SNMMI Mid-Eastern Chapter

Cardiac PET/CT

- Superior Image Quality
- High Diagnostic Accuracy
- Short Imaging Time
- Safe
- Independent on Body size
- Quantification of MBF

Underutilization of Rb-82 PET Cardiac Imaging

Jason Jenkins BS CNMT PET CT(R)
Preview of Presentation

- Discuss Healthcare Environment
- Clinical Implementation of Technical Innovations
- SNMMI/ASNC Joint Statement on Rb-82 Cardiac PET
- Imaging Protocol
- Principles of Rb-82 Cardiac Imaging
- Technical Issues
- MBF Quantification
- Economic Analysis
Value-Based Healthcare Culture

New Healthcare Landscape

Value

COST

Outcome of Care

Researchers: Medical errors now third leading cause of death in United States
New Care Delivery Models

- Evidence-Based Medicine (Best Practice Standards)
- Pay-4-Performance Model
- Cost and Waste Reduction
- High Value Care Delivery System

Technical Innovation

- Where does Diagnostic Imaging fit in all this?
  - Continuous Quality Improvement (CQI)
  - Appropriate use Criteria
  - Promote Innovation

- PET/CT Cardiac Imaging Techniques
  - N-13 Ammonia
  - Rb-82 Chloride
Joint Position Statement

American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET

Writing Group:
Timothy M. Bateman MD (Co-Chair), Vasken Dilsizian MD (Co-Chair), Rob S. Beanlands MD, E. Gordon DePuey MD, Gary V. Heller MD, PhD, and David A. Wolinsky MD

- SNMMI
- American Society of Nuclear Cardiology
- Myocardial Perfusion PET
  - Preferred
  - Recommended
Cardiac PET: Advantages

- High Diagnostic Accuracy
  - High Sensitivity/ Specificity

- High Image Quality
  - High Spatial Resolution

- Low Radiation Exposure
  - 2-3 mSv

- Short Acquisition Protocols

- MBF Quantification

- Strong Prognostic Power (Risk Stratification)
Rb-82 MPI PET: Protocol

Increase Patient Throughput

Timeline
Rb-82 PET/CT Cardiac Stress

1. Patient Prep. 15 mins.
2. LDCT 15 sec
3. Rest Perfusion Imaging 8 mins.
4. Stress Perfusion Imaging 8 mins.
5. Recovery/Image Processing 10 mins.
6. End of Exam

Total 41 mins.

❑ Tc-99m SPECT Technique: 3+ hours
(Decreases patient throughput)
LDCT Attenuation Profile

- **Traditional MPI SPECT**
  - Non-uniform attenuation artifacts
  - Breast/ Diaphragm
  - Lower Specificity

- **SPECT CT MPI**
  - CT attenuation component
  - Increase specificity

- **PET/CT attenuation**
  - CT vs. Radionuclide Attenuation

Rb-82 Generator

- K+ Analog
- Proportional to MBF
- Sr-82/Rb-82 (Parent/ Daughter)
- 0.9 Saline Elution: Rb-82
- Tin oxide binds Sr-82
- QC: Sr-82/ Sr-85 Ratio
- T1/2: 75s
- Repeat Elution: 10 min

### Rb-82: Resolution

<table>
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<tr>
<th>Positron Range</th>
<th>Resolution</th>
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<tr>
<td>F-18 1.03 mm</td>
<td>□ Long Positron Range</td>
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<tr>
<td>N-13 2.53 mm</td>
<td>□ Degrades Resolution</td>
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<tr>
<td>O-15 4.14 mm</td>
<td>□ Rb-82 5.7 mm</td>
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<tr>
<td>Rb-82 8.6 mm</td>
<td>□ Tc-99m 12 mm</td>
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- High Spatial Resolution

Rb-82: Extraction Fraction
Rest Perfusion: Imaging

Dynamic Imaging
- 12 frames x 5s
- 6 Frames x 10s
- 4 frames x 20s
- 4 frames x 40s

Gated/ Static Imaging
- 1 bed position
- 90s delay
- 390s Imaging
- NAC Image Recon

Acquisition Parameters
Rest Perfusion: Possible Errors

**Sources of Error**

- Patient Anxiety *(Motion)*
- Arms get tired *(Motion)*
- High Pressure Error
- Clamped IV
- Dose Infiltration
- Positional IV
- Pump Limit Reached

- **Time/ Motion Sensitive Procedure**
Stress Perfusion Imaging

**Concern**

- SOB
- Chest Discomfort
- Nausea
- Claustrophobia
- Patient Moves
- Mismatch PET-CT Profiles
- Attenuation Correction Error

**Heightened Patient Awareness**
Image Registration

Image Registration

Resulting AC Image

104 102 100 98 96
104 102 100 98 96
43 45 47 49 51 53
45 47 49 51 53
Heart Failure Patients

- Increase Delay time from 90s to ±120s
Incorrect Window

Gated Image

- Normal
- Low Count
- Incorrect Window
Extra Cardiac Activity

- Incidental Findings
- SPN
MBF Quantification

- Absolute Flow Measurement (ml/g/min)
- Severity of CAD burden
- Compartment Model (Flow Kinetics)
- Vascular vs. Tissue Compartment
- Validation: Repeatability
- Normal Flow Reserve > 2

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Anyone Still With Me?
Joint Statement Review

- **High Diagnostic Accuracy**
  - Sensitivity/Specificity
  - Image Quality
  - Spatial Resolution

- **MBF Quantification**
  - Rest/Stress MBF
  - Flow Reserve
  - Pharmacologic Response

- **Low Radiation Exposure**
  - Annual Natural Exposure
  - Short Acquisition Time
  - Increase Throughput

- **Strong Prognostic Power**
  - Risk Stratification
  - Risk Level Discrimination
## Economic Analysis: Procedure Cost

### Comparative Analysis

- Rb-82 PET Cardiac more expensive than Tc-99m Cardiac SPECT
- Does greater diagnostic yield compensate for high cost?
  - Quite Possibly!
- As a General Principle: Diagnostic Accuracy and Value
- Sensitivity and Specificity
- Impact on Overall Cost of Medical Management
Overall Economic Analysis

Sensitivity

True Positives

Specificity

True Negative

Quality

Safety

Efficiency

Diagnostic Accuracy

VALUE  ➔  Cost & Outcome of Care
SNMMI/ASNC Joint Statement: Cardiac PET Imaging

Adequate Responds to Value-Based Healthcare Culture

Will continue to meet the diagnostic imaging needs of our patients.
Thanks for Listening!