATi), total abdominal adipose tissue volume normalized with height^2 (ATATi), total lean thigh muscle volume normalized with body weight (muscle ratio) and liver proton density fat fraction (PDFF) were measured with a 2-point Dixon imaging protocol covering neck to knee and a 10-point Dixon single slice protocol positioned within the liver using a 1.5T MR-scanner (Siemens, Germany). The MR-images were analyzed using AMRA® Profiler research (AMRA, Sweden). 213 subjects with history of cardiovascular events (angina, heart attack, or stroke) (event group) were age and gender matched to subjects with high blood pressure (HBP group), and subjects without CVD (controls). Kruskal-Wallis and Mann-Whitney U tests were used to test the observed differences for each measurement and group without correction for multiple comparisons.

RESULTS
VATi in the event group was 1.73 (1.13 - 2.32) l/m2 (median, 25%-75% percentile) compared to 1.68 (1.19 - 2.23) in the HBP group, and 1.30 (0.82-1.87) in the controls. ATATi in the event group was 4.31 (2.90-5.39) l/m2 compared to 4.05 (3.07-5.12) in the HBP group, and 3.48 (2.48-4.61) in the controls. Muscle ratio in the event group was 0.13 (0.12 - 0.15) l/kg as well as in the HBP group, compared to 0.14 (0.12 - 0.15) in the controls. Liver PDFF in the event group was 2.88 (1.77 - 7.72) % compared to 3.44 (2.04-6.18) in the HBP group, and 2.50 (1.58 - 5.15) in the controls. Kruskal-Wallis test showed significant differences for all variables and group comparisons (p<0.007). The post hoc test showed significant differences comparing the controls to both the event group and the HBP group. These were more significant for VATi and ATATi (p<10^-4) than for muscle ratio and PDFF (p<0.03). No significant differences were detected between the event group and the HBP group.

CONCLUSION
Cardiovascular disease is strongly associated with high VATi, liver fat, and ATATi, and with low muscle ratio.

CLINICAL RELEVANCE/APPLICATION
The metabolic syndrome component in CVD can be effectively described using MRI-based body composition profiling.

SSM04-02 Monoenergetic Reconstructions for Imaging of Coronary Artery Stents Using A Novel Dual Layer CT: First In-vitro Experience

Wednesday, Nov. 30 3:10PM - 3:20PM Room: S504AB

Participants
Tilman Hickethier, MD, Cologne, Germany (Presenter) Nothing to Disclose
Bettina Baessler, MD, Cologne, Germany (Abstract Co-Author) Nothing to Disclose
Jochen von Spiczak, Muenster, Germany (Abstract Co-Author) Nothing to Disclose
Jan-Robert Kroeger, Muenster, Germany (Abstract Co-Author) Nothing to Disclose
Jonas Doerner, MD, Cologne, Germany (Abstract Co-Author) Nothing to Disclose
Guido Michelis, Cologne, Germany (Abstract Co-Author) Nothing to Disclose
Alexander C. Bunck, Koln, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To describe...
In-stent restenosis have an important impact on long-term prognosis after percutaneous coronary intervention (PCI). However, accurate assessment of coronary stents after PCI using non-invasive CT imaging remains challenging despite new stent materials and improvements in CT technology. A new dual layer detector technology now allows monoenergetic (monoE) image reconstructions, which are supposed to decrease artifacts caused by coronary stents. Therefore we systematically investigated the influence of different monoE reconstructions on the visualization of the coronary stent lumen.

METHOD AND MATERIALS

Ten different coronary stents (diameter 3.0 mm) embedded in plastic tubes filled with contrast agent (500 HU) were scanned with a 128-slice dual layer CT (IQon, Philips, 120 kV, 125 mAs). Images were reconstructed (0.67mm slice thickness, 0.35mm increment) with standard filtered back projection (FBP) and 6 different monoE settings (60, 70, 80, 90, 100, 150 keV). Each stent and reconstruction was assessed using established parameters: image noise (standard deviation (SD) in a standardized ROI), in-stent attenuation difference (mean attenuation difference between stented and non-stented lumen) and visible lumen diameter (mean visible diameter of the stented tube).

RESULTS

The image noise was significantly lower in all monoE data compared with FBP (FBP 13.41, 60 keV 11.62, 70 keV 11.67, 80 keV 11.69, 90 keV 11.71, 100 keV 11.75, 150 keV 11.80 HU SD; p < .01). The in-stent attenuation difference was significantly smaller in monoE data with higher keV levels than in FBP (FBP 148.18, 60 keV 154.13 p=.036, 70 keV 143.43 p=.109, 80 keV 137.25 p=.052, 90 keV 133.02 p=.043, 100 keV 130.12 p=.039, 150 keV 123.99 HU p=.035). The visible lumen diameter was significantly greater in monoE data with higher keV levels than in FBP (FBP 0.65, 60 keV 0.68 p=.541, 70 keV 0.71 p=.053, 80 keV 0.74 p<.01, 90 keV 0.77 p<.01, 100 keV 0.79 p<.01, 150 keV 0.90 mm p<.01).

CONCLUSION

Well-established objective CT image-quality assessment parameters of coronary stents are significantly improved by utilization of monoE reconstructions with adequate keV level.

CLINICAL RELEVANCE/APPLICATION

Non-invasive evaluation of coronary stents is an important and challenging task. MonoE reconstructions have the potential to improve coronary stent assessment crucially.
METHOD AND MATERIALS

Late enhancement MRI was performed in 248 randomly chosen 70-year-olds. Individuals with myocardial infarction (MI) scars, with or without a hospital diagnosis of MI were classified as recognized MI (RMI) or UMI, respectively. Medical records and death certificates were scrutinized. MACE was defined as cardiac death, non-fatal MI, a new diagnosis of angina pectoris, or symptom-driven coronary artery revascularization.

RESULTS

During follow-up (mean 11 years) MACE occurred in 10% (n=18/182) of the individuals without MI scars, in 20% (n=11/55) of the individuals with UMI, and in 45% (n=5/11) of the individuals with RMI, with a significant difference between the UMI group and the group without MI scars (p=0.045), and between the RMI group and the group without MI scars (p=0.0004). Hazards ratios for MACE adjusted for risk factors and sex were 2.55 (95% CI 1.20-5.42; p=0.015) for UMI and 3.28 (95% CI1.16-9.22; p=0.025) for RMI.

CONCLUSION

The presence of an MRI-detected UMI entailed a more than double risk for MACE in community living 70-year-old individuals.
CONCLUSION
The image quality of the single breath-hold 3D mDixon sequence is not inferior to the multi-breath-hold 2D-IR sequence for cardiac LGE imaging at 3T MRI, and it may shorten the acquisition time.

CLINICAL RELEVANCE/APPLICATION
Single breath-hold isotropic LGE imaging with the 3D-mDixon technique can markedly reduce the scan time and the image quality is not inferior to that of the 2D-IR sequence at cardiac 3T MRI.

SSM04-06  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. 30 3:50PM - 4:00PM Room: S504AB

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 cardiological 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 dyssynergy 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 dyssynergy isn't feasible and a previous possible myocardial infarction has to be determined.
SSM15

Nuclear Medicine (Comparative Methodologies and Emerging Technologies)

Wednesday, Nov. 30 3:00PM - 4:00PM Room: S505AB

CT NM

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

FDA Discussions may include off-label uses.

Participants
Nathan C. Hall, MD, PhD, Philadelphia, PA (Moderator) Nothing to Disclose
Adam J. Bobbey, MD, Columbus, OH (Moderator) Nothing to Disclose

Sub-Events

SSM15-01 Comparative Performance of Two Tc-99m Radiopharmaceuticals for Intraoperative Identification of Sentinel Lymph Nodes in Breast Cancer

Wednesday, Nov. 30 3:00PM - 3:10PM Room: S505AB

Awards

Student Travel Stipend Award

Participants
Aurela I. Clark, MD, Lexington, KY (Presenter) Nothing to Disclose
Elizabeth Cheatham, Lexington, KY (Abstract Co-Author) Nothing to Disclose
Peter A. Hardy, PhD, Lexington, KY (Abstract Co-Author) Nothing to Disclose
M. Elizabeth Oates, MD, Lexington, KY (Abstract Co-Author) Nothing to Disclose

PURPOSE

Surgical staging of regional lymph nodes with intraoperative lymphatic mapping and sentinel lymph node (SLN) biopsy is the standard of care for patients with early stage breast cancer. Tc-99m filtered sulfur colloid (SC) is the traditional radiopharmaceutical for guiding intraoperative SLN biopsy. In May 2013, the FDA approved Tc-99m tilmanocept (TM) (Lymphoseek), a low molecular weight, mannose receptor-targeted radiopharmaceutical. While published data suggest that TM may reduce the number of “hot” lymph nodes needed for accurate staging, the higher cost of TM is paramount to its clinical acceptance.

METHOD AND MATERIALS

Retrospective analysis compared two cohorts of female patients with breast cancer: 52 TM (age range 21-79, mean 58.5 yr) and 50 SC (age range 35-88, mean 60.3 yr) who were operated on by one of two experienced surgeons. Primary measures were number of “hot” SLN removed, intraoperative gamma probe counts on those SLN, and determination of positive (metastatic) SLN.

RESULTS

The number of SLN removed was similar in both cohorts (mean TM: 2.13 vs. SC: 3.22, p<0.10). There was no difference in the sensitivity of the radiopharmaceuticals in determining metastatic involvement (mean TM 0.08 vs SC 0.18, p<0.14). At least one “hot” SLN was identified in every patient. In patients with more than one SLN removed, the second SLN demonstrated lower counts in both cohorts.

CONCLUSION

In comparing the number of excised “hot” lymph nodes, there was no statistical difference between the TM and SC cohorts. There was equivalent sensitivity of both radiopharmaceuticals for determining the presence of regional lymphatic metastases. Based on these results, it is difficult to justify the higher cost of TM.

CLINICAL RELEVANCE/APPLICATION

Currently, the contract price for TM is approximately four times that of SC. The prices of TM and SC will increase in 2016; there will continue to be an approximately 3.6-fold difference in cost. Reimbursements for SC and TM are now bundled into the payment for the procedure. Given that TM has not been shown to result in higher sensitivity for detection of metastatic regional spread to SLN, its clinical relevance becomes less favorable, particularly in the face of increasing prices and bundled reimbursements.

SSM15-02 First Clinical Study with a New Respiratory Gating Device Aiming to Improve 4D PET/CT Studies: SPIRO PET: Phase I Study

Wednesday, Nov. 30 3:10PM - 3:20PM Room: S505AB

Participants
Frederic Courbon, MD, PhD, Toulouse, France (Presenter) Research Grant, General Electric Company
Cyril Jaudet, PhD, Brussel, Belgium (Abstract Co-Author) Nothing to Disclose
Olivier Caselles, PhD, Toulouse, France (Abstract Co-Author) Grant, General Electric Company
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Séverine Brillouet, Toulouse, France (Abstract Co-Author) Nothing to Disclose
Mathilde Bauriaud, Toulouse, France (Abstract Co-Author) Nothing to Disclose
David Didierlaurent, Toulouse, France (Abstract Co-Author) Nothing to Disclose
Delphine Vallot, Toulouse, France (Abstract Co-Author) Nothing to Disclose

PURPOSE
We have previously demonstrated that SPI can measure physiological breathing signal while processing trigger signals with a high temporal accuracy. The primary objective was to assess the feasibility (patient’s tolerance), to perform clinical gated PET-CT study with SPI device. The secondary objectives were to compare the accuracy (inhalation peaks detection, time lags, the baseline drift and reproducibility of the time binning) of RPM and SPI.

**METHOD AND MATERIALS**

A prospective phase I clinical study (AFSSAPS and the ethic committee approval n°UEC/DA2012 on patients referred to our center for a 18-FDG-PET-CT study for either lung cancer staging, solitary pulmonary nodule viability assessment or BTV definition for treatment planning. After whole body PET-CT, a 4D PET CT acquisition centered over the torso is carried on. The SPI-mask is placed over the mouth and nose and the RPM box is placed over the abdomen. The patient is asked to breathe normally during the acquisition. Heart rate, blood oxygen saturation (%SpO2) levels, blood pressure are monitored. PET gated acquisition duration is 12 minutes followed by a 4D CT 120 kV - 30 mA, 256x256 of 2min30sec.

**RESULTS**

46 patients were included, all the patients went through the treatment phase (5 minutes) 5 patients were removed from the study because of metastatic extension, and one because a blood glucose level > 1.9g/L. No serious adverse events are to be reported. Among the remaining 40 pts only one is considered as failure of the SPI device because of patient discomfort during the gated PET-CT acquisition, for this patient. The tolerance was excellent for the 39 other patients. Among them all respiratory cycles were detected by SPI, 3 were missed with the RPM (p < 0.0001) SPI improve significantly the inhalation peaks detections and the reduce the time lags between the inhalation peak detection and triggers. Reproducibility is also improved as the baseline drift (inspiration end) is also smaller (p<0.0018).

**CONCLUSION**

This first clinical study confirms that this novel respiratory tracking device (SPI) is well tolerated and that it improves PET-CT synchronisation in prospective mode.

**CLINICAL RELEVANCE/APPLICATION**

It is our assumption that the improvement provided by SPI is particularly adapted for the new PET-CT system with increased spatial resolution, improved quantification accuracy, reduced CT induced radiation exposure.

**SSM15-03  Respiratory Phase Matching in Whole-Body PET/CT Using Fast Spiral CT**

Wednesday, Nov. 30 3:20PM - 3:30PM Room: S505AB

**Participants**

James Hamill, PhD, Knoxville, TN (Presenter) I am employed by Siemens Healthcare
Osama R. Mawlawi, PhD, Houston, TX (Abstract Co-Author) Research Grant, General Electric Company; Research Grant, Siemens AG
Joseph Meier, Houston, TX (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Patient motion affects the alignment of PET and CT images, sometimes leading to errors in image interpretation and PET attenuation correction. We propose and evaluate a novel method for aligning PET and CT images in normal PET/CT protocols. The CT radiation dose is low and the alignment is applied in all bed positions in the chest and abdomen.

**METHOD AND MATERIALS**

Our protocol includes a non-gated low-dose spiral CT scan during free breathing, followed by listmode PET, also in free breathing. A respiration monitoring device collects waveform data during CT and PET. We reconstructed eight bins of gated PET (4D PET). All phases of respiration were represented by the 4D PET series, but each axial slice in CT matched just one phase. Our novel method created a matched 3D PET series by selecting, slice by slice, the phase in 4D PET that matched CT in that slice, based on the respiratory waveform measured during CT. PET and CT were aligned even though breathing motion affected the CT image. PET/CT data were acquired in step and shoot and continuous bed motion modes on Siemens mCT and mCT Flow PET/CT systems with 22 cm axial coverage. We tested the method with a phantom that had a stationary line source and one that moved during CT and PET. The alignment of PET and CT, measured in mm, and PET’s spatial resolution, were evaluated for static PET, optimally gated 3D PET (HD Chest), 4D PET, and matched 3D PET. We will present matched 3D PET/CT images from 20 whole-body oncological FDG PET patients.

**RESULTS**

The average alignment error in the phantom study with slow CT was 9 mm for static PET, 4 mm for HD Chest, and 0.3 mm for matched 3D PET. The sharpest image resolution was seen in the HD Chest image and in two of the eight gates in 4D PET, though resolution was degraded in the other gates. In patient studies, increased PET image noise was noted, as in conventional 4D PET, but alignment of PET and CT was improved and the CT dose was unchanged from conventional PET/CT.

**CONCLUSION**

The matched 3D PET images were spatially matched quite closely to free-breathing CT.

**CLINICAL RELEVANCE/APPLICATION**

Good alignment of PET and CT normally requires additional patient radiation dose for 4D CT, extra scan time for triggered CT, or breath control. Our method is simple and uses a fast spiral CT.

**SSM15-04  Whole Body Hybrid PETMRI: Comparison Between Contrast Enhanced and Non-Enhanced MRI Protocols for the Evaluation of Malignancies**

Wednesday, Nov. 30 3:30PM - 3:40PM Room: S505AB

**Participants**

Filiz Celebi, MD, Istanbul, Turkey (Presenter) Nothing to Disclose
Numan C. Balci, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare between non-contrast (NC) and contrast enhanced (CE) MRI protocols in Whole Body Hybrid PETMRI.

**METHOD AND MATERIALS**

53 Patients with known primary tumor underwent whole body hybrid PETMRI for initial staging with the use of NC and CE MRI protocols for simultaneous PET and MRI acquisitions. NC PETMRI protocol consisted of diffusion weighted (b=0 s/mm2 and 800s/mm2) and T1-weighted Turboflash in axial, T2 weighted HASTE sequence in coronal planes (Σ=25 minutes). CE PETMRI was performed with the acquisition of axial serial contrast enhanced 3D FS VIBE images in the upper abdomen, whole body coronal fat saturated 3D VIBE Dixon and axial 3D FS VIBE for the brain (Σ=30 minutes). Total numbers of malignancies were determined on PETMRI images and differences between two protocols were analyzed with the use of Wilcoxon signed-rank test.

**RESULTS**

All malignancies that were seen on NC MRI were also present on CE MRI protocol. The mean numbers of malignancies on NC MRI and CE MRI were 13.2 ± 18.5 and 12 ± 18.3 respectively. There was significant difference for the total number of malignancies (p=0.007) Significant differences in number malignancies were observed in favor of contrast enhanced protocol in the abdomen (p=0.001) in the brain (p=0.01) and in the bone. There were no differences between two protocols for the number of malignancies in head and neck (p=0.317), thorax (p=0.204), and lymph nodes (p=0.799).

**CONCLUSION**

Whole body hybrid PETMRI with the use of CE MRI is superior to NC MRI protocol for the detection malignancies.

**CLINICAL RELEVANCE/APPLICATION**

To establish most optimal protocol for whole body hybrid PETMRI.

**SSM15-05  The 10x Challenge for PET: A Radical Concept for Lower Dose and/or Faster Acquisitions**

Wednesday, Nov. 30 3:40PM - 3:50PM Room: S505AB

**Awards**

Student Travel Stipend Award

Participants
Michelle I. Knopp, Columbus, OH (Presenter) Nothing to Disclose
Jun Zhang, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Katherine Binzel, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Ajay Siva, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Philip Bardos, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Talha Saif, Columbus, OH (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

While major radiation dose reductions have been accomplished for CT, FDG PET tracer dosing has remained unchanged in the last two decades despite major advances. With introduction of next generation solid state, digital PET detectors, we escalated our effort to lower dose levels into a moon shot challenge to reduce the FDG dose or acquisition time by a factor of 10.

**METHOD AND MATERIALS**

We perform clinical trials on a next generation digital dPET/CT (Vereos) in a pre-commercial release version and intra-individual comparisons with current generation, photomultiplier tube, time of flight (TOF) cPET/CT (Gemini). The TOF timing resolution of 325ps dPET is best in class compared to 525ps in cPET. Prior to clinical testing, our team performed extensive phantom testing and recon development to enable selective clipping of list mode PET datasets for in silico simulation of acquisition / dose reductions. Our standard of care PET imaging protocol is 14 mCi FDG, time of flight and 90s per bed position imaged 75min p.i. After simulations, we decided to generate 10x initially by performing 1/10 acquisition time scans using 9s per bed position on both the cPET and dPET systems. Images were qualitatively analyzed by blinded readers and quantitatively by 3D ROI placement on target and background lesions.

**RESULTS**

25 1/10 acquisition time wholebody scans were acquired on dPET, 7 on cPET in addition to the 90s scans. We were also able to recon a simulated 1/10th acq.time image set that showed less than 10% variability from the real. The reduced county density led to increased noise levels, however target lesion detection achievable with slightly below borderline quality. We quickly realized that reconstruction has to be reoptimized if not radically changed. Subsequently, the noise level was considerably reduced and ROI SUV values found to be within 15% of the 10x benchmark.

**CONCLUSION**

The 10x challenge for dose or acquisition time reduction appears reachable with digital detection technology and reconstruction redesign. A 5x reduction goal is already being validated.

**CLINICAL RELEVANCE/APPLICATION**

This study demonstrates that substantial PET tracer dose reductions are achievable by leveraging new detector and reconstruction technologies.
Purpose

In the event of a misadministration of Yttrium-90 (90Y) microspheres during interventional radioembolization, evaluation of the delivery system for retained 90Y activity is often necessary. The purpose of this study is to assess the technical feasibility of next generation digital photon counting PET (dPET) detector technology for imaging ultra-low residual doses of 90Y activity within the delivery system and compare to conventional photomultiplier-tube based PET (cPET) technology.

Method and Materials

A pre-commercial release dPET/CT system (Vereos TF, Philips) and cPET/CT (Gemini TF, Philips) were used to image six 90Y delivery systems (typically < 37 MBq of 90Y) following interventional radioembolization to detect and localize any residual 90Y activity. Both dPET and cPET images were acquired in list-mode using a single bed position for 60 m and then for 7 m. In order to determine the optimal imaging time, list-mode clipping of the 60 m dPET and cPET data sets were performed to simulate shorter total acquisition times (i.e., 50, 40, 30, 20, 10 and 7 m). Intra-individual comparison of the dPET and cPET image characteristics for the true acquisitions and the list-mode clipping simulations were performed by a blinded 3 reader panel.

Results

Detection of ultra-low levels of 90Y activity within the delivery system was feasible with both cPET and dPET systems. Residual 90Y activity was consistently detected in the microsphere source vial and some activity was in the catheter tubing. Although more 90Y internal pair-production events were detected with 60 m acquisitions, there was no difference in image quality or 90Y detectability when compared with true 7 m acquisitions for cPET and dPET. List-mode clipping of the PET data sets also confirmed that the clipped 7 min simulations were visually indistinguishable from true 7 min PET acquisitions.

Conclusion

This study demonstrates the feasibility of precisely imaging ultra-low levels of 90Y activity within a microsphere delivery system using cPET and dPET systems. It also appears feasible that total image acquisition time may be further reduced (i.e., < 7 m) without a significant impact on visual detection of residual 90Y activity.

Clinical Relevance/Application

In case of a 90Y misadministration event, it is feasible to quickly and precisely detect residual 90Y activity within the delivery system using conventional and digital PET approaches.
RSNA/ESR Hybrid Imaging Symposium: Hybrid Imaging of the Brain (An Interactive Session)

Wednesday, Nov. 30 3:30PM - 5:00PM Room: S402AB

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

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, (katrine.ahlstrom.riklund@umu.se) (Moderator) Nothing to Disclose

Sub-Events

MSSR44A Neurodegenerative Disorders

Participants
Henryk Barthel, Leipzig, Germany, (henryk.barthel@medizin.uni-leipzig.de) (Presenter) Consultant, Siemens AG; Consultant, The Piramal Group; Travel support, Siemens AG; Travel support, The Piramal Group; Speaker, Siemens AG; Speaker, The Piramal Group
Jonathan E. McConathy, MD, PhD, Birmingham, AL (Presenter) Research Consultant, Eli Lilly and Company; Research Consultant, Blue Earth Diagnostics Ltd; Research Consultant, Siemens AG; Research Consultant, General Electric Company;

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.

ABSTRACT

MSSR44B Brain Tumors

Participants
Jonathan E. McConathy, MD, PhD, Birmingham, AL (Presenter) Research Consultant, Eli Lilly and Company; Research Consultant, Blue Earth Diagnostics Ltd; Research Consultant, Siemens AG; Research Consultant, General Electric Company;

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.

ABSTRACT

MSSR44C Interactive Case Discussion

Participants
Henryk Barthel, Leipzig, Germany, (henryk.barthel@medizin.uni-leipzig.de) (Presenter) Consultant, Siemens AG; Consultant, The Piramal Group; Travel support, Siemens AG; Travel support, The Piramal Group; Speaker, Siemens AG; Speaker, The Piramal Group
Jonathan E. McConathy, MD, PhD, Birmingham, AL (Presenter) Research Consultant, Eli Lilly and Company; Research Consultant, Blue Earth Diagnostics Ltd; Research Consultant, Siemens AG; Research Consultant, General Electric Company;

LEARNING OBJECTIVES
1) To learn about evaluation of hybrid imaging in neurodegenerative disorders. 2) To learn about evaluation of hybrid imaging of brain tumours.

ABSTRACT
Participants
Richard K. Brown, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Murray D. Becker, MD, PhD, New Brunswick, NJ (Abstract Co-Author) Nothing to Disclose
Matthew Manganaro, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Wahida T. Rahman, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Jason J. Bailey, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Levi Sokol, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Mark A. Helvie, MD, Ann Arbor, MI (Abstract Co-Author) Institutional Grant, General Electric Company
Donna Eckstein, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
John D. Millet, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1) Learn the salient imaging findings of fat necrosis and giant cell arteritis on PET/CT. 2) Recognize the pattern of uptake on sulfur colloid imaging seen in focal nodular hyperplasia. 3) Learn how to use correlative imaging to assist in the diagnosis of pathology seen on nuclear medicine studies.
PET/CT and SPECT/CT in Movement Disorders and Epilepsy

Thursday, Dec. 1 8:30AM - 10:00AM Room: S505AB

NR  CT  NM

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

FDA

Discussions may include off-label uses.

Participants

Sub-Events

RC611A  DAT Scans and Movement Disorders

Participants
Vani Vijayakumar, MD, Ridgeland, MS, (vvijayakumar@umc.edu) (Presenter) Grant, General Electric Company

LEARNING OBJECTIVES

1) Apply basic knowledge and skills relevant to clinical practice of Movement Disorders. 2) Assess the potential of emerging technological innovations and advances to enhance clinical practice and problem-solving. 3) Develop new ideas from experts and peers in the nuclear imaging sciences. 4) Differentiate Essential Tremor and Presynaptic Parkinson Diseases on DATscans. 5) Compare different image findings for interpretation of Movement Disorders.

ABSTRACT

Introduction: Parkinson Disease (PD) is the most common movement disorder affecting 1-2% of the general population over the age of 65 years and the second most common neurodegenerative disorder after Alzheimer’s disease (AD). PD presents with 3 most common symptoms.

1. Resting tremor: Most common first symptom, usually asymmetric and most evident in one hand with the arm at rest.
2. Bradykinesia: Difficulty with daily activities such as writing, shaving, using a knife and fork, and opening buttons; decreased blinking, masked facies, slowed chewing and swallowing.
3. Rigidity: Muscle tone increased in both flexor and extensor muscles providing a constant resistance to passive movements of the joints; stooped posture, anteflexed head, and flexed knees and elbows.

Nuclear Imaging Diagnosis:

Datscan: (123I-ioflupane)

Patient preparation: Thyroid blockade with Lugols- 3 drops one hour before stop medicines that bind to the dopamine transporter 7 days prior to study, e.g. SSRIs, amphetamine, benzotropine, cocaine, mazindol, methylphenidate and phentermine and sertraline.

Radiopharmaceutical: (123I-ioflupane) is a molecular imaging agent 3-5 mCi IV and Brain SPECT in 3 hours.

Used to demonstrate the location and concentration of dopamine transporters (DaTs) in the synapses of striatal dopaminergic neurons.

Interpretation:

Normal: comma shaped striatum
Abnormal: dot, asymmetric caudate or putamen, high background

Summary:

A highly sensitive marker for accurate assessment of striatal dopaminergic function to differentiate Essential Tremor from PDEarly diagnosis of presynaptic Parkinsonian syndromes

Differentiation of presynaptic Parkinsonian syndromes from parkinsonism without presynaptic dopaminergic loss, such as drug-induced parkinsonism or psychogenic parkinsonismA straightforward one-day protocol An objective adjunct to the differentiation of PD syndromes from ET in clinically uncertain patients

A diagnostic tool helping differentiate between probable DLB and AD

Visualizing DaT distribution is useful as a novel diagnostic adjunct in movement disorders and dementia

Handout: Vani Vijayakumar

RC611B  Imaging for Epilepsy

Participants
Anson L. Thaggard, MD, Jackson, MS, (athaggard@umc.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Define the components of a multidisciplinary evaluation for the surgical treatment of epilepsy. 2) Compare brain SPECT with FDG PET for evaluation of an epileptogenic focus. 3) Discuss barriers to the use of ictal SPECT imaging and functional MRI. 4) Appraise the added value of fusion imaging in epilepsy evaluation.

ABSTRACT

Active Handout: Anson Lee Thaggard

RC611C  Neurologist’s Perspective on Functional Imaging for Epilepsy and Movement Disorders

Participants
Juebin Huang, MD, Jackson, MS (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Recognize challenges to the accurate and timely diagnosis of tremor and Parkinson syndrome in clinical practice. 2) Learn how DaTscan-SPECT can improve Neurologist’s diagnosis and management of clinically uncertain Parkinsonian and tremor syndromes. 3) Outline when functional neuroimaging is appropriate in the diagnostic workup of patients with movement disorders. 4) Increase knowledge of functional imaging’s role in localization and surgically treatment of epilepsy. 5) Understand how newly developed functional imaging techniques can change Neurologists’ practice now and in the future.
Interactive Game: Challenging Cases in Body Oncologic Imaging

Thursday, Dec. 1 8:30AM - 10:00AM Room: S103AB

CT MR NM OI US
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

**RC618A Ultrasound**

Participants
Deborah J. Rubens, MD, Rochester, NY, (Deborah_rubens@urmc.rochester.edu)  (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

**RC618B Magnetic Resonance Imaging**

Participants
Alexander R. Guimaraes, MD, PhD, Portland, OR, (guimaraa@ohsu.edu)  (Presenter) Speakers Bureau, Siemens AG;

**LEARNING OBJECTIVES**

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). At the end of this course the attendee through case studies will demonstrate a greater understanding of the following: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**

RC618C PET/CT

Participants
Gary A. Ulaner, MD, PhD, New York, NY, (ulanerg@mskcc.org)  (Presenter) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd

**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 indispensable 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 determines 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.
**Molecular Imaging Mini-Course: Advanced Molecular Imaging**

**RC623A**  
**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.

**RC623B**  
**Novel Instrumentation (PET/MR)**

Participants  
Ciprian Catana, MD, PhD, Charlestown, MA, (ccatana@nmr.mgh.harvard.edu) (Presenter) Research Consultant, Cubresa, Inc

**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.

**ABSTRACT**
Molecular Imaging (New Tracers/Methods)

Thursday, Dec. 1 10:30AM - 12:00PM Room: SSQ11AB

Participants
Vikas Kundra, MD, PhD, Houston, TX (Moderator) License agreement, Introgen Therapeutics, Inc
Zaver M. Bhujwalla, PhD, Baltimore, MD (Moderator) Nothing to Disclose

Sub-Events
SSQ11-01 Novel Intrinsically Zirconium-89 Radiolabeled Self-Destructing Mesoporous Silica Nanostructures for in Vivo Biodistribution and Tumor Vasculature Targeting Studies

Thursday, Dec. 1 10:30AM - 10:40AM Room: SSQ11AB

Awards
Student Travel Stipend Award

Purpose
Long residence times and resultant toxicity remains a major roadblock in clinical translation of nanomaterials. We present synthesis of biodegradable mesoporous silica nanoparticles, to carry multiple cargos types and self-destruct over time after release of payload. Chelator-free labeling of bMSNs with 89Zr (t1/2 = 72.8 h) was used to track their in vivo pharmacokinetics and CD105 targeting ability via positron emission tomography (PET) imaging.

Materials and Methods
Multi-generational bMSNs with tunable pore diameters, were synthesized via biphasic stratification approach and characterized. In vitro degradation and dual drug release studies were carried out in simulated body fluid (SBF) for 21 days. bMSNs were intrinsically chelated with oxophilic radionuclide 89Zr, followed by conjugation with polyethylene glycol (PEG) and TRC105 antibody to form (89Zr)bMSN-PEG-TRC05 for in vivo PET imaging in 4T1 metastatic murine breast tumor model.

Results
Degradation of nanocarriers into biocompatible and non-toxic byproducts presents a favorable prospect for their clinical translation. Dendritic bMSNs with spoke-like radiating bimodal mesoporous channels showed large pore size (5.4 nm and 12 nm) resulting in rapid and complete degradation in SBF within 21 days. bMSNs showed high co-encapsulation and pH-dependent release of the drugs. Excellent 89Zr labeling yield (~ 98% within 2 h at 75 °C) and radiostability (> 95% upto 72 h) were observed. CD105 specificity of (89Zr)bMSN-PEG-TRC05 was confirmed in vivo with PET images with significantly enhanced tumor uptake (4.5±0.6, 11.2±2.1, 11.5±1.3 and 11.2±0.9 %ID/g at 0.5, 6, 24 and 48 h post injection). The specificity was further confirmed with systematic ex vivo biodistribution and histological examination.

