AMERICAN SOCIETY OF NUCLEAR CARDIOLOGY POSITION STATEMENT

The initial evaluation of patients presenting to emergency departments with chest pain of suspected cardiac origin is critical in determining hospital admission or discharge. Clinical evaluation alone has been unsatisfactory as a complete triage tool in this setting. This has resulted in numerous unnecessary hospital admissions, as well as unfortunate hospital discharge of patients with coronary artery disease. The situation has become more critical as hospitals, particularly in large metropolitan centers, are above capacity, resulting in closing of hospital admitting and emergency departments to critically ill patients. Acute rest myocardial perfusion imaging has been clearly documented as an extremely useful tool in the evaluation of such patients. However, uniform standards have been lacking.

This position statement by an American Society of Nuclear Cardiology task force on chest pain centers clearly demonstrates the value of acute rest myocardial perfusion imaging in the triage of patients with suspected acute coronary syndromes. The document further elucidates steps necessary for such evaluation and the type of patients for whom this evaluation is best suited. As such, the document furthers our appreciation of acute rest myocardial perfusion imaging in the emergency setting.

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American Society of Nuclear Cardiology position statement on radionuclide imaging in patients with suspected acute ischemic syndromes in the emergency department or chest pain center

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INTRODUCTION

The American Society of Nuclear Cardiology (ASNC), founded in 1993, is a professional medical society whose mission is to foster optimal delivery of nuclear cardiology services through professional education, leadership in the establishment of standards and guidelines for training and practice, and the promotion of research. ASNC will intermittently publish "position statements," which reflect the growth of knowledge and evidence in a specific, focused area of the application of radionuclide imaging techniques for the clinical care of patients with known or suspected heart disease. Policy/position statements define the official opinion of ASNC and are approved or endorsed by the ASNC Board of Directors. Previous ASNC position statements have included statements on electrocardiographic gating of myocardial perfusion scintigrams,[1] the clinical relevance of a normal myocardial perfusion scintigraphic study,[2] and the value and use of attenuation correction for single photon emission computed tomography (SPECT) imaging.[3]

This position statement will examine the role of myocardial perfusion imaging (MPI) for use in the early evaluation of patients with suspected acute coronary syndromes (ACS), specifically those who are being

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Table 1. NPV of resting MPI for acute MI in the ED

Author	y	N (total)	N (normal rest MPI)	NPV
Varetto et al[4]	1993	64	34	100%
Hilton et al[5]	1994	102	70	99%
Tatum et al[6]	1997	438	338	100%
Kontos et al[7]	1997	532	361	99%
Heller et al[8]	1998	357	204	99%
Kontos et al[10]	1999	620	379	99%

evaluated in the emergency department (ED) setting or in a chest pain center.

The timely identification, triage, and management of the patient presenting with possible ACS remain problematic. Among the large number of patients (>6,000,000 in the United States annually) who present with nonspecific symptoms possibly due to ACS and nonischemic electrocardiographic changes, the actual incidence of ACS is relatively low. Yet, the clinical risk in patients with ACS is relatively high and may be mitigated by the use of effective but time-sensitive therapies. Moreover, large numbers of such patients are admitted to hospitals or chest pain centers for prolonged observation but ultimately are found not to have had an acute ischemic syndrome, resulting in substantial unnecessary resource utilization.

POSITION STATEMENT

It is the position of ASNC that evidence supports the use of acute rest SPECT MPI as a means for triaging selected patients with suspected ACS. Acute rest MPI in patients with suspected ACS has a high negative predictive value (NPV) for excluding myocardial infarction (MI), as well as predicting the absence of future adverse cardiac events. Thus, in most cases, patients with normal acute rest MPI results do not need to be hospitalized. Positive (abnormal) acute rest MPI results are associated with a high probability of ACS and justify hospital admission for early initiation of treatment. Effective implementation of acute rest MPI for detecting ACS requires high-quality MPI performed in a well-defined population with use of a systematic evaluation protocol.

