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EDUCATIONAL TRACK FOR RESIDENTS−REVIEW ARTICLE

How to Write a Good Myocardial Perfusion Imaging Report: Current North American Reports

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Abstract

Myocardial perfusion imaging (MPI) reports play a critical role in communicating results to referring physicians. A well-structured report is succinct, easy to understand and guides physicians in appropriate decision-making. Although the structure of MPI reports may differ across institutions and countries, they serve a common goal of informing the referring physician. In Japan, there are no standard reporting guidelines. However it is desirable to follow standards published in peer-reviewed consensus statements and guidelines. We review current North American reporting methods in hopes that can better guide trainees and imaging physicians toward simple standardized and informative MPI reports that will ultimately improve patient care.

Keywords: Cardiac imaging, Guidelines, Myocardial perfusion imaging, Nuclear cardiology, Standardized reports

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Stress/rest myocardial perfusion imaging (MPI) is used to assess patients with suspected or documented coronary artery disease. As such, the MPI report must convey sufficient information for diagnostic and therapeutic decision making while simultaneously remaining succinct for busy clinicians. It is desirable to follow a defined structure that includes important and salient data elements. The European Association of Nuclear Medicine (EANM) and the American Society of Nuclear Cardiology (ASNC) have published consensus statement and reporting guidelines (1-5). This review will focus on a reporting structure for MPI with single photon emission computed tomography (SPECT-MPI).

The standard structure of a myocardial perfusion imaging report

A structured report should be composed of standard components that can be easily reviewed by clinicians. Standardized reports that use clear headings enhance communication and serve as a useful template to guide MPI reporting by trainees and imaging physicians. Components of a MPI report should include: site administrative data; demographics such as patient information and medication; stress testing data; ECG data; imaging data; overall interpretation (3).

Administrative data

Administrative data includes information (patient name, date of birth, sex, unique identifiers, address, contact information, name and affiliation of the referring physician) which ensures correct identification of the patient and to whom the results will be sent.

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Patient demographics

Patient demographics and clinical information are reported so that the MPI images can be interpreted in clinical context. The patient's symptoms, previous cardiac history, coronary risk factors, and active medications should be described. Pre-test probability of obstructive coronary artery disease can be calculated by Diamond Forrester risk stratification (6). The appropriateness of the study (appropriate, may be appropriate, rarely appropriate) may also be stated to educate the referring physician (7).

Stress information

Baseline vital signs should be documented for comparison with the stress data. The type of stress (i. e., exercise or pharmacological) should be reported. For exercise stress, the exercise protocol (e.g., Bruce, modified Bruce, or Naughton), duration of exercise, peak heart rate and blood pressure should be included. For pharmacological stress, the pharmacological agent and reversal agents used, the dose administered, the infusion rate and duration, hemodynamic changes, and adjunctive exercise should be described. Any other high risk features should be highlighted.

Rest and stress ECG interpretation

It is important to interpret the resting ECG and note any abnormalities which may preclude or affect the accurate interpretation of the stress ECG, such as: >1 mm of baseline ST-segment depression (which can often be seen in the context of left ventricular hypertrophy with strain pattern or digoxin use), left bundle branch block (LBBB), paced ventricular rhythm, or pre-excitation (Wolff-Parkinson-White pattern). Stress ischemic ECG changes (including the time of onset, extent, and magnitude) as well as any arrhythmias should be described. When evaluating an ECG during stress, ST segment deviation relative to the PR segment should be measured. Horizontal or downsloping ST depression of ≥1 mm (0.1 mV) measured 60 to 80 ms after the J point on three or more consecutive beats is considered positive (8). Upsloping ST depression is generally less predictive for the presence of myocardial ischemia (8), but markedly depressed upsloping ST depression (≥2 mm) measured 80 ms after the J point may be predictive of future adverse events in patients with angina (9). The report should also include whether or not the patient developed chest pain. Specific to exercise stress studies, the reason for stopping exercise should be stated, and, if the Bruce protocol is used, the Duke treadmill score may be reported (10).