Conclusion
The versatile and easily tunable approach shows great potential for bench-to-bedside transition of personalized nanomedicine. The nanoparticles can be tailored to (i) label clinically relevant diagnostic and therapeutic radiotracers without tiresome chelator chemistries, (ii) carry small-molecule and large biomolecular drugs for combination therapy, (iii) specifically target any tumor type by modifying the targeting ligand, and, (iv) auto-destruct and excrete from the body within a reasonable time period.

Clinical Relevance/Application
Biodegradable nanoparticles with multiple cargo carrying ability combat two primary roadblocks in clinical translation of nanomedicine.

SSQ11-02 Protein Corona: A Simple Solution that Enables Clinical Translation of Stem Cell Imaging

Thursday, Dec. 1 10:40AM - 10:50AM Room: SSQ11AB

Awards
Student Travel Stipend Award

Purpose
The protein corona is a simple solution that enables clinical translation of stem cell imaging.

Materials and Methods
Protein corona is a simple solution that enables clinical translation of stem cell imaging.

Results
The protein corona is a simple solution that enables clinical translation of stem cell imaging.

Conclusion
The protein corona is a simple solution that enables clinical translation of stem cell imaging.

Clinical Relevance/Application
The protein corona is a simple solution that enables clinical translation of stem cell imaging.
PURPOSE

To develop a new, transfection-agent free labeling approach that is clinically applicable for localizing and tracking stem cells, using MR imaging with minimum manipulation of nanoparticles and cells.

METHOD AND MATERIALS

We labeled human mesenchymal stem cells (hMSC) by ferumoxytol in media containing human serum (group 1), fetal bovine serum (group 2), StemPro® media (group 3), protamine (group 4) and protamine-heparin (group 5). Formation of protein corona around ferumoxytol was characterized by dynamic light scattering (DLS), zeta potential, and liquid chromatography–mass spectrometry (LC-MS). Iron uptake was evaluated by DAB-prussian blue, Lysotracker and inductively coupled plasma spectrometry (ICP). To evaluate the effect of different labeling methods on MR signal, labeled and unlabeled hMSCs were imaged in vitro as well as ex vivo in pig knee. MR imaging was performed in a 3T MR scanner, using T2W FSE and MESE sequences to calculate T2 relaxation times. Data was analyzed using ANOVA test with p<0.05.

RESULTS

DLS and zeta potential showed more disperse nanoparticles and decrease of negative charge of nanoparticles in all groups compared to bare nanoparticles. LC-MS revealed different proteins covering nanoparticles. Most common proteins in group 1 were Apolipoprotein A-I, E, C-I, and A-II, and in group 2 were Hemoglobin alpha and beta, Apolipoprotein A-II, Alpha-2-HS-glycoprotein, and Albumin. ICP and histology results showed higher iron uptake in group 1 compared to other groups. hMSCs in group 1 revealed significantly shorter T2 relaxation times (17.03±0.23ms) compared to unlabeled, group 2, 3, 4, and 5 hMSCs (33.29±1.22, 26.79±1.46, 20.70±0.81, 25.61±0.33, 21.90±0.44 ms) (p<0.05). After implantation into pig knee, Labeled hMSCs in group 1 revealed significantly shorter T2 relaxation times (12.68±0.11ms) compared to unlabeled, group 2, 3, 4, and 5 hMSCs (35.74±2.75, 20.94±3.9, 17.50±0.33, 19.46±1.13, 17.42±0.21 ms) (p<0.05). In vivo applications in pig knees are ongoing.

CONCLUSION

This study showed a significant higher ferumoxytol uptake by hMSCs labeled with human serum containing media compared to previously reported approaches with transfection agents.

CLINICAL RELEVANCE/APPLICATION

Protein-corona-mediated cell labeling represents a new and readily clinically translatable method for labeling “off the shelf” cell products with ferumoxytol.

SSQ11-03 Radiotracer Derivatives of Trimethoprim (TMP) for Imaging Transgenic Cells

Thursday, Dec. 1 10:50AM - 11:00AM Room: S505AB

Awards

Student Travel Stipend Award

Participants

Mark A. Selimyer, MD, PhD, Philadelphia, PA (Presenter) Nothing to Disclose
Iljung Lee, philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Catherine Hou, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Brian Lieberman, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Chenbo Zeng, philadelphia, PA (Abstract Co-Author) Nothing to Disclose
David A. Mankoff, MD, PhD, Philadelphia, PA (Abstract Co-Author) Speaker, Koninklijke Philips NV; Consultant, General Electric Company; Advisory Board, Reflexion Medical Inc
Robert Mach, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose

PURPOSE

There is a clinical need for quantitative, sensitive methods to image genetically engineered cells, including immune cells used for cell-based therapy. Given the genetic manipulation inherent to gene therapy, a genetic imaging handle / reporter protein is a logical solution and positron emission tomography (PET) can provide the desired sensitivity and spatial resolution. We developed a PET imaging strategy based on the bacterial protein E. coli dihydrofolate reductase (Ec DHFR) and its highly specific small molecule inhibitor, trimethoprim (TMP). Here, we describe the initial synthesis and testing of [18F] fluoropropyl-TMP, [18F]FPTMP.

METHOD AND MATERIALS

[18F]FPTMP was synthesized via a bis-boc protected reaction. HCT116 cells were transduced with YFP-Ec-DHFR fusion gene and sorted by FACS. Cell uptake, time course and saturation assays with [18F]FPTMP were performed (and with competing cold TMP or methotrexate). Protein was quantified by Lowry method. To show in vivo activity, immune deficient mice were xenografted with HCT116 DHFR and control cells. Tumors were grown for 2 weeks prior to injection of ~ 200 μCi of [18F]FPTMP. PET/CT imaging, time activity curves and biodistribution studies were performed.

RESULTS

[18F]FPTMP radiosynthesis showed high specific activity and there was rapid uptake (~3-fold at 5 minutes) and excellent overall target to background (over 16-fold at 2h) in vitro in HCT116 DHFR cells. Cold TMP completely inhibited uptake and methotrexate had no effect in control cells, suggesting no cross reactivity with mammalian DHFR. [18F]FPTMP saturation studies showed an expected low Kd of 0.46 nM (+/- 0.07) and Bmax of 2870 +/- 106 fmol/mg. In a mouse xenograft model, there was over 6-fold specific signal induction in Ec DHFR tumors with [18F]FPTMP and over 40-fold induction relative to muscle. [18F]FPTMP showed a favorable biodistribution, with mixed renal and hepatobiliary metabolism.

CONCLUSION

The radiosynthesis and in vivo application of [18F]FPTMP for PET reporter gene imaging is a simple solution providing a quantitative, sensitive tool that could be easily applied to imaging cell therapy in humans.

CLINICAL RELEVANCE/APPLICATION

Clinicians are interested in basic questions for cell therapies – Are the cells getting to where they are supposed to go and are there sites of off-target accumulation? – And TMP radiotracers may provide a single, facile reporter to allow such monitoring.
SSQ11-04  Non-Invasive Quantification of Macrophage Recruitment in Head and Neck Carcinoma using Flourine 19MRI

Thursday, Dec. 1 11:00AM - 11:10AM Room: S505AB

PURPOSE
Head and neck squamous cell carcinoma (HNSCC) is a source of significant morbidity and mortality worldwide with risk factors including HPV status, tobacco and alcohol. In HPV negative tumors, reduced survival outcomes associated with tumor protein 53 (TP53) mutation only occur in combination with loss of chromosome 3p with reduction in median survival from 5 years for TP53 mutations to 1.7 years for a double hit (TP53 and 3p). The reasons for worse outcomes are still unclear with potential explanations including decreased radiosensitivity of double-hit tumors and/or role of infiltrating host immune cells/macrophages. Previous studies have also shown that “double-hit/Cal27” xenografts have higher matrix metalloproteinase (MMP) activity and since a significant amount of MMP is provided by tumor associated macrophages, we expect more macrophage accumulation for the “double-hit/Cal27” group compared to the “single-hit/SCC4” group.

METHOD AND MATERIALS
A novel perfluorocarbon (PFC) emulsion was used to tag macrophages in situ with high specificity and sensitivity and no background. Approximately 5x106 cells of two different cell lines, single-hit/ SCC4 and double-hit/ Cal27, were injected in bilateral flanks of 10 mice (n=5 in each group). These mice were then injected intravenously with 0.2ml of PFC emulsion (VS-1000, Celsense, Inc., Pittsburgh, PA) and 19F and proton MRI was performed on Day 2 & 10 post-injection. Tumors were then excised for histology to evaluate immune cell recruitment and to differentiate between M1 & M2 macrophages.

RESULTS
The average number of 19F spins within the tumors were significantly more (approximately double, p<0.05) for the “double-hit/Cal27” group compared to the “single-hit/SCC4” group (3.94x1019 compared to 1.98x1019 19F / tumor) signifying increased tumor associated macrophage burden in the double hit tumors. The number of infiltrating macrophages per tumor decreased in both groups over the course of 8 days but not significantly.

CONCLUSION
These preliminary results show that by using a PFC nanoemulsion via an IV injection and 19F MRI, tumor associated macrophage burden of prognostically different double hit and single hit tumors can be easily differentiated in vivo.

CLINICAL RELEVANCE/APPLICATION
This non-invasive method to quantify tumor associated macrophage burden will pave the way to identify prognostically poor head and neck tumors with the 19F MRI in clinical trials.

SSQ11-05  Chelator-Free 89Zr-Labeling of Gd2O2S:Eu Nanoparticles with Super In Vivo Radio-Stability

Thursday, Dec. 1 11:10AM - 11:20AM Room: S505AB

PURPOSE
Owing to the special electronic shell structure of Eu atom, Gd2O2S:Eu nanoparticles can be excited by Cerenkov or γ radiation. The intense luminescence in the red region can be observed, which can be harnessed for optical imaging. Herein we report the first study of 89Zr-labeled Gd2O2S:Eu nanoparticles ([89Zr]Gd2O2S:Eu) with high radio-stability for in vivo radioluminescence imaging (RLI).

METHOD AND MATERIALS
Monodispersed Gd2O2S:Eu nanoparticles (diameter ~20 nm) were synthesized using a co-thermal decomposition of precursors Gd(ddtc)3(Phen) and Eu(ddtc)3(Phen) and surface modified with amphiphilic DSPE-PEG5k. The abundant O atoms in the Gd2O2S:Eu nanoparticles were utilized for chelator-free radiolabeling with oxophilic isotope, zirconium-89 (89Zr; t1/2 = 78.4 h). PET imaging was used to study the in vivo radiostability of the [89Zr]Gd2O2S:Eu nanoparticles.[89Zr]Gd2O2S:Eu nanoparticles were subcutaneously/intravenously injected into mice to demonstrate RLI in vivo.
RESULTS

\([89\text{Zr}]\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\) nanoparticles were successfully synthesized for RLI studies. ~ 76.1% \(89\text{Zr}\)-labeling yield was achieved upon. RL intensity of \([89\text{Zr}]\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\) nanoparticles was depended on the radioactivity, concentration of \([\text{Eu}]\) and the distance between \(89\text{Zr}\) and \(\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\). In vivo, the \([89\text{Zr}]\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\) yielded enhanced optical signal with open (collecting both RLI signal from \([89\text{Zr}]\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\) and Cerenkov luminescence signal) and 620 nm (collecting only the RLI signal from \([89\text{Zr}]\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\), but not the Cerenkov luminescence signal from \(89\text{Zr}\)) filters. Separately injected \(89\text{Zr}\) and \(\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\), and \(89\text{Zr}\) only controls showed significantly reduced signal intensity. PET imaging indicated high radiostability of \([89\text{Zr}]\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\) complex in intravenously injected mice. Dominant liver and spleen uptake and low bone uptake was seen up to 7 days.

CONCLUSION

We demonstrate the synthesis, in vitro and in vivo applications of radioluminescent nanoparticles. \(89\text{Zr}\) could be intrinsically labeled to \(\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\), with high labeling yield and good in vivo radiostability. RLI overcomes the tissue penetration limitation of traditional optical imaging modalities, due to the excitation of \(\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\) from Cerenkov radiation or higher energy particles from \(89\text{Zr}\) decay.

CLINICAL RELEVANCE/APPLICATION

Our proof-of-principle study conveys the promising potential of \([89\text{Zr}]\text{Gd}_{2}\text{O}_2\text{S}:\text{Eu}\) nanoparticles as multimodality (PET/Cerenkov/RL/CT) imaging probes.

SSQ11-06  Pharmacokinetic Analysis and Extravasation Study of a Novel Nanobubble Ultrasound Contrast Agent

**Thursday, Dec. 1 11:20AM - 11:30AM Room: S505AB**

Participants
Hanping Wu, MD, Cleveland, OH (Presenter) Nothing to Disclose
Reshani Perera, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Agata A. Exner, PhD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE

Our group recently presented a simple strategy using the nonionic surfactant, Pluronic, as a size control excipient to produce nanobubbles in the 100 nm range which exhibited stability and echogenicity on par with clinically available microbubbles. The objective of the current study was to evaluate biodistribution and extravasation of the Pluronic-stabilized lipid nanobubbles compared to microbubbles in two experimental tumor models in mice.

METHOD AND MATERIALS

Standard microbubbles or Pluronic L10 lipid-stabilized perfluoropropane nanobubbles were bolus injected into mice bearing either an orthotropic mouse breast cancer (BC4T1) or subcutaneous mouse ovarian cancer (OVCAR-3) through tail vein. The mean echo-power value in the liver, kidney and tumor as function of time was acquired and the peak enhancement and decay slope were calculated for each tissue. To quantify extravasation, fluorescently-labeled nanobubbles and microbubbles were intravenously injected into mice bearing the same tumors. Three hours later, 0.1 ml fluorescein labeled tomato lectin (1mg/ml) was i.v. injected into mice to label the vessels. The mice were then perfused with PBS, the tumor tissue was harvested and imaged to measure bubble signal in tissue.

RESULTS

The mean diameter of nanobubble and microbubble was 123.0 nm ± 24.9 and 685.0 nm ± 129.5, respectively. No significant differences were observed in peak enhancement between the nanobubble and microbubble groups in the three tested regions (tumor, liver and kidney). The decay rates of nanobubbles in all 3 ROIs were slower than those of microbubbles, and significant differences were noted in tumor of both models (0.79 dB/min ± 0.40 vs 1.13 dB/min ± 0.24 in BC4T1 tumor, and 1.66 dB/min ± 0.76 vs 2.64 dB/min ± 0.46 in OVCAR-3 tumor, respectively). Nanobubbles were also retained in tumor tissue to a higher extent compared to microbubbles in both tumor models.

CONCLUSION

Pluronic-stabilized nanobubbles show equivalent peak enhancement and slower washout in tumors compared to microbubbles. Histological analysis demonstrates enhanced nanobubble extravasation and enhanced retention within tumor tissue. This study demonstrates potential augmented utility of these agents in ultrasound molecular imaging and drug delivery beyond the tumor vasculature.

CLINICAL RELEVANCE/APPLICATION

Pluronic-stabilized nanobubbles can offer more robust properties in areas of molecular imaging and drug delivery.

SSQ11-07  Is Delayed Dynamic PET Acquisition Still Valuable for 18F-FLT Kinetics Quantification?

**Thursday, Dec. 1 11:30AM - 11:40AM Room: S505AB**

Participants
Xiaoli Liu, Columbus, OH (Abstract Co-Author) Nothing to Disclose
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Michael V. Knopp, MD, PhD, Columbus, OH (Presenter) Nothing to Disclose

PURPOSE

Cancer patients with poor veins frequently have venous access problems and cannot be injected on the PET table for dynamic imaging, which leads to the loss of early kinetic information. In this study we investigate whether kinetic parameters can still be accurately estimated using a delayed dynamic FLT PET acquisition, and how long a dynamic acquisition is required for accurate quantification.

METHOD AND MATERIALS
30min-dynamic FLT PET scans were acquired on a Gemini TF 64 system in continuous list mode. Dynamic PET data were reconstructed following a 26-frame protocol (8x15s, 6x30s, 5x1min, 5x2min, 2x5min). Maximum activity concentrations (Bq/mL) of both tumors and plasma in the descending aorta were obtained with 3D VOI. Ki values were calculated using Patlak Analysis based on different linear regression onset time (T0) points (1, 6, 7, 8, 9 and 10min) and end time (Td) points (16, 20, 25 and 30min). Ki of the 1-30min data set were taken as the gold standard and compared with the rest data series. Pearson product-moment correlation coefficient (R) of 0.9 was chosen as a limit for the correlation coefficient. A total of 32 data sets were evaluated.

