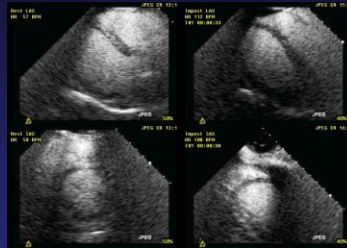


Getting the Most Out of Stress Echo



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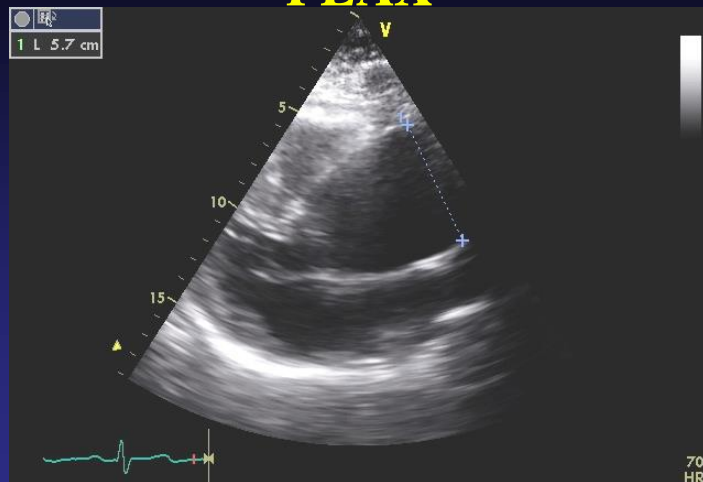
No Disclosures



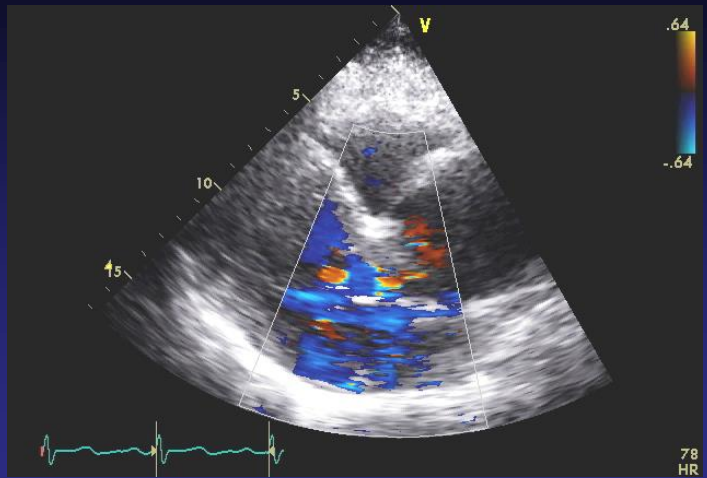
History

- 52 yo M w/ HTN, HL presented with chest pressure and headache.
- Chest pressure began after pt began after a migraine.
- Describes chest sensation as constant "pressure" in substernal, as if "someone were pressing on my chest".
- Chest pressure was constant, lasted until pt received SLNG in ED.
- In ED, noted new heart murmur. EKG was non-ischemic. CXR negative for acute process. Trop=0.02
- Echo with Doppler/stress echo ordered

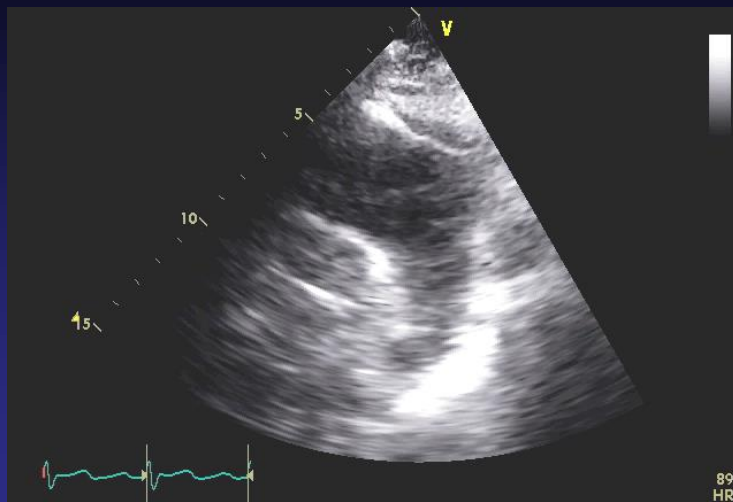
PLAX



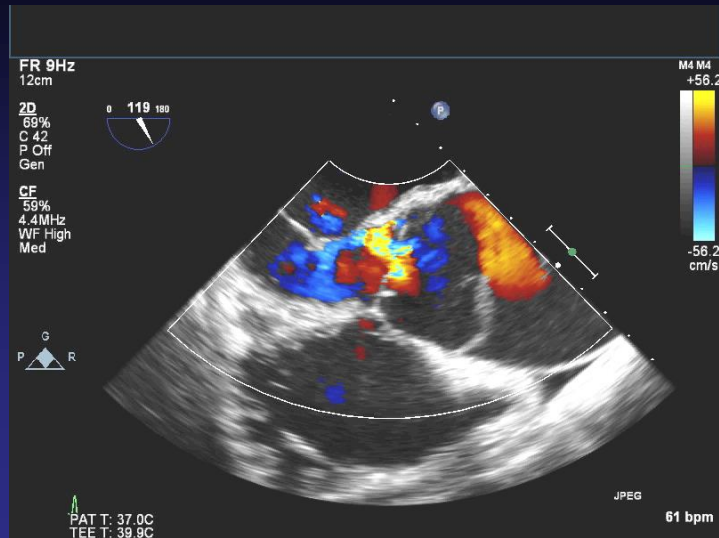
PLAX



Suprasternal Notch



Intra-op TEE



Who Should Have a Stress Echo?

Patients with:

- Nondiagnostic or uninterpretable ECGs
- Known CAD and extent/location of disease is needed
- Need for risk stratification post-MI
- Need for evaluation of viability
- Structural heart disease

APPROPRIATE USE OF ECHOCARDIOGRAPHY

ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/ SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography

A REPORT OF THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION APPROPRIATE USE CRITERIA TASK FORCE, AMERICAN SOCIETY OF ECHOCARDIOGRAPHY, AMERICAN HEART ASSOCIATION, AMERICAN SOCIETY OF NUCLEAR CARDIOLOGY, HEART FAILURE SOCIETY OF AMERICA, HEART RHYTHM SOCIETY, SOCIETY FOR CARDIOVASCULAR ANGIOGRAPHY AND INTERVENTIONS, SOCIETY OF CRITICAL CARE MEDICINE, SOCIETY OF CARDIOVASCULAR COMPUTED TOMOGRAPHY, SOCIETY FOR CARDIOVASCULAR MAGNETIC RESONANCE AMERICAN COLLEGE OF CHEST PHYSICIANS

(J Am Soc Echocardiogr 2011;24:229-67.)



Table 9 Stress echocardiography for detection of CAD/Risk assessment: Symptomatic or ischemic equivalent

| Indication | Appropriate use score (1-9) |
|--|-----------------------------|
| Evaluation of Ischemic Equivalent (Nonacute) With Stress Echocardiography | |
| 114. <ul style="list-style-type: none"> • Low pretest probability of CAD • ECG interpretable and able to exercise | I (3) |
| 115. <ul style="list-style-type: none"> • Low pretest probability of CAD • ECG uninterpretable or unable to exercise | A (7) |
| 116. <ul style="list-style-type: none"> • Intermediate pretest probability of CAD • ECG interpretable and able to exercise | A (7) |
| 117. <ul style="list-style-type: none"> • Intermediate pretest probability of CAD • ECG uninterpretable or unable to exercise | A (9) |
| 118. <ul style="list-style-type: none"> • High pretest probability of CAD • Regardless of ECG interpretability and ability to exercise | A (7) |

Table 10 Stress echocardiography for detection of CAD/Risk assessment: Asymptomatic (without ischemic equivalent)

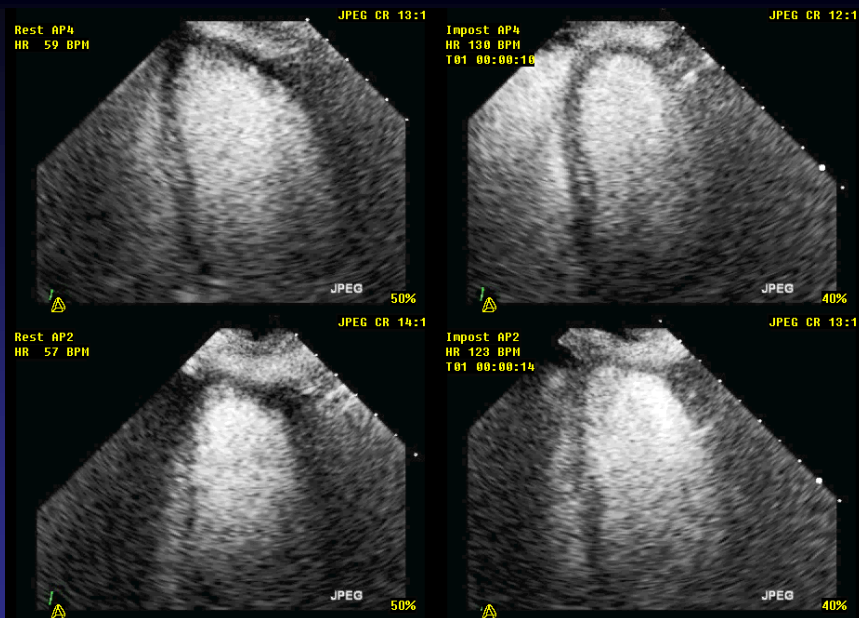
| Indication | Appropriate use score (1-9) |
|--|-----------------------------|
| General Patient Populations With Stress Echocardiography | |
| 124. <ul style="list-style-type: none"> • Low global CAD risk | I (1) |
| 125. <ul style="list-style-type: none"> • Intermediate global CAD risk • ECG interpretable | I (2) |
| 126. <ul style="list-style-type: none"> • Intermediate global CAD risk • ECG uninterpretable | U (5) |
| 127. <ul style="list-style-type: none"> • High global CAD risk | U (5) |

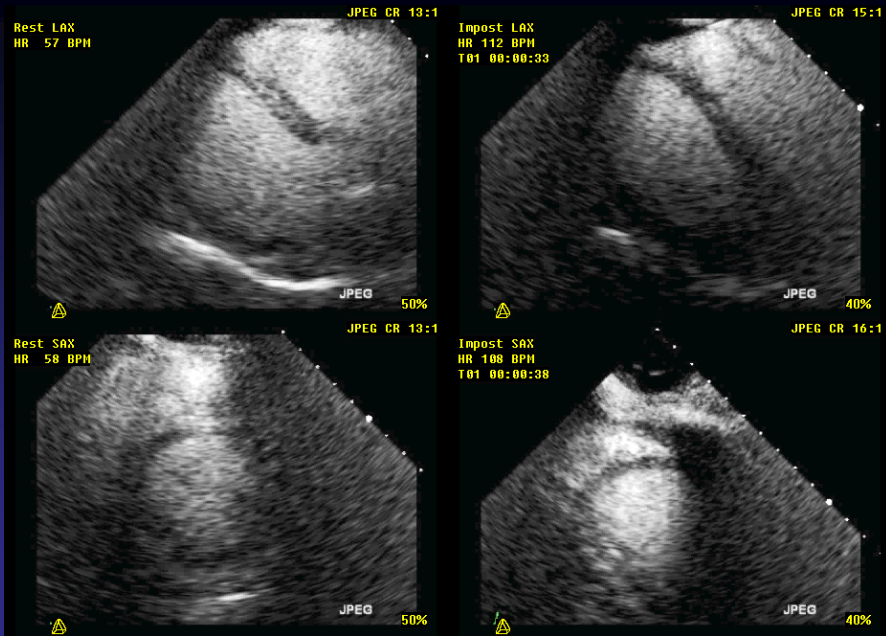
A indicates appropriate; I, inappropriate; U, uncertain.



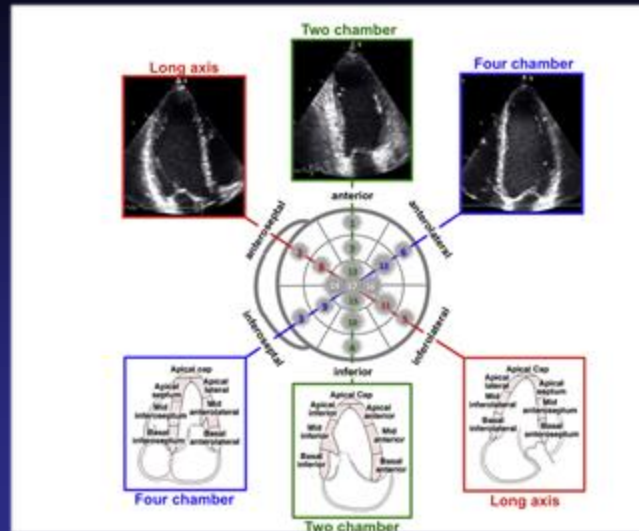
Methodology/Interpretation

- Side by side rest and stress image interpretation
- LV size, shape
- Regional wall motion
- Coronary distribution





Segmental Analysis of LV Walls



J Am Soc Echocardiogr 2015; 28:1-39

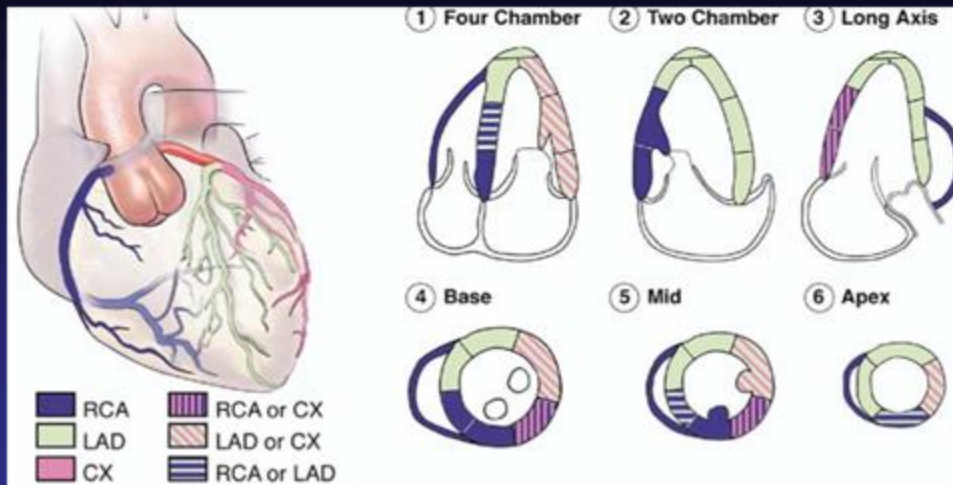
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Hospital
Northwestern
Medicine

Combination of Rest and Stress Wall Motion

| <i>Rest</i> | <i>Stress</i> | <i>Interpretation</i> |
|----------------------|----------------------|----------------------------|
| Normal | Hyperkinetic | Normal |
| Normal | Hypokinetic/akinetic | Ischemic |
| Akinetic | Akinetic | Infarction |
| Hypokinetic | Akinetic/dyskinetic | Ischemic and/or infarction |
| Hypokinetic/akinetic | Normal | Viable |

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Northwestern
Medicine

Coronary Distribution



J Am Soc Echocardiogr 2015; 28:1-39



Accuracy of Stress Echo vs Nuclear

| References | Stress | No. of Patients | Echocardiography | | Nuclear | |
|------------------------|---------------------|-----------------|------------------|-----------------|-----------------|-----------------|
| | | | Sensitivity (%) | Specificity (%) | Sensitivity (%) | Specificity (%) |
| Marwick et al., 1993 | Dob-echo Aden-MIBI | 97 | 85 | 82 | 86 | 71 |
| Forster et al., 1993 | Dob-echo Dob-MIBI | 105 | 75 | 89 | 83 | 89 |
| Marwick et al., 1993 | Dob-echo Dob-MIBI | 217 | 72 | 83 | 76 | 67 |
| Quinones et al., 1992 | Exer-echo Exer-thal | 292 | 74 | 88 | 75 | 81 |
| Hecht et al., 1993b | Exer-echo Exer-thal | 71 | 88 | 87 | 80 | 84 |
| Fragasso et al., 1999 | Dob-echo Exer-MIBI | 101 | 88 | 80 | 98 | 36 |
| San Roman et al., 1995 | Dob-echo Dob-MIBI | 102 | 78 | 88 | 87 | 70 |

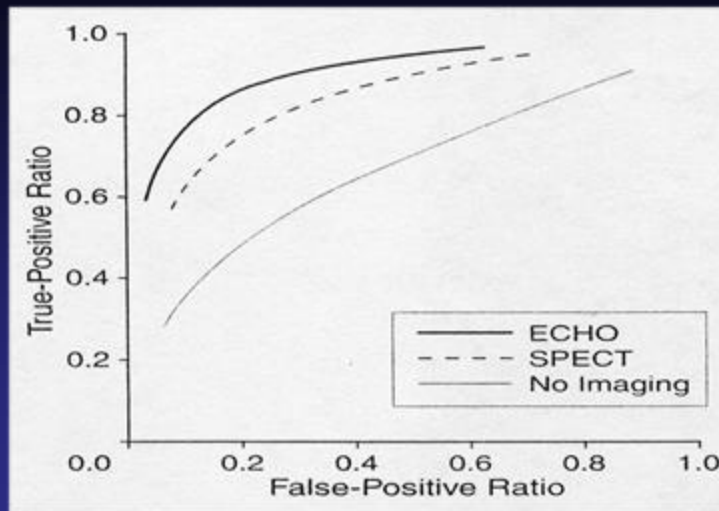
Aden, adenosine; Dob, dobutamine; Exer, exercise; MIBI, sestamibi; thal, thallium.



Feigenbaum's Echocardiography, 7th edition



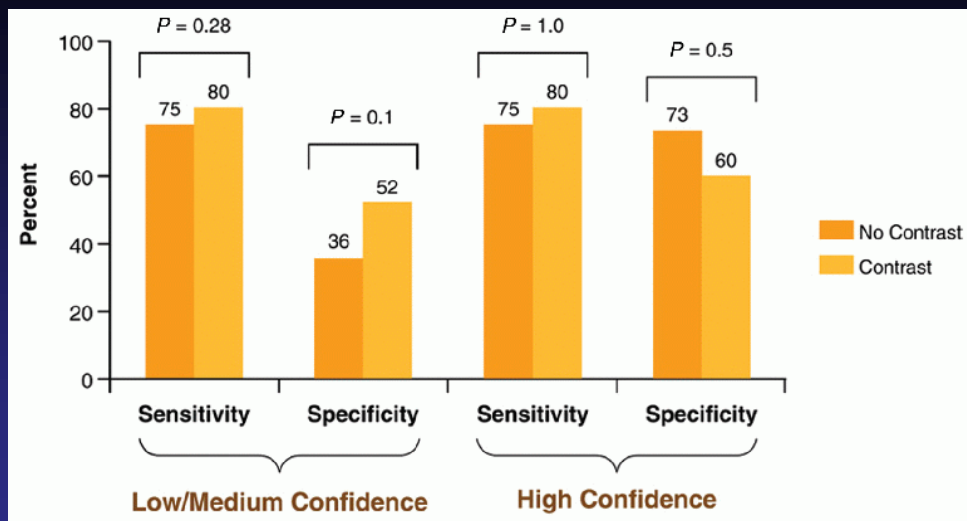
Exercise Stress Echo vs Exercise SPECT Imaging



Fleishmann KE, et al. JAMA 1998;280:913-920



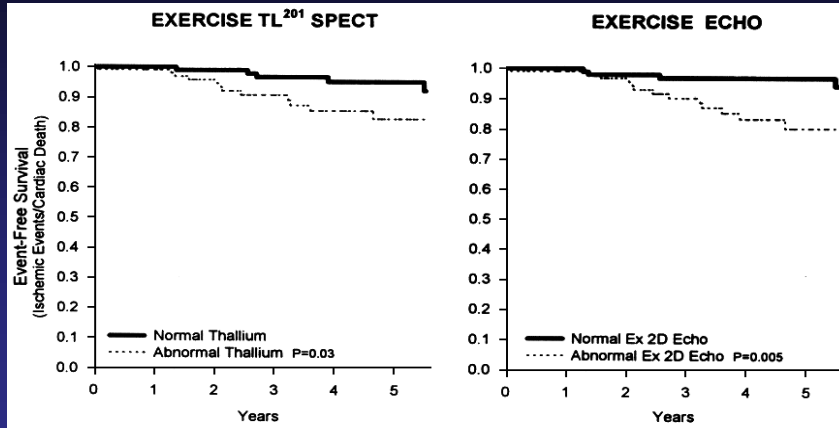
Impact of Contrast Use on Accuracy



J Am Coll Cardiol Imaging 2008;1:145-152



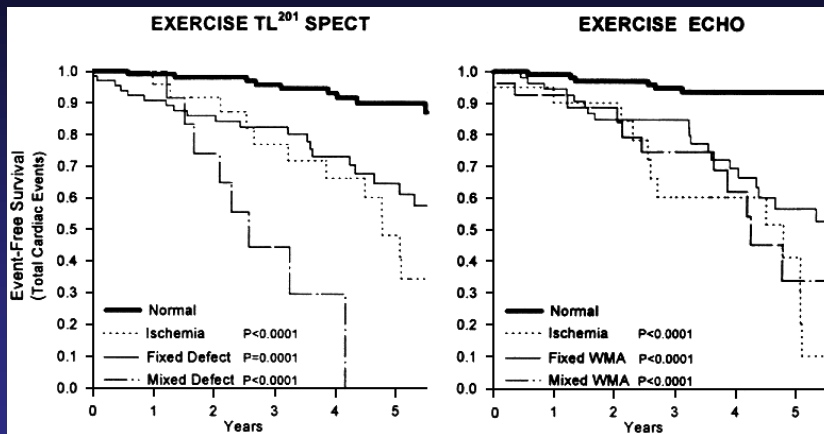
Prognostic Value of Exercise Stress Echo vs TI-SPECT



Olmos et al. Circulation 1998;98:2679-2686



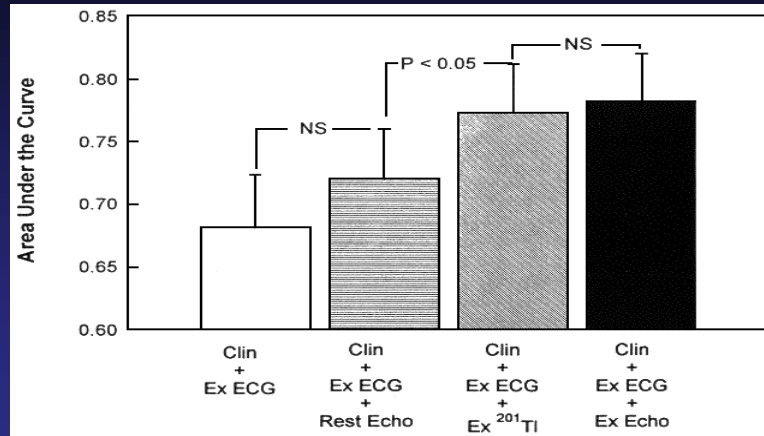
Prognostic Value of Exercise Stress Echo vs TI-SPECT



Olmos et al. Circulation 1998;98:2679-2686

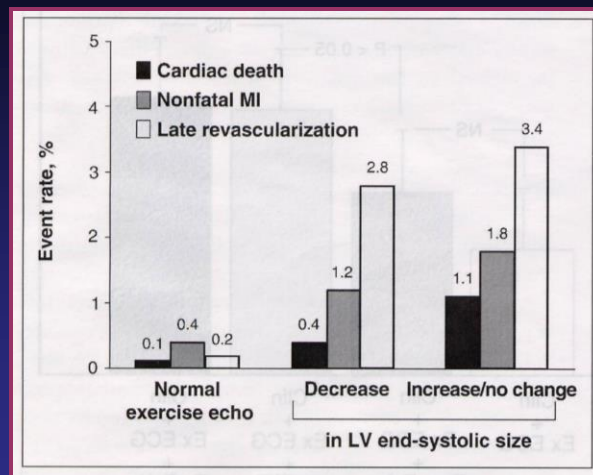


Prognostic Value of Exercise Stress Echo vs TI-SPECT



Olmos et al. Circulation 1998;98:2679-2686

Prognostic Value of Stress Echo



McCully RB et al. J Am Coll Cardiol 2002;398:1345-1352

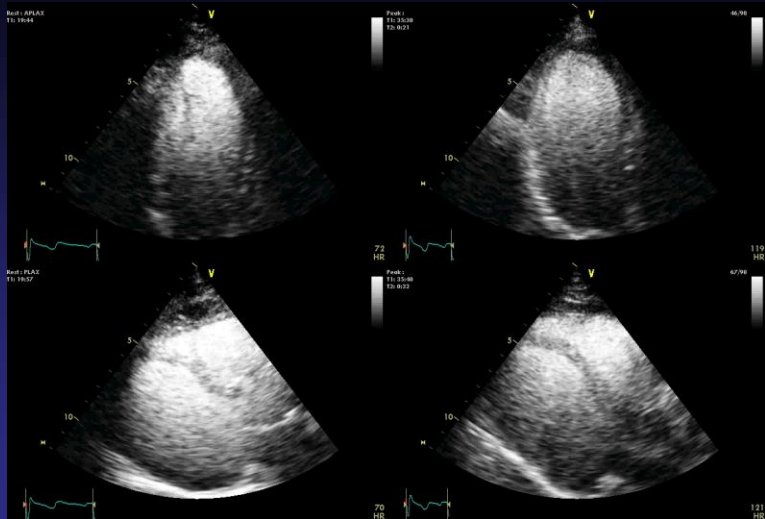
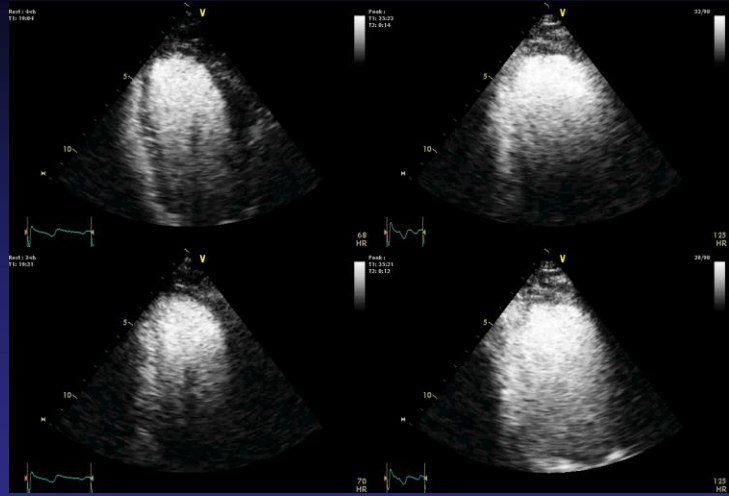
Variables Increasing Sensitivity of Stress Echo

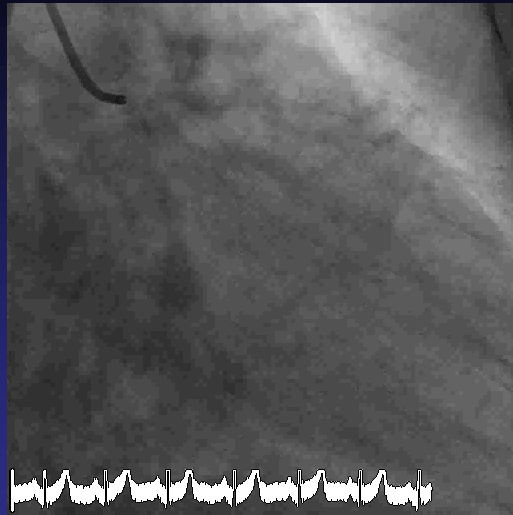
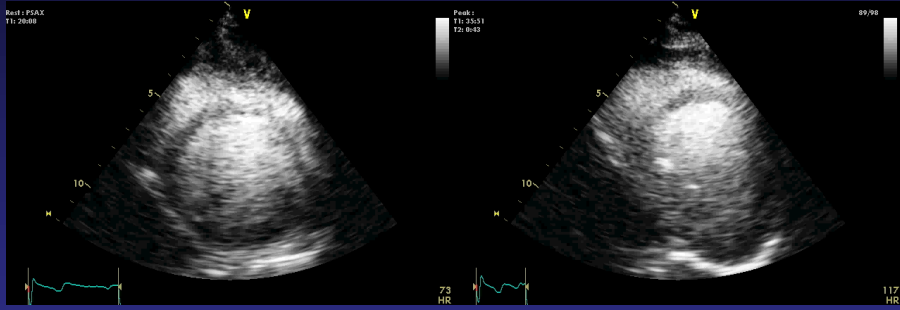
- Achieving a high exercise work load
- Coronary Stenosis >90%
- Proximal location of stenosis
- Multiple Stenoses
- Baseline WMA
- Digital analysis



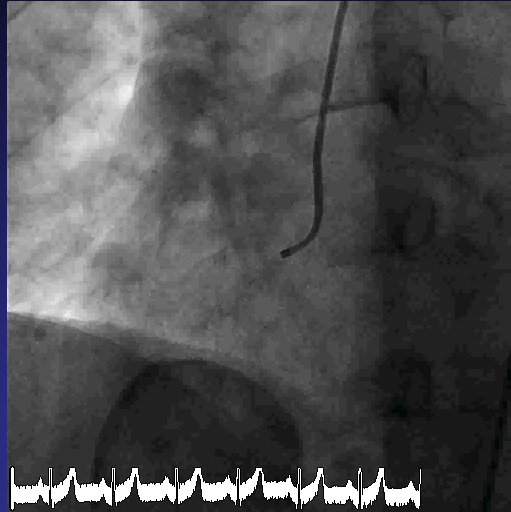
- 56 yr old male with history of HTN, high cholesterol and ESRD. He needs a kidney transplant. He has exertional dyspnea
- She exercised for 12:00 minutes of the Bruce protocol. He had no symptoms.
- 1-2 mm horizontal ST segment depression at peak exercise noted on ECG.







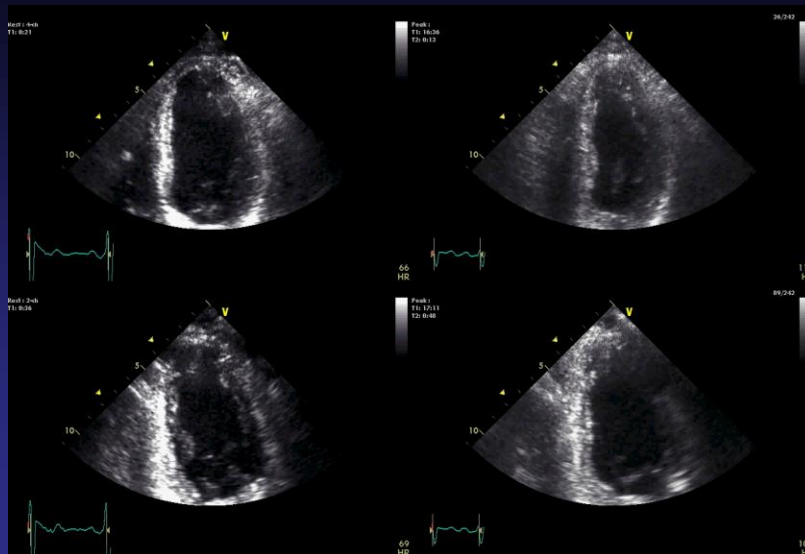
Cardiac Cath

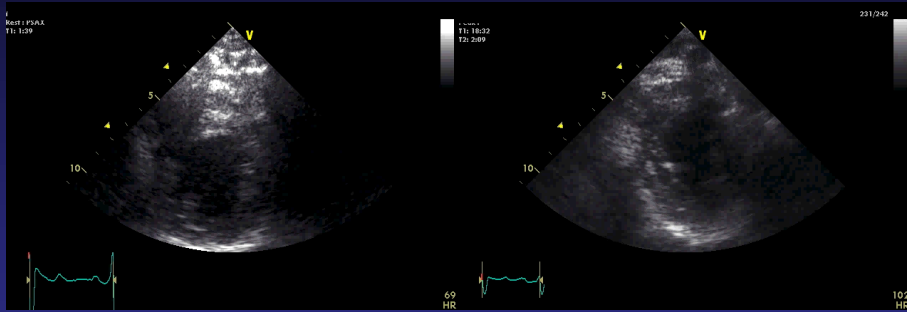
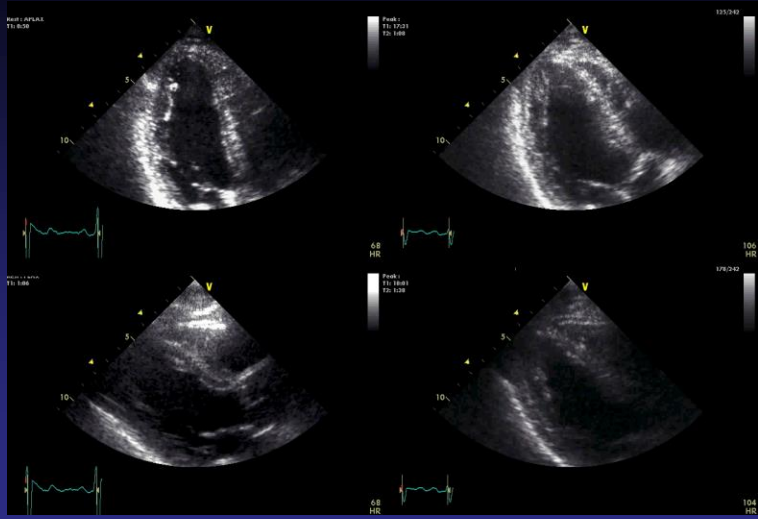


Variables Decreasing Sensitivity of Stress Echo

- Achieving a submaximal work load
- Lesser degrees of coronary stenosis
- Presence of collaterals
- Anti-anginal drug therapy
- Too much time used to capture post-exercise images
- Suboptimal Image quality

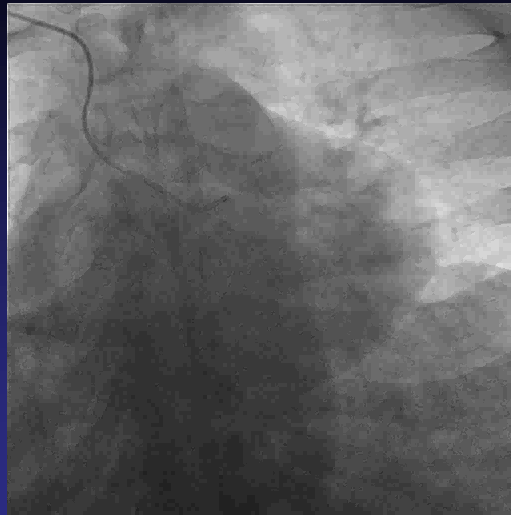
- 58 yr old male with DM, high cholesterol, smoking hx who came to the ER c/o throat and chest burning while driving his cab.
- Enzymes and ECG were negative
- Exercise time: 9:03 minutes
- Reached 78% max predicted HR
- Stopped due to fatigue. Borderline ECG changes

