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# ASNC STRESS TESTING **PRACTICE POINTS**

# Exercise Stress Testing

## OVERVIEW

The purpose of this document is to provide a guide to the performance of exercise stress testing. The critical components involved in performing exercise stress testing will be specifically outlined and will serve as a standard guideline for nuclear cardiology laboratories. It will cover the indications, contraindications, limitations, testing procedure and indications for early termination of exercise.

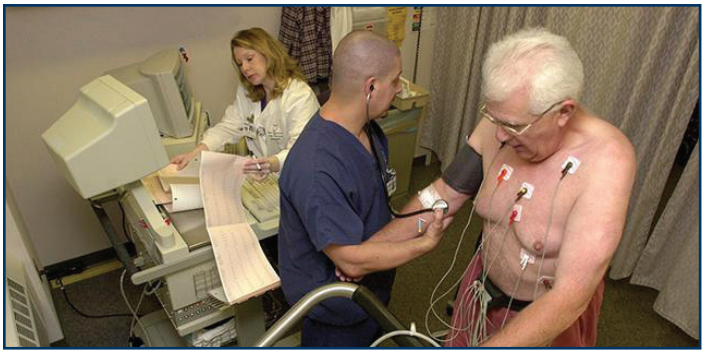
## EXERCISE STRESS TEST

Exercise testing has been used for more than 60 years for diagnostic purposes in symptomatic patients and for prognosis and risk stratification in patients with known coronary artery disease (CAD) including those with a history of myocardial infarction or documented CAD and in these with a high-risk for the presence of CAD (diabetes mellitus, peripheral, or cerebral vascular disease).

In patients who are able to achieve at least 85% maximum predicted heart rate (MPHR) and achieve at least 5 metabolic equivalents (METs), exercise is the preferred stress modality.

The treadmill is the most widely used stress modality, with the most commonly used treadmill stress protocol being the Bruce and modified Bruce protocol. Upright bicycle exercise is preferred if dynamic first pass imaging is planned during exercise.

Detailed recommendations including testing environment, equipment, emergency preparation and protocols, patient preparation, test performance, and personnel qualifications have been developed by the American Heart Association.



## INDICATIONS

Indications for stress testing includes the following:

- 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 such as diabetes mellitus, peripheral or cerebrovascular disease.
- Risk stratification of patients post myocardial infarction (MI).
  - Before discharge submaximal test (70% of age predicted MPHR) at 4 to 6 days post AMI. If results are negative for ischemia then a symptom limited exercise stress test may be done later after discharge at 3-6 weeks.
  - Soon after discharge a symptom limited exercise stress test may be performed at 14-21 days post MI.
- Risk stratification of patients with chronic stable CAD into a low risk category that can be managed medically or high risk category that should be considered for coronary revascularization.
- Risk stratification of low risk acute coronary syndrome patient (without active ischemia and/or heart failure) 6-12 hours after presentation or intermediate risk acute coronary syndrome patients 1-3 days after presentation.
- Risk stratification before noncardiac surgery in patients with known CAD, diabetes mellitus, peripheral or cerebrovascular disease.
- 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 patient with known CAD.

ASNC thanks the following members for their contributions to this document:

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### CONTRAINDICATIONS

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| High-risk unstable angina. However, patients with chest pain syndromes at presentation who are otherwise stable and pain free can undergo exercise stress testing |
| Decompensated or inadequately controlled congestive heart failure |
| Systolic BP at rest >200 or diastolic BP at rest >110 mmHg |
| Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise |
| Severe symptomatic aortic stenosis |
| Acute pulmonary embolism |
| Acute myocarditis or pericarditis |
| Acute aortic dissection |
| Severe pulmonary hypertension |
| Acute myocardial infarction (less than 2 to 4 days), if clinically stable |
| Acutely ill for any reason |

### RELATIVE CONTRAINDICATIONS

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| Known significant left main coronary artery stenosis |
| Asymptomatic severe aortic stenosis |
| Hypertrophic obstructive cardiomyopathy or other forms of severe left ventricular outflow tract obstruction |
| Significant tachyarrhythmia or bradyarrhythmia. |
| High-degree atrioventricular (AV) block |
| Electrolyte abnormalities |
| Mental or physical impairment leading to inability to exercise adequately |

### LIMITATIONS

In patients who are unable to achieve an adequate heart rate (HR) and blood pressure (BP) response, exercise stress testing has a lower diagnostic value.

If exercise stress testing is being combined with imaging, patients with complete left bundle branch block (LBBB), permanent pacemakers and ventricular pre-excitation (Wolff-Parkinson- White (WPW)) syndrome should preferentially undergo a vasodilator pharmacological stress test. Dobutamine should be avoided.

### PROCEDURE

- Patients should not eat for 3 hours before the test. Patients who are scheduled later in the morning may have a light breakfast. Caffeine should be avoided for at least 12 hours. BP medications with antianginal properties will lower the diagnostic utility of the stress test.
- An intravenous cannula (> 24-gauge is preferred) should be inserted for injection of the radiopharmaceutical.
- The electrocardiogram (ECG) should be monitored continuously during the exercise test and for at least 4 minutes into the recovery phase. A 12-lead ECG should be obtained at every stage of exercise, at peak exercise, and at the termination of recovery phase.
- HR and BP should be recorded at least every 3 minutes during exercise, at peak exercise and at least 4 minutes into the recovery phase.
- The end point of all exercise tests should be symptoms (moderate to severe chest pain, excessive shortness of breath, fatigue). Achievement of 85% of maximum, age-adjusted, predicted HR is not an indication for termination of the test.
- The radiopharmaceutical tracer should be injected as close as possible to peak exercise and patients should continue to exercise for at least 1 minute following injection.

Patients referred for a diagnostic stress test may be converted to a pharmacologic stress test or a combination of both if they cannot exercise adequately for a meaningful period of time.

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### INDICATIONS FOR EARLY TERMINATION OF EXERCISE

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| Moderate or severe angina pectoris |
| Marked dyspnea or fatigue |
| Ataxia, dizziness or near-syncope |
| Signs of poor perfusion such as cyanosis or pallor |
| Patient's request to terminate exercise |
| Excessive (>2mm from baseline) ST-segment depression |
| ST elevation (>1 mm) in leads without diagnostic Q waves, except for leads V1 and aVR |
| Sustained supraventricular or ventricular tachycardia |
| Development of left bundle branch block (LBBB) or intraventricular conduction delay that cannot be distinguished from ventricular tachycardia |
| Decrease in systolic BP >10 mmHg from baseline despite an increase in exercise workload when accompanied by other evidence of ischemia |
| Hypertensive response to exercise (systolic BP >250 mmHg and /or diastolic pressure >115 mmHg) |
| Technical difficulties in monitoring the ECG or systolic BP |
| In patients with implantable cardioverter defibrillators, when the HR attained is within 20 bpm of the lowest HR at which therapy is programmed to be delivered |

### SUGGESTED READING


Henzlova MJ, et al. ASNC imaging guidelines for SPECT nuclear cardiology procedures: Stress, protocols and tracers. J. Nucl Cardiol. 2016;23:606-639.

Myers J, et al. Recommendations for clinical exercise laboratories: A scientific statement from the American Heart Association. Circulation. 2009;119:3144-61.

Fletcher GF, et al. Exercise standards for testing and training: A scientific statement from the American Heart Association. Circulation. 2013;128:873-934.

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 Guidelines (Exercise Testing) 2002. Available at: *www.acc.org/clinical/guidelines/exercise/dirIndex.htm.*



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