RESULTS
Ki calculated with 6-8min injection-to-acquisition time showed excellent correlations (R>0.9) with gold standard regardless of Td value. When acquisition started 9min after dose injection, Td should be ≥20min to ensure accurate Ki estimation. If acquisition were initiated 10min post dose injection, Td=30min was required for accurate Ki estimation. 6-25min acquisition generated the best Ki correlation (R=0.99) while the worst occurred with 10-16min acquisition (R=0.62). Equivalent acquisition durations (EAD) were calculated by Td-T0; data acquired with shorter injection-to-acquisition time generated more accurate Ki values (R=0.96 and 0.80 for 6-16min and 10-20min, respectively). Acquisitions with EAD8min could provide accurate Ki values (R>0.9) except for those of 10-20min (R=0.80) and 10-25min (R=0.89).

CONCLUSION
Dynamic FLT PET acquisition after 6-10min injection-to-acquisition delay can still generate accurate Ki values, even with equivalent acquisition duration as short as 8 minutes.

CLINICAL RELEVANCE/APPLICATION
This study demonstrated the ability of delayed dynamic FLT PET imaging without influencing the kinetic quantification, making its application more feasible for clinical therapy response assessment.

SSQ11-08  Pseudo-Cloaking Contrast Media (PCCM's) for In vivo Differentiation using Detection-based spectral CT
Thursday, Dec. 1 11:40AM - 11:50AM Room: S505AB

Participants
Khaled A. Nasr, PhD, Dallas, TX (Presenter) Nothing to Disclose
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Matthew A. Lewis, PhD, Dallas, TX (Abstract Co-Author) Research collaboration, CMR Naviscan Corporation

PURPOSE
To develop and evaluate simultaneously administered contrast media that exhibit pseudo-cloaking (PCCM’s) for in vivo differentiation using clinical detection-based spectral CT.

METHOD AND MATERIALS
Compound of elements (Z=70 to Z=78) were purchased and used for phantom studies. Nanopowder colloidal of tungsten carbide (WC, 20 mg/mL W), tungsten oxide (WO3, 20 mg/mL W) and rhenium sulfide (ReS2, 20 mg/mL Re), tantalum (Ta, 20 mg/mL), tantalum oxide (Ta2O5, 20 mg/mL) were synthesized by colloidal and microemulsion method in 2% carboxymethylcellulose. Four female Fischer rats (n = 4) averaging 150 g mass were fasted for 24 hours. The rats were then given 4 mL of oral contrast.

RESULTS
Phantom images exhibit a clear separation between elements (Z=70 to Z=78) and iodine-based contrast media. As a result, two contrast media, one made from high-Z elements and the second made from iodine-based contrast media could be used simultaneously to distinguish between an oral and vascular contrast in a single CT examination. Unfortunately, most compounds of high-Z elements have unknown or high toxicity (LD50) making them unsuitable to be used for in vivo CT imaging. In this study we selected tungsten carbide (LD50=2000 mg/Kg), tungsten trioxide (LD50=1059 mg/Kg rat oral), tantalum (LD50=2500 mg/Kg), tantalum oxide (LD50=8000 mg/Kg) and rhenium sulfide as an oral contrast and iopamidol as iodine-based vascular contrast agent for phantoms and in vivo imaging. Both PCCM’s and iodine-based contrast media appear in the conventional image with high attenuation. In the virtual non-contrast (VNC) images, contrast from iodine was removed but tungsten and rhenium contrast was not affected. In iodine-no-water images (I-n-W), iodine contrast was not affected but contrast from tungsten and rhenium was removed.

CONCLUSION
Colloidal nanoparticles of low toxicity compounds of tantalum, tungsten and rhenium were shown to be excellent candidates of PCCM’s providing a clear separation from iodine-based contrast media observed in phantom and in vivo imaging using detection-based spectral CT. Both barium and bismuth-based contrast media were shown to have similar radiographic appearance as Iodine.

CLINICAL RELEVANCE/APPLICATION
High-Z element PCCM’s can provide clear oral and vascular differentiation in a single CT examination detection-based spectral CT.

SSQ11-09  Pharmacokinetic Monitoring of Adoptively Transferred CEA-Targeted Human T Lymphocytes with a Dual-Modal Positron Emission Tomography (PET) Near-Infrared Fluorescent (NIRF) Imaging Agent
Thursday, Dec. 1 11:50AM - 12:00PM Room: S505AB

Participants
Stefan Harmesen, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
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Purpose
Despite the remarkable progress of adoptive T cell therapy in cancer treatment, there remains an urgent need for the noninvasive tracking of the transfused T cells. Therefore, we developed a dual-modal PET/NIRF nanoparticle-based imaging agent to efficiently label human CAR T cells ex vivo and monitored the therapeutic effect of CAR T-cell in a murine model of ovarian cancer.

Method and Materials
Human T lymphocytes co-transduced with chimeric antigen receptors (CAR) specific for human carcinoembryonic antigen and a Renilla luciferase, were labeled with the extrinsic 89Zr-PET/NIRF nanoparticle-based imaging agent ex vivo. The labeled CEA-targeted CAR T cells were injected (i.p. and i.v.) into SCID mice bearing intraperitoneal lesions of human ovarian carcinoma cells (SKOV3) engineered to overexpress hCEA and transduced with firefly reporter gene Renilla luciferase reporter gene. The localization of adoptively transferred T cells in this peritoneal ovarian carcinomatosis model was monitored with bioluminescence imaging (BLI) as well as small-animal PET and end-point near infrared fluorescence imaging (λmax=800 nm).

Results
The adoptively transferred CEA-targeted CAR T cells were efficiently labeled with the dual-modal PET/NIRF imaging agent without affecting CAR T cell viability and cytotoxic functionality on the target cells. Small animal PET imaging enabled whole-body tomographic CAR T cell tracking over a long period of time to establish the pharmacokinetic profile of these T cells following i.p. or i.v. administration. More importantly, by correlating the PET imaging with BLI, it was shown that i.p. is the most effective route of administration in terms of co-localization with the peritoneal ovarian cancer tumor deposits. Lastly, end-point NIRF imaging of the labeled CAR T cells demonstrated specific infiltration in CEA-overexpressing tumor deposits.

Conclusion
These results show that noninvasive monitoring of genetically engineered human T lymphocytes labeled by our dual-modal PET/NIRF imaging agent provides high resolution anatomically correlated information on T-cell trafficking and has translational implications.

Clinical Relevance/Application
Clinically applicable strategies of noninvasive cell tracking can greatly impact the design and development of T cell-mediated cancer therapy, the assessment of patient response to antitumor treatment, and the optimization (personalization) of therapeutic plans.
SSQ13

Nuclear Medicine (Breast/Chest Imaging)
Thursday, Dec. 1 10:30AM - 12:00PM Room: S504CD

Participants
Matthias J. Eiber, MD, Muenchen, Germany (Moderator) Nothing to Disclose
Terence Z. Wong, MD, PhD, Chapel Hill, NC (Moderator) Nothing to Disclose

Sub-Events

SSQ13-01  Positron Emission Tomography (PET) Imaging of Chemokine Receptor CXCR4 in Patients with Breast Carcinoma: Initial Experience
Thursday, Dec. 1 10:30AM - 10:40AM Room: S504CD

Participants
Tibor Vag, MD, PhD, Munich, Germany (Presenter) Nothing to Disclose
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Katja Steiger, Munich, Germany (Abstract Co-Author) Nothing to Disclose
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Markus Niemeyer, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Stefan Paepke, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Hans-Jurgen Wester, Munich, Germany (Abstract Co-Author) CEO, SCINTOMICS GmbH
Markus Schwaiger, MD, Munich, Germany (Abstract Co-Author) Research Grant, Siemens AG; Speaker, Siemens AG

PURPOSE
CXCR4 is a chemokine receptor that is overexpressed in several types of human cancers including breast cancer and seems to play crucial role in the mechanism of metastasis. The aim of this proof of concept study was to evaluate the novel CXCR4 targeted Positron Emission Tomography (PET) probe 68Ga-Pentixafor for Imaging of breast carcinoma.

METHOD AND MATERIALS
10 patients suffering from breast cancer (9 patients with primary breast cancer, one patient with local recurrent breast cancer) underwent either PET/CT or PET/MR imaging using 68Ga-Pentixafor. The lesions included 9 invasive ductal carcinomas (IDC) and one invasive lobular cancer (ILC). Maximum standardized uptake values (SUVmax) and tumor-to-background ratios (T/B ratio) were determined in the breast cancer lesions and correlated with immunohistochemistry.

RESULTS
8 of 10 breast cancers were visually detectable with a mean SUVmax of 3.1 (range 1.7 to 4.5) and a mean T/B ratio of 2.8. The visually undetectable lesions included the case of ILC and one IDC (T2 Grade 2). Immunohistochemistry revealed highest CXCR4 staining intensity in the patient with local recurrent breast cancer which also showed highest T/B ratio of all examined lesions. Lowest CXCR4 staining intensity was observed in the visually undetectable case of ILC. Interestingly, the CXCR4 positive cells in immunohistochemical workup not only comprised tumor cells but also surrounding lymphocytes.

CONCLUSION
CXCR4 directed PET imaging of breast cancer is feasible. Moreover, based on these first observations in this small patient cohort, histopathological CXCR4 expression profile on the tumor cell surface seems to correlate with signal intensity in PET imaging.

CLINICAL RELEVANCE/APPLICATION
CXCR4 directed PET imaging might be a promising new tool in oncology. Further studies are necessary to evaluate, if signal intensity of the primary cancer in PET is associated with prognostic factors, e.g with metastatic potential of the tumor.

SSQ13-02  Impact of High Definition Reconstruction in FLT PET/CT
Thursday, Dec. 1 10:40AM - 10:50AM Room: S504CD

Participants
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Katherine Binzel, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Nathan C. Hall, MD, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Bhuvaneswari Rameswamy, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Jun Zhang, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
18F-fluorothymidine (FLT) is a promising non-invasive PET/CT imaging biomarker taken up in proliferative tissues such cancer lesions, bone marrow and liver that is also used for therapy response assessments which necessitates precise delineation and accurate SUV measurements. We therefore proposed and assessed the benefits of reducing the image reconstruction voxel volume 64mm3 (SD)⇒8mm3 (HD) and thus increasing the effective imaging matrix size.

METHOD AND MATERIALS
Using the list mode raw data from a FLT PET/CT therapy assessment trial, 10 breast cancer patients studies that were imaged
RESULTS

Initially we compared the different subset approaches for the HD reconstruction and found the 3i9s rated as clinically preferable and was subsequently used. Image quality, lesion detectability and lesion delineation was rated preferable by blinded review and was found to be significantly (p<0.01) improved on the high definition recon. Our quantitative assessment included 72 lesions across the 24 PET exams, the SUV_Mean of lesions increased on average by 18%, while the liver background SUV_Mean varied by only 2-3% between HD and SD recon. Substantial increases in SUV_Mean were also noted in the bone marrow (13%).

CONCLUSION

High definition image reconstruction was found to be feasible and highly beneficial for FLT PET leading to substantially improved image quality and lesion delineation as well as more accurate quantification.

CLINICAL RELEVANCE/APPLICATION

FLT PET imaging benefits from high definition reconstruction leading to improved image quality, lesion delineation and quantitative accuracy.

SSQ13-03 Quantification Accuracy in Detection of Primary Breast Cancer and Axillary Lymph Node Metastasis by Whole-body (WB) and Prone Breast PET/MR Compared with PET/CT

Thursday, Dec. 1 10:50AM - 11:00AM Room: SS04CD

Participants
Sirong Chen, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose
Catherine Wong, Hong Kong, Hong Kong (Presenter) Nothing to Disclose
William Cheung, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose
Yim Lung Leung, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose
Thomas K. Cheng, MBBS, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose
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Gladys G. Lo, MD, Happy Valley, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose
Chi Lai Ho, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose

PURPOSE

In this prospective study, we focus on evaluating PET quantification accuracy in primary breast carcinoma (CA) and axillary lymph node (LN) metastasis using WB PET/MR and regional prone PET/MR acquired with breast coil, as compared with PET/CT.

METHOD AND MATERIALS

From April to June 2015, 13 breast CA patients (age=53.4±10.5y) were enrolled for clinically indicated PET/CT and subsequent PET/MR (Biograph mCT & mMR). PET/CT acquired with 2min/bed at ~70min post 18F-FDG injection. WB PET/MR started at ~120min with 5min/bed PET acquisition and axial T2 HASTE, DWI & coronal T2. Regional prone PET/MR with breast coil began at ~160min with 5min PET acquisition and routine breast sequences. PET/CT and PET/MR for primary and axillary LN disease were interpreted individually, with SUVmax and ADC measured.

RESULTS

A total of 20 breast CA lesions (size=2.6±2.0cm) and 11 axillary LN metastases were confirmed by histopathology and follow-up. PET/CT identified 18/20 primary lesions and 9/11 metastatic axillary LN. For primary breast CA, WB PET/MR detected 15/20 lesions and SUVmax was underestimated compared to PET/CT (5.5±4.5 vs 6.9±6.3; median %change=-20%, range=31~0%). Prone breast PET/MR detected 18/20 lesions with SUVmax comparable to that of PET/CT (6.8±6.2 vs 6.9±6.3; median %change=3%, range=10~9%), while inversely correlated with ADC (range=0.59~1.03, mean=0.85±0.12 ×10^-3mm^2/s, r=-0.627, p<0.05). For axillary LN metastasis, WB PET/MR was similar to PET/CT for identifying 9/11 nodes with comparable SUVmax (%change=0~0%) compared with PET/CT, which was due to various segmentation misclassification errors of the adjacent non-breast soft tissue as seen on the attenuation coefficient maps, including the axillae.

CONCLUSION

Regional prone PET/MR with breast coil was comparable to PET/CT in quantitative assessment of primary breast CA but was not suitable for evaluation of the axillary nodes, whereas results were opposite for WB PET/MR. Combined prone breast and WB PET/MR is the recommended procedure, particularly if monitoring treatment response is needed for these 2 locations.

CLINICAL RELEVANCE/APPLICATION

Regional prone PET/MR with dedicated breast coil has higher PET quantification and diagnostic accuracy for primary breast tumors than WB PET/MR but should not be used for non-breast tissue assessment.


Thursday, Dec. 1 11:00AM - 11:10AM Room: SS04CD

Participants
Johannes Grueneisen, Essen, Germany (Presenter) Nothing to Disclose
Lino Sawicki, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Benedikt M. Schaarschmidt, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Axel Wetter, Essen, Germany (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS

Using a newly implemented high definition (HD) reconstruction approach. The previous FLT datasets were used as comparator and had been reconstructed using a standard definition (SD) default approach using 4 mm voxel length and 33 subsets with 3 iterations. For the HD approach using the 2mm voxel length which leads to 1/8 of the referenced voxel volume, 4 reconstructions with 3 iterations and 33, 21, 15 and 9 subsets were performed on Baseline and follow-up FLT scans. Quantitative assessments were performed by placing 3D ROIs on lesions as well as healthy liver and bone marrow (L1, L3 & L5 vertebrae). Image review was done by three blinded readers.

RESULTS

Initially we compared the different subset approaches for the HD reconstruction and found the 3i9s rated as clinically preferable and was subsequently used. Image quality, lesion detectability and lesion delineation was rated preferable by blinded review and was found to be significantly (p<0.01) improved on the high definition recon. Our quantitative assessment included 72 lesions across the 24 PET exams, the SUV_Mean of lesions increased on average by 18%, while the liver background SUV_Mean varied by only 2-3% between HD and SD recon. Substantial increases in SUV_Mean were also noted in the bone marrow (13%).

CONCLUSION

High definition image reconstruction was found to be feasible and highly beneficial for FLT PET leading to substantially improved image quality and lesion delineation as well as more accurate quantification.

CLINICAL RELEVANCE/APPLICATION

FLT PET imaging benefits from high definition reconstruction leading to improved image quality, lesion delineation and quantitative accuracy.

SSQ13-03 Quantification Accuracy in Detection of Primary Breast Cancer and Axillary Lymph Node Metastasis by Whole-body (WB) and Prone Breast PET/MR Compared with PET/CT

Thursday, Dec. 1 10:50AM - 11:00AM Room: SS04CD

Participants
Sirong Chen, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose
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Chi Lai Ho, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose

PURPOSE

In this prospective study, we focus on evaluating PET quantification accuracy in primary breast carcinoma (CA) and axillary lymph node (LN) metastasis using WB PET/MR and regional prone PET/MR acquired with breast coil, as compared with PET/CT.

