Stress echocardiography modalities, laboratory requirements, safety

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Learning goals

- Methods – selecting the appropriate stress
  - Exercise – supine bicycle
  - Dobutamine
  - Vasodilator-multiparametric stress

- Laboratory requirements
  - Staff
  - (equipment)
  - training

- Safety
Exercise stress echocardiography

Supine bicycle
Rest
25 Watts 3 min
50 Watts 3 min
75 Watts 3 min
100 Watts 3 min
Recovery

CA-Infusion or CA-Bolus

12 lead ECG RR every min

Echo recordings
4CV 2CV 3CV Sax
4CV 2CV 3CV Sax

Mazankowski Alberta Heart Institute
1. When attempting to see the display of the ergometer, many patients strain the abdominal muscles and narrow the spaces between the ribs by raising the head. A comfortable support pillow for the head results in a significant improvement in image quality. This way the head is not actively raised when looking at the display.

2. With this trick many patients can be scanned laying on their back or tilted 5° to the left if necessary. The left arm should grip the handle and be lifted above the head.
3. The transducer is placed almost horizontally to the floor and quite laterally.

4. The rest images are recorded while the patient pedal without resistance. The movement of the legs changes the position of the chest and results in a surprising improvement of the image quality.

*We owe this practical advice to Dr. S. Beckmann, Berlin*
Reaching the target heart rate is no reason for termination of exercise!

When exercise is stopped at the 85% of the maximum heart rate (target heart rate), the exercise capacity and extent of myocardial ischemia may be underestimated (Jain et al. 2011). Therefore the patients should continue pedalling after reaching 85% of maximum heart rate as long as they are not exhausted or other termination criteria apply.
When is exercise stress first choice?

| Special echo couch for supine bicycle testing available | Good mobility and motivation | High probability that the patient can reach target heart rate — 85% of maximum heart rate (220 - age) | Beta-blocker paused |
| No left bundle branch block or paced rhythm | Suboptimal native image quality (which precludes reliable assessment of myocardial perfusion) | Patient not suitable for adenosine stress | Contraindications to adenosine (asthma, conduction abnormalities) |
| | | | No expertise of the echocardiographer |
| | | | In CFR and myocardial perfusion |

With ultrasound contrast agents the LV wall motion can be reliably assessed in patients with poor acoustic windows; however, myocardial perfusion may be limited.
When exercise stress is not possible

<table>
<thead>
<tr>
<th>Consider vasodilator stress</th>
<th>Consider dobutamine stress</th>
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<tbody>
<tr>
<td><strong>Adenosine preferable</strong></td>
<td><strong>Good native image quality</strong></td>
</tr>
<tr>
<td>Possible with betablocker, LBBB and</td>
<td><strong>No contraindication to adenosine (asthma, conduction abnormalities)</strong></td>
</tr>
<tr>
<td>paced rhythm</td>
<td><strong>Expertise of the echocardiographer in CFR and myocardial perfusion</strong></td>
</tr>
<tr>
<td><strong>Ideally betablocker pause, but in</strong></td>
<td><strong>Suboptimal native image quality</strong></td>
</tr>
<tr>
<td>patients on beta-blockers the target</td>
<td><strong>Contraindication to adenosine</strong></td>
</tr>
<tr>
<td>heart rate often can be achieved</td>
<td><strong>No expertise in CFR, perfusion imaging</strong></td>
</tr>
<tr>
<td>after atropine injections</td>
<td><strong>No left bundle branch block or paced rhythm</strong></td>
</tr>
<tr>
<td><strong>With a atropine injections</strong></td>
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GUIDELINES AND RECOMMENDATIONS

Stress echocardiography in coronary artery disease: a practical guideline from the British Society of Echocardiography

Richard P Steeds¹,* Richard Wheeler²,* Sanjeev Bhattacharyya³ Joseph Reiken⁴ Petros Nihoyannopoulos⁵,* Roxy Senior⁶,* Mark J Monaghan⁶,* and Vishal Sharma⁷,*†

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⁷Department of Cardiology, Royal Liverpool and Broadgreen University Hospital, Liverpool, UK
2019 BSE guidelines: equipment requirements for stress echocardiography

All cases

1. Digital echocardiography machine with appropriate SE analysis package.
2. Automated blood pressure machine with manual back up if needed.
3. Continuous ECG monitoring.
4. Fully equipped resuscitation trolley with defibrillator.
5. Oxygen supply and suction.
6. Availability of transpulmonary contrast when echo window is suboptimal.
7. Drugs to manage severe allergic reactions and anaphylactic shock. To include – IV/IM adrenaline 1:1000, IV chlorpheniramine, IV hydrocortisone, salbutamol nebuliser – in dose and preparation to meet current Resuscitation UK guidelines
8. Cannulation equipment
2019 BSE guidelines: equipment requirements for stress echocardiography

Specific to exercise stress echo
1. Exercise treadmill and/or semi-supine bike with protocol options.

Specific to dobutamine stress echo
1. Dobutamine infusion and administration pump.
2. IV Atropine – up to 1.2 mg.
3. IV beta-blockers e.g. metoprolol.
A minimum of two individuals are required

1. **Sonographer/Physician:** for scanning
   BSE TTE Proficiency Accreditation or equivalent
   BSE stress echo accreditation desirable

2. **Clinician, nurse, cardiac physiologist, clinician:**
   for haemodynamic monitoring,
   ECG acquisition and drug administration
91% maximum predicted heart rate
RR × HR 30668
No significant ECG changes
Dobutamine Stress Echocardiography
- assessment of LV wall motion -

Endpoints

- Reach target heart rate

Clinical practice of contrast echocardiography: recommendation
by the European Association of Cardiovascular Imaging (EACVI) 2017
Handgrip exercise to mitigate discomfort during dobutamine stress
When to stop dobutamine infusion?

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<table>
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<tbody>
<tr>
<td>1.</td>
<td>Target heart rate</td>
</tr>
<tr>
<td>2.</td>
<td>Severe chest pain, shortness of breath</td>
</tr>
<tr>
<td>3.</td>
<td>Arrhythmias: atrial fibrillation, ventricular arrhythmias</td>
</tr>
<tr>
<td>4.</td>
<td>Systolic blood pressure &gt;240 mmHg, diastolic blood pressure &gt;120 mmHg</td>
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<tr>
<td>5.</td>
<td>Drop in systolic pressure, drop &gt;20 mmHg</td>
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<tr>
<td>6.</td>
<td>New LV wall motion abnormalities in &gt;2 segments</td>
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Rest

10µg/kg/min Dobutamine

20µg/kg/min Dobutamine

target heart rate achieved
The future
## Stress Echocardiography - safety

Major life-threatening effects (myocardial infarction, ventricular fibrillation, sustained ventricular tachycardia, stroke)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Exercise stress</td>
<td>1 in 6000 tests</td>
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<tr>
<td>Dobutamine</td>
<td>1 in 600 tests</td>
</tr>
<tr>
<td>Dipyridamole</td>
<td>1 in 1200 tests</td>
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