Pitfalls and Artefacts in Nuclear Cardiology

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Disclosures

None
Question #1

What is your interpretation?

1. Normal Study
2. Inferior Scar, No Ischemia
3. Uninterpretable
4. More data might help
Diaphragmatic Attenuation
Prone SPECT Acquisition
Prone Imaging: Diaphragmatic Attenuation

Stress Prone
Stress
Rest
Stress Prone
Stress
Rest
Stress Prone
Stress
Rest
Filtered Back Projection

CT Attenuation Correction
Question # 2

- Upon review of these images you think the study:
  1. Shows breast attenuation
  2. Shows a lateral wall infarction
  3. Has diaphragmatic attenuation
  4. Should be repeated with patient positioned differently
Left Arm Down Attenuation
Question #3

That’s a lot of GI/ liver uptake… What can I do?

1. Wait and acquire images a little bit later
2. Have patient drink water
3. Iterative reconstruction instead of FBP
4. Any or all of the above
Left lobe liver activity resolved with 2-hour delay

35 min post stress

145 min post stress
After 16 oz. water
GI Uptake
Filtered Back Projection
GI Uptake: Iterative Reconstruction
Pharm Stress SPECT

SHORT AXIS

VERTICAL LONG AXIS

HORIZONTAL LONG AXIS
Pharm Stress SPECT

sLVEF: 44%

rLVEF: 47%
Question # 4

- What is the most likely reason for the poor image quality?
  1. Injected dose too low
  2. Obese patient
  3. Imaging acquisition time too short
  4. Camera is >10 years old
Pharm Stress SPECT

BMI 40.2
Obese Patient

- SPECT perfusion images felt to be probably normal, but of poor quality due to patient’s obesity
- The patient was referred for $^{82}$Rb-PET MPI
sLVEF: 41%

rLVEF: 37%
AMERICAN SOCIETY OF NUCLEAR CARDIOLOGY AND SOCIETY OF NUCLEAR MEDICINE AND MOLECULAR IMAGING JOINT POSITION STATEMENT ON THE CLINICAL INDICATIONS FOR MYOCARDIAL PERFUSION PET

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Myocardial Perfusion Positron Emission Tomography (PET)

The American Society of Nuclear Cardiology (ASNC) and the Society of Nuclear Medicine and Molecular Imaging (SNMMI) have concluded that the properties of myocardial perfusion PET according to the published literature are sufficient to advance recommendations for its use in clinical practice.

**PROPERTIES OF MYOCARDIAL PET**

- High diagnostic accuracy
- Consistent high quality images
- Low radiation exposure
- Short image acquisition time
- Quantification of myocardial blood flow
- Strong prognostic power

**PREFERRED TEST**

Myocardial perfusion PET is a first-line preferred test for patients:

- With known or suspected CAD,
- Who meet appropriate criteria for a stress-imaging test, and
- Are unable to complete a diagnostic-level exercise stress imaging study.

There are no clinical scenarios where PET should not be considered a preferred test for patients who meet appropriate criteria for a stress imaging test and who require pharmacologic stress.

**RECOMMENDED TEST**

Patients with suspected active CAD who meet appropriate criteria for a stress-imaging test and who also meet one or more of the following criteria:

- Poor quality prior stress imaging study
- Young patients with established CAD
- Body characteristics that commonly affect image quality
- High-risk patients
- Patients in whom myocardial blood flow quantification is needed

For additional details, please visit [www.asnc.org](http://www.asnc.org) for a link to the American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET.
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Exercise SPECT

Indication: Abnormal ECG
Question # 5

• Your interpretation of the images would be:
  • 1. Helped by reviewing the ECG
  • 2. This is septal Ischemia.
  • 3. Improved by reprocessing the images
  • 4. More certain after reprocessing the study
Left Bundle Branch Block
Pharm SPECT

No defect as HR did not increase
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<thead>
<tr>
<th>Rb-82 PET MPI</th>
<th>Stress</th>
<th>Rest</th>
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Blood Pooling

• Most often occurs if acquisition is started to soon
  – LVEF > 45% : 90 - 120 sec
  – LVEF < 45%: 120 – 180 sec
• May also be caused by kinked IV line
• Acquisition needs to be repeated
Stress

Rest

Rb-82 PET MPI

Short Axis

Vertical-Long Axis

Horizontal-Long Axis
Question # 6

• Your interpretation of the study is:

• 1. Severe inferior ischemia
• 2. Image acquisition problem
• 3. Diaphragmatic attenuation
• 4. CT attenuation map misregistration
Stress

Horizontal-Long Axis

Short Axis

Rest

Rb-82 PET MPI

Stress

Rest

Vertical-Long Axis

Stress

Rest

Horizontal-Long Axis
Cutoff Myocardium

- Occurs when patient is positioned to high or low in field of view
- Also may be caused if patient moves during any part of the acquisition
- Acquisition has to be repeated
Reversible Anterior Defect?
Shifting Breast Attenuation
Repositioned Similar to Rest
PET/CT
Question # 7

• The PET CT scan is notable for:

  • 1. Misregistration of the PET and CT data
  • 2. Moderate anterolateral ischemia
  • 3. “Shifting” breast attenuation
  • 4. Lateral chest wall fat attenuation
PET/CT
Misregistration

- Occurs when PET and CT are not aligned
- Common cause is patient motion between CT and PET acquisition
- Some systems do have correction software
- Not identifiable until acquisition is complete
Resting inferoapical defect
No known h/o CAD
Question # 8

- What is the Technologist thinking?
- 1. Patient may have had silent myocardial infarction, need MD to review before stress
- 2. Another problem with the camera
- 3. Patient motion- will try to correct
- 4. Why didn’t the docs buy that camera with attenuation correction?
Flood Field Non-Uniformity
Myocardial SPECT Acquisition → Flood Field Non-Uniformities → Reconstructed SPECT Ring Artifacts → SA Tomogram with Artifacts
Normalization
What is the Diagnosis

HLAR

VLAR
Apical Hypertrophy

HLAR

VLAR
What is wrong?
Center of Rotation Artifact
Misregistration by Filtered Backprojection

Resulting SPECT Artifacts
Anything Wrong?

SA apex

SA mid

SA base

VLA

HLA
Infiltrated Dose

SA apex

VLA

SA mid

SA base

HLA
Anything Different?

VLAR
Attenuation from breast implants