Imaging data

In this section, the imaging process including the protocol utilized (1-day or 2-day protocol for ^{99m}Tc-labelled tracers), the patient position (supine or prone for SPECT-MPI), and the tracer administered and dose of radioactivity should be reported. The presence of potential artifacts due to patient motion, diaphragmatic attenuation, variable breast attenuation, or sub-diaphragmatic scatter may be described. The type of SPECT camera and whether attenuation correction, prone imaging, or other image acquisition protocol variations were used that could affect the image quality and accuracy of interpretation should also be reported. The findings of tracer distribution, left ventricular volumes/ejection fraction/wall motion at both stress and rest, and the presence of transient ischemic dilatation (TID) should be reported. The size (small, moderate, or large), severity (mild, moderate, or severe) and location (using a standard 17-segment model) of the perfusion defect on the stress images are usually described first, followed by the changes seen on the resting images in relation to the stress images. LV ischemia and scar quantification may be useful to help guide patients' care. A single-center observational study with patients presenting for SPECT-MPI showed that the extent of ischemic myocardium predicted reduction in the risk of death with revascularization compared with optimal medical therapy for those patients with ≥10% of ischemic myocardium in the LV, as long as there was no extensive scar (encompassing ≤10% of the LV) present (11).

Summary interpretation

This section is the most important portion of the MPI report as it summarizes the pertinent findings from the previous sections with sufficient detail to guide physician decision making. The first line states if the study is normal, abnormal, or inconclusive (Appendix 1 and 2). If normal, many referring physicians may not need to review the remainder of the report. However, if abnormal, referring physicians would review the report in detail to understand the diagnostic and prognostic implications of the MPI study. When available, it is also useful to compare the MPI findings with those of previous studies. If the study is inconclusive, alternative testing can be suggested to assist the referring physician in diagnosis and decision making. Examples of images of exercise and pharmacological stress SPECT-MPI with corresponding clinical reports are shown in Fig. 1 and Appendix 1, and Fig. 2 and Appendix 2, respectively.

Conclusion

MPI reports must contain adequate information structured in a way that highlights the pertinent findings to allow guidance of physician decision-making. At the same time, it must be concise and easy to understand. Following a standardized reporting scheme based on consensus statements and guidelines as described above is essential to achieving these goals and ensuring high-quality patient care.

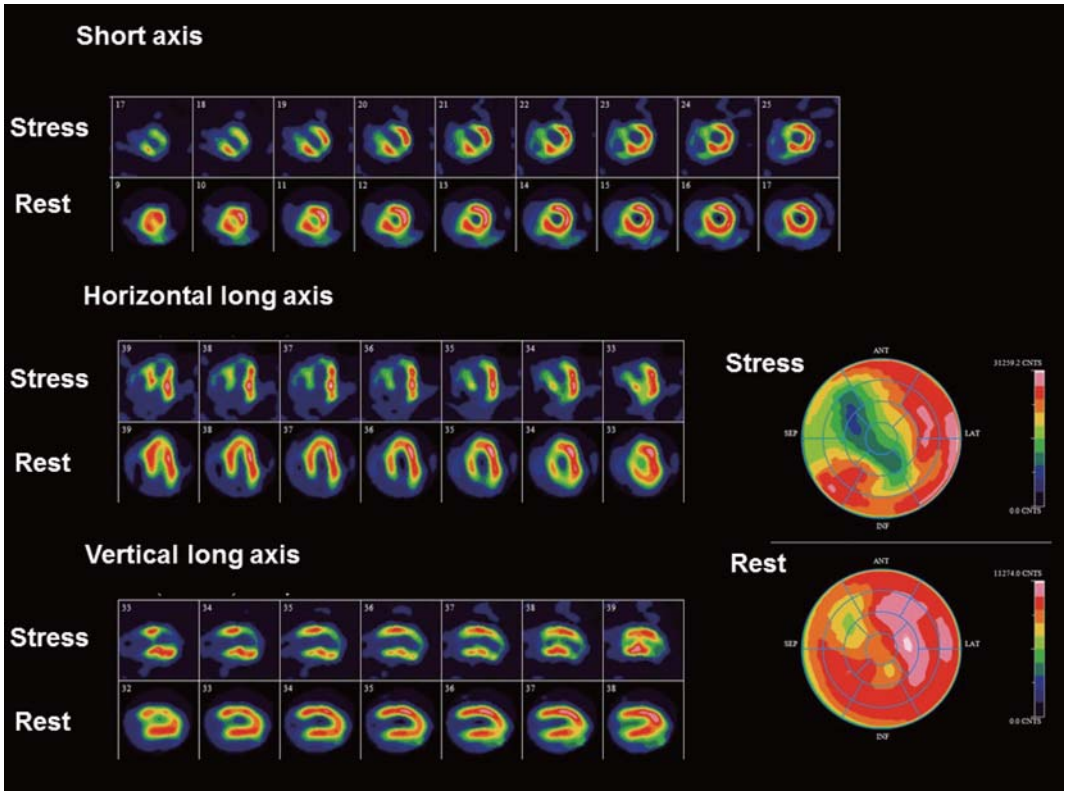

Fig. 1 A representative case with exercise SPECT-MPI
A 63-year-old male patient presenting with exertional chest pain. ^{99m}Tc-tetrofosmin demonstrates a moderate to severe defect at stress with partial resolution at rest, indicating ischemia and nontransmural scar in the left anterior descending (LAD) artery territory.

Appendix 1 Exercise Myoview myocardial perfusion and function

REASON FOR STUDY: 63-year-old male with exertional chest pain. Coronary risk factors: type 2 diabetes, hypertension and dyslipidemia. Medications: aspirin, clopidogrel, atorvastatin, metoprolol, gliclazide, and metformin. Exercise Myoview to assess for ischemia.
CARDIAC MEDICATION: Discontinued as directed.
DURATION OF EXERCISE: 6 min. 10s. PROTOCOL: Bruce.
REASON FOR TERMINATION: General fatigue.
VITAL SIGNS: Resting HR: 75 bpm. BP: 144/90 mmHg.
Peak stress HR: 155 bpm. BP: 176/96 mmHg.
Percent maximum HR: 87%.
ECG: Resting: Normal sinus rhythm. Q waves in leads V1 and V2 indicative of old anteroseptal myocardial infarction.
Exercise: No significant ST segment depression during exercise. Exercise induced chest pain. No arrhythmia.
TECHNICAL FACTORS: Good quality gated tomographic myocardial perfusion images acquired following dipyridamole stress and at rest using CZT camera without attenuation correction. Technetium-99m tetrofosmin was administered intravenously at rest 141 MBq and at peak stress 501 MBq. Height 175 cm. Weight 88 kg. Artifacts: None.
LV FUNCTION:
REST: Ejection fraction 67%, LVEDV (ml): 73, LVESV (ml): 25.
POST-STRESS: Ejection fraction 65%, LVEDV (ml): 62, LVESV (ml): 22.
TID Ratio: 0.88 (Normal <1.2).
OPINION:

1. Abnormal study. Half radiation dose protocol used. High risk scan.
2. EXERCISE ECG: Negative for ischemia by ST segment criteria. Non-limiting exercise-induced anginal chest pain. Duke Treadmill Score=2 (intermediate risk).
3. MYOCARDIAL PERFUSION: Post stress images demonstrate a moderate to severe reduction in tracer uptake in the entire anteroseptal wall, apical wall segments, and apex with significant improvement on rest imaging. This is consistent with a large area of moderate ischemia and a small area of nontransmural scar in the LAD territory.
% LV ischemia=17.6%. % LV scar=4.4%
4. LV FUNCTION- REST: Normal LV ejection fraction. Normal LV cavity size. Mild hypokinesis of the anteroseptal wall.
POST-STRESS: Moderate hypokinesis of the anteroseptal wall, apical wall segments, and apex which is compatible with post ischemic stunning. No significant change in the LV ejection fraction or cavity size.

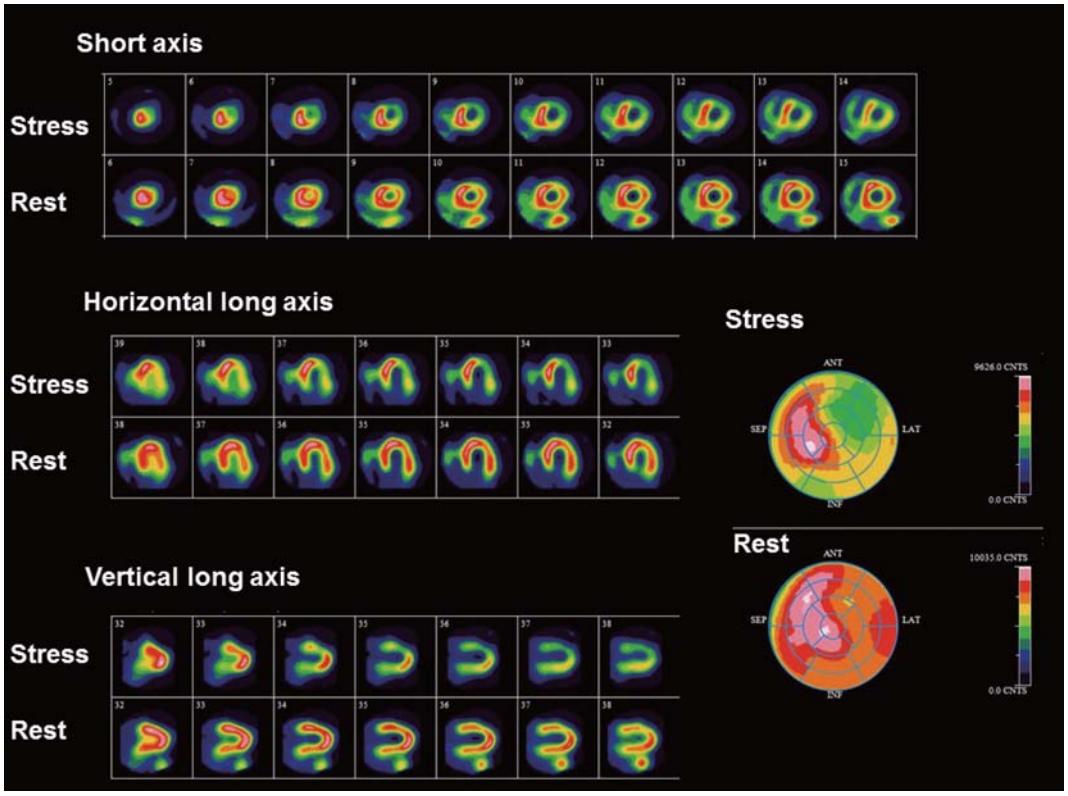

Fig. 2 A representative case with pharmacological SPECT-MPI
^{99m}Tc-tetrofosmin SPECT images from a 69-year-old male patient with prior coronary bypass grafting presenting with chest pain, demonstrating a large area of moderate ischemia in the left circumflex (LCx) and LAD artery territories.

Appendix 2 Dipyridamole (Persantine) Myoview myocardial perfusion and function

REASON FOR STUDY: 69-year-old male with prior coronary artery bypass grafting in 2001 presenting with chest pain. Coronary risk factors: type 1 diabetes and hypertension. Medications: insulin, aspirin, metoprolol, ramipril, and rosuvatstatin. Dipyridamole Myoview to assess for ischemia.
CARDIAC MEDICATION: Discontinued as directed.
DIPYRIDAMOLE ADMINISTERED INTRAVENOUSLY: 50 mg.
AMINOPHYLLINE ADMINISTERED INTRAVENOUSLY: 75 mg.
VITAL SIGNS: Pre-dipyridamole: 88 bpm. BP: 170/68 mmHg.
Post-dipyridamole: 101 bpm. BP: 136/60 mmHg.
ECG: Resting: Sinus rhythm. Incomplete right bundle branch block. Nonspecific ST-T abnormalities.
Dipyridamole: No significant ST segment depression. Dipyridamole induced chest pain. No arrhythmia.
TECHNICAL FACTORS: Good quality gated tomographic myocardial perfusion images acquired in supine position following dipyridamole stress and at rest using CZT camera without attenuation correction. Imaging was also acquired in prone position. Technetium-99m tetrofosmin was administered intravenously at rest 160 MBq and at peak stress 509 MBq. Height 160 cm. Weight 70 kg. Half dose protocols used to acquire rest and stress images. Artifacts: Diaphragmatic attenuation.
LV FUNCTION:
REST: Ejection fraction 63%, LVEDV (ml): 65, LVESV (ml): 24
POST-STRESS: Ejection fraction 66%, LVEDV (ml): 59, LVESV (ml): 20
TID Ratio: 0.81 (Normal <1.2).
OPINION:

1. Abnormal study. Half radiation dose protocol used.
2. DIPYRIDAMOLE ECG: Negative for ischemia by ST segment criteria. Dipyridamole induced chest pain. No arrhythmia.
3. MYOCARDIAL PERFUSION: Post stress images demonstrate a moderate reduction in tracer uptake in the basal to apical segments of the anterior, anterolateral, and inferolateral walls with complete improvement on rest images. This is consistent with a large area of moderate ischemia in the territory of the LCx and LAD (sparing the apex, suggesting that the graft to the LAD is patent). % LV ischemia=17.6%. % LV scar=0%.
4. LV FUNCTION- REST: Normal LV size, ejection fraction and wall motion. Paradoxical septal motion consistent with previous cardiac surgery.

POST-STRESS: No significant change compared to rest imaging.

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Conflicts of interest

None

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