1 in 3 American Adults Have Heart Disease

About half of us will have Heart Disease after 40 years of age (men > women)

The American Heart Association estimates that an MI (myocardial infarction) occurs every 44 seconds in the United States

15% of MI’s result in Death

**Cardiac Stress Testing: An Overview**

- Diagnose Coronary Artery Disease
- Guide Treatment of Heart Disease; Evaluate effectiveness
- Diagnose Heart Rhythm Problems (Arrhythmias)
- Functional Testing - anatomical stenosis does not reliably predict ischemia

**Types of Stress Testing**

- Imaging?
- Exercise vs Pharmacological

**Importance of Imaging Modalities**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise ECG, ETT</td>
<td>~61%</td>
<td>~73%</td>
</tr>
<tr>
<td>Exercise Echo</td>
<td>~77%</td>
<td>~83%</td>
</tr>
<tr>
<td>Exercise SPECT MPI</td>
<td>~85%</td>
<td>~79%</td>
</tr>
<tr>
<td>Coronary Angiography</td>
<td>~94%</td>
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</table>

**Exercise**

Exercise Capacity is one of the strongest predictors of ischemic heart disease; therefore exercise stress testing is preferable for assessing patients able to achieve a maximal workload.
Due to patient variability the ability to reach 85%(90%) during exercise may not be sufficient to produce an interpretable result and should be not used as test termination.

**Indications for ending exercise testing:**
- Systolic blood pressure drop
- Significant angina
- Near syncopy
- Sustained tachycardia
- ST elevation (>1mm) or ST Depression (>2mm)
- Extreme fatigue or shortness of breathe
- Increasing Chest Pain
- Hypertensive Response (blood pressure > 250/115)

**Exercise options:**
- Treadmill
- Recumbent Bike

**Alternatives to exercise stress testing: Pharmacological intervention:**
- Other Limiting Health Issues
- Mobility issues
- Deconditioning
- Abnormal Heart Rhythms - LBBB

**Common pharmacological stress agents:**
- Lexiscan (Regadenoson)
- Adenosine
- Dobutamine

**Exercise stress test alternatives:**
- Exercise Stress Test
- Exercise Stress Echo
- Exercise Myocardial Perfusion Imaging
- Dobutamine Echo
- Lexiscan Myocardial Perfusion Imaging
**Exercise Stress Test**
- Bruce Protocol (3 minutes steeper and faster)
- Most stress test under 10 minutes
- The hill will get you not the speed!
- Heart Rate, ECG, and Blood Pressure monitored during each stage.
- Low Cost (if no additional testing)
- Accessible
- Lowest Sensitivity (missing 4/10)
- No further evaluation with an Abnormal Baseline ECG

**Stress Echocardiography**
- Patients imaged at rest and after max exercise.
- Uses Ultrasound beams reflected by Cardiovascular Structures to visualize anatomical features
- IV contrast agents becoming common
- Difinity and Optison
- Several areas of Assessment
  - Ventricular function
  - Chamber size
  - Wall thickening
  - Aortic root and valves

**Dobutamine Stress Echo**
- Patients imaged at rest and during dobutamine infusion.
- Dobutamine infusion 10mcg/kg/min increasing every 3 minutes until max dose of 40 mcg/kg/min attempting to reach THR
- Atropine Kicker
- IV contrast agents becoming common
- Several areas of Assessment
  - Ventricular function
  - Chamber size
  - Wall thickening
  - Aortic root and valves

**Echo Opportunities and Challenges**
- No radiation Exposure
- Not used for patients with LBBB (Septal Abnormality)
- Technique and Sonographer dependent
- Evaluate changes in LV function caused by demand ischemia
- A normal stress echo = very low risk of cardiac related death
- Transient ischemic dilation correlates with high likelihood of severe CAD
- Image difficulties when patients have emphysema, atypical chest structure, or obesity
- Probably more cost effective than MPI

**Myocardial Perfusion Imaging**
- Requires the use of radioisotopes (tracers)
- Patients injected for rest and for stress images. Generally requires both sets for complete evaluation.
- Isotope binds to cellular structures (Magic)
  - Sestamibi binds to cellular mitochondria
  - Only 2% free isotope after 2 minutes
- Thallium, Cardiolite, Sestamibi, Myoview
- Radiopharmaceutical - Gamma Emmitter not able to ionize tissue.
- Perfusion Defects can be defined and quantified
- LV function.
- Less technologist influence than Echo.
**Exercise Myocardial Perfusion Imaging**

- Uses Exercise Testing Protocols - Bruce
- Patient injected as they are exercising and patient should continue exercising for at least another minute.
- Highest predictable Sensitivity
- Probably the least cost effective
- Radiation exposure - lottery tickets

**Lexiscan**
- Resting imaging acquired as typical
- Lexiscan comes in a prefilled syringe; not weight based. One size fits all.
- Lexiscan is given over 10 seconds followed with saline flush for 10-15 seconds
- Stress Isotope is given 20 seconds after saline flush
- Lexiscan Bolus = more GI Symptoms
- Lexiscan, Adenosine compete with Caffeine for Receptor sites.
- Works with LBBB patients, no septal wall defects

**Variables Affecting Imaging Results**

- Cardiac Medications
  - Beta Blockers - Atenolol, Metoprolol, Coreg
  - New Diagnosis VS Medical Therapy Evaluation
- Caffeine
  - High levels can affect ECG
  - Competes with Lexiscan
- Eating Before Stress Testing
  - Affects isotope target to ratio
  - Shifts cardiac anatomy
  - Increased nausea during exercise
Modality | Benefits | Negative
--- | --- | ---
Stress ECG | Low cost and available. | Lowest sensitivity. May require add’l testing. No reasonable Pharmacological alternative.
REFERENCES

1. Fihn SD, Gardin JM, Abrams et al.  Guideline For The Diagnosis And Management Of Patients With Stable Ischemic Heart Disease.  Journal of the American College of Cardiology 2012