3. Blood pool activity:
   a. Increased blood pool activity is commonly seen due to low ejection fraction.
   b. Reconstruction of the images with an appropriate pre-scan delay may improve blood pool activity and image resolution (Table 2).

   **Table 3. Elements of a comprehensive PET MPI report**

<table>
<thead>
<tr>
<th>Imaging Parameters</th>
<th>Imaging Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Patient demographics</td>
</tr>
<tr>
<td>Technique and radiotracer dose</td>
<td>Technique and radiotracer dose</td>
</tr>
<tr>
<td>Stress test information</td>
<td>Technique and radiotracer dose</td>
</tr>
<tr>
<td>Technique for attenuation correction and calcium scoring (when applicable)</td>
<td>Technique and radiotracer dose</td>
</tr>
<tr>
<td>Left ventricular volumes</td>
<td>Left ventricular volumes</td>
</tr>
<tr>
<td>Regional wall motion</td>
<td>Regional wall motion</td>
</tr>
<tr>
<td>Rest and peak stress left ventricular ejection fraction</td>
<td>Rest and peak stress left ventricular ejection fraction</td>
</tr>
<tr>
<td>Agatston calcium score</td>
<td>Agatston calcium score</td>
</tr>
<tr>
<td>Percentile values based on age and gender</td>
<td>Percentile values based on age and gender</td>
</tr>
<tr>
<td>Ancillary findings</td>
<td>Ancillary findings on the transmission and emission imaging</td>
</tr>
<tr>
<td>Conclusions</td>
<td>An overall interpretation of the findings (ischemia, scar, or combined findings) in a vascular distribution.</td>
</tr>
<tr>
<td></td>
<td>The final impression should include a comprehensive interpretation of MPI results in conjunction with stress ECG changes, rest and peak stress ejection fraction, presence or absence of transient ischemic dilation of the left ventricle as well as calcium scoring. Discordant findings should be interpreted</td>
</tr>
</tbody>
</table>

3. Non-cardiac findings:
   a. If a gated calcium score is performed, those findings must be incorporated into the report.
   b. A review of the transmission CT scan for the presence or absence of coronary artery calcium is not recommended. The slice thickness (~5 mm) and motion blurring from cardiac and breathing motion can render coronary calcium estimates erroneous, especially if there is no coronary artery calcium detected.

3. Non-cardiac findings:
   a. Transaxial perfusion images should be routinely inspected for pathological extracardiac uptake.
   b. Review of the low resolution transmission CT scan is helpful in identifying extracardiac pathology (pleural or pericardial effusions, coronary or aortic/aortic valve calcifications, mediastinal masses, lung nodules, etc.).

**SUGGESTED READING**
Dilsizian V, Bacharach SL, Beanlands RS, et al. Imaging guidelines for nuclear cardiology procedures: PET myocardial perfusion and metabolism clinical imaging. J Nucl Cardiol 2009;16:doi: 10.1016/j.jncl.2009.09.004-9. ASNC thanks the following members for their contributions to this document: Writing Group: Sharmila Dorbala, MD (Chair); Karthik Ananthasubramaniam, MD; Mosaz H. Al-Mallah, MD; and Rupa Mehra, MD. Reviewers: Vasken Dilsizian, MD; Edward P. Ficaro, PhD; Christopher L. Hansen, MD.

**PET Myocardial Perfusion Imaging (MPI)**

**OVERVIEW**
The purpose of this document is to specifically identify the critical components involved in performing myocardial perfusion imaging (MPI) with positron emission tomography (PET). This document will cover advantages, disadvantages, patient selection, test preparation, procedural details, and image interpretation and reporting of PET MPI.

**INDICATIONS**
PET MPI is indicated for the diagnosis of patients with suspected coronary artery disease (CAD) and risk stratification of patients with known CAD, when they are unable to exercise, have a left bundle branch block pattern, paced rhythm on electrocardiogram (ECG), or an equivocal single photon emission computed tomography (SPECT) MPI. PET MPI is also indicated for the detection of the co-presence of CAD and for the assessment of resting myocardial perfusion in patients undergoing the assessment of myocardial viability with F-18 Fluorodeoxyglucose (FDG) PET.

**CONTRAINDICATIONS**
Contraindication to stress testing:
- Standard contraindications to exercise stress testing or to pharmacological stress

Contraindications to PET imaging:
- Inability to lie flat or lie still for the duration of the scan
- Claustrophobia (occasionally)

**ADVANTAGES**
As compared to SPECT MPI, PET MPI provides:
- Rapid imaging protocols and faster laboratory throughput
- Increased diagnostic accuracy

**DISADVANTAGES**
As compared to SPECT MPI, PET MPI’s drawbacks include:
- Limited availability
- More expensive equipment and associated costs
- Difficult to use with exercise stress
- Lack of experienced/trained staff

**PATIENT SELECTION**
Patients who benefit from PET MPI include those who:
- Have an equivocal SPECT MPI for diagnosis or risk stratification of known or suspected CAD

- Require pharmacologic stress imaging
- Are more prone to attenuation artifacts (obese patients, female patients, arms down imaging)
- Require myocardial viability assessment
PET MPI

Table 1. Pharmacologic stress procedures for PET MPI

<table>
<thead>
<tr>
<th>Imaging Procedure</th>
<th>Adenosine*</th>
<th>Dipyridamole*</th>
<th>Dobutamine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Peripheral IV lines recommended</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Radiotracer Injection</td>
<td>Mid infusion</td>
<td>3 minutes after completion of infusion</td>
<td>When target heart rate is reached</td>
</tr>
</tbody>
</table>

Table 2. Imaging parameters for PET MPI

<table>
<thead>
<tr>
<th>Imaging Procedure</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topogram/Scout</td>
<td>Computed Tomography (CT) Scout or 10-20 mCi (370-740 MBq) Rubidium-82 (Rb-82) or 1-2 mCi (37-74 MBq) N-13 ammonia to localize the heart position</td>
</tr>
<tr>
<td>Transmission scan</td>
<td>Measured attenuation correction before or after emission</td>
</tr>
<tr>
<td>Radiotracer dose</td>
<td>CT scan (10-30 seconds) CT parameters: 80-140 kVp, 10-20 mA, shallow tidal breathing, field of view carina to 2 cm below the heart, 4-5 mm slice thickness</td>
</tr>
<tr>
<td>- Mode of acquisition</td>
<td>2D or 3D List mode (start imaging with injection of radiotracer), gated or static imaging</td>
</tr>
<tr>
<td>- Scan duration</td>
<td>3-7 minutes (Rubidium-82), 10-15 minutes (N-13 ammonia)</td>
</tr>
<tr>
<td>- Prescan delay</td>
<td>70-90 seconds (Rubidium-82 left ventricular ejection fraction (LVEF) &gt;50%) 90-120 seconds (Rubidium-82 LVEF &lt;50%) 90-180 seconds (N-13 ammonia)</td>
</tr>
<tr>
<td>- Reconstruction</td>
<td>Filtered back projection or iterative reconstruction (OSEM)</td>
</tr>
</tbody>
</table>

Note: Patients should not eat or drink for 6 hours before the procedure. Anti-anginal therapies (beta blockers, nitrates) should be held in patients without a known diagnosis of coronary artery disease (diagnostic test).

* Avoid caffeine intake for >12 hours and avoid theophylline intake for > 48 hours

** Table 2.

1. Patient preparation is similar to that of pharmacologic SPECT (Table 1).
2. Patient height, weight, chest circumference (to ensure patient will fit on the scanner), ejection fraction (as it will affect pre-scan delay, see Table 2), and history of claustrophobia are assessed.
3. Exercise stress is feasible but may be cumbersome due to high radiation dose to personnel, coordination with the cyclotron, and patient motion.

** TEST PREPARATION**

1. Most PET stress scans are performed using pharmacologic stress with vasodilator stress being the most common.
2. The radiotracer is injected during peak hyperemia using the same or a separate intravenous line (Table 1).
3. Exercise stress is feasible but may be cumbersome due to high radiation dose to personnel, coordination with the cyclotron, and patient motion.

** STRESS PROCEDURES**

1. Topogram/Scout scan: This is a computed tomography (CT) or a low-dose radionuclide-based image to localize the heart position.
2. Transmission scan: After obtaining the topogram, a radionuclide scan or a low-dose CT transmission scan is obtained for attenuation correction.
3. Emission scan: The emission image acquisition starts with the bolus injection of the radionuclide (list mode) or after a pre-scan delay as static or gated images (Table 2). In a list mode (images are acquired with a time signal as well as an ECG signal), a single radiotracer injection and image acquisition allows multiple image reconstructions (i.e., summed static images, multi-frame ECG gated images, and multi-frame dynamic images). A list mode or rest- and stress-gated acquisition is recommended.

** IMAGING PROCEDURE**

Commonly used imaging parameters for PET MPI are shown in Table 2. There are three steps in acquiring a PET MPI study (Figure 1):

1. Topogram/Scout scan: This is a computed tomography (CT) or a low-dose radionuclide-based image to localize the heart position.
2. Transmission scan: After obtaining the topogram, a radionuclide scan or a low-dose CT transmission scan is obtained for attenuation correction.
3. Emission scan: The emission image acquisition starts with the bolus injection of the radionuclide (list mode) or after a pre-scan delay as static or gated images (Table 2). In a list mode (images are acquired with a time signal as well as an ECG signal), a single radiotracer injection and image acquisition allows multiple image reconstructions (i.e., summed static images, multi-frame ECG gated images, and multi-frame dynamic images). A list mode or rest- and stress-gated acquisition is recommended.

** QUALITY CONTROL, INTERPRETATION AND REPORTING**

Physicians interpreting perfusion PET need to have a thorough understanding of coronary physiology and myocardial perfusion imaging with nuclear techniques (PET and SPECT).

** QUALITY CONTROL**

Quality control of PET MPI is important and includes the evaluation of the following:

1. Patient motion:
   a. Is more difficult to recognize with PET (due to simultaneous acquisition of counts, not step and shoot) and can degrade images.
   b. Can be minimized by ensuring proper patient instruction and positioning.
2. Attenuation correction:
   a. Interpret only attenuation-corrected PET MPI.
   b. Review an overview of the transmission and emission images to ensure appropriate registration because misregistration of transmission and emission images can result in artifactual defects (most common in the antero-lateral walls from under-correction by emission images overlying lung tissue).
   c. Software programs are available for the appropriate registration of the PET and CT images.

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