Stress Echocardiography: When is it the best test?  
RI-ACC Symposium

Athena Poppas, MD FACC  
Director, Echocardiography Laboratory  
Rhode Island Hospital  
Associate Professor of Medicine  
Brown Medical School

Disclosures: Philips research grant
Stress Echocardiography: Case History

45 year old women smoker with left-sided, sharp chest pain
PE: BP 152/88 HR 80
ECG: WNL LABS: LDL 170, HDL 38

What is the pretest probability of CAD?

a. 5%
b. 20%
c. 40%
d. 80%
Pretest Likelihood of CAD: Low versus high risk patients

<table>
<thead>
<tr>
<th>Age</th>
<th>Noncardiac CP</th>
<th>Atypical CP</th>
<th>Typical CP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>W</td>
<td>M</td>
</tr>
<tr>
<td>35</td>
<td>3-35</td>
<td>1-19</td>
<td>8-59</td>
</tr>
<tr>
<td>45</td>
<td>9-47</td>
<td>2-22</td>
<td>21-70</td>
</tr>
<tr>
<td>55</td>
<td>23-59</td>
<td>4-25</td>
<td>45-79</td>
</tr>
<tr>
<td>65</td>
<td>49-69</td>
<td>9-29</td>
<td>71-86</td>
</tr>
</tbody>
</table>

High risk = tob, lipids, HTN w/ nml ECG Duke Database
Stress Echocardiogram: Results

- Exercised 7:34 minutes on Bruce protocol
- Peak HR=158 BPM, peak BP=160/80
- Stress ECG: 2mm inferolateral, downsloping ST depression
- Symptoms: leg fatigue, typical chest pain
- Echo results:
Stress Echocardiogram
Cardiac Catheterization-images
After LAD stent implantation
Bayes’ Theorem: test intermediate risk

Patterson and Horowitz
When is echo the best test?

- **Detection of CAD**
  - Regional *and* global LV *and* RV function
  - Low EF: viability with dobutamine

- **Other etiologies of chest pain, dyspnea**
  - Pulmonary hypertension

- **Hemodynamics***
  - HCM: provovable gradients
  - Moderate to severe valvular disease
When is echo NOT the best test?

- Severe lung disease
  - Obesity limits any imaging
- Circumflex ischemia
  - Related to experience of reader
- Patient’s unable to cooperate
  - Frail and elderly limited in any imaging
Noninvasive Risk Stratification in Patients with Suspected Ischemic Chest Pain†

High risk – greater than 3 percent annual mortality rate
1. Severe resting left ventricular dysfunction (LVEF < 35 percent)
2. High-risk treadmill score (score ≤ -11)
3. Severe exercise left ventricular dysfunction (exercise LVEF < 35 percent)
4. Stress-induced large perfusion defect (particularly if anterior)
5. Stress-induced multiple perfusion defects of moderate size
6. Large, fixed perfusion defect with LV dilation or increased lung uptake (thallium-201)
7. Stress-induced moderate perfusion defect with LV dilation or increased lung uptake (thallium-201)
8. Echocardiographic wall motion abnormality (involving greater than two segments) developing at low dose of dobutamine (≤ 10 mg/kg/min) or at a low heart rate (< 120 beats/min)
9. Stress echocardiographic evidence of extensive ischemia

Intermediate risk – 1 percent to 3 percent annual mortality rate
1. Mild/moderate resting left ventricular dysfunction (LVEF = 35 percent to 49 percent)
2. Intermediate-risk treadmill score (-11 < score < 5)
3. Stress-induced moderate perfusion defect without LV dilation OR increased lung intake (thallium-201)
4. Limited stress echocardiographic ischemia with a wall motion abnormality only at higher doses of dobutamine involving less than or equal to two segments

Low risk – less than 1 percent annual mortality rate
1. Low-risk treadmill score (score ≥ 5)
2. Normal or small myocardial perfusion defect at rest or with stress*
3. Normal stress echocardiographic wall motion or no change of limited resting wall motion abnormalities during stress*

* Although the published data are limited, patients with these findings will probably not be at low risk in the presence of either a high-risk treadmill score or severe resting left ventricular dysfunction (LVEF < 35 percent).

## Stress Echocardiography

<table>
<thead>
<tr>
<th></th>
<th>N*</th>
<th>Sensitivity/Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>750</td>
<td>84-88%</td>
</tr>
<tr>
<td>SVDz</td>
<td></td>
<td>58-92%</td>
</tr>
<tr>
<td>MVDz</td>
<td></td>
<td>82-100%</td>
</tr>
<tr>
<td>LAD&gt;RCA&gt;L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cx</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dobutamine Stress Echocardiography Predictive of Prognosis

- 3,156 patients
  - 1,355 women
  - Age = 63 ± 12 yrs
  - F/U = 3.8 ± 1.9 yrs
- +DSE predictive of:
  A. Total mortality
  B. Cardiac mortality

Marwick JACC 2001;37:754
Exercise Stress Echocardiography Predictive of Prognosis

- 5798 patients (2,476 women), 3.2 ± 1.7 yrs
  - age 62 ± 12 years
- History of prior PTCA/CABG/MI
  - Men=56% Women=22%
- Positive tests: 35% men, 25% women
- MI/death: 5.3% men, 3.1% women
- MVA predictors of events:
  - Exercise WMSI and workload <6METS
Stress Echocardiography Compared with other modalities

- Meta-analysis comparing:
  - exercise SPECT (27 studies)
  - exercise echo (24 studies)

- Predominately male populations (69%)

- High prevalence of CAD (66-78%)

- Similar sensitivity
  - 85% vs 87%

- Stress echo had higher specificity
  - 77% vs 64%

Ischemia Cascade

## Stress Echocardiography

**Compared with other modalities**

<table>
<thead>
<tr>
<th>ECHO</th>
<th>NUCLEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac function</td>
<td>Relative perfusion</td>
</tr>
<tr>
<td>Real-time imaging</td>
<td>Quantitation of extent of perfusion abnormalities</td>
</tr>
<tr>
<td>Additional information</td>
<td>Literature on prognosis</td>
</tr>
<tr>
<td>Patient convenience</td>
<td>Fewer False Negatives: Preop high risk surgery</td>
</tr>
</tbody>
</table>

Fewer False Positives:
Younger, lower risk

Fewer False Negatives: