Stress echocardiography

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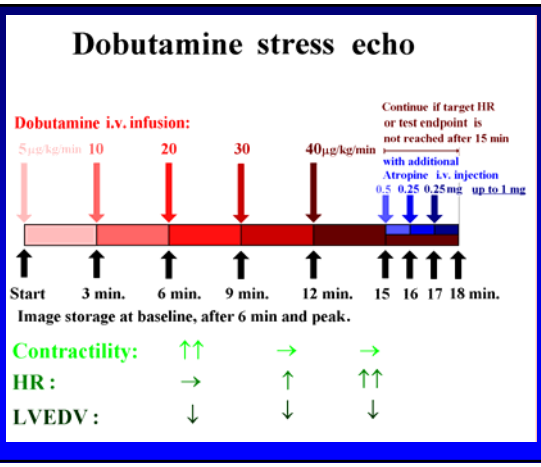
Stress echocardiography:

Detection of myocardial ischemia induced by stress, by wall motion abnormalities seen by echocardiography.

Stress modalities:

- **Exercise**
  - **Sitting bicycle**
  - **Supine bicycle**
  - **Threadmill**
- **Pharmacological**
  - **Dipyridamole – vasodilating**
  - **Adenosine – vasodilating**
  - **Dobutamine**
    - **Contractility and HR increase**



Indications I:

- **Diagnosis of ischemia:**
  - **Better accuracy than exercise ECG.**
  - **DSE possible in patients unable to exercise.**
  - **(Risk stratification of known angina.)**
- **Risk stratification before major non-cardiac surgery, especially vascular.**
- **(After AMI:)**
  - **Early wall motion abnormality predicts new event.**
  - **Remote wall motion abnormality predicts multivessel disease.**
  - **Viability of akinetic area:**
    - **Sustained improvement: Good prognosis**
    - **Biphasic response: Good prognosis with revascularisation, poor without.**

Indications II:

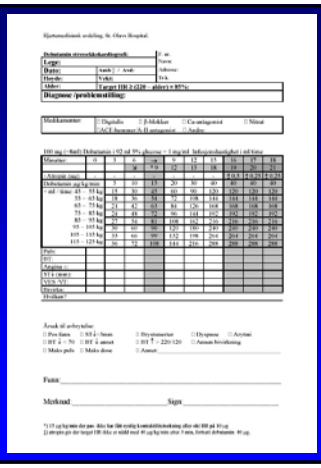
- Before PCI / CABG:
  - Significance of stenosis. (NB: only most severe stenosis usually responsive).
  - Viability
- Assess aortic stenosis with poor LV function. Generally low gradient and low area. With low dose Dobutamine:
  - Increase in gradient: significant AS,
  - increase in aortic valve area: poor hemodynamics and non-significant AS.
- (After PCI / CABG: control for restenosis / graft patency)

Contraindications:

- Dobutamine
  - Uncontrolled hypertension: >220/120 resting
  - Known hypertrophic obstructive cardiomyopathy.
  - Known malignant ventricular arrhythmia.
- Dipyridamole:
  - AV-block
  - COPD

Preparations and monitoring:

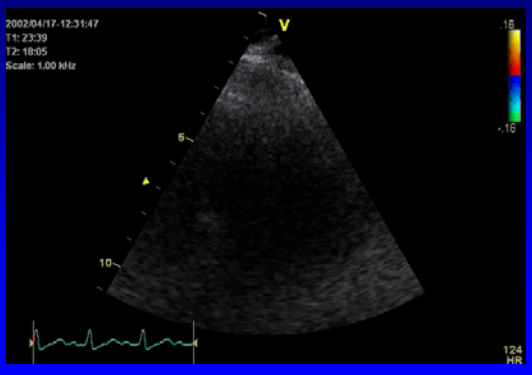
- Personnel requirement: doctor and nurse minimum.
- Patient fasting for 2 hours previously.
- Basic and advanced CPR available.
- Beta blockers discontinued for at least 24 hours
- 12 lead ECG monitored by experienced nurse
- Continuous non-invasive blood pressure monitoring
- Echocardiography: continuous monitoring.



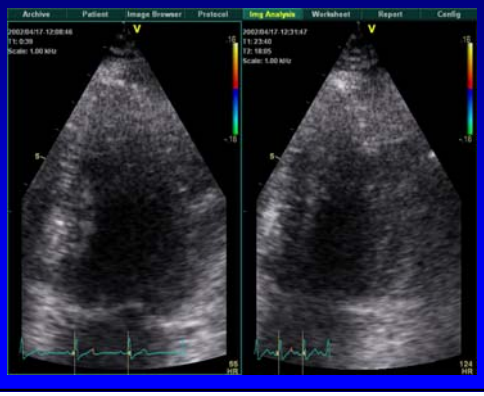
Echocardiography:

- ECG must be optimal for triggering
- Select protocol for optimal windows
- Use whole window for left ventricle
- If not tissue Doppler: Dual focus
- If Tissue Doppler: Highest framerate.
- Continuous monitoring
- Recording of cine loops at baseline, low dose, high dose, and recovery (optional).
- Record 3 cycles

3 cycles:



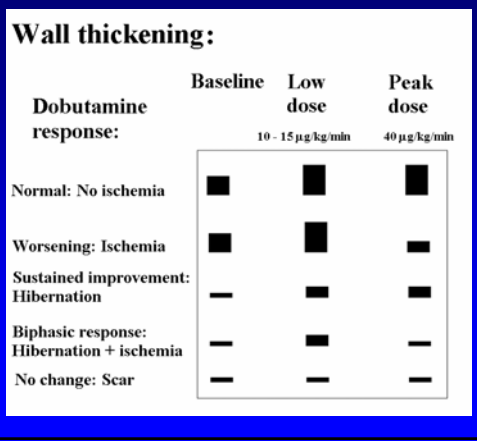
Side-by side comparison:



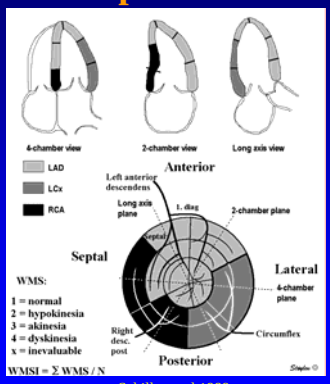
Termination criteria:

- Positive finding by echo: New wall motion abnormality
- ST depression > 3 mm
- BP limits:
  - > 220/120
  - < 70/systolic if good ventricular function
  - any BP drop > 100 mmHg if poor or reduced LV function
- Arrhythmia: Non-sustained VT or sustained SVT
- Intolerable symptoms (Angina, nausea)
- Target Heart rate (> 85% of 220 - age)
- Maximum dose (40 µg/kg/min + up to 1 mg atropine)

Wall thickening:



Interpretation:



Schiller et al 1989

Positive stress echo test:

- Positive test:
  - ≥1 segment with new a- or dyskinesia or
  - ≥ 3 segments with new hypokinesia
  - (= WMSI > 1.25 or increase by 0.25)
- Additional criteria:
  - Tardykinesia
  - Post-systolic thickening
  - Diastolic abnormalities

Information:

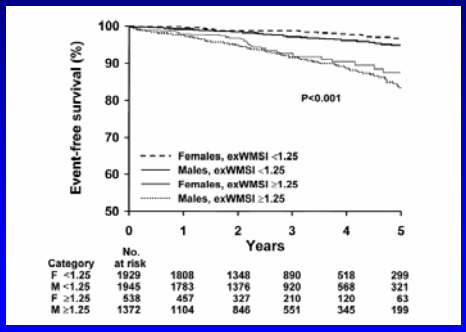
- Severity of ischemia
- Threshold of ischemia
- Extent of ischemia

- Usually only symptom-limiting stenosis

Diagnostic value:

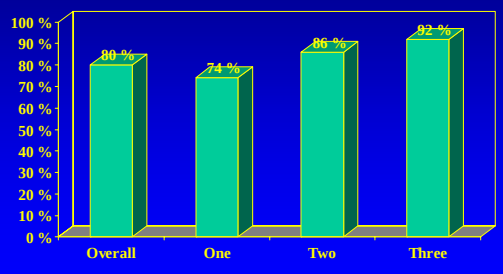
- **Sensitivity: 80 - 90%**
  - **If target HR reached**
- **Specificity: 80 – 100 %**
- **Comparable to perfusion scintigraphy**

Stress echo and prognosis:



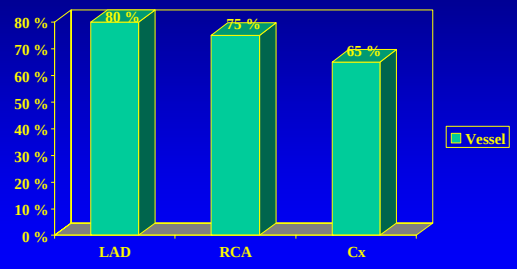
Arruda-Olsen et al JACC 2002

Sensitivity:



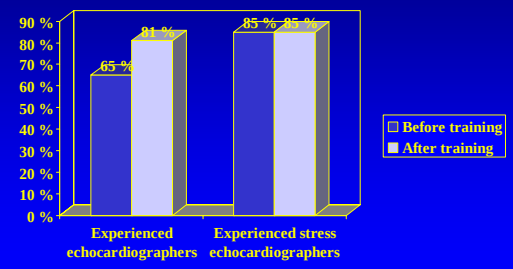
Gibbons et al 1999

Sensitivity:



Segar et al -92, Ho et al - 95

Experience and sensitivity:



Picano -91

ASE recommendations for training:

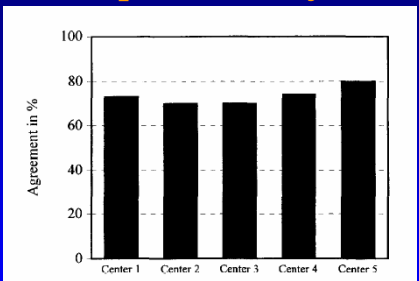
Table 1 Summary of recommendations for training in stress echocardiography

	Fellows in training	Postfellowship training	Maintenance of skills
Qualifications for training	• Level 2 training + ability to interpret resting wall motion.*	• Level 2 training or equivalent. • Current active practice of echocardiography.*	Not applicable.
Conditions for training	• Laboratory performing 40 stress echo studies per month. • Supervisor with Level 3 training and experience with more than 200 stress echo studies.	• Laboratory performing 40 stress echo studies per month. • Supervisor with Level 3 training and experience with more than 200 stress echo studies.	Not applicable.
Number of cases recommended	• Participation in performance of at least 50 exercise echo and/or pharmacologic stress echo studies. • Interpretation of a least 100 stress echo studies with supervision as above.	• Participation in performance of at least 50 exercise echo and/or pharmacologic stress echo studies. • Interpretation of 100 stress echo studies under supervision as above.	Interpretation of 15 stress echo studies per month.

*See text.

Popp et al, JASE-98;
www.asecho.org

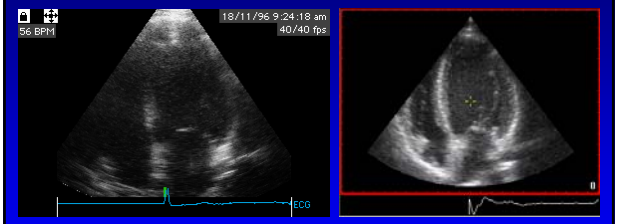
Reproducibility:



73% agreement, κ 0.37.

Hoffmann et al JACC 1996.

Impact of Harmonic imaging:



- **Native imaging (1996)** **Harmonic Imaging (2001)**

Impact of Harmonic imaging:

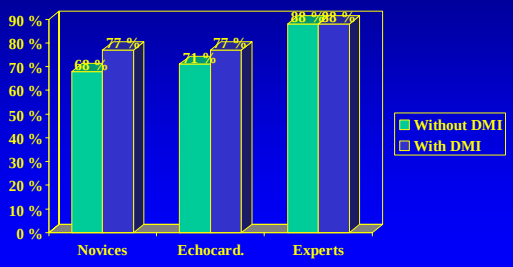
	Fundamental	Harmonic
Sensitivity:	**64%**	**92%**
Specificity:	**75%**	**75%**
κ-coefficient:	**0.40**	**0.69**

Francke et al 2000

Quantitative stress echo:

- **Colour kinesis**
- **Contrast echocardiography?**
- **AV-plane motion?**
- **MPI?**
- **Tissue Doppler**
- **Strain rate imaging?**

Impact of DMI on sensitivity:

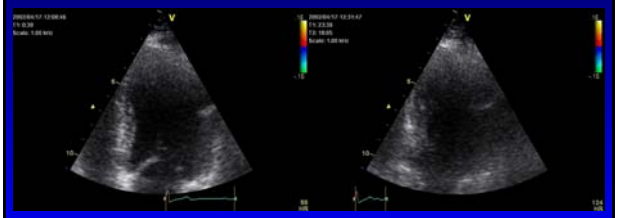


Fathi, Cain et al 2001

Doppler Myocardial Imaging:

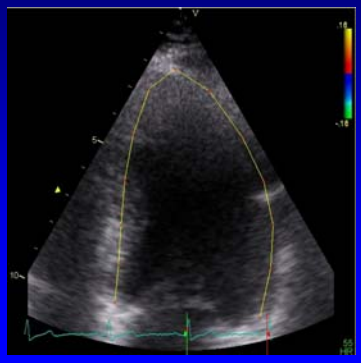
- Longitudinal velocities:
  - **Cain et al 2001:**
    - **Peak systolic velocities > 5-7 cm/s: normal**
  - **Frazer:**
    - **Cutoff 10 cm/s:**
      - **Sens. 63%, spec. 64%**
    - **Statistical model integrating:**
      - **Velocity**
      - **BMI**
      - **Age**
      - **Sensitivity of 80 – 93%, specificity of 85%**

Stress echo 4 chamber view:

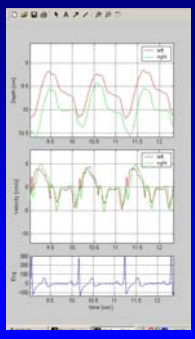


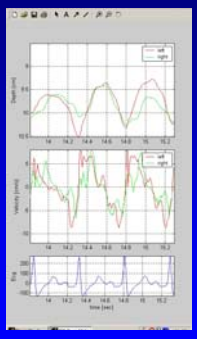
- Baseline HR 65 peak stress HR 125

Curved M-mode:



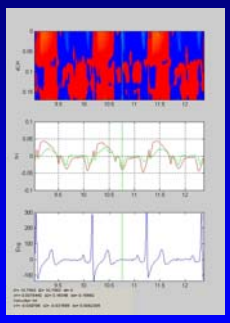
AV-plane motion:

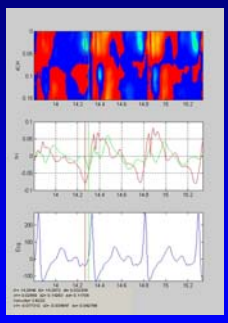




– Baseline HR 65 peak stress HR 125

Tissue Doppler:

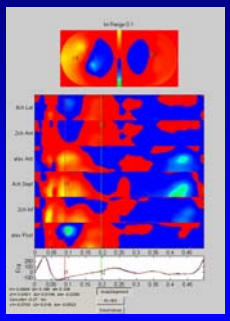


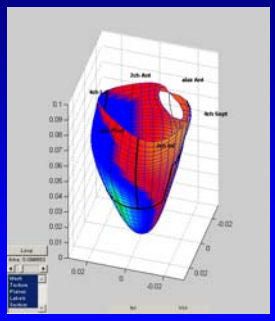


– Baseline HR 65 peak stress HR 125

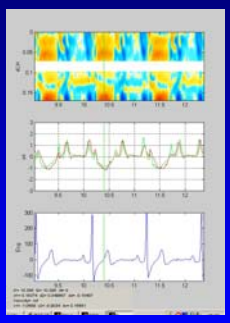
– No, QRS is not broader, it is shorter HR displayed over the same length.

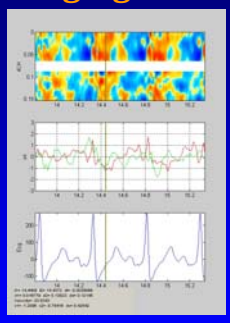
Tissue Doppler – peak stress:





Strain rate imaging:





– Baseline HR 65 peak stress HR 125

Strain rate – peak stress: