Exercise Stress Test

OVERVIEW

The purpose of this document is to specifically identify the critical components involved in performing an exercise stress test. This information serves as a standard for all nuclear cardiology laboratories.
This document will cover **indications, contraindications, limitations, testing procedure, and indications for early termination of exercise.**

EXERCISE STRESS TEST

Exercise is the preferred stress modality in patients who are able to achieve at least 85% of age-adjusted maximal predicted heart rate (MPHR) and five metabolic equivalents.

Exercise stress testing is a powerful risk stratification tool and is useful in assessing the efficacy of anti-ischemic drug therapy and/or coronary revascularization.

The treadmill is the most widely used stress modality. The most commonly employed treadmill stress protocols are the Bruce and modified Bruce. Upright bicycle exercise is preferable if dynamic first-pass imaging is planned during exercise.
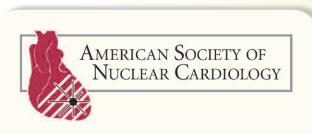
INDICATIONS

Indications for an exercise stress test are:
1) Detection of coronary artery disease (CAD) in patients with an intermediate pretest probability of CAD based on age, gender, and symptoms, or in patients with high-risk factors for CAD (i.e. diabetes mellitus, peripheral or cerebrovascular disease).
2) Risk stratification of post-myocardial infarction patients:
     a. Before discharge: submaximal test (often defined as 70% of the age-adjusted MPHR at 4-6 days.
      If test results are negative, then later after discharge: symptom-limited at 3-6 weeks.
      b. Soon after discharge: symptom-limited at 14-21 days.
3) Risk stratification of patients with chronic stable CAD into a low-risk category that can be managed medically or a high-risk category that should be considered for coronary revascularization.
4) Risk stratification of low-risk acute coronary syndrome patients (without active ischemia and/or heart failure) 6-12 hours after presentation or intermediate-risk acute coronary syndrome patients 1 to 3 days after presentation.
5) Risk stratification before noncardiac surgery in patients with known CAD, diabetes mellitus, peripheral or cerebrovascular disease.
6) To evaluate the efficacy of therapeutic interventions (anti-ischemic drug therapy or coronary revascularization) and in tracking subsequent risk based on serial changes in myocardial perfusion in patients with known CAD.

CONTRAINDICATIONS

Contraindications are considered absolute or relative. Absolute contraindications include:
1) High-risk unstable angina. However, patients with chest pain syndromes at presentation, who are otherwise stable and pain free, can undergo exercise stress testing.
2) Decompensated or inadequately controlled congestive heart failure
3) Uncontrolled hypertension (blood pressure > 200/110 mm Hg)
4) Uncontrolled cardiac arrhythmias (causing symptoms or hemodynamic compromise)
5) Severe symptomatic aortic stenosis
6) Acute pulmonary embolism
7) Acute myocarditis or pericarditis
8) Acute aortic dissection
9) Severe pulmonary hypertension

Exercise Stress Test *continued*

10) Acute myocardial infarction (less than 4 days)
11) Acutely ill for any reason

Relative contraindications for exercise stress testing include:
1) Known left main coronary artery stenosis
2) Moderate aortic stenosis
3) Hypertrophic obstructive cardiomyopathy or other forms of outflow tract obstruction
4) Significant tachyarrhythmias or bradyarrhythmias
5) High-degree atrioventricular block
6) Electrolyte abnormalities
7) Mental or physical impairment leading to inability to exercise adequately

LIMITATIONS

Exercise stress testing has a lower diagnostic value in patients who cannot achieve an adequate heart rate and blood pressure response.

Note: *If combined with imaging, patients with complete left bundle branch block (LBBB), permanent pacemakers, and ventricular pre-excitation (Wolff-Parkinson-White syndrome) should preferentially undergo a pharmacologic vasodilator stress (not a dobutamine stress test).*

TESTING PROCEDURE

Patients may not eat 2 hours before the test. Patients scheduled for later in the morning may have a light breakfast.

Exercise stress tests require:
1) Properly trained nurses, nurse practitioners, physician assistants, and medical technicians to administer tests and an appropriately trained supervising physician immediately available
2) Records of the heart rate, a 12-lead ECG, and blood pressure at each stage of exercise. Records should also be taken with the appearance of any clinical symptoms. All measurements are repeated during recovery, typically every 3 minutes for at least 5 minutes after cessation of exercise.
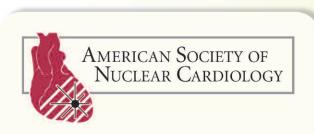3) Continuous electrocardiographic monitoring during the test and in the recovery period. Monitoring is continued for at least 5 minutes into the recovery period or until the resting heart rate is less than 100 beats per minute or dynamic ST segment changes have resolved.
4) A large bore (18 to 20 gauge) intravenous cannula for radiopharmaceutical injection
5) Radiopharmaceutical injection as close to peak exercise as possible
6) Exercise for at least 1 minute after radiopharmaceutical injection

INDICATIONS FOR EARLY TERMINATION OF EXERCISE

All exercise tests should be symptom-limited. Achievement of 85% of age-adjusted MPHR is not an indication for termination of the test.

In patients who cannot exercise adequately (eg., achieve 85% of age-adjusted MPHR prior to radiopharmaceutical administration and for at least 1 minute following radiotracer administration; achieve 5 METS or 5 minutes total exercise time on a Bruce protocol), the radiotracer should not be injected at peak exercise and a pharmacologic stress test should be considered. Blood pressure medications with antianginal properties will lower the diagnostic accuracy of a stress test. However, testing patients with CAD on their anti-ischemic regimens may be useful in monitoring their response to therapy. Indications for early termination of exercise include:
1) Moderate to severe angina pectoris
2) Marked dyspnea or fatigue
3) Ataxia, dizziness, or near-syncope
4) Signs of poor perfusion (cyanosis and pallor)
5) Patient's request to terminate the test
6) Excessive ST-segment depression (> 2mm)
7) ST elevation (> 1mm) in leads without diagnostic Q waves (except for leads V_1 or aVR)
8) Sustained supraventricular or ventricular tachycardia
9) Development of LBBB or intraventricular conduction delay that cannot be distinguished from ventricular tachycardia
10) Drop in systolic blood pressure of greater than 10mm Hg from baseline, despite an increase in workload,

when accompanied by other evidence of ischemia

11) Hypertensive response (systolic blood pressure > 250mm Hg and/or diastolic pressure > 115 mm Hg)

12) Technical difficulties in monitoring the ECG or systolic blood pressure

SUGGESTED READING

Henzlova MJ et al. ASNC Imaging Guidelines for Nuclear Cardiology Procedures: Stress protocols and tracers. J Nucl Cardiol 2009; doi: 10.1007/s12350-009-9061-5.

Gibbons RJ, et al. ACC/AHA 2002 guideline update for exercise testing: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guideines (Exercise Testing) 2002. Available at: www.acc.org/clinical/guidelines/exercise/dirIndex.htm.