**Cardiac Stress Tests**

**When do you need a cardiac stress test?**

* Detection of CAD in patients with risk factors and symptoms
* Recent ACS or acute chest pain that has resolved (do not perform if unstable symptoms until they have relief of symptoms) anytime in past 3 months
* Known CAD but change in functional status
* One time monitoring of patient with prior catheterization/CABG (typically 5 years out)- can monitor efficacy of the intervention
* Symptoms suggestive of angina (aka exertional chest pain)
* Workup for etiology of new CHF
* Workup for valvular heart disease
* Known LV dysfunction/CHD who may be candidates for revascularization
* Workup for certain arrhythmias (heart block, exercise induced arrhythmia)
* Pre-Op eval for patients with active cardiac conditions/risk factors (CAD, DM, CVD, PVD)

**Don’t Test:**

* If LOW probability for CHD, do NOT stress test patients with atypical or non-cardiac sounding pain.
* Similarly, do NOT test patients who are asymptomatic!
* If they have UNSTABLE symptoms→ you need NM study (see below)

**The test you pick depends on:**

* The patient's ability to exercise
* The resting ECG
* The clinical indication for performing the test
* The patient's body habitus
* History of prior revascularization

**In brief, if they can exercise- that’s always best!**

* How do you know? In general, if a person can walk for more than 5 minutes on flat ground or up one to two flights of stairs without needing to stop, they most likely can achieve an adequate workload during exercise stress testing.
  + Ask about knee and back pain, as well as balance and asthma! They can ‘modify’ the Bruce protocol by decreasing incline, but at some point they have to get to a higher HR - if you think they can’t do that- don’t order treadmill!
* If they can’t achieve 85% of their max heart rate- the test is not ‘complete’- in that case, you then have to order a NM study

**Contraindications to exercise treadmill testing:**

* Any ongoing badness: MI within past two days, acute PE, aortic dissection, acute myocarditis/pericarditis/endocarditis
* Unstable angina
* Uncontrolled cardiac arrhythmias causing symptoms/hemodynamic issues
* Severe aortic stenosis
* Uncontrolled symptomatic heart failure
* Acute medical issue that affects exercise (infection, thyrotoxicosis, renal failure)
* Inability to obtain consent
* Symptomatic SVT
* High grade AV block
* Severe HTN (SBP >200, DBP>110
* Severe mental illness, drug toxicity or electrolyte abnormality
* Extreme obesity (>350 lbs)

**EKG findings that could make treadmill not the best test:**

* LBBB
* V-paced rhythm
* V pre-excitation (WPW)
* > 1mm ST depression at rest
* T wave inversions at rest
* Digoxin use
* LVH
* Hypokalemia causing ST-T changes
* HOCM

\*Prior re-vascularization

\*If they have one of these things- you add imaging- meaning with echo or with NM perfusion imaging

**What are you looking for in the test:**

Patients will follow something called the Bruce Protocol, which increases the speed and inclination of the treadmill at certain intervals until the goal HR is achieved. The technician of the test can ‘modify’ this protocol as needed (avoid increasing the inclination if the patient has pain, wait longer to increase speed, etc)

* Duration of exercise. If they can go on treadmill for over 9 minutes, they have <5% risk! Duration is the most important indicator.
* Down sloping (bad). Upslope not a big deal
* Achieving 85% max HR (failure of HR to increase normally is a bad sign→ chronotropic incompetence predicts all cause cardiovascular death
* HR recovery afterwards → failure of HR to fall by 12 beats in first minute after exercise also predicts all cause mortality/cardiovascular death
* Ventricular ectopy in recovery period
* Hypotension during the test (not normal!)
* Severe Hypertension (SBP >200)
* How long before they have to terminate 2/2 fatigue
* Calculating their METs and capacity

If they do a treadmill and its negative → really good prognosis.

**Duke Treadmill Score** - A Prognostic score calculated from the treadmill test

* low risk - score > +5
* medium risk - score +4 to -10
* high risk - score < -10
* This score is sometimes inaccurate!
* The Duke calculation:  
  *Exercise time - (5 x max ST deviation in mm) - (4 x exercise angina score)*
  + The exercise time is the minutes they did the Bruce protocol
  + The Angina score is 0 for no pain, 1 for non-limiting pain, 2 for exercise limiting pain

**What if they can’t exercise or have a contraindication to treadmill testing?**

Then you are looking at pharmacologic stress testing. They give a medication to stress the heart. This can sometimes be combined with some exercise. The two main tests used at our institution are the Stress Echo and the NM perfusion study (pThal)

**Stress Echo:** More specific, less sensitive

* Used to detect hemodynamically significant CHD, localize ischemia in known CHD, risk stratify, assess valvular disease, or assess myocardial viability
* Detect ischemia through the development of new regional wall motion abnormalities or worsening of pre-existing regional wall motion abnormalities.
* Also look for left ventricular cavity dilatation or a decline in global left ventricular systolic function with stress
* Can be limited if pt has resting regional wall motion abnormalities or severe systolic dysfunction
* Provides info on hemodynamics during stress (diastolic function, systolic pulmonary artery pressure response, etc)
* In general, use this if no wall motion abnormalities are present at rest

**Stress myocardial perfusion:** More sensitive, less specific

* Look at the myocardial blood flow or perfusion between the resting and stressed states.
* Areas with decreased myocardial perfusion during stress are considered to be indicative of ischemia
* Areas with already reduced perfusion, or a “matched reduction” in perfusion between the rest and stress images is suggestive of a myocardial infarction
* Helps you LOCALIZE ischemia
* Can tell you about cardiac size, function, LV volume, EF
* In general, use this if LBBB, V pacing, Afib, or significant resting wall motion abnormalities

**Contraindications to certain pharmacologic stress tests:**

**Vasodilator stress testing contraindications:**

* Bronchospastic airway disease
* Hypotension
* Shock
* Sick sinus syndrome
* High degree AV block
* If on dipyridamole → they can’t use adenosine or A2A receptor agonists

**Dobutamine stress testing contraindications:**

* Ventricular arrhythmia
* Recent MI (in past 3 days)
* Unstable angina
* LV outflow obstruction that is hemodynamically significant
* Aortic dissection
* Severe Systemic Hypertension

**What medications do I stop prior to testing?:**

That’s complicated and depends on the Cardiologists and why you are ordering the test

* If the test is being done to diagnose CHD, withhold medical therapy to optimize sensitivity/specificity.
  + This is often why we hold Beta Blockers for 48 hours prior.
  + Often also hold CCB and nitrates for 48 hours as well
  + If stress testing:
    - hold caffeine (12 hrs prior), dipyridamole (48 hrs prior), and aminophylline (24 hrs prior)
* If the test is done to evaluate the effectiveness of therapy in patients with known CHD, the cardiologists will often want you to continue their medications