

Cardiac Stress Testing

Indications and Test Selection

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More than 13 million Americans have coronary artery disease (CAD). Although 6 million patients present annually with classic angina, more complain of atypical chest pain.¹ For even experienced nurse practitioners, the diagnosis and treatment of CAD can be challenging. Cardiac stress testing is a useful tool to determine the presence and, to some degree, the extent of CAD. Health care providers may only think of standard exercise electrocardiography (exercise treadmill testing, or ETT), when in fact several stress modalities and data forms are available. Matching a patient's medical history, physical and exercise capacities (when known), and baseline resting electrocardiogram (ECG) with the appropriate study will allow for the safest and most cost-effective test selection.

INDICATION

Cardiac stress testing is most commonly used to determine whether myocardial ischemia is the cause of

ABSTRACT

Coronary artery disease (CAD) is the leading cause of death in this country. Appropriate evaluation of chest pain or its equivalent is essential to diagnosis and management of CAD. However, many nurse practitioners have limited knowledge about cardiac stress testing. This article reviews the types of tests available, the information obtained from each, and how to choose the most appropriate test for each patient.

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chest pain (or suspected equivalent symptoms) in patients at risk for CAD.² Several additional applications, however, are available: evaluation of new or worsening symptoms in patients with known CAD, preoperative risk stratification before noncardiac surgery, assessment for residual ischemia after myocardial infarction, diagnosis of suspected exercise-induced arrhythmias, and determination of functional capacity during evaluation of patients with heart failure being considered for transplantation.³

Patients with chest pain who are evaluated in emergency room settings and identified, using standard algorithms, as low risk for short-term cardiac events are excellent candidates for outpatient stress testing in lieu of hospital admission.⁴ Testing is best used in patients with an intermediate risk of CAD (when discrimination is maximal, 20%–80% pretest probability), rather than patients with low risk (because of a high incidence of false-positive results) or high risk (because of frequent false-negative results).⁵ Stress testing is generally not indicated as a screening test in asymptomatic patients, although it has been made a class IIb recommendation (possibly useful) in men older than 40 years and women older than 50 years who have multiple atherosclerotic risk factors. It may also be appropriate for sedentary patients planning to start vigorous exercise programs and for patients employed at occupations responsible for public safety such as airplane pilots, first responders, and truck drivers.³

TEST SELECTION

Exercise Treadmill Test

Treadmill ECG is a valuable procedure for CAD evaluation, with a mean overall sensitivity and specificity in diagnosing obstructive disease of 67% and 72%, respectively.² The risk of associated myocardial infarction or death is less than 1 in 2500,³ and additional risks include arrhythmias, falling, or injury on the treadmill. It usually can be completed in less than 30 minutes, and results are immediately available. Blood pressure and a 12-lead ECG are recorded at regular intervals, and heart rhythm is monitored continuously while the patient walks on a medical treadmill. The standard Bruce protocol is the most commonly used procedure and increases the treadmill speed and incline every 3 minutes. Other protocols, such as the modified Bruce and Naughton, use lower and more gradual

increases in speed and can be used for patients with certain physical limitations.⁶ Criteria for test termination include attainment of at least the target heart rate (THR), which is 85% of maximal predicted heart rate for age [$0.85 \times (220 - \text{age})$]; development of clearly positive ECG findings (horizontal or downsloping ST segment depression >1 mm); hypotension or marked hypertension; serious tachyarrhythmias or bradyarrhythmias; or the perception that the patient is unable to continue the exercise for any reason (fatigue, dyspnea, claudication, back pain). Usually, patients must be able to walk briskly up hill in a comfortable and coordinated manner on a treadmill to successfully complete a maximal ETT.⁷ If a patient is unable to reach THR, the test is considered submaximal and nondiagnostic unless the ECG is clearly positive at the heart rate achieved; an alternative stress modality is usually required for definitive diagnosis in these cases (see below).

Because interpretation of the results of ETT are almost entirely based on ST and T wave changes, patients should have a normal resting ECG to maximize the accuracy of the study. Left bundle-branch block (LBBB), left ventricular hypertrophy with repolarization changes, and significant ST segment deviations at rest decrease test specificity and generally require stress imaging (see below). Certain medications can limit the accuracy of the stress ECG in diagnosis of CAD. Digoxin can produce ST segment depression in patients free of CAD. Nitrates and other antianginal medications can reduce the sensitivity in diagnosing obstructive CAD by exercise testing. β -Blockers, some calcium channel antagonists (verapamil, diltiazem), clonidine,⁸ and parasympathomimetic drugs (drugs that stimulate or mimic the parasympathetic nervous system) can blunt heart rate response to exercise, leaving patients unable to attain THR. β -Blockers should be held for 24 to 48 hours before the test unless the goal of stress testing is to assess the efficacy of an antianginal regimen in patients with established CAD³ or to assess rhythm or rate control in patients with chronic arrhythmias, but this decision should always be individualized according to patient condition. Although not indicated in these conditions, other medical states which can induce myocardial ischemia in the absence of obstructive CAD (aortic stenosis, hypertrophic cardiomyopathy,⁹ uncontrolled hypertension) may yield “false-positive” results (ie,

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