SNM PERFORMANCE IMPROVEMENT PROJECT

Interpretative Accuracy and Diagnostic Certainty of Myocardial Perfusion Imaging

I. OVERVIEW

This Performance Improvement Project (PIP) is designed to improve interpretative accuracy (higher sensitivity and specificity), and diagnostic certainty (fewer equivocal reports) of myocardial perfusion imaging. Completion of this project may be used for the Part IV requirement of the American Board of Nuclear Medicine and the American Board of Radiology for Maintenance of Certification.

This PIP is appropriate for physicians performing and interpreting myocardial perfusion studies performed with SPECT (single photon emission computed tomography).

II. OBJECTIVES

Physicians who complete this PIP should

• Improve diagnostic accuracy compared to coronary arteriography (abnormal studies) or normalcy rates (normal studies) so that overall accuracy is > 80% per patient

• Improve diagnostic certainty so that > 80% of reports will be reported as normal or abnormal (i.e. < 20% equivocal interpretations)

III. BACKGROUND

Myocardial perfusion imaging with SPECT has an average sensitivity and specificity of 87% and 73% for detection of coronary artery stenoses > 50% (1-2). Diagnostic certainty (studies read as definitely normal or definitely abnormal) is > 80% (3). Studies may be performed with thallous-201 chloride, Tc-99m sestamibi, or Tc-99m tetrofosmin (4-6). EKG gated studies may be performed for measurement of end diastolic/end systolic left ventricular volume, and left ventricular ejection fraction, as well as evaluation of cardiac wall motion and systolic thickening, which provide additional diagnostic and prognostic information (7-8). Myocardial perfusion is evaluated at baseline (rest), and following exercise or administration of a pharmacologic agent to increase coronary blood flow (stress). Low-level exercise may also be combined with pharmacologic agents (9). Pharmacologic agents include dipyridamole, adenosine, regadenoson, and dobutamine (5-6,10). One-day rest/stress and stress/rest protocols may be used (6,11).

Attenuation correction using a transmission scan is recommended to improve accuracy (12).

Semi quantitative analysis of data, and use of normal databases decreases inter observer variability, improves reader confidence, and increases accuracy (8).
One of the more commonly used methods of interpretation, and one used in many studies of the prognostic use of myocardial perfusion imaging, is semi quantitative visual analysis that divides the myocardium into 17 segments (13-14).

**SHORT AXIS**

- Apical
- Mid
- Basal

**VERTICAL LONG AXIS**

- Mid

Perfusion in each segment is scored according to a 5-point scale:

0 = **normal**; 1 = **mildly abnormal**; 2 = **moderately abnormal**; 3 = **severely abnormal**; 4 = **absent**

Scores of the stress images are totaled to produce the summed stress score (SSS), which characterizes the extent and severity of coronary disease in a semi-quantitative fashion. The summed rest score (SRS) represents defects present at rest and reflects extent and severity of infarction. The summed difference score (SDS) is the difference between the SSS and SRS, and represents the extent and severity of stress-induced ischemia.

The SSS is classified as follows:

- **< 4 = normal**; 4 – 8 = **mildly abnormal**; 9 – 13 = **moderately abnormal**;
- > 13 = **severely abnormal**

Artifacts due to signal attenuation, patient movement, and other factors have been well described (15). Prone imaging may reduce signal attenuation in the inferior wall and improve specificity (16). The presence of normal wall motion and systolic thickening also improves specificity for fixed defects in the inferior as well as anterior wall (17).

Physicians who desire an in-depth review of acquisition, processing, display, and interpretative criteria are referred to practice guidelines of SNM (4) and the American Society of Nuclear Cardiology (6) and the American College of Radiology (5).