METHOD AND MATERIALS

From April to June 2015, 13 breast CA patients (age=53.4±10.5y) were enrolled for clinically indicated PET/CT and subsequent PET/MR (Biograph mCT & mMR). PET/CT acquired with 2min/bed at ~70min post 18F-FDG injection. WB PET/MR started at ~120min with 5min/bed PET acquisition and axial T2 HASTE, DWI & coronal T2. Regional prone PET/MR with breast coil began at ~160min with 5min PET acquisition and routine breast sequences. PET/CT and PET/MR for primary and axillary LN disease were interpreted individually, with SUVmax and ADC measured.

RESULTS

A total of 20 breast CA lesions (size=2.6±2.0cm) and 11 axillary LN metastases were confirmed by histopathology and follow-up. PET/CT identified 18/20 primary lesions and 9/11 metastatic axillary LN. For primary breast CA, WB PET/MR detected 15/20 lesions and SUVmax was underestimated compared to PET/CT (5.5±4.5 vs 6.9±6.3; median %change=-20%, range=31~0%). Prone breast PET/MR detected 18/20 lesions with SUVmax comparable to that of PET/CT (6.8±6.2 vs 6.9±6.3; median %change=3%, range=10~9%), while inversely correlated with ADC (range=0.59~1.03, mean=0.85±0.12 ×10^-3mm^2/s, r=-0.627, p<0.05). For axillary LN metastasis, WB PET/MR was similar to PET/CT for identifying 9/11 nodes with comparable SUVmax (%change=0~0%) compared with PET/CT, which was due to various segmentation misclassification errors of the adjacent non-breast soft tissue as seen on the attenuation coefficient maps, including the axillae.

CONCLUSION

Regional prone PET/MR with breast coil was comparable to PET/CT in quantitative assessment of primary breast CA but was not suitable for evaluation of the axillary nodes, whereas results were opposite for WB PET/MR. Combined prone breast and WB PET/MR is the recommended procedure, particularly if monitoring treatment response is needed for these 2 locations.

CLINICAL RELEVANCE/APPLICATION

Regional prone PET/MR with dedicated breast coil has higher PET quantification and diagnostic accuracy for primary breast tumors than WB PET/MR but should not be used for non-breast tissue assessment.
**RESULTS**

Tumor recurrence was present in 21/32 (66%) patients and a total of 141 lesions (malignant, n = 101; benign, n = 40) were described. On a lesion based analysis, MRI revealed a sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 81%, 85%, 93%, 64% and 82%, respectively and a confidence level (CL) of 2.24 ± 0.71 for the identification of tumor recurrence. All three PET/MR readings were rated higher than MRI alone (PET/MR-HASTE/DWI: 92%, 93%, 97%, 82% and 92%; CL: 2.44 ± 0.66; PET/MR-HASTE/VIBE: 93%, 93%, 97%, 84% and 93%; CL: 2.65 ± 0.53; PET/MR-HASTE/DWI/VIBE: 94%, 95%, 98%, 86% and 94%; CL: 2.72 ± 0.49). Furthermore, mean values for lesion conspicuity were 3.30 ± 0.82 (VIBE), 3.02 ± 0.84 (HASTE) and 2.82 ± 1.15 (DWI), respectively and differed significantly from each other.

**CONCLUSION**

Our results demonstrate the usefulness of 18F-FDG PET data as a valuable additive to MR imaging for more accurate restaging of breast cancer patients. Furthermore, the presented data underline the benefit of contrast-enhanced MR sequences and questions the use of DWI.

**CLINICAL RELEVANCE/APPLICATION**

Well-considered MR protocols are required for an accurate and effective oncological work-up of breast cancer patients using integrated PET/MRI. The omission of DWI does not result in a significant impairment of the staging performance but enables a distinctive reduction in scan-duration accompanied by improved patient comfort.

**SSQ13-05 Integrative and Comparative Analysis of 18F-FDG PET/CT and DWIFASE, DWIEPI, STIR on 3T and 1.5T MR Imaging: Strategy to Converge More the Trajectory for Diagnosis and Prognostication of Lung Cancer**

Participants
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**PURPOSE**

To quantitatively compare the potential of FDG PET/CT and diffusion-weighted imaging obtained with fast advantage spin-echo sequence (DWIFASE), echo planar imaging sequence (DWIEPI), and short inversion time inversion recovery (STIR) imaging on 3T as well as 1.5T MR imaging in the diagnosis and prognostic prediction of lung cancer.

**METHOD AND MATERIALS**

3T and 1.5T MRI and PET/CT were prospectively performed in 75 consecutive patients with suspicious lung cancer, followed by surgical treatment. ADCs from DWI and tumor-to-muscle ratio from STIR was calculated in terms of primary lesions as ADCFASE, ADCFIEP, 3T or ADCFIEP, 1.5T and STIR3T or STIR1.5T. Spearman correlation coefficient was analyzed between ADCs or STIR values. Multivariate logistic regression analysis was performed to investigate the discriminating factors of malignancy from benign lesions in terms of 1.5T MRI & PET or 3T MRI & PET. Also, all ADC and STIR values and SUVmax as well as clinical characteristics such as staging, histologic subtype, age, sex, and smoking history were investigated with univariate and multivariate Cox regression analysis to evaluate the prognostic potential, where ROC analysis was used to estimate the discriminating performance of prediction model built.

**RESULTS**

All 83 lung lesions (72 malignant, 11 benign) were analyzed. STIR3T were higher than STIR1.5T (2.40 ± 0.757 and 1.40 ± 0.507, R = 0.533, P < 0.001). ADCFASE and ADCFIEP, 1.5T were correlated better than correlations with ADCFIEP, 3T (R = 0.876, 0.821, and 0.659, all Ps < 0.001). Multivariate logistic regression analysis helped identify STIR1.5T (OR, 1.006), ADCFIEP, 1.5T (0.007) and SUVmax (1.862) in 1.5T as well as ADCFASE (0.752) and SUVmax (1.664) in 3T as significant differentiators of malignancy, with 96.9% sensitivity & 75% specificity, 98.5% & 78.6%). Multivariate analysis revealed sex (HR, 0.042), pathologic subtype (0.007), and STIR3T (17.418) are independent predictors for clinical outcome, with Az of ROC curve of 0.891.
CONCLUSION
We found the potential of DWI and STIR on 3T MRI and 1.5T MRI as well as PET/CT regarding the diagnostic and prognostic prediction of lung cancer, for which the capability was improved when sequences were combined efficiently.

CLINICAL RELEVANCE/APPLICATION
Quantitative image variables from DWI and STIR on 3T and 1.5T MRI can allow more accurate diagnosis and prognostication of lung cancer, thus may contribute to more robust predictive and prognostic biomarkers.

**SSQ13-06**  Do Staging Differences Between Thoracic 18F-FDG PET/CT and 18F-FDG PET/MR Lead to Different Therapeutic Decisions in Patients Suffering from Non-Small Cell Lung Cancer?

Thursday, Dec. 1 11:20AM - 11:30AM Room: S504CD

Participants
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PURPOSE
To investigate whether differences in thoracic tumor staging between 18F-fluordeoxyglucose positron emission tomography / computed tomography (18F-FDG PET/CT) and 18F-FDG PET / magnetic resonance (18F-FDG PET/MR) imaging change therapeutic decisions in Non-Small Cell Lung Cancer (NSCLC) patients.

METHOD AND MATERIALS
Seventy-seven NSCLC patients (34 female, 43 male, mean age 61 ± 10y) that underwent whole-body 18F-FDG PET/CT from the base of skull to the upper thighs and subsequent thoracic 18F-FDG PET/MR were enrolled in this retrospective study. Thoracic 18F-FDG PET/CT and 18F-FDG PET/MR images were staged by two independent radiologists according to the 7th edition of the AJCC staging manual. Treatment strategies based on staging results of either thoracic 18F-FDG PET/CT or 18F-FDG PET/MR were discussed separately in a simulated interdisciplinary tumor board consisting of an oncologist, a radiation oncologist, a thoracic surgeon and a radiologist under consideration of the histopathological subtype and all available clinical data at the timepoint of imaging. Therapeutic decisions based on both imaging modalities were recorded. Descriptive statistics were used for comparison of the results and reasons for changes in the therapeutic decision were investigated.

RESULTS
Differences in thoracic tumor staging were observed in 35% of patients (27 patients) between thoracic 18F-FDG PET/CT and 18F-FDG PET/MR. Differences between both hybrid imaging modalities were detected when assessing the T-stage in 18% (n = 14), the N-stage in 23% (n = 18), and the M-stage in 1% (n = 1). However, these differences in thoracic tumor staging changed patient therapy management in only six patients (8%).

CONCLUSION
Thoracic 18F-FDG PET/CT and PET/MR lead to comparable therapeutic decisions in patients suffering from NSCLC. 18F-FDG PET/MR can be considered a true alternative to 18F-FDG PET/CT for clinical NSCLC staging.

CLINICAL RELEVANCE/APPLICATION
Comparable therapeutic decisions in PETCT and PET/MR in NSCLC patients allow prospective randomized studies on PET/MR in NSCLC imaging and will speed up its introduction in clinical practice.

**SSQ13-07**  Clinical Utility of PET/CT’s Triggered by ACR LungRads Category 4A or 4B Lung Cancer Screening CT Result

Thursday, Dec. 1 11:30AM - 11:40AM Room: S504CD

Participants
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Matthew P. Thorpe, PhD, MD, Savoy, NC (Abstract Co-Author) Nothing to Disclose
Joseph G. Mammarapalli, MD, PhD, Durham, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE
F-18 FDG PET/CT (PCT) is invaluable in pulmonary nodule workup, and uptake correlates with malignancy and, in early stage lung cancers, survival. The National Lung Cancer Screening Trial demonstrated mortality benefit of low-dose screening CT (LDCT) for high risk persons. In ACR LungRads, Category 4 is “suspicious” for malignancy: For 4A, PCT is triggered for an 8-15 mm solid nodule on baseline and for 4B, for a new solid nodule/ solid component of part-solid nodule measuring >= 8 mm. Previous literature rates PCT performance as poor for nodules < 10 mm, however. Given FWHM of PCT scanners is ~8 mm, the lower limit trigger of 8 mm in LungRads will include small nodules which may be underestimated by partial volume effect (3D PET, 3*FWHM = 24 mm). PCT may be insensitive when used in this manner and regular screening may be equivalent. Our study goal is to report the diagnostic utility of PCT performed for workup of Category 4 findings on LDCT.

METHOD AND MATERIALS
This IRB-approved, HIPAA-compliant study retrospectively reviewed PCT from Feb 2015- March 2016, prompted by positive screening LDCT (Category 4A/4B or read as positive= greater than mediastinum). Standardized uptake value (SUVmax) of nodules was measured. LDCT nodule size and morphology were recorded. Results were correlated with pathology and change in clinical management.

RESULTS
16 patients underwent 16 PCT with 21 nodules yielding mean CT size of 14 (range 8-30) mm and CT features of solid, part solid, cavitary, speculated. 6 were PET-positive and of these, 4 malignant on histology; 2 were inflammatory on histology. 15 nodules were PET-negative; 3 of these were classified as benign with no further followup recommended; 12 were scheduled for CT follow up per LungRads. PET-positive rate was 29.5 ± 5E 0.10% overall, and PPV as judged by histology or stable behavior on subsequent CT was 0.66 (95% CI 0.29-1.0).

CONCLUSION

38% of nodules on PCT performed for Category 4 LDCT were positive, and 67% of these were malignant. Average nodule size in our population was >8 mm trigger, but <24 mm limit for full PET recovery. PET-negative nodules were not sampled, but many of these nodules were stable in size. Further study is needed in a larger patient cohort with longer followup.

CLINICAL RELEVANCE/APPLICATION

Although PCT redemonstrates utility in workup of indeterminate nodules, optimal triggers for PCT in the setting of CT lung cancer screening need further study.

SSQ13-08 Whole-Body FDG-PET/MRI: Comparison of the Capability for the IASLC/ ITMIG Thymic Epithelial Tumor Staging with Whole-Body MRI, Integrated FDG-PET/CT and Conventional Radiological Examination

Thursday, Dec. 1 11:40AM - 11:50AM Room: S504CD

Participants

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PURPOSE

To compare the diagnostic capability for the IASLC/ ITMIG thymic epithelial tumor staging among whole-body FDG-PET/MRI, whole-body MRI including diffusion weighted imaging (DWI), integrated FDG-PET/CT with contrast-enhanced (CE-) brain MRI and conventional radiological examination including whole-body CE-CT and CE-brain MRI.

METHOD AND MATERIALS

64 consecutive thymic epithelial tumor patients (30 men, 34 women; mean age 56 years) prospectively underwent whole-body MRI including DWI, integrated FDG-PET/CT with contrast-enhanced (CE-) brain MRI and conventional radiological examination including whole-body CE-CT and CE-brain MRI.

RESULTS

Inter-observer agreements of each factor on all methods were determined as substantial or almost perfect (0.67

CONCLUSION

Inter-observer agreements of each factor on all methods were determined as substantial or almost perfect (0.67

CLINICAL RELEVANCE/APPLICATION

Whole-body PET/MRI and MRI have better potential for the IASLC/ ITMIG thymic epithelial tumor staging than conventional radiological examination.

SSQ13-09 Sensitivity of PET/MR for Detecting Pulmonary Nodules in Pediatric Cancer Patients

Thursday, Dec. 1 11:50AM - 12:00PM Room: S504CD

Participants

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Purpose

To compare the diagnostic capability for the IASLC/ ITMIG thymic epithelial tumor staging among whole-body FDG-PET/MRI, whole-body MRI including diffusion weighted imaging (DWI), integrated FDG-PET/CT with contrast-enhanced (CE-) brain MRI and conventional radiological examination including whole-body CE-CT and CE-brain MRI.

Method and Materials

64 consecutive thymic epithelial tumor patients (30 men, 34 women; mean age 56 years) prospectively underwent whole-body MRI including DWI, integrated FDG-PET/CT with contrast-enhanced (CE-) brain MRI and conventional radiological examination including whole-body CE-CT and CE-brain MRI.

Results

Inter-observer agreements of each factor on all methods were determined as substantial or almost perfect (0.67

Conclusion

Inter-observer agreements of each factor on all methods were determined as substantial or almost perfect (0.67

Clinical Relevance/Application

Whole-body PET/MRI and MRI have better potential for the IASLC/ ITMIG thymic epithelial tumor staging than conventional radiological examination.
PURPOSE
To determine the sensitivity of MR, integrated PET+MR and PET+CT for the detection of pulmonary nodules in pediatric cancer patients compared to clinical CT as a standard of reference.

METHOD AND MATERIALS
In this prospective IRB-approved, HIPAA-compliant study we performed 15 "one stop" whole body PET/MR scans of 11 pediatric and young adult patients with lymphoma (n=6), bone sarcoma (n=2) and other cancers (n=3). Scans were performed on a GE Signa 3T hybrid PET/MR scanner 60 minutes after 18F-FDG (2-3MBq/kg), using free-breathing axial T2-FSE (TR 5048ms/TE 116ms) and PROPELLER (TR 5669ms/TE 101ms) sequences with simultaneous PET-data acquisition. Two experienced reviewers assessed the number, location and size of pulmonary nodules on CT, MR, PET+MR (i.e. positive on PET and MR) and PET+CT (i.e. positive on PET and CT) scans. Sensitivities of MR, PET+MR and PET+CT were compared with CT as standard of reference.

RESULTS
CT revealed 151 total nodules with 59 ≥ 10mm, 48 between 5-9mm, 34 between 3-4mm and 10 < 3mm in size respectively. MR detected 116 total nodules with 59 ≥ 10mm, 44 between 5-9mm, 12 between 3-4mm and 1 < 3mm in size respectively. Considering clinically significant nodules ≥ 3mm, sensitivity was 81.5% for MR, 56% for PET+MR and 49% for PET+CT. PET+MR and PET+CT detected 59 and 57 nodules > 1 cm, 22 and 14 nodules 5-9 mm, and 4 and 3 nodules 3-4 mm, respectively. The mean effective dose of PET/MR (2.5 mSv) was significantly lower compared to PET/CT (11.4 mSv).

CONCLUSION
MR provided comparable sensitivity compared to CT for the detection of pulmonary nodules ≥ 5 mm, but inferior sensitivity for the detection of 3-4 mm nodules. The PET part of the PET/MRI outperformed the PET part of the PET/CT in the detection of FDG-avid nodules. PET/MR reduced the radiation exposure of the patient by 75% compared to PET/CT.

CLINICAL RELEVANCE/APPLICATION
Solving the limited sensitivity of MRI for the detection of pulmonary nodules will enable "one stop" staging of pediatric cancer patients with substantially reduced radiation exposure compared to PET/CT. Our ongoing studies address further improvement of MRI technologies for detection of clinically relevant pulmonary nodules with a size of 3-4mm.
NM239-SD-THA7
Prostate Specific Membrane Antigen (PSMA) PET/CT Imaging Improves Staging Accuracy and Management in Prostate Cancer Patients at Time of Initial Diagnosis or Biochemical Failure

Station # 7

Participants
Frederik L. Giesel, MD, MBA, Heidelberg, Germany (Moderator) Patent application for F18-PSMA-1007

Sub-Events

PURPOSE
68Gallium- Prostatic Specific Membrane Antigen (PSMA) PET/CT has been recently introduced for the assessment of patients with prostate cancer and few studies have reported its value in disease management. We report our initial experience with PSMA PET/CT imaging.

METHOD AND MATERIALS
Ninety patients, mean age 70.5 years (range 50-90), were referred for PSMA PET/CT for staging (n=11), biochemical failure (n=53) or evaluation of known metastatic disease (n=26). Mean Gleason score: 7.6 (range 6-10) and mean PSA: 10.3ng/ml (range 0.04-129). The initial pre-scan therapy plan and revised post-scan recommendations were documented according to National Comprehensive Cancer Network (NCCN) guidelines.

RESULTS
PSMA-PET/CT was positive in 68/90 pts. (75.5%); SUV max 10.7+8.8. Local recurrence was observed in the prostate or prostate fossa in 21 pts and 5 pts respectively (28.9%); lymph nodes (n=34, 37.8%), or distant metastasis (n= 35, 38.9%). PSMA PET/CT changed clinical management at time of initial staging in 7/11 (63.6 %) patients, at time of biochemical failure in 36/53 (67.9 %) patients and in only 2/25 (8 %) of patients with known metastatic disease. Changes in management included: Androgen Deprivation Therapy (ADT) to local therapy (n=21), ADT to observation (n=11), local therapy to ADT (n=7), local therapy to observation (n=1), observation to ADT (n=1), and change in radiation therapy plan (n=11).

CONCLUSION
PSMA PET/CT had an impact on clinical management in 66% of prostate cancer patients referred for staging or initial biochemical failure but had little benefit when used for management of known metastatic disease.

CLINICAL RELEVANCE/APPLICATION
PSMA-PET-CT may be useful in initial staging and treatment planning for patients with intermediate and high risk prostate cancer.

NM240-SD-THA8
The Calue of Adding Delayed Scans of the Abdomen and Pelvis in the Screening FDG-PET/CT: A Retrospective Cohort Study on Total of 17395 Examinees

Station # 8

Awards
Student Travel Stipend Award

Participants
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Naoto Hayashi, MD, Bunkyo-ku, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate how the results of screening were improved by adding delayed scan in FDG-PET/CT.
Patients with primary hyperparathyroidism (PHPT) are diagnosed clinically by overproduction of PTH. Approximately 80% are single adenomas, 10% hyperplasia, 10% multiple adenomas, and, rarely, parathyroid carcinoma. Histologically, adenomas and hyperplasia may demonstrate similar hypercellular appearance. Application of an intraoperative PTH (IOPTH) level algorithm of >50% decrease and normalized PTH level <65 pg/mL increases cure rate. Preoperative parathyroid adenoma localization using technetium-99m Sestamibi scans (MIBI) is essential to minimize operative time. At our institution we often see patients with a long term clinical diagnosis of PHPT, yet the MIBI scan is negative. Our objective was to retrospectively investigate the etiology of our negative MIBI scans.

METHOD AND MATERIALS

101 patients with a clinical diagnosis of PHPT who underwent a MIBI scan with subsequent parathyroid surgery were included. The results of the MIBI scans was correlated with levels of PTH, vitamin D, calcium, BMI, preoperative and IOPTH levels, number of glands resected, and trend of IOPTH decrease.

RESULTS

99/101 patients had ≥1 gland resected; 13/99 patients had adenoma, 74/99 hypercellular, 9/99 cellular, and 1/99 carcinoma. 90/101 patients also had thyroid US. No patient with a negative MIBI had a positive US (38/90). Among 63/99 positive MIBI scans, only 43 had positive US. No optimal PTH level was found to correlate with scan performance. Negative MIBI scans were associated with resection of a higher number of glands to achieve a normal level of IOPTH with mean (±SD) of 2.34 glands (±1.02) compared with 1.81 (±1.04) for positive scans, p=0.01. Trends of IOPTH decrease for the number of glands removed was significant when 3 glands were excised and the scan was negative, p=0.02. No correlations between the MIBI results and levels of calcium, vitamin D, or BMI were found, p>0.05.

CONCLUSION

Patients with the clinical diagnosis of PHPT who demonstrate a negative MIBI scan will likely undergo resection of two or more parathyroid glands to achieve normal levels of PTH. This may be partly explained by lack of preoperative localization or underlying hypercellular etiology.

CLINICAL RELEVANCE/APPLICATION

We suspect that the clinical identification of adenoma may be overestimated and hyperplasia underestimated. The findings on the MIBI scan may help predict the length of surgery and the pathological results.
PURPOSE

To directly compare the capability for evaluation of TNM and limited vs. extensive stage systems between integrated FDG-PET/CT with contrast-enhanced (CE-) brain MRI and conventional radiological examination in patients with small cell carcinoma (SCLC).

METHOD AND MATERIALS

Fifty consecutive pathologically diagnosed SCLC patients (44 men, 6 women; mean age 69 years) underwent integrated PET/CT, conventional radiological examinations including CE-brain MRI, whole-body CE-CT and bone scintigraphy, and follow-up examination. According to results of all radiological examinations as well as medical records, each patient was evaluated by two stage systems. To determine the capability of each method for assessing these two stage systems in all patients, all PET/CT data were independently evaluated by two radiologist who had more than 10 year experiences as board certified PET physicians. In addition, all conventional examination data were evaluated by other two radiologists. Then, final evaluation results on each method were made by consensus of two readers. Interobserver agreements of all assessments on both methods were assessed by kappa statistics followed by χ2 test. Agreements of each factor and clinical stage in both stage systems between each method and final diagnosis were also evaluated by kappa statistics followed by χ2 test. Finally, diagnostic accuracies were statistically compared between both methods by McNemar’s test.

RESULTS

Inter-observer agreements of all assessments were determined as significantly substantial or almost perfect on PET/CT (0.80

CONCLUSION

FDG-PET/CT has better potential than conventional radiological examination for evaluation of TNM stage and limited vs. extensive stage systems in patients with SCLC.

CLINICAL RELEVANCE/APPLICATION

FDG-PET/CT has better potential than conventional radiological examination for evaluation of TNM stage and limited vs. extensive stage systems in patients with SCLC.
Detection of Primary and Metastatic Lesions of Urinary Tract Tumors by 18F-FLT PET/CT

**PURPOSE**

The aim of this study is to investigate the efficacy of 18F-FLT PET/CT for detection of primary and metastatic lesions of urinary tract tumors.

**METHOD AND MATERIALS**

Twenty-two (16 men, 6 women) patients were examined by 18F-FLT PET/CT (Siemens Biograph 16). All the patients received surgical operation or biopsy and the tumor was diagnosed histopathologically.

**RESULTS**

In 22 patients examined by 18F-FLT PET/CT, 13 were confirmed histopathologically to be urothelial cell carcinoma, 6 renal cell carcinoma, 2 retroperitoneal liposarcoma, and 1 bladder carcinoma. Five patients had lung metastases, 2 had lymph node metastases, and 1 had gallbladder cancer synchronously. In 7 of the 13 patients with urothelial carcinoma and 1 with bladder carcinoma, the primary tumor could not be detected due to retention of urine in the ureter and urinary excretion of 18F-FLT. In the other 6 patients with urothelial cell carcinoma, 2 with retroperitoneal liposarcoma, and 1 with renal cell carcinoma, the primary tumor could be detected due to lack of urinary excretion of 18F-FLT by renal insufficiency. 18F-FLT uptake in the tumor site expressed as SUVmax in 18F-FLT PET was 2.17-28.99 (mean±S.D. 8.51±11.50) in urothelial cancer, 1.65 in renal cell carcinoma, and 9.35 and 4.24 (6.8±3.61) in retroperitoneal liposarcoma. Lung metastases after nephrectomy for renal cell carcinoma in 5 patients could be detected (SUVmax: 3.24-6.44 (4.45±1.13)). Lymph node metastases in 5 patients also could be detected (SUVmax:2.16-6.35 (4.45±1.73)).

**CONCLUSION**

Usually, 18F-FLT PET/CT is not suitable for detection of the primary lesions of urinary tract tumors because of its urinary excretion, whereas their metastatic lesions can be detected by 18F-FLT PET/CT. Nevertheless, in patients whose urinary excretion of 18F-FLT is disturbed by renal failures, 18F-FLT PET/CT is useful for detection of the primary lesions of urinary tract tumors.

**CLINICAL RELEVANCE/APPLICATION**

18F-FLT PET/CT is not suitable for detection of the primary lesions of urinary tract tumors because of its urinary excretion, whereas their metastatic lesions can be detected by 18F-FLT PET/CT.
METHOD AND MATERIALS

We evaluated 44 patients who underwent pretreatment FDG PET and MRI. First-order and higher-order textural features of primary tumor were extracted by PET texture analysis. On MRI, the mean, standard deviation, minimum, maximum, skewness and kurtosis of the ADC values were calculated for the first-order texture analysis. The difference between minimum and maximum ADC values (ADCdiff) was calculated. The relationships between tumor-stroma ratio and imaging parameters were evaluated. To assess and compare the predictive performance of imaging parameters, time-dependent receiver operating characteristics (ROC) curves for censored survival data and areas under the ROC curve (AUC) were used. The associations between imaging parameters and recurrent free survival (RFS) were assessed using Cox proportional hazard regression models.

RESULTS

Low-intensity short-run emphasis \( (r = -0.382) \), coarseness \( (r = -0.382) \), strength \( (r = -0.390) \), low-intensity zone emphasis \( (r = -0.380) \), and low-intensity short-zone emphasis \( (r = -0.411) \) on PET and ADC \( (r = 0.434) \), ADCdiff \( (r = 0.534) \) on MRI were significantly correlated with stroma proportion. The best imaging biomarker for 2 year-RFS prediction was coarseness on PET \( (AUC = 0.741) \) and ADCdiff on MRI \( (AUC = 0.779) \). After adjusting for age, clinical tumor stage and clinical node stage, the multivariate analysis showed that coarseness \( (HR = 10.549, 95\% CI = 2.544-43.748, P = 0.001) \) and ADCdiff \( (HR = 3.274, 95\% CI = 1.016-10.551, P = 0.047) \) were independent prognostic factors for RFS.

CONCLUSION

Heterogeneity parameters derived from FDG PET and MRI are significantly associated with tumor-stroma ratio, a surrogate marker for tumor microenvironment. In addition, these imaging biomarkers may help to facilitate the risk stratification for tumor recurrence in head and neck cancer.

CLINICAL RELEVANCE/APPLICATION

Intratumoral heterogeneity parameters derived from FDG PET and MRI may help to facilitate the risk stratification for tumor recurrence in head and neck cancer.

NM245-SD-THB8  Quantitation of Cancer Treatment Response by FDG PET/CT: Multi-Center Assessment of Variability

Participants

Joo Hyun O, MD, Baltimore, MD (Presenter) Nothing to Disclose
Brandon Luber, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Hao Wang, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Jeffrey P. Leal, BA, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Richard L. Wahl, MD, Saint Louis, MO (Abstract Co-Author) Consultant, Nihon Medi-Physics Co, Ltd;

PURPOSE

Our aim was to study the variability of quantitative PET parameters used in assessments of treatment response across multiple sites and readers when assessing identical digital images.

METHOD AND MATERIALS

Paired pre- and post-treatment FDG PET/CT images of 30 oncologic patients were distributed to 22 readers across 15 US and international sites. One reader was aware of the full medical history (readreference), while the 21 other readers were unaware. The readers selected the single "hottest tumor" from each study, and made standard uptake value (SUV) measurements from this target lesion and the liver. Descriptive statistics, percent changes in the measurements, and their agreements were obtained.

RESULTS

The intra-class correlation coefficient (ICC) for the percent change in maximum SUV (%ΔSUVmax) of the hottest tumor was 0.894 (95\% CI 0.813, 0.941) and the individual equivalence coefficient (IEC) was 1.931 (95\%CI 0.568, 6.449) when all reads were included \( (n=638) \). Including only the measurements agreeing with the readreference on target selection \( (n=486) \), the ICC for the %ΔSUVmax was 0.944 (95\%CI 0.90.841, 0.989), and the IEC was -0.688 (95\%CI -1.810, -0.092). For percent change in mean SUV from the liver corrected for lean body mass, the ICC was 0.751 (95\%CI 0.631, 0.810), and the IEC was 7.799 (95\%CI 3.417, 18.493).

CONCLUSION

The quantitative tumor SUV changes measured across multiple sites and readers show very high correlation, suggesting that FDG PET/CT studies may be implemented in a more general manner for treatment response assessment. Ensuring selection of the same target among readers is necessary.

CLINICAL RELEVANCE/APPLICATION

FDG PET quantitation of changes in tumor SUVmax and liver mean SULmean from multiple sites have high, though not perfect, degrees of agreement.

Differences in reader selection of target lesions contribute to variability of quantitative measurements from identical image data sets

Honored Educators

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Richard L. Wahl, MD - 2013 Honored Educator
The purpose of this study is to evaluate the utility of FDG-PET/CT in detecting tumor sites and degree of FDG avidity associated with clinical and pathologic features of mycosis fungoides.

METHOD AND MATERIALS
This is an IRB-approved retrospective study including 39 patients with pathologic confirmed mycosis fungoides, who underwent 18F-FDG PET/CT examination for initial disease staging or disease relapse. The physical examination findings of the skin lesion and related pathologic findings were recorded using patients’ electronic medical records. The FDG-PET/CT scans were evaluated by a board certified nuclear medicine physician using SUVmax and the Lugano classification score for each scan.

RESULTS
Out of the total of 39 patients included in the study, more than half of the patients had patches or plaques (24/39, 61.5%), eight patients had maculopapular rashes (20.5%), and the remaining seven patients (18%) had nodular lesions or eczematous rashes. Twenty patients (51.3%) demonstrated FDG avid lesions on the PET/CT scan. Lugano classification showed score 1 in 20 patients, score 2 in 1 patient, score 3 in 5 patients, score 4 in 8 patients, and score 5 in 5 patients. The average SUVmax for the FDG-avid lesions was 3.38 (range 0.8-8.7). Extracutaneous sites with FDG-avid lymph node involvement were present in 25.6% of the cases (10/39).

CONCLUSION
Our findings suggest that 18F-FDG PET/CT scan demonstrates FDG avid cutaneous and extracutaneous lymphomatous involvement in a majority of patients, which may be beneficial in diagnosis, biopsy localization, staging and potential therapy assessment.

CLINICAL RELEVANCE/APPLICATION
FDG-PET/CT is useful in the staging and management of patients with mycosis fungoides.

NM247-SD-THB10 Performance of 18F-FDG PET/CT in the Diagnosis of Solitary Pulmonary Nodules with Different CT Attenuation Patterns

Station #10

Participants
Haiping Liu, BSD, MS, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Ping Chen, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Peng Hou, guangzhou, China (Abstract Co-Author) Nothing to Disclose
Jingwu Chen, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Huaifu Deng, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Yulei Jiang, Ph.D, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Yonglin Pu, MD, PhD, Chicago, IL (Presenter) Nothing to Disclose

PURPOSE
The solitary pulmonary nodules (SPNs) are often evaluated with 18F-FDG PET/CT. We determined the diagnostic performance of 18F-FDG PET/CT for diagnostic differential diagnosis SPNs with different CT attenuation patterns.

