

Cardiac Stress Testing

Why do we stress test?

- To evaluate patients symptoms
- To monitor patency of vessels in patients that have had coronary revascularization procedures
- To evaluate a patient who may be at risk for developing CAD
- Medical clearance for fitness memberships
- Insurance policies/job related screenings
- To evaluate arrhythmias
- To monitor progress of exercise intervention

What do we look for in a test?

- Blood pressure response
- Heart rate response
- EKG changes
- Patient symptoms

Contraindications to exercise testing

- Absolute
- Relative

Indications for terminating an exercise test

- Absolute
- Relative

Different Types of CV Tests

- Graded exercise test (GXT)
- Myocardial Perfusion Imaging
- Ultrasound Imaging
- PET Scans
- MUGAs
- Radionuclide angiograms

Diagnostic Accuracy

- Evaluating a test's accuracy requires confirmation with a gold standard, for CAD the standard is coronary angiography
- Sensitivity refers to the percent of positive results in patients with disease
- Specificity refers to the percent of negative results in patients without disease

Diagnostic Accuracy con't.

- True positive test: the test is abnormal and the patient has CAD
- True negative test: the test is normal and the patient does not have CAD
- False positive test: the test is abnormal, but the patient does not have CAD
- False negative test: the test is normal, but the patient does have CAD

Graded Exercise Test (GXT)

- Continuous monitoring of 12-lead EKG, hemodynamic response and symptoms during the test (treadmill or bike).
- Generally, used for patients who have normal resting EKG, low risk, atypical symptoms, or arrhythmias.
- 68% sensitivity and 77% specificity

Myocardial Perfusion Imaging with Single Photon Emission Computed Tomography (SPECT)

- Nuclear tracer injected at rest and stress to assess for any blockages and/or heart muscle damage
- SPECT imaging allows us to see tracer uptake in the heart muscle (or lack of)
- Nuclear tracers include Cardiolite, thallium and Myoview
- Performed on patients with a higher risk or higher probability of CAD, abnormal resting EKG, abnormal GXT, or previously diagnosed CAD

Myocardial Perfusion Imaging con't

- Used in patients with typical symptoms
- Used for patients who cannot use treadmill or bike due to orthopedic limitations, severe deconditioning, or previous failure to achieve 85% of APMHR on an exercise test
- Used to rule out false negative and false positive GXTs
- Increased sensitivity of 90%, specificity of 93%

Myocardial Perfusion Imaging con't

- Defines the presence and extent of myocardial ischemia or infarction and differentiates between them
- Determines the location of lesions
- Assesses myocardial viability
- Establishes diagnosis and prognosis of CAD
- Evaluates results of therapeutic interventions
- Assesses patency of coronary artery bypass grafts

Myocardial Perfusion Imaging con't

- During peak exercise nuclear tracer is injected one minute prior to treadmill slowing down to give it time to circulate to the heart tissue
- Drug study protocols all vary depending on what drug is used
 - Adenosine
 - Persantine
 - Dobutamine

Results of Myocardial Perfusion Imaging

- A myocardial perfusion defect seen at exercise, but not at rest is typical of ischemia, but a viable myocardium (referred to as “filling in” defect)
- A defect seen at exercise and at rest is characteristic of non-viable tissue or scar tissue (infarction)
- MPI has become the standard non-invasive procedure to assess the functional importance of coronary stenosis

What if patients can't exercise?

Pharmacological Stress Test

- In order to detect clinically important CAD vasodilation must be induced and coronary flow reserve assessed. Potent vasodilation stimuli include transient arterial occlusion, intense rhythmic exercise, and certain pharmacological agents.
- Pharmacological vasodilators include Adenosine, Persantine, and Dobutamine

Ultrasound/Echocardiogram

- Diagnostic test using sound waves to evaluate cardiac wall motion and valve function
- Commonly ordered for patients with heart murmurs, congestive heart failure, cardiomyopathy, endocarditis, myocarditis, pericarditis, or any valve problems
- Can be ordered as just a resting echo, but also is used to assess heart function with exercise or dobutamine

Stress Echos

- Looking for wall motion before exercise, immediately post exercise and in recovery
- Abnormal wall motion during exercise is indicative of ischemia
- Abnormal wall motion at rest is indicative of infarcted tissue (will be abnormal during stress as well)
- Can also be used to assess valve quality and function with and increased stress

Stress Echocardiography

- 84% sensitivity, 86% specificity
- Normal response is to increase contractility and wall motion
- Akinesis: Ventricular wall not moving as would be expected
- Dyskinesis: Left ventricle that expands rather than contracts
- Hypokinesis: Diminished or slow movement in ventricular wall

MUGAs/RNAs

- Multi-Gated Acquisition/Radionucleotide Angiograms
- Examines the function of the ventricles, primarily the left
- Detects CAD, evaluates unstable angina, monitors cardiotoxicity, prioritizes heart transplant patients, evaluates ventricular regional wall motion, quantifies ventricular ejection fraction
- 89% sensitivity, 89% specificity

PET Scans

- Positron Emission Tomography (PET) imaging
- A reported high sensitivity (92-95%) and a high specificity (95%) of disease detection
- Added value compared with SPECT for obese individuals and women with large breasts where SPECT is less effective
- Typically uses pharmacological stressors to obtain stress images
- Better at evaluating small vessel disease than SPECT imaging