Appropriateness use criteria for cardiac radionuclide imaging have been published by the American College of Radiology (18-20), as well as the American College of Cardiology Foundation in collaboration with multiple specialty societies (21).
This PIP allows the physician to use myocardial perfusion studies acquired, processed, and displayed according to personal preference and local routine. The suggested learning tools allow the physician to

- Explore different acquisition and processing protocols
- Compare different interpretative criteria, including visual, semi quantitative, and normal databases
- Improve interpretive skills

IV. INSTRUCTIONS

Plan

Determine if this PIP is relevant to your clinical practice. Consider how you will identify the patients to be included, and how you will collect the clinical, scintigraphic, and arteriographic data. Set a goal for completing the PIP within a defined period of time.

Do

Select 20 patients who had myocardial perfusion imaging followed by coronary arteriography within 3 months.

Select another 10 patients who had myocardial perfusion imaging and a low likelihood (< 5%) of coronary artery disease based on clinical and exercise parameters (22-23). Patients in this group should have no history of coronary artery disease or confounding cardiac conditions, negative treadmill stress EKG with an adequate level of stress (≥ 85% predicted maximum heart rate), normal myocardial perfusion imaging of good to excellent quality, no evidence of transient ischemic dilatation, as well as normal ventricular volumes, wall motion and ejection fraction.

Transfer the findings and interpretation from the medical record to Form 1, or enter the information after reviewing the studies.

Enter the clinical history and/or findings from coronary arteriography on Form 1.

Transfer the data for each patient to Form 2 to calculate overall accuracy.

Enter the percentage of myocardial perfusion imaging studies interpreted as equivocal on the bottom of Form 2.

Enter the overall accuracy of myocardial perfusion imaging on the bottom of Form 2. If the percentage of equivocal studies is < 20%, and overall accuracy is > 80% consider choosing another PIP.
**Study**

If the number of equivocal myocardial perfusion imaging studies is > 20%, or overall accuracy is < 80%, formulate a personal action plan to improve deficiencies identified during analysis of the baseline data. The action plan should identify specific educational activities that might include, but are not limited to, the following activities:

- Review practice guidelines of SNM, ACR, ASNC, ACC, and other medical organizations:
  


- Do SNM 2004 gated cardiac imaging phantom exercise or 2003 myocardial perfusion imaging phantom exercise (must have been previously purchased)

- Read SNM LLSAP (Life-long Self Assessment Program) modules, available [http://www.snm.org/](http://www.snm.org/)

  Cardiovascular SPECT & PET: Part I
  SPECT Data Acquisition and Quality Control
  Factors Affecting High Quality SPECT
• Read Nuclear Cardiology Knowledge Self Assessment Program (NCKSAP), available at http://www.asnc.org/section_15.cfm

• Review SNM on-line interactive myocardial perfusion cases, available at http://www.snm.org/

• Prospectively correlate findings on myocardial perfusion imaging studies with coronary arteriography for a predetermined number of cases, or for a predetermined length of time

• Do a mini-fellowship in an imaging department where there is a high-level of expertise and high volume of myocardial perfusion imaging studies.

• Attend educational programs of professional organizations such as SNM, ASNC, ACC, RSNA concentrating on activities regarding performance and interpretation of myocardial perfusion imaging studies

**Act**

Summarize what was learned from the educational activities, and make a list of how the information will be used to improve performance. Be as specific as possible regarding the practice changes (e.g. changes made in study acquisition or processing, changes made in study interpretation)

Apply the information learned from the educational activities to the interpretation of an additional 30 myocardial perfusion studies (20 patients with coronary arteriography within 3 months, and 10 patients with a low-likelihood of coronary artery disease).

Review the studies (do not use reports from the medical record this time), and enter the findings and interpretation on Form 1.

Transfer the data for each patient to Form 2 to calculate overall accuracy.

Enter the percentage of myocardial perfusion imaging studies interpreted as equivocal on the bottom of Form 2.

Enter the overall accuracy of myocardial perfusion imaging on the bottom of Form 2.

Compare the findings and results on Form 2 after using the suggested educational tools with the results on Form 2 before starting this PIP.

If satisfied with the improvement, send both Form 2s to SNM for documentation and credit.