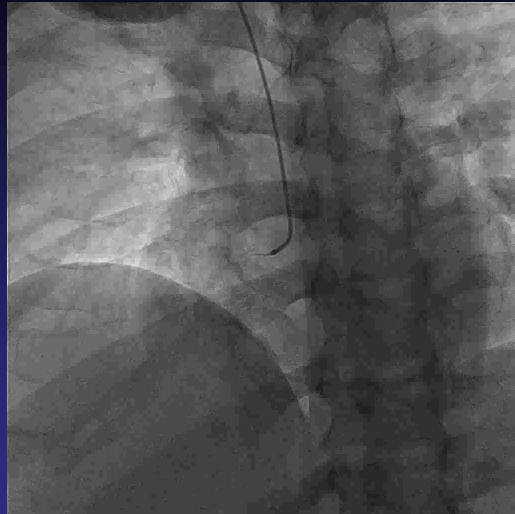




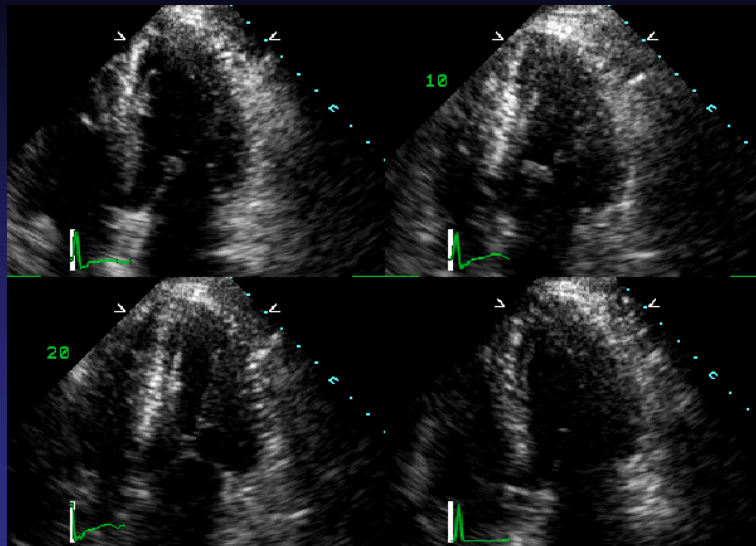
How do you interpret this stress test?

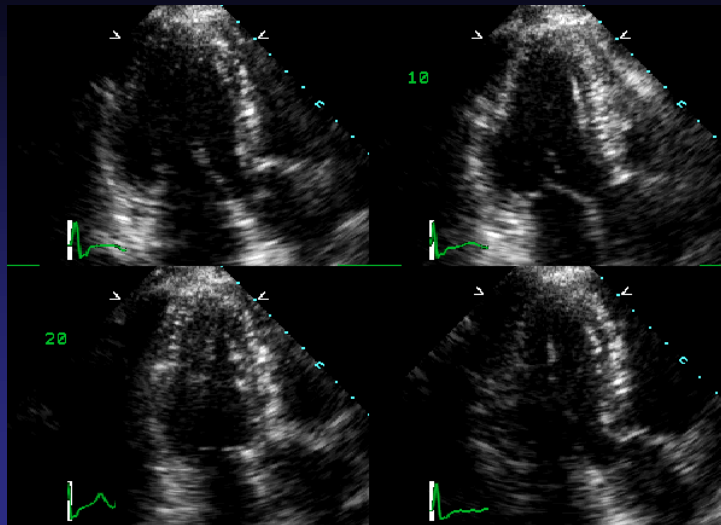
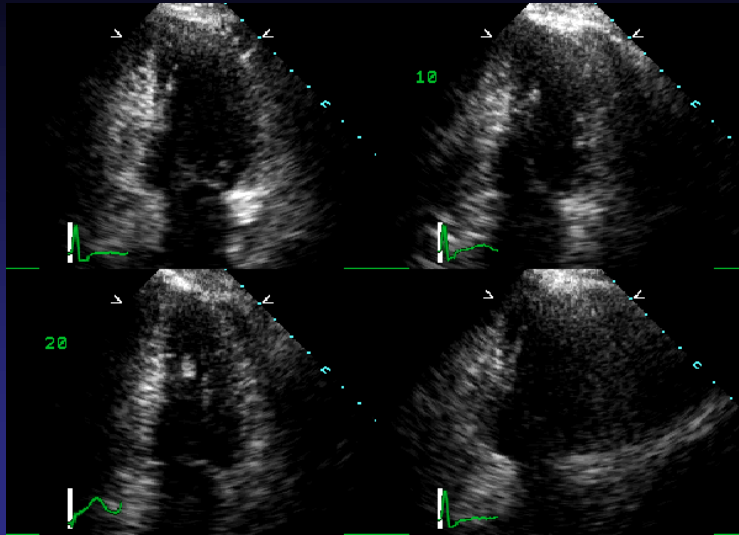
- A. Normal
- B. 1 vessel CAD
- C. 2 vessel CAD
- D. Multi-vessel CAD

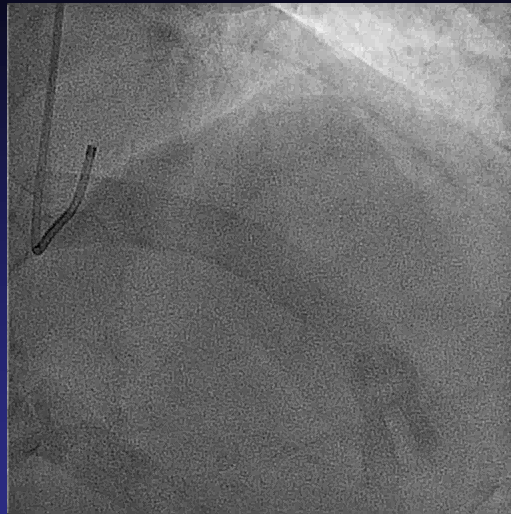




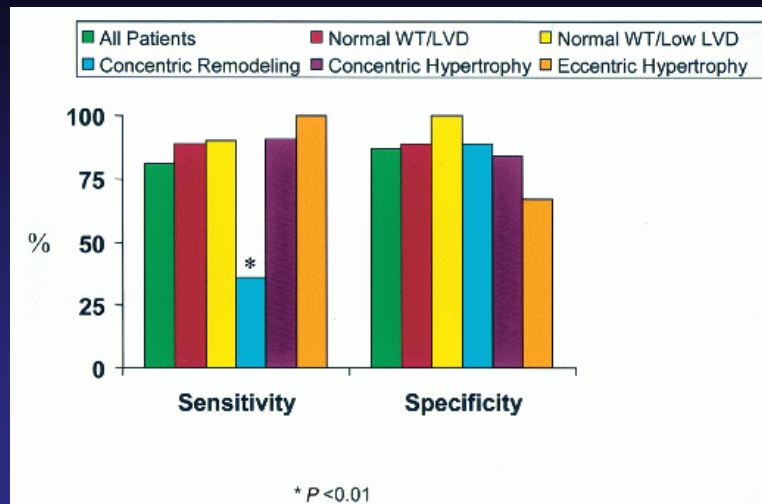
- 75 yr old female with h/o HTN who complains of recurrent episodes of atypical chest pain.
- Chest pain unresponsive to PPI







Effect of Concentric Remodeling on Accuracy of Stress Echo



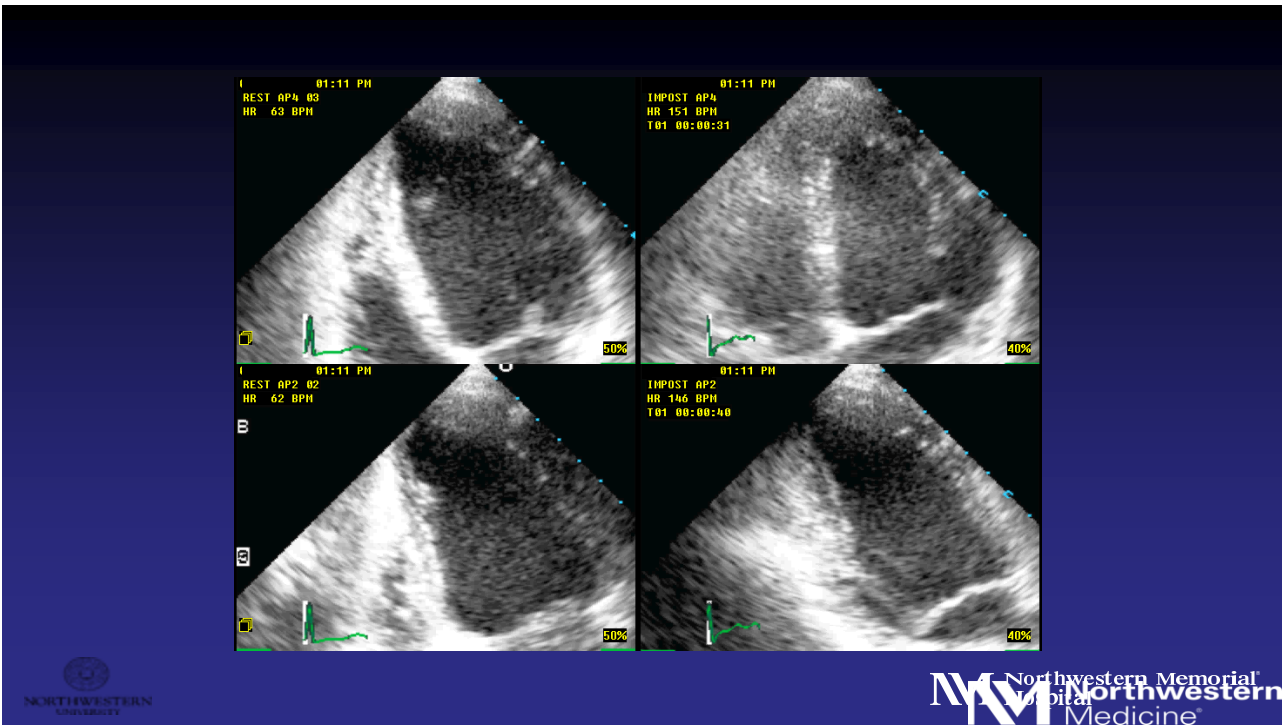
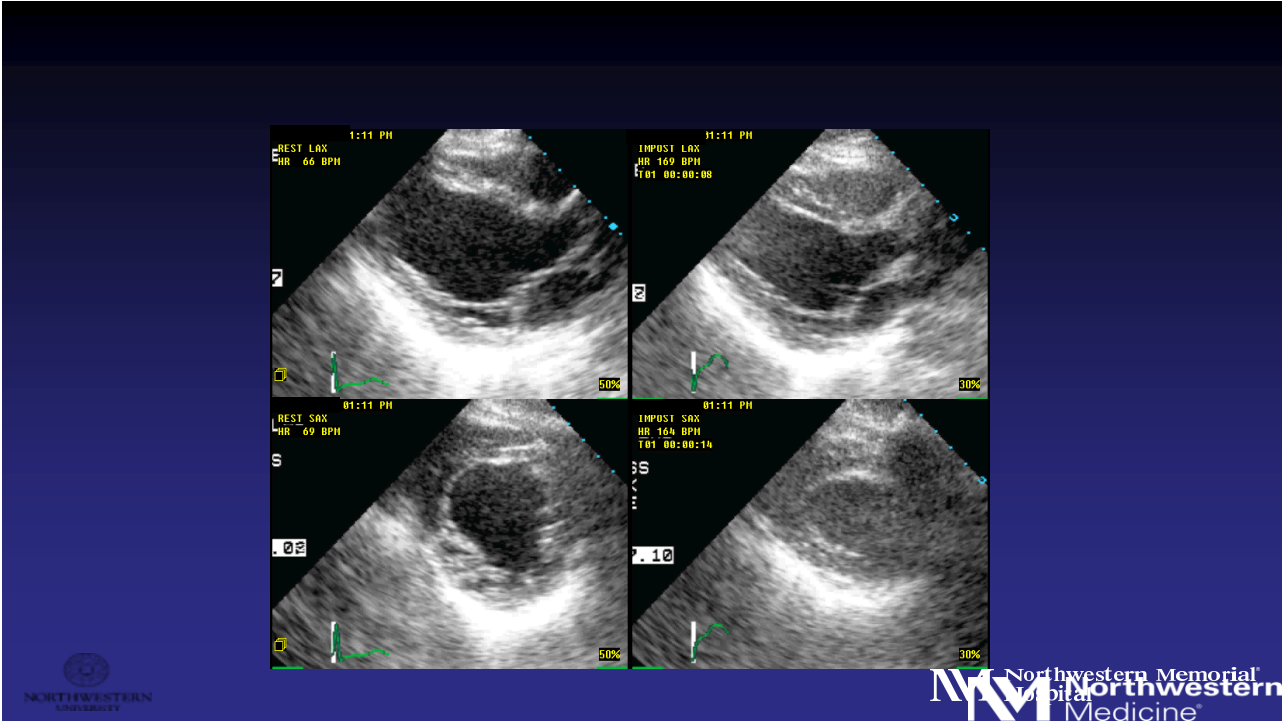
Variable Decreasing Specificity

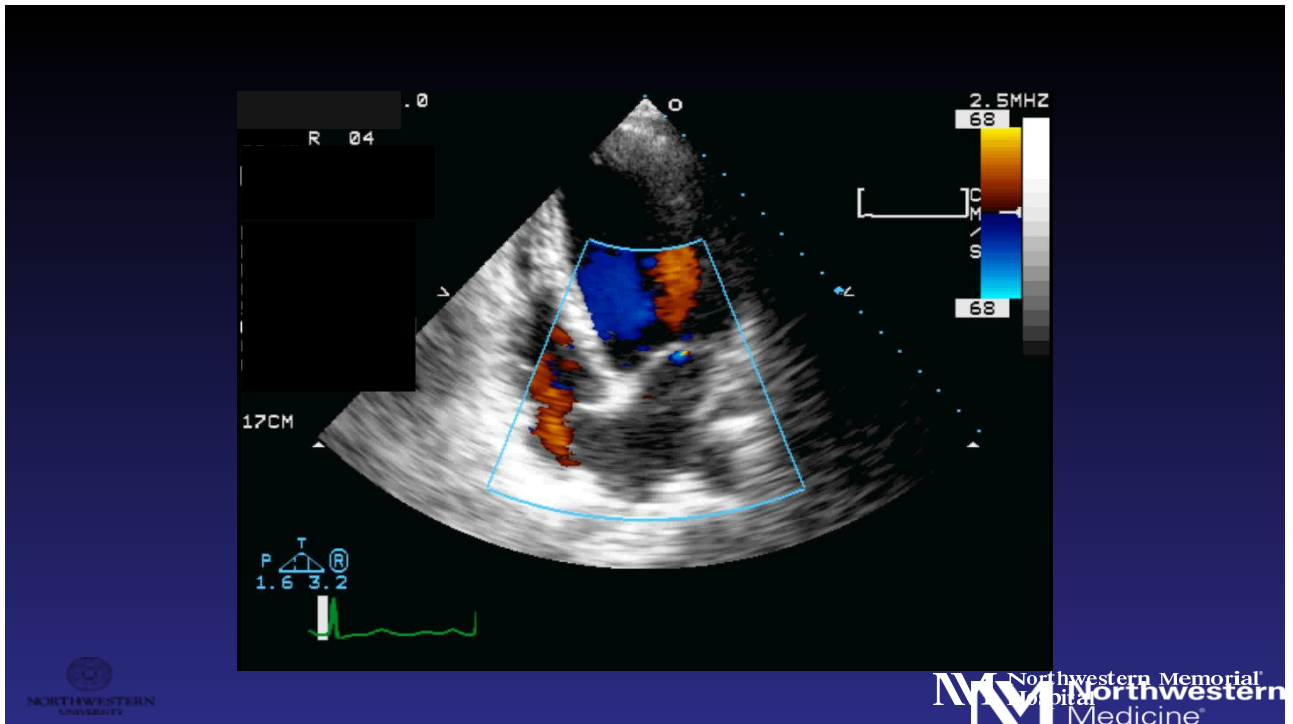
- Underlying cardiomyopathy
- Severe Hypertension
- Left bundle branch block
- Poor digital capture



- 59 yr old female with an asymptomatic murmur







Limitations of Stress Echo

- *Image acquisition may be a challenge in certain patients*
 - Improved with contrast
- *Detection of single vessel disease*
 - Especially if lesion is distal, less stenosed, collaterals are present
- *Assessment of inducible WMA difficult in setting of resting WMA – lesser with DSE*

Limitations of SPECT

- *Attenuation artifacts*
 - These may mimic defects in areas of normal perfusion or may underestimate areas of abnormal perfusion
 - Particularly problematic in females and obese patients.



EACVI/ASE CLINICAL RECOMMENDATIONS

The Clinical Use of Stress Echocardiography in Non-Ischaemic Heart Disease: Recommendations from the European Association of Cardiovascular Imaging and the American Society of Echocardiography

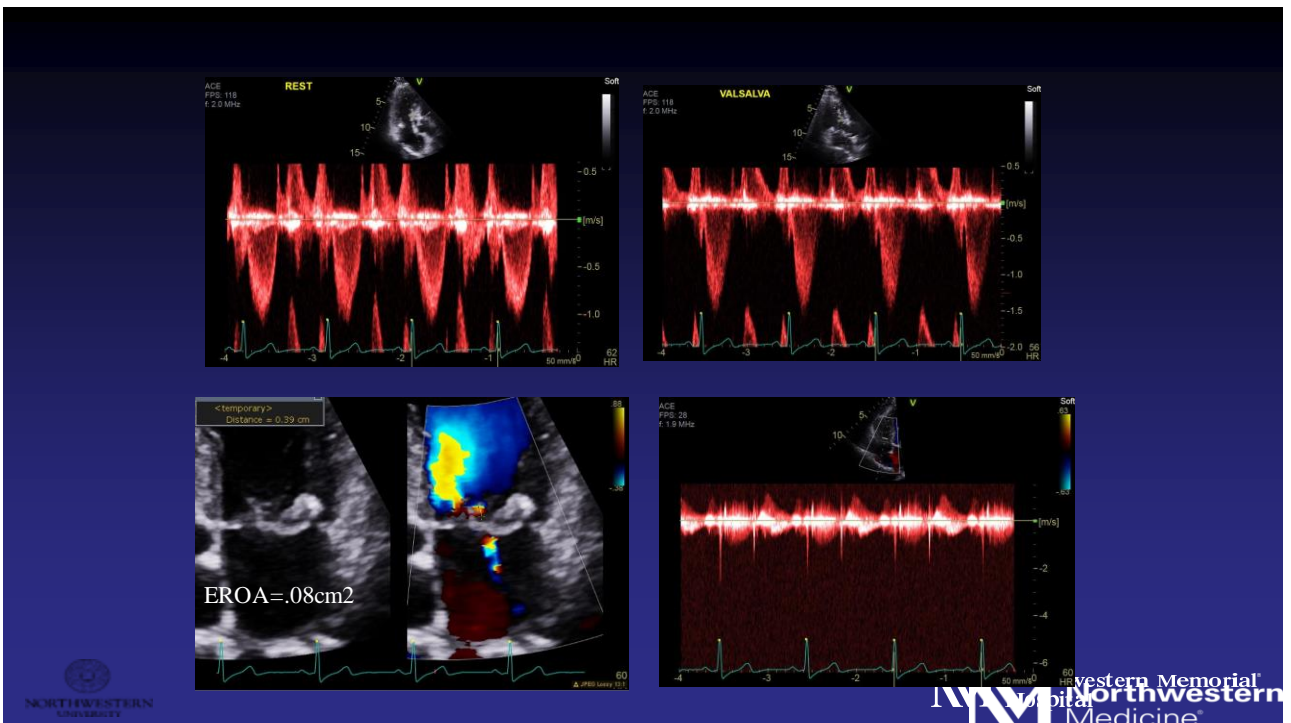
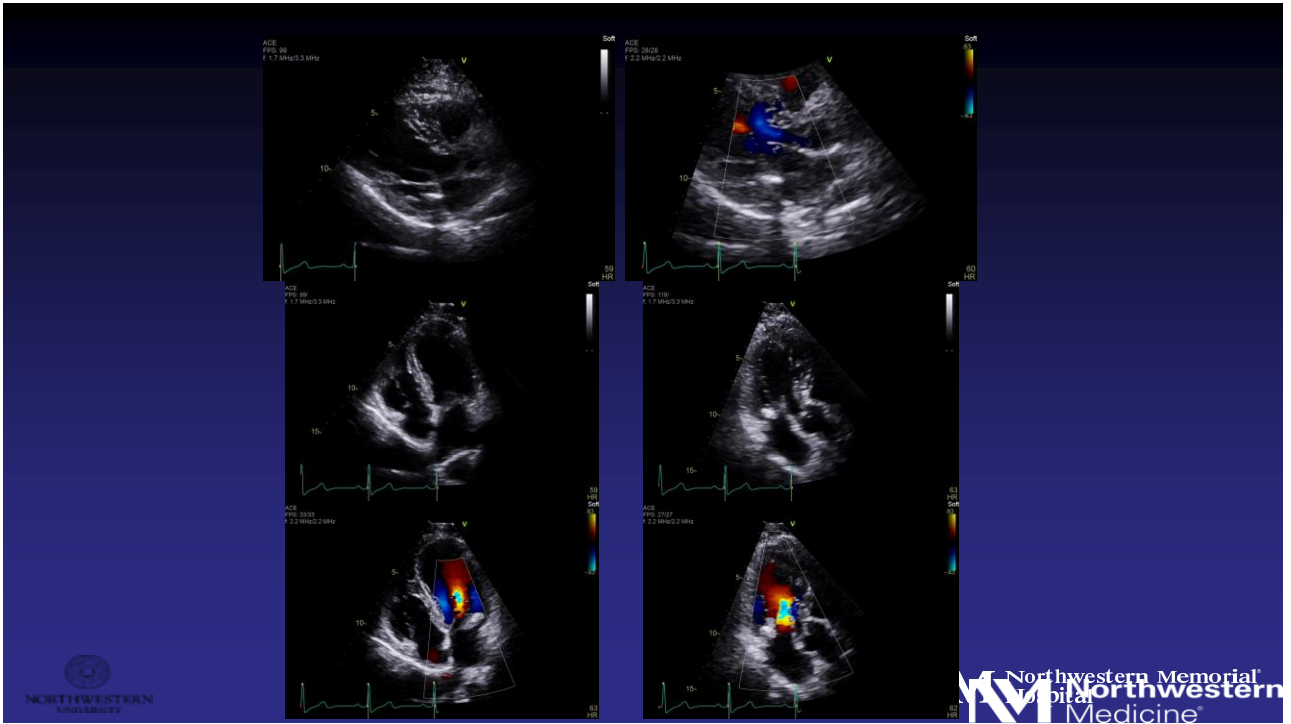


