Long-Term Risk Assessment After the Performance of Stress Myocardial Perfusion Imaging

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KEYWORDS

• Myocardial perfusion imaging • Myocardial ischemia • Coronary artery disease • SPECT

KEY POINTS

- Stress-rest myocardial perfusion imaging (MPI) is a potent method for assessing the presence and magnitude of inducible myocardial ischemia.
- Stress MPI currently faces increased scrutiny for its therapeutic effectiveness because of the emergence of other competing means for assessing clinical risk.
- Changing patterns of coronary artery disease (CAD) presentation are reshaping the optimal utility of MPI.
- New data have examined the usefulness of stress-rest-MPI as a predictor for long-term clinical outcomes, in contrast to its traditional role for assessing short-term cardiovascular risk.
- These data indicates that temporal risk is highly influenced by both the magnitude of ischemia and various baseline clinical factors.
- An optimized assessment of stress MPI, which includes long-term risk prediction, might improve the potential future clinical effectiveness of this imaging modality.

Stress-rest MPI is a strongly proved method for assessing the presence and magnitude of inducible myocardial ischemia. The technique is inherently quantitative and reproducible and has been shown to predict adverse outcomes in a wide variety of clinical settings. Nevertheless, stress MPI currently faces increased scrutiny for its therapeutic effectiveness because of the emergence of other competing means for assessing clinical risk. This article evaluates the historical evidence that first established the clinical utility of stress-rest MPI and then reviews changing patterns of CAD presentation that are reshaping the optimal utility of MPI. New data are then reviewed that have examined the usefulness of SPECT-MPI as a predictor for long-term clinical outcomes, in contrast to its traditional role for assessing short-term cardiovascular risk. Finally, how an optimized assessment of stress MPI to include long-term risk prediction might improve the potential future clinical effectiveness of this imaging modality is reviewed.

INITIAL VALIDATION STUDIES AND CLINICAL USES OF STRESS-REST MYOCARDIAL PERFUSION IMAGING

In the 1960s, a standardized protocol was widely adopted for the performance of graded treadmill exercise ECG, based on the work of Robert Bruce

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and colleagues.[1] The same decade saw the advent of cardiac catheterization and coronary artery bypass surgery, and subsequent research demonstrated that the results of exercise ECG, such as exercise capacity and the ST segment response to exercise, could help identify which cardiac patients were at high risk and thus, presumably, most likely to benefit from bypass surgery. In the mid- to late 1970s, MPI, initially performed with planar imaging and subsequently using SPECT, was introduced into medicine. This test had a rapid and wide adoption across medical centers due to various innate characteristics of the test.

First, early research demonstrated that stress MPI had inherently greater sensitivity and specificity for the detection of angiographically significant CAD compared with exercise ECG. Subsequent work demonstrated that stress MPI provided incremental prognostic information when first assessing risk according to more readily available clinical information, such as CAD risk factors and the results of exercise ECG.[2–4] Moreover, whereas exercise ECG is an imprecise measure of the magnitude of inducible myocardial ischemia, stress MPI can precisely quantify the magnitude of ischemia according to its regional extent (eg, the number and location of reversible myocardial perfusion defects) and the severity of perfusion defects. In important early work, Ladenheim and colleagues[5] demonstrated the presence of an exponential relationship between the magnitude of ischemia as assessed by MPI and the likelihood of adverse cardiac events. The extent and severity of myocardial perfusion defects were found to provide independent and thus incremental information to each other for the prediction of cardiac events, as illustrated in Fig. 1. Thus, there was quick recognition that the results of stress

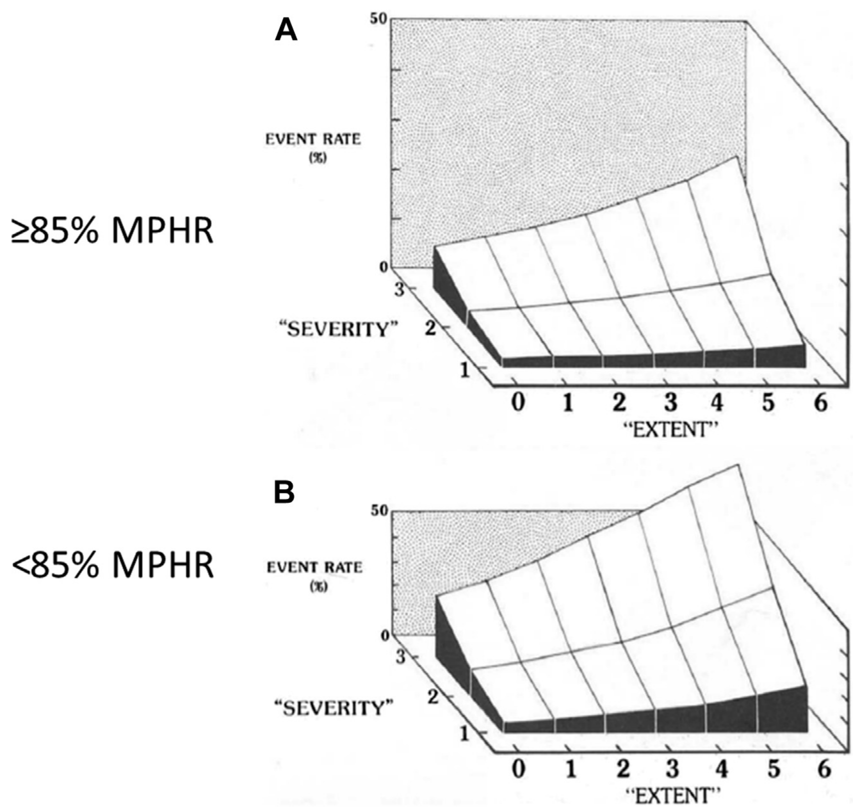

Fig. 1. Orthogonal axes show the number of perfusion defects, ranging from 1 to 6 regions; the severity of perfusion defects, ranging from none (score = 0) to severe (score = 3); and the frequency of cardiac events. (*A*) The graph is for patients achieving greater than or equal to 85% of maximal predicted heart rate and (*B*) the graph is for patients failing to achieve 85% of maximal predicted heart rate. In both cases, the event rate increased as a curvilinear function of the extent and severity of myocardial hypoperfusion. There was an at least 3-fold increase in cardiac events for the patients who could not achieve greater than or equal to 85% of maximal predicted heart rate. (*From* Ladenheim ML, Pollock BH, Rozanski A, et al. Extent and severity of myocardial hypoperfusion as predictors of prognosis in patients with suspected coronary artery disease. J Am Coll Cardiol 1986;7:469; with permission.)