If no improvement, consider repeating the PIP after additional education. You may receive credit without repeating the PIP by submitting both Form 2s to SNM with an explanation why further improvement is unlikely.
V. REFERENCES


Form 1
ASSESSMENT OF MYOCARDIAL PERFUSION AND LV FUNCTION

Study Identifier  ____________________________

Date of Study  ____________________________

Reason for Study (select one)

☐ Diagnosis of coronary artery disease

☐ Evaluation of severity and extent of coronary artery disease

☐ Other

Original STUDY Interpretation (select one)

☐ Normal

☐ Equivocal

☐ Abnormal

Physicians Visual Interpretation of Myocardial Perfusion

Use the following diagrams to record myocardial perfusion in each segment on a scale from 0 (normal) to 4 (severely abnormal).

<table>
<thead>
<tr>
<th>STRESS</th>
<th>SHORT AXIS</th>
<th>VERTICAL LONG AXIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apical</td>
<td>Mid</td>
<td>Basal</td>
</tr>
</tbody>
</table>

SSS =  

< 4 = normal; 4 – 8 = mildly abnormal; 9 – 13 = moderately abnormal; > 13 = severely abnormal
SRS = _______
< 4 = normal; 4 – 8 = mildly abnormal; 9 – 13 = moderately abnormal; > 13 = severely abnormal

Physicians Visual Interpretation of Left Ventricular Function

What is the left ventricular ejection fraction using your preferred software?

**Stress LVEF _____ %**  **Rest LVEF _____ %**

Use the following table to record your visual assessment of wall motion for any segments that show *fixed* myocardial perfusion defects.

<table>
<thead>
<tr>
<th>Location</th>
<th>Hyperkinetic</th>
<th>Normal</th>
<th>Hypokinetic</th>
<th>Akinetic</th>
<th>Dyskinetic</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Mild</td>
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<td>Severe</td>
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<tr>
<td>Apex</td>
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<td>Anterior</td>
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<td>Septum</td>
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<td>2,3,8,9,14</td>
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<td>4,10,15</td>
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<td>Lateral</td>
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<td>5,8,11,12,16</td>
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</table>

**New STUDY Interpretation** (select one)

☐ Normal
☐ Equivocal
☐ Abnormal
INSTRUCTIONS FOR COMPLETING FORM 2

Enter data in each column using ‘0’ (or leave blank) or ‘1’.

Transfer the myocardial perfusion imaging data for each patient from Form 1.

If the patient has a low-likelihood of disease, enter ‘1’ in the appropriate column.

If the patient had coronary arteriography, enter the overall findings: normal = all vessels < 50% stenosis; mild to moderate disease = at least one vessel with a 50 – 70% stenosis, and no vessel with > 70% stenosis; abnormal = at least one vessel with > 70% stenosis.

Sum the score in each column.

For calculating the accuracy of myocardial perfusion imaging, all equivocal studies may be designated as normal or abnormal. Use the method that gives the highest accuracy.

Patients with a low likelihood of coronary artery disease should be included with patients whose coronary arteriograms are normal.

All patients with mild to moderate disease on coronary arteriography may be designated as normal or abnormal. Use the method that gives the highest accuracy.

The accuracy of myocardial perfusion imaging is calculated according to the following formula: (True positive MPI + True negative MPI) ÷ Total number of patients
## Form 2
### ACCURACY OF MYOCARDIAL PERFUSION IMAGING

<table>
<thead>
<tr>
<th>STUDY ID</th>
<th>MYO PERF IMAGING</th>
<th>LOW PROB</th>
<th>ANGIOGRAPHY(^1)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>NL</td>
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</table>

\(^1\)Angiography: normal < 50% stenosis; mild – moderate = 50 – 70% stenosis; abnormal > 70% stenosis

**Percentage of myocardial perfusion imaging studies interpreted as equivocal** ______ %

**Accuracy of myocardial perfusion imaging** ______ %