Exercise Stress Testing

Apical two-chamber view of a single rest image is compared with three post exercise images. With exercise, there was an increase in end systolic volume with akinesis of the apex in this patient with severe left anterior descending stenosis.

Vasodilator Stress Echocardiography

Vasodilator stress echocardiography with myocardial perfusion imaging. Perfusion and wall motion were normal at baseline. With stress, there was severe hypoperfusion (contrast defect) of the apex with accompanying akinesis of this region.

Dobutamine Stress Echocardiography

Parasternal long axis views show mild global hypokinesis at rest, augmentation of contractility with low dose dobutamine (viability), hypokinesis of the distal anteroseptum at pre-peak, and near global hypokinesis at peak. The patient had multivessel coronary artery disease.
Apical images before (left) and after (right) treadmill exercise. There were no regional wall motion abnormalities, but the end systolic volume did not decrease. This may occur with a hypertensive response.
Exercise Echocardiography Protocol

Symptom limited

Workload

Time (min)

BP

Echo

ECG

* Increase treadmill speed and grade or bicycle resistance

** Longer echo exam

*** Echo imaging completed in 1 min after exercise, then repeated

Images obtained at rest and immediately post exercise.

Reasons for Stopping Test

- Maximum exercise until fatigue or symptoms
- Significant arrhythmia
- Hypotension, severe hypertension
Dobutamine Echocardiography Protocol

Atropine .5 mg repeat .25 min

Doputamine dose (mcg/kg/min)
Time (min)
BP
Echo
ECG

* Atropine may be administered at an earlier stage

Images obtained at rest and at each stage of stress.

Reasons for Stopping Test
- Peak dose
- Target heart rate .85 (220-age)
- Moderate or extensive wall motion abnormalities
- Significant arrhythmia
- Hypotension, severe hypertension
- Intolerable symptoms
**Stress Echocardiography Report**

**Wall Motion: Rest**
Score index 1.06 (normal 1.00)
- Apical Cap
- Apex
- Mid-vent
- Base
- Ant.
- Lat.
- Inf.

**Wall Motion: Stress** (Worsening wall motion abnormality)
Score index 1.12

Legend and score values
- Normal
- Hypokinesis
- Aneurysm
- Not seen
- Akinesis
- Dyskinesia
- Scarred

**Summary**
- Exercise echo mildly positive for ischemia
- Good exercise capacity (8 minutes Bruce protocol, 102% functional aerobic capacity)
- Rest images: Normal left ventricular size, ejection fraction of 56%, inferior wall hypokinesis
- Exercise images: Decrease in end systolic size; inferior wall worsened
Response of Infarcted and Viable Myocardium to Dobutamine

Coronary Artery

<table>
<thead>
<tr>
<th>Occluded</th>
<th>Rest</th>
<th>Low Dose</th>
<th>High Dose</th>
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<tbody>
<tr>
<td></td>
<td>Infarction</td>
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<table>
<thead>
<tr>
<th>Occluded to open</th>
<th>Sustained improvement (Stunned)</th>
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<tr>
<th>Severe narrowing 80%</th>
<th>Biphasic response (Hibernating)</th>
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# Normal and Ischemic Responses for Stress Modalities

<table>
<thead>
<tr>
<th>Very Low Risk</th>
<th>Low Risk</th>
<th>Factors Increasing Risk</th>
<th>High Risk</th>
</tr>
</thead>
</table>
| *MI, Cardiac Events*  
*< 1% per yr* | *MI, Cardiac Death*  
*< 2% per yr* | *Increasing age*  
*Male gender*  
*Diabetes*  
*High pretest probability*  
*History of dyspnea or CHF*  
*History of myocardial infarction*  
*Limited exercise capacity*  
*Inability to exercise*  
*Stress ECG with ischemia*  
*Rest WMA*  
*Left ventricular hypertrophy*  
*Stress echo with ischemia*  
*Reduced baseline EF*  
*No change or increase ESV with stress*  
*No change or decrease EF with stress*  
*Increasing wall motion score with stress* | *Extensive Rest WMA*  
*(4 to 5 segments of LV)*  
*Baseline EF < 40%*  
*Extensive ischemia*  
*(4 to 5 segments of LV)*  
*Multivessel ischemia*  
*Rest WMA & remote ischemia*  
*Low ischemic threshold*  
*Ischemia with 0.56 mg/kg dipyridamole or 20 mcg/kg/min dobutamine or based on heart rate*  
*Ischemic WMA, no change or decrease in exercise EF* |

- Normal exercise echocardiogram with good exercise capacity
- 7 METs men
- 5 METs women

- Normal pharmacologic stress echocardiogram with adequate stress, defined as achievement of HR > 85% age-predicted maximum for dobutamine stress, and low to intermediate pretest probability of CAD
<table>
<thead>
<tr>
<th>Stress Method</th>
<th>Regional</th>
<th>Ischemic Response</th>
<th>Normal Response</th>
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</thead>
<tbody>
<tr>
<td>Treadmill</td>
<td>Peak exercise increase in function compared to rest</td>
<td>Increase in ESV compared to rest or LV main disease</td>
<td>Decrease in ESV and decrease in EF in multivessel disease</td>
</tr>
<tr>
<td>Supine Bicycle</td>
<td>Peak exercise increase in function compared to rest</td>
<td>Increase in ESV compared to rest or LV main disease</td>
<td>Decrease in ESV and decrease in EF in multivessel disease</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>Increase in function, velocity of contraction compared to low dose</td>
<td>Decrease in ESV, marked increase in EF</td>
<td>Occasionally, ischemia produces decreased EF, cavity dilatation occurs infrequently</td>
</tr>
<tr>
<td>Vasodilator</td>
<td>Increase in function compared to rest</td>
<td>Increase in ESV compared to rest or LV main disease</td>
<td>Decrease in ESV, decrease in EF</td>
</tr>
<tr>
<td>Atrial Pacing</td>
<td>No change in function compared to rest</td>
<td>No change in ESV compared to rest or LV main disease</td>
<td>No change in ESV, decrease in EF</td>
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