METHOD AND MATERIALS
This study was approved by the institutional review board. 1406 patients with SPNs underwent 18F-FDG PET/CT scan from January 2006 to June 2015 were included in this study. The attenuation patterns of the SPNs were assessed retrospectively and independently by two radiologists from CT images. Differences in interpretations were resolved by consensus. Maximal standardized uptake value (SUVmax) of SPNs was evaluated on the PET/CT. The reference standard for the diagnosis of the SPNs was pathology and CT follow-up. Receiver operating characteristic (ROC) curve was used to evaluate diagnostic performance of the PET/CT. The reference standard for the diagnosis of the SPNs was pathology and CT follow-up. The optimal cut-off value of the SUVmax for the differential diagnosis of malignant and benign nodules was 2.78 for solid SPNs, 1.06 for part-solid SPNs and 0.55 for GGOs, respectively. The area under the ROC curve (AUC) of SUVmax of the SPNs was 0.885 (95% CI, 0.863-0.904, P<0.0001), 0.930 (95% CI, 0.892-0.958, P<0.0001) and 0.569 (95% CI, 0.495-0.640, P = 0.103) for the differential diagnosis of malignant and benign solid nodules, part-solid SPNs and GGOs, respectively.

CONCLUSION
18F-FDG PET/CT shows excellent diagnostic performance for differentiating malignant from benign solid and part-solid SPNs, but poor diagnostic performance for GGOs.

CLINICAL RELEVANCE/APPLICATION
Solid and part-solid SPNs on CT can be further evaluated with 18F-FDG PET/CT. However, 18F-FDG PET/CT is not useful for...
NM005-EB-THB

Before the Force Awakens: Role of 11C-DTBZ in Early Stage Detection of Parkinson's Disease

Hardcopy Backboard

Participants
Yean P. Silva Hidalgo, MD, Mexico, Mexico (Presenter) Nothing to Disclose
Luis A. Ruiz Elizondo, MD, Mexico City, Mexico (Abstract Co-Author) Nothing to Disclose
Mary C. Herrera-Zarza, MD, Mexico City, Mexico (Abstract Co-Author) Nothing to Disclose
Gisela Estrada, MD, Mexico City, Mexico (Abstract Co-Author) Nothing to Disclose
Cesar N. Cristancho Rojas, MD, Mexico City, Mexico (Abstract Co-Author) Nothing to Disclose
Rafael Curiel Reyes, MD, Morelia, Mexico (Abstract Co-Author) Nothing to Disclose
Ana M. Lopez, MD, Mexico City, Mexico (Abstract Co-Author) Nothing to Disclose
Jose L. Criales, MD, Mexico City, Mexico (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

Parkinson disease (PD) is the second most frequent neurodegenerative disorder after Alzheimer in the elderly population, in recent years imaging has taken a greater role in diagnosis and management. PD is characterized pathologically by loss of dopamine neurons in the substantia nigra pars compacta. 11C-9-fluoropropyl-(+)-dihydrotetabenzazine (11C-DTBZ) is a PET radiotracer of the dopaminergic system that has affinity for VMAT2 (vesicular monoamine transporter 2). VMAT2 is a specific presynaptic protein involved in the transportation of monoamines from the cytosol into the terminal nerves, directly proportional to the neuronal integrity of the dopaminergic system. 95% is concentrated in the striatal regions, one of the main physiological uptake zones, therefore a decreased uptake at this level is highly suggestive of Parkinson's disease. THE AIM OF THIS EXHIBIT: Review the pathophysiology of Parkinson disease Describe the molecular basis and mechanism of action of 11C-DTBZ. Describe the of 11C-DTBZ normal uptake and illustrative cases.

TABLE OF CONTENTS/OUTLINE

Introduction. Parkinson disease analysis. 11C-DTBZ molecular basis. Illustrative pathologic cases. Conclusion.
Head and Neck Cancer PET Interpretation with Case Examples (An Interactive Session)

Thursday, Dec. 1 4:30PM - 6:00PM Room: S505AB

Participants

LEARNING OBJECTIVES

Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC711A  
Practical Approach for Interpreting Head and Neck PET/CT

Participants
Rathan M. Subramaniam, MD, PhD, Dallas, TX (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To understand the value of PET/CT in the care process of managing head and neck cancer. 2) To learn common pathways of tumor spread in head and neck. 3) To review illustrative cases and pitfalls of interpretation.

ABSTRACT

FDG-PET/CT provides valuable information in the assessment of the patient with cancers of the head and neck. The metabolic information determined by FDG is complimentary and additive to the anatomic information from CT, and can be used to direct surgery, plan radiation therapy, and evaluate response to systemic or localized treatment. In this presentation, the role of FDG-PET/CT in the management of head and neck cancer will be presented, using case examples to illustrate the utility of PET as well as common pitfalls.

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Eric M. Rohren, MD, PhD - 2015 Honored Educator

RC711B  
PET/CT for Head and Neck Cancer: Clinical Applications and Case Studies

Participants
Eric M. Rohren, MD, PhD, Houston, TX, (Eric.Rohren@bcm.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review head and neck anatomy and physiologic sites of FDG uptake. 2) Review the impact of FDG-PET/CT on the management of patients with head and neck malignancies.

ABSTRACT

FDG-PET/CT provides valuable information in the assessment of the patient with cancers of the head and neck. The metabolic information determined by FDG is complimentary and additive to the anatomic information from CT, and can be used to direct surgery, plan radiation therapy, and evaluate response to systemic or localized treatment. In this presentation, the role of FDG-PET/CT in the management of head and neck cancer will be presented, using case examples to illustrate the utility of PET as well as common pitfalls.

RC711C  
The Head and Neck Surgeon’s Perspective: What I Need to Know

Participants
Nishant Agrawal, MD, Chicago, IL, (nishant.agrawal@uchicago.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review the indications of PET/CT in head and neck cancer. 2) Review the impact of PET/CT on staging in head and neck cancer. 3) Review the role of PET/CT in the evaluation of the unknown primary. 4) Review the role of post-treatment PET/CT.

ABSTRACT
Emerging Technology: Immuno Imaging Probes-Opportunities and Challenges

Friday, Dec. 2 8:30AM - 10:00AM Room: E353A

RC811A A Primer on 89Zr-ImmunoPET

Participants
Terence Z. Wong, MD, PhD, Chapel Hill, NC (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) To learn about the basic physical and chemical properties of the radioisotope 89Zr.
2) To understand the basic components of a 89Zr-labeled radioimmunoconjugate.
3) To understand how 89Zr-labeled radioimmunoconjugates are synthesized and purified.
4) To gain an appreciation of the forces behind the recent advent of 89Zr-based immunoPET imaging.
5) To explore the PSMA-targeting radioimmunoconjugate 89Zr-DFO-J591 as a case study for the journey of an immunoPET imaging agent from the laboratory to the clinic.

ABSTRACT

Currently monoclonal antibodies (mAbs) are an expanding innovative class of cancer drugs. Numerous mAbs, including several antibody-drug conjugates, are in advanced clinical development, forming an important part of the many molecularly targeted anticancer therapeutics currently in development. Development and treatment decisions for registered mAbs could benefit from quantitative biomarkers, enabling visualization of the tissue distribution of (potentially modified) therapeutic mAbs to confirm effective whole-body target expression, engagement, and modulation and to evaluate heterogeneity across lesions and patients. Such biomarkers may be realized with positron emission tomography (PET) imaging of radioactively labeled antibodies, a process called immunoPET or with a fluorescently labeled antibodies and optical imaging. This approach could potentially increase the power and value of trials and clinical practice by improving patient selection, optimizing dose and schedule, and rationalizing observed drug responses.

RC811B Engineered Antibodies for immunoPET: Probes for Profiling Tumors and Immune Responses

Participants
Anna M. Wu, PhD, Los Angeles, CA (awu@mednet.ucla.edu) (Presenter) Stockholder, ImaginAb, Inc; Consultant, ImaginAb, Inc; Consultant, Avidity NanoMedicines, LLC;

LEARNING OBJECTIVES
1) Identify key properties of antibodies that can be modified/improved to produce probes optimized for in vivo imaging.
2) Discuss applications of new immunoPET tracers to address challenges in oncology and immunology.
3) Describe the process and potential of translating immunoPET probes into clinical use.

RC811C Clinical Applications of Immuno Probes in Oncology

Participants
Elisabeth G.E. de Vries, MD, PhD, Groningen, Netherlands (Presenter) Institutional Research Grant, F. Hoffmann-La Roche Ltd; Institutional Research Grant, Amgen Inc; Institutional Research Grant, Novartis Ag; Institutional Research Grant, SERVIER; Data Safety Monitoring Board, BioMarin Pharmaceutical Inc; Advisory Board, Synthion Holding BV; Advisory Board, Merck & Co, Inc; ; ; ; ; ; ; ; ; ;

LEARNING OBJECTIVES
1) To learn about the answers immuno probes can provide in clinical oncology.
2) To learn about the potential of the immuno probes consisting of radioactively labeled antibodies as well as fluorescently labeled antibodies in the clinic.

ABSTRACT

Currently monoclonal antibodies (mAbs) are an expanding innovative class of cancer drugs. Numerous mAbs, including several antibody-drug conjugates, are in advanced clinical development, forming an important part of the many molecularly targeted anticancer therapeutics currently in development. Development and treatment decisions for registered mAbs could benefit from quantitative biomarkers, enabling visualization of the tissue distribution of (potentially modified) therapeutic mAbs to confirm effective whole-body target expression, engagement, and modulation and to evaluate heterogeneity across lesions and patients. Such biomarkers may be realized with positron emission tomography (PET) imaging of radioactively labeled antibodies, a process called immunoPET or with a fluorescently labeled antibodies and optical imaging. This approach could potentially increase the power and value of trials and clinical practice by improving patient selection, optimizing dose and schedule, and rationalizing observed drug responses.

RC811D Companion Imaging Diagnostics: Small Molecule Ligands versus Immune-Based Agents

Participants
Michael D. Farwell, MD, MA, New York, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe desirable properties of a companion diagnostic imaging probe.
2) Discuss likely clinical scenarios where companion diagnostic might be used.
3) List advantages and disadvantages of small molecule versus immune-based probes as comparative diagnostics.
Honored Educators

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David A. Mankoff, MD, PhD - 2013 Honored Educator
Comparative Performance of Two Tc-99m Radiopharmaceuticals for Intraoperative Identification of Sentinel Lymph Nodes in Melanoma

PURPOSE
Surgical staging of regional lymph nodes with intraoperative lymphatic mapping and sentinel lymph node (SLN) biopsy is the standard of care for patients with melanomas exceeding 1 mm in depth. Tc-99m filtered sulfur colloid (SC) is the traditional radiopharmaceutical for guiding intraoperative SLN biopsy. In May 2013, the FDA approved Tc-99m tilmanocept (TM) (Lymphoseek), a low molecular weight, mannose receptor-targeted radiopharmaceutical. While published data suggest that TM may reduce the number of “hot” lymph nodes needed for accurate staging, the higher cost of TM is paramount to its clinical acceptance.

METHOD AND MATERIALS
Retrospective analysis compared two cohorts of male and female patients with melanoma: 41 TM (age range 11-92, mean 55.9 yr) and 41 SC (age range 23-84, mean 56.3 yr). Primary measures were number of “hot” SLN removed, determination of positive (metastatic) SLN, and average time required to visualize lymph nodes by preoperative scintigraphy when requested by the single surgeon.

RESULTS
The number of excised “hot” SNL was similar in both cohorts (mean TM: 1.6 vs SC: 2.1, p<0.79). There was no difference in the sensitivity of the radiopharmaceuticals in determining metastatic involvement (mean TM 0.37 vs SC 0.49, p<0.64). Less time was required to complete preoperative imaging on SC patients (mean TM: 54 min vs SC: 30 min, p<0.04).

CONCLUSION
In comparing the number of excised “hot” lymph nodes, statistically there was no difference between the TM and SC cohorts. There was equivalent sensitivity of both radiopharmaceuticals for determining the presence of regional lymphatic metastases. When imaged, on average, it required less time to visualize the SLN for the SC cohort. Based on these results, it is difficult to justify the higher cost of TM.

CLINICAL RELEVANCE/APPLICATION
Currently, the contract price for TM is approximately four times that of SC. The prices of TM and SC will increase in 2016; there will continue to be an approximately 3.6-fold difference in cost. Reimbursements for SC and TM are now bundled into the payment for the procedure. Given that TM has not been shown to result in higher sensitivity for detection of metastatic regional spread to SLN, its clinical relevance becomes less favorable, particularly in the face of increasing prices and bundled reimbursements. Additionally, longer imaging times limit camera availability for other examinations.

SUV Max: An Underused Tool in the Prognostication of Uveal Melanoma

PURPOSE
Surgical staging of regional lymph nodes with intraoperative lymphatic mapping and sentinel lymph node (SLN) biopsy is the standard of care for patients with melanomas exceeding 1 mm in depth. Tc-99m filtered sulfur colloid (SC) is the traditional radiopharmaceutical for guiding intraoperative SLN biopsy. In May 2013, the FDA approved Tc-99m tilmanocept (TM) (Lymphoseek), a low molecular weight, mannose receptor-targeted radiopharmaceutical. While published data suggest that TM may reduce the number of “hot” lymph nodes needed for accurate staging, the higher cost of TM is paramount to its clinical acceptance.

METHOD AND MATERIALS
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CONCLUSION
In comparing the number of excised “hot” lymph nodes, statistically there was no difference between the TM and SC cohorts. There was equivalent sensitivity of both radiopharmaceuticals for determining the presence of regional lymphatic metastases. When imaged, on average, it required less time to visualize the SLN for the SC cohort. Based on these results, it is difficult to justify the higher cost of TM.

CLINICAL RELEVANCE/APPLICATION
Currently, the contract price for TM is approximately four times that of SC. The prices of TM and SC will increase in 2016; there will continue to be an approximately 3.6-fold difference in cost. Reimbursements for SC and TM are now bundled into the payment for the procedure. Given that TM has not been shown to result in higher sensitivity for detection of metastatic regional spread to SLN, its clinical relevance becomes less favorable, particularly in the face of increasing prices and bundled reimbursements. Additionally, longer imaging times limit camera availability for other examinations.
PURPOSE

The diagnosis of uveal melanoma is a devastating one with 50% of patients going on to develop metastasis. Despite advancements in modern medicine, the median survival for liver metastasis remains at 6 months. The purpose of this study was to correlate maximal Standardized Uptake Values (SUV max) on PET-CT for primary uveal melanoma with prognostic factors and outcomes post treatment of the tumor. Can SUV max be used to forecast likely disease progression in patients diagnosed with uveal melanoma?

METHOD AND MATERIALS

160 patients who received a clinical diagnosis of uveal melanoma between January 2012 to June 2015 and underwent a staging PET-CT scan were included in this retrospective study. The metabolic activities of these tumors were established by recording the SUV max of the tumor. This information was correlated with patient's demographic information, tumor size, stage and cytogenetic analysis. Additionally, SUV max was correlated with outcomes post treatment, namely tumour recurrence, metastasis and uveal melanoma related mortality.

RESULTS

The age and gender of patients conferred no significant difference in the SUV max recorded. There was a significant positive correlation between tumour height (P<0.0001, r=0.61) and tumour diameter (P<0.0001. r=0.35). SUV max was significantly higher with worsening stages of melanoma according to COMS and AJCC staging. SUV max was significantly increased in patients who developed tumor metastasis compared with those who did not (P<0.0001). The was also a significant difference in the SUV max of patients who died under 12 months from diagnosis of their melanoma compared with those who did not (p=0.0027). There was no significant difference in the SUV max of patients who developed recurrence.

CONCLUSION

SUV max greater than 6 can be associated with a greater risk of metastasis and mortality under 12 months from diagnosis. Increasing intensity of metabolic activity can be positively correlated with a worse outcome from the diagnosis of uveal melanoma and can be used to risk stratify patients, especially those who may warrant more frequent surveillance.

CLINICAL RELEVANCE/APPLICATION

SUV max greater than 6 can be used to risk stratify patients at greater risk of metastasis and mortality under 12 months from diagnosis of Uveal Melanoma.

SST07-03 Diffusion Weighted Chest MRI and FDG-PET/CT in Pediatric Patients Suffering from Primary Lymphoma: Does the Apparent Diffusion Coefficient (ADC) Correlate with Tracer Uptake (SUV)

Friday, Dec. 2 10:50AM - 11:00AM Room: E353C

Participants
Marc Regier, Hamburg, Germany (Presenter) Nothing to Disclose
Melissa Stoffels, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Cyrus Behzadi, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Michael G. Kaul, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Jochen Herrmann, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate diffusion weighted MR imaging (DWI) with ADC measurement for quantitative tumor analysis in primary pediatric lymphoma and to compare it to standardized uptake values (SUV) determined by FDG-PET/CT.

METHOD AND MATERIALS

Both DWI (TR/TE, 2000/66ms; FOV, 425x298mm; Matrix 256; slice thickness, 4mm; b-values, 0,25,50,75,100,500 and 1000s/mm² at 3T) and FDG-PET/CT were performed in 37 consecutive pediatric patients with histologically verified primary lymphoma prior to initiation of treatment. By placing a Region of Interest (ROI) encompassing the entire tumor manifestation the mean (ADCmean), minimum (ADCmin) and maximum ADC (ADCmax) were determined by two independent radiologists. Furthermore, the relative ADCmin (rADCmin=ADCmin/ADCmean) and ADCmax (rADCmax=ADCmax/ADCmean) were assessed. Reading the FDG-PET/CT images calculation of the mean (SUVmean) and maximum (SUVmax) tumor metabolism as well as the relative SUVmean (rSUVmean) and SUVmax (rSUVmax) was consensually performed. The results of DWI and PET-CT were intraindividually compared. For statistical analysis Pearson’s correlation coefficient was assessed.

RESULTS

Comparison of the ADCmin (mean, 0.89x10-3mm2/s) and SUVmax (mean, 6.2) revealed an inverse correlation (r,0.81; p,0.04). Furthermore, the rADCmin and rSUVmax showed a strong inverse correlation which was statistically significant (r,0.91; p,0.024). In contrast, there was no correlation between maximum ADCs and minimum SUVs (r,0.21; p,0.69) or between mean ADCs and SUVs (r,0.32; p,0.49), regardless of absolute or relative quantitative analysis.

CONCLUSION

Minimum ADCs correlate with higher tumor metabolism as determined by FDG-PET/CT and SUV measurements. As higher standardized uptake values can indicate a rather limited clinical course in primary lymphoma, DWI with ADC measurement might serve as a radiation free alternative severity marker in pediatric patients suffering from primary lymphoma.

CLINICAL RELEVANCE/APPLICATION

Due to the absence of x-ray exposition, injection of tracer or contrast material diffusion weighted MRI with determination of the minimum ADC might prove to serve as a valuable complementary technique in the evaluation of tumor metabolism in pediatric lymphoma patients.
The average of volume reduction rate (%), rate of achievement of normalized serum TSH, and rate of recurrence of AFTN associated with complete disappearance of Tc uptake on the nodule and complete blocking of feeding artery (n=32). Based upon findings of fusion images of 2nd study, patients were assigned to either of the following subgroups; A) those injected into the nodule under the guidance of a 12MHz US probe. Ethanol was also injected to make embolization in the feeding artery as a feeding artery of the nodule in all. PEI was performed as a fractionated session. After local anesthesia, absolute ethanol was injected into the nodule under theguidance of a 12MHz US probe. Ethanol was also injected to make embolization in the feeding artery. The injection time was limited to 15 minutes and the injection pressure was limited to 10 cc/min. Images were obtained using a workstation. On the 3D images, the superior thyroid artery was identified. PEI was performed as a fractionated session. After local anesthesia, absolute ethanol was injected into the nodule under the guidance of a 12MHz US probe. Ethanol was also injected to make embolization in the feeding artery. The injection time was limited to 15 minutes and the injection pressure was limited to 10 cc/min. Images were obtained using a workstation. On the 3D images, the superior thyroid artery was identified. The initial workflow consisted of 28 minutes for patient preparation, 117 minutes for the actual PET/MR scan, and 8.5 hours for data post-processing. Upon streamlining the workflow patient preparation took 9 minutes; the PET/MR scan with coil placement could be reduced to 90 minutes; and data post-processing took less than 60 minutes. These time-savings of 19, 27 and 450 minutes were statistically significant. This led to improved patient satisfaction. Radiologist satisfaction was also elevated due to faster image data access, exam loading time, and sequence identification.

CONCLUSION
The workflow of whole-body PET/MR can be specifically streamlined for cancer staging of pediatric patients. This improves satisfaction of both patients and radiologists and results in a more economic scan protocol.

CLINICAL RELEVANCE/APPLICATION
PET/MR combines the high anatomical resolution and soft tissue contrast of MRI with the high sensitivity of PET, thereby overcoming both the limited sensitivity of traditional MRI approaches and the limited anatomical detail of PET/CT scans. Pediatric patient-specific workflows will improve the integration of this new technology into clinical practice.

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David B. Larson, MD, MBA - 2014 Honored Educator

SST07-05 Use of Tc-99m SPECT/ CT Fusion Images to Enhance Therapeutic Efficacy of Percutaneous Ethanol Injection (PEI) in Autonomously Functioning Thyroid Nodule (AFTN)

Participants
Kunihiro Nakada, Sapporo, Japan (Presenter) Nothing to Disclose
Keiichir Kamijo, MD, PhD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Noriyoshi Kato, MD, PhD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Masayuki Sakurai, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
This study was aimed to determine whether fusion images of Tc-99m SPECT and CT is valuable in improving therapeutic efficacy of PEI for AFTN.

METHOD AND MATERIALS
39 patients with solitary AFTN and 7 patients with multiple AFTNs underwent PEI. 21 patients had hyperthyroidism while the remaining 25 had subclinical hyperthyroidism. 6 patients were refractory to I-131 therapy. All nodules were proved to be benign by FNA and were 3.1-5.3 cm in diameter. Combination of Tc-99m SPECT and CT were repeatedly performed before and after completion of PEI session. Thin-slice MPR images of the neck were obtained using a 64-row MDCT with enhancement. 2D and 3D fusion images of Tc-SPECT and CT were obtained using a workstation. On the 3D images, the superior thyroid artery was identified as a feeding artery of the nodule in all. PEI was performed as a fractionated session. After local anesthesia, absolute ethanol was injected into the nodule under the guidance of a 12MHz US probe. Ethanol was also injected to make embolization in the feeding artery. Based upon findings of fusion images of 2nd study, patients were assigned to either of the following subgroups; A) those associated with complete disappearance of Tc uptake on the nodule and complete blocking of feeding artery (n=32), or B) others (n=7). Patients were further followed up for 36 months or longer.

RESULTS
The average of volume reduction rate (%), rate of achievement of normalized serum TSH, and rate of recurrence of AFTN associated with complete disappearance of Tc uptake on the nodule and complete blocking of feeding artery (n=32).
CONCLUSION

Fusion images of Tc-99m SPECT and CT are highly predictive of outcome of PEI in AFTN. Disappearance of Tc uptake and blocking of the feeding artery indicates long-lasting efficacy of PEI.

CLINICAL RELEVANCE/APPLICATION

• By use of SPECT/CT fusion image, feeding artery can be easily identified. Ablation of feeding artery may be a key issue for successful PEI for AFTN

PURPOSE

Ectopic thyroid tissue (ETT) can be readily localized with radioiodine SPECT/CT but may remain indeterminately localized with conventional radioiodine whole body scans (RWBS). We aimed to visualize ETT on RSPECT/CT and correlate the presence of orthotopic thyroid tissue (OTT) and/or ETT with quantitative parameters of functioning thyroid tissue in thyroid cancer patients after total thyroidectomy.

METHOD AND MATERIALS

A retrospective review of 20 consecutive patients with pathologically confirmed thyroid cancer who underwent radioiodine imaging after total thyroidectomy was performed over an 18-month period. RWBS were used to identify functioning thyroid tissue while RSPECT/CT was used to determine the thyroid tissue as orthotopic or ectopic, with ETT defined as thyroid tissue beyond C5-C7. The thyroglobulin (TG) to thyroid stimulating hormone (TSH) ratio, total uptake count, and total lesion volume were analyzed. The TG/TSH ratio equaled the total TG per number of post-operative days divided by the total TSH per number of post-operative days. Total lesion volume equaled the sum of the ellipsoid volume of each lesion. Total uptake count equaled the sum of the counts per lesion, calculated from total volume multiplied by the count difference/1.8 cm³ at the lesion center, with count difference as count at the lesion center minus the background count measured at the C3 vertebral body.

RESULTS

On RSPECT/CT, 13 of 20 cases showed both OTT and ETT: 5 with high TG/TSH ratios (>1), 2 with expected high TG/TSH ratios (TG level not obtained due to slow-rising TSH after thyroidectomy), and 6 with low TG/TSH ratios (<1). Seven of 20 cases showed OTT only with low TG/TSH ratios. Seven of 20 cases had high or expected high TG/TSH ratios accompanying both OTT and ETT. Among cases with both OTT and ETT, total volumes averaged 3684.56 mm³ in patients with high TG/TSH compared with 2601.50 mm³ in patients with low TG/TSH; total counts averaged 13,973.25 in patients with high TG/TSH compared with 12,089.94 in patients with low TG/TSH.

CONCLUSION

All patients with high TG/TSH ratios had both ETT and OTT. Overall, high TG/TSH ratios were associated with higher total lesion volumes and total lesion counts per patient.

CLINICAL RELEVANCE/APPLICATION

ETT may cause subjective airway obstruction post-I-131 therapy, affect the dose for remnant ablation, or increase the risk of recurrent cancer; its recognition may impact thyroid cancer management.

PURPOSE

Salivary gland damages are a common adverse effect of high dose radioiodine therapy for thyroid cancer. So far, less is known about possible salivary gland damages after remnant tissue ablation with low dose (30mCi) I-131. The aim of this study was to investigate whether salivary gland damages is induced by low dose I-131 ablation for thyroid cancer.
56 patients with post-surgical papillary thyroid cancer, who were to undergo first radioiodine ablation with 30mCi of I-131, were enrolled. None of the patients had previous history of salivary gland disorders, diabetes, or collagen tissue diseases. TSH stimulation was achieved by i.m. injection of rhTSH for 2 consecutive days. On the next day of 2nd rhTSH, 30 mCi of I-131 was administered. Low iodine diet was applied from 7 days before to 3 days after I-131 administration. Salivary gland scintigraphy (SGS) using Tc-99m was performed within one month before and 4 to 5 months after ablation. Dynamic data (10 sec/F) were acquired in 128 × 128 matrix with or 30min. Lemon juice was administered at 20 min after Tc i.v. to stimulate salivary excretion. Both scan images and time activity curves for major salivary glands were evaluated. Clinical symptoms were assessed using a visual analogue scale. 41 out of 56 patients underwent follow-up SGS 2 to 3 years after ablation. I-131 uptake in the major salivary glands (RIU) was visually graded on the ost therapy scan imaged 3 days after administration of I-131 in a 4 point scale; (-), (+), (++), and (++).  

RESULTS
All patients had normal findings on the pre-ablation SGS. RIU was (-) in 46 glands, (+) in 104 glands, (+) in 50 glands, and (+++) in 28 glands, respectively. Acute salivary injury was not observed in any of the patients. However, 3 of 56 patients (5%) showed abnormal findings on the post-ablation SGS. 2 patients showed adverse events in the unilateral PTG 4 months after ablation. One showed sialadenitis and another showed impaired patency salivary duct. In the remaining one, non-functioning in the left PTG was observed 3 years later. RIU was (+) or (+) in the affected PTG in those patients.

CONCLUSION
Although frequency of the events seems fewer than that with high-dose therapy, low dose I-131 ablation may induce subsequent salivary gland famagures.  

CLINICAL RELEVANCE/APPLICATION
Performance of SGS at regular interval is impotant in early detecting of I-131 induced salivary gland dysfunction after low dose remnant ablation.

SST07-08 (11)C-Choline PET/CT for Detection and Localization of Parathyroid Adenomas

Friday, Dec. 2 11:40AM - 11:50AM Room: E353C

METHOD AND MATERIALS

In this single-institution retrospective study, 7088 11C-choline PET/CT scans performed in 2933 males with PRCA from 1/2005-2/2016 were evaluated. Patients with suspected parathyroid adenomas were identified through a review of the electronic medical record and relevant imaging. Patient demographics, laboratory results, and lesion characteristics were noted. Pathologically proven parathyroid adenomas and lesions in patients with imaging and/or laboratory findings consistent with the diagnosis were considered positive.  

RESULTS
Thirteen male patients (mean age 72 +/- 7 years) with pathologic and/or laboratory proven parathyroid adenomas were identified. All had abnormally elevated serum calcium and parathyroid hormone (PTH) levels. All adenomas were tracer-avid on choline PET/CT (SUV max 5.6 +/- 3.0), with activity averaging 4.2 times blood pool and 2.1 times adjacent thyroid. Adenomas measured 9 +/- 3 mm by 6 +/- 2 mm (mean long axis by short axis diameter), with an estimated volume of 262 +/- 170 mg. One case of an ectopic adenoma was identified. Of the six pathologically confirmed cases, none displayed high-grade features such as capsular, vascular, or adjacent tissue invasion. Other imaging modalities included dual isotope scans (6/13), CT (4/13), ultrasound (11/13), and magnetic resonance imaging (1/13). Three patients with possible adenomas on choline PET/CT went on to have thyroid pathology; however, none of these patients had abnormal calcium or PTH levels. Nine patients with possible adenomas on choline PET/CT did not undergo laboratory testing or surgery, presumably due to their PRCA and other comorbidities.

CONCLUSION
In our patient population, 11C-choline PET/CT identified parathyroid adenomas with high specificity. Prospective investigation is warranted to validate this result and delineate the utility of choline PET/CT relative to other modalities.  

CLINICAL RELEVANCE/APPLICATION
11C-choline PET/CT shows promise in identifying parathyroid adenomas and may be a useful adjunct to established imaging modalities.

Honored Educators

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124I-mIBG PET/MRI versus PET/CT for Staging Patients with Metastasized Malignant Pheochromocytoma

Friday, Dec. 2 11:50AM - 12:00PM Room: E353C

Participants
Lale Umutlu, MD, Essen, Germany (Presenter) Consultant, Bayer AG
Markus Ruhlmann, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Walter Jentzen, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Bockisch, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Verena Ruhlmann, Essen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
The aim of this study is to compare the diagnostic potential of 124I-mIBG (metaiodobenzylguanidine) PET/MRI to PET/CT for staging patients with metastasized malignant pheochromocytoma.

METHOD AND MATERIALS
10 patients (5 male, 5 female, age 53 ±20 years) with histopathologically confirmed malignant pheochromocytoma underwent a whole-body contrast-enhanced PET/CT (Biograph mCT 128, Siemens) and thereafter a whole-body contrast-enhanced PET/MR examination approximately 24 hours after injection of 40-50 MBq 124I-mIBG (Biograph mMR, Siemens). The MR protocol comprised the following sequences: 1) T1w VIBE ax. post contrast, 2) T2 HASTE ax., 3) DWI ax. and 4) TIRM cor. The datasets (PET/CT, PET/MRI) were read by a radiologist and a nuclear medicine specialist regarding lesion conspicuity (4 point ordinal scale) and lesion localization. Maximum and mean standardized uptake values (SUVmax and SUVmean) using volume of interest (VOI) technique were assessed from the PET(CT) and PET(MR) datasets. Statistical analysis included comparison of mean values using Mann-Whitney U test and correlation of SUVmax and SUVmean using Pearson’s correlation.

RESULTS
44 malignant mIBG-positive lesions were detected with both PET/CT and PET/MRI with strongly positive correlated mean SUVmax (Pearson’s correlation r=0.88) and SUVmean (Pearson’s correlation r=0.95). Comparably high lesion conspicuity in the PET component of PET/CT (2.8 ±0.7) and PET/MRI (2.9 ±0.4; p=0.03) could be assessed with significant higher lesion conspicuity in MRI (2.8 ±0.7) compared to CT (2.5 ±0.8; p=0.03). Two small lung lesions were not visible on MRI and three predominantly osteolytic bone lesions could not be assessed on CT, but showed an easily definable hyperintense signal on MRI.

CONCLUSION
Integrated 124I-mIBG-PET/MRI shows high potential as a diagnostic procedure in metastasized malignant pheochromocytoma with in comparison to PET/CT comparable detection rate and high lesion conspicuity in PET, but significant higher lesion conspicuity in MRI compared to CT.

CLINICAL RELEVANCE/APPLICATION
PET/MRI may serve as a powerful alternative to PET/CT for staging of patients with malignant pheochromocytoma, particularly for pretherapeutic dosimetry prior to 131I-mIBG-therapy.