BACKGROUND

Acute rest MPI is particularly useful in patients in the ED with acute chest pain and normal or nonischemic rest electrocardiogram (ECG) results. The NPV of acute rest MPI to exclude MI in these patients ranges from 99% to 100% (Table 1), and the NPV for excluding future cardiac events during medium-term follow-up is approximately 97%.[3-8] Acute rest MPI in this setting is highly sensitive for the detection of acute MI[4-11] and is capable of detecting myocardial ischemia in the absence of necrosis.[4,7,10,11] One study has shown incremental value of acute rest MPI data over demographic, clinical, ECG, and enzyme information in prediction of short-term cardiac events.[8] The consistently high NPV found in many studies suggests that patients with a normal acute rest SPECT perfusion study may be safely discharged from the ED and scheduled for outpatient follow-up at a later time.

Thus there is a large body of observational studies that support the use of acute rest SPECT MPI in patients presenting with suspected acute ischemia. There have been 2 prospective randomized studies that evaluated the impact of acute rest MPI on ED physicians' triage decision making, length of hospital stay, and health care costs.[12,13] In both studies patients were randomized to a strategy that incorporated SPECT MPI or a strategy without imaging. In the first trial, median hospital costs were $1843 less, median length of stay in the intensive care unit was 1.0 day shorter, and median hospital length of stay was 2.0 days shorter for patients who had MPI-guided management than for those who had conventional management. This study also demonstrated that physicians who had access to MPI results ordered fewer cardiac catheterizations without any difference in outcomes at hospital discharge or at 30 days' follow-up.

A much larger prospective randomized study[13] evaluated the role of acute rest MPI on triage decisions by ED physicians in patients who were randomly assigned to receive either the usual ED evaluation or the usual strategy supplemented with acute rest MPI data. The results demonstrated that unnecessary hospitalizations were significantly reduced in the imaging strategy group, with no differences in outcomes between the usual care and MPI groups. Thus these 2 prospective randomized trials showed that acute rest MPI in patients presenting to the ED with low-to-intermediate–risk chest pain and nondiagnostic ECG results can improve the overall clinical effectiveness of the initial triage process and potentially provide cost savings.

Appropriate Selection of Patients for Evaluation

Patients with obvious clinical and ECG evidence for ACS should be admitted to the hospital for appropriate aggressive treatment and do not benefit from rest SPECT MPI. The patient populations best suited for an ED triage strategy that incorporates acute rest MPI are those in whom the initial history and ECG do not suggest a high or very low probability of ACS. These are patients with symptoms suggestive but not typical for ACS and normal or nonischemic rest ECG results. In this patient cohort, further evaluation is necessary before a confident triage decision can be made. Importantly, other nonischemic and noncardiac causes for chest discomfort, such as pulmonary embolism, infection, arrhythmia, or aortic dissection, should always be considered. Patients with prior MI, especially those with Q waves on the ECG, are likely to have resting myocardial perfusion defects and therefore will require subsequent repeat MPI after a pain-free period to differentiate new ischemia from old MI. Therefore the utility of the initial rest SPECT MPI in this patient cohort is limited unless a prior study is available for comparison.

Image Interpretation

In a minority of patients the results of acute rest MPI will be equivocal, neither clearly normal nor clearly abnormal. Only one fully published report has separately evaluated such patients, who were found to have an event rate slightly higher than patients with normal MPI results but lower than those with abnormal MPI results.[5] Thus, for the purpose of optimizing the sensitivity of detecting ACS and minimizing the "missed MI" rate, it is recommended that equivocal MPI be categorized as mildly abnormal and that further evaluation, such as stress testing, be completed. The use of attenuation correction in this setting has not been elucidated but might be useful.

Presence of Symptoms During Injection of Radiopharmaceutical

One issue not completely resolved is the importance of injecting the radiopharmaceutical during ongoing chest discomfort. In the largest published experience, patients were studied after injection as long as 6 hours after cessation of symptoms.[6,8] Even at this time point, normal acute rest MPI was associated with a very low risk of a cardiac event over the subsequent 12-month period. Theoretically, a delay between the cessation of symptoms and the time of radionuclide injection may result in a missed diagnosis of ischemia and should be taken into account during image interpretation. This was convincingly demonstrated in patients with unstable angina.[11,14] Therefore it is recommended that a radiopharmaceutical preferably be injected during ongoing pain and not more than 2 hours after symptoms have abated.

Comparison of Acute Rest MPI and Cardiac Biomarkers

Two studies have compared the results of acute rest MPI with serial creatine kinase–MB and troponin analysis.[10,15] The sensitivity for detecting acute MI was similar between the two strategies, but acute resting MPI was positive earlier after presentation. These studies confirmed what could be expected based on the known release kinetics of the various widely used cardiac markers and the underlying pathophysiology of acute MPI. Whereas cardiac markers require 6 to 12 hours to become positive, rest MPI immediately reflects the status of regional myocardial blood flow at the time of radiopharmaceutical injection.

Choosing an Evaluation Strategy

For an ED staff or a multidisciplinary clinical group considering optimal strategies for evaluating patients with suspected acute ischemia, the choice of strategies, as well as the decision on whether to include resting MPI, involves a careful evaluation of local nuclear cardiology imaging expertise and the ability of the local imaging laboratory to provide imaging services and reports in a timely fashion. A strategy of observation with serial cardiac enzyme analysis and subsequent stress testing is widely applicable and widely practiced.[16]

Although published observational and randomized trial data regarding acute rest MPI are strong (Table 1), this approach is not as widely practiced. This may reflect the necessity of significant cooperation between the multiple stakeholders in the process, including ED physicians, providers of nuclear cardiology services (who may be radiologists, nuclear medicine physicians, or cardiologists), cardiologists who may be involved in consulting on clinical decision making, and other health care professionals including nursing and transport personnel.

Follow-up After Initial Evaluation Strategy

The initial goal of evaluating patients with suspected acute ischemia and nonischemic ECG results in the ED, through use of either resting MPI or serial cardiac serum markers, is to determine the likelihood of ACS and to assign patients into a high- or low-risk category for acute MI or unstable angina. Subsequently, the presence of coronary disease as a possible contributor to symptoms usually needs to be determined (particularly in patients with a negative initial evaluation and those injected without symptoms), and this is generally done best with some form of stress testing.[17] Decisions about the type of stress used (treadmill exercise or pharmacologic stress) and the type of analysis performed (ECG testing alone or ECG testing in conjunction with perfusion or function imaging) can be made based on well-established clinical protocols such as those outlined in the American College of Cardiology/American Heart Association stable angina guidelines.[18] It is recommended either that such stress testing is performed in the chest pain center before the patient is discharged or that the patient is discharged with an appointment for an outpatient stress test within 1 week.

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References

1. Bateman TM, Berman DS, Heller GV, Brown KA, Cerqueira MD, Verani MS, et al. American Society of Nuclear Cardiology position statement on electrocardiographic gating of myocardial perfusion SPECT scintigrams. J Nucl Cardiol 1999;6:470-1.
2. Bateman TM. Clinical relevance of a normal myocardial perfusion scintigraphic study. American Society of Nuclear Cardiology. J Nucl Cardiol 1997;4:172-3.
3. Hendel RC, Corbett JR, Cullom SJ, DePuey EG, Garcia EV, Bateman TB. The value and practice of attenuation correction for myocardial perfusion SPECT imaging. a joint position statement from the American Society of Nuclear Cardiology and the Society of Nuclear Medicine. J Nucl Cardiol 2002;9: 135-43.
4. Varetto T, Cantalupi D, Altieri A, Orlandi C. Emergency room technetium-99m sestamibi imaging to rule out acute myocardial ischemic events in patients with nondiagnostic electrocardiograms. J Am Coll Cardiol 1993;22:1804-8.
5. Hilton TC, Thompson RC, Williams HJ, Saylors R, Fulmer H, Stowers SA. Technetium-99m sestamibi myocardial perfusion imaging in the emergency room evaluation of chest pain. J Am Coll Cardiol 1994;23:1016-22.
6. Tatum JL, Jesse RL, Kontos MC, Nicholson CS, Schmidt KL, Roberts CS, et al. Comprehensive strategy for the evaluation and triage of the chest pain patient. Ann Emerg Med 1997;29: 116-23.
7. Kontos MC, Jesse RL, Schmidt KL, Ornato JP, Tatum JL. Value of acute rest sestamibi perfusion imaging for evaluation of patients admitted to the emergency department with chest pain. J Am Coll Cardiol 1997;30:976-82.
8. Heller GV, Stowers SA, Hendel RC, Herman SD, Daher E, Ahlberg AW, et al. Clinical value of acute rest technetium-99m tetrofosmin tomographic myocardial perfusion imaging in patients with acute chest pain and nondiagnostic electrocardiograms. J Am Coll Cardiol 1998;31:1011-7.
9. Kontos MC, Arrowood JA, Jesse RL, Ornato JP, Paulsen WH, Tatum JL, et al. Comparison of echocardiography and myocardial perfusion imaging for diagnosing emergency department patients with chest pain. Am Heart J 1998;136: 724-33.
10. Kontos MC, Jesse RL, Anderson FP, Schmidt KL, Ornato JP, Tatum JL. Comparison of myocardial perfusion imaging and cardiac troponin I in patients admitted to the emergency department with chest pain. Circulation 1999;99:2073-8.
11. Bilodeau L, Theroux P, Gregoire J, Gagnon D, Arsenault A. Technetium-99m sestamibi tomography in patients with spontaneous chest pain. correlations with clinical, electrocardiographic and angiographic findings. J Am Coll Cardiol 1991;18:1684-91.
12. Stowers SA, Eisenstein EL, Th Wackers FJ, Berman DS, Blackshear JL, Jones AD Jr, et al. An economic analysis of an aggressive diagnostic strategy with single photon emission computed tomography myocardial perfusion imaging and early exercise stress testing in emergency department patients who present with chest pain but nondiagnostic electrocardiograms. results from a randomized trial. Ann Emerg Med 2000;35:17-25.
13. Udelson JE. The ERASE Chest Pain Trial. Presented at "Special Session: Clinical Trials" at the 72nd Scientific Sessions of the American Heart Association, Atlanta, Ga, November 10, 1999.
14. Wackers FJ, Lie KI, Liem KL, Sokole EB, Samson G, van der Schoot JB, et al. Thallium-201 scintigraphy in unstable angina pectoris. Circulation 1978;57:738-42.
15. Duca MD, Giri S, Wu AH, Morris RS, Cyr GM, Ahlberg A, et al. Comparison of acute rest myocardial perfusion imaging and serum markers of myocardial injury in patients with chest pain syndromes. J Nucl Cardiol 1999;6:570-6.
16. Farkouh ME, Smars PA, Reeder GS, Zinsmeister AR, Evans RW, Meloy TD, et al. A clinical trial of a chest-pain observation unit for patients with unstable angina. Chest Pain Evaluation in

the Emergency Room (CHEER) Investigators. N Engl J Med 1998;339:1882-8.
17. Abbott BG, Abdel-Aziz I, Nagula S, Monico EP, Schriver JA, Wackers FJT. Selective use of single-photon emission computed tomography (SPECT) myocardial perfusion imaging in a chest pain center. Am J Cardiol 2001;87:1351-5.
18. Gibbons RJ, Chatterjee K, Daley J, Douglas JS, Fihn SD, Gardin JM, et al. ACC/AHA/ACP-ASIM guidelines for the management of patients with chronic stable angina. a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Patients With Chronic Stable Angina). J Am Coll Cardiol 1999;33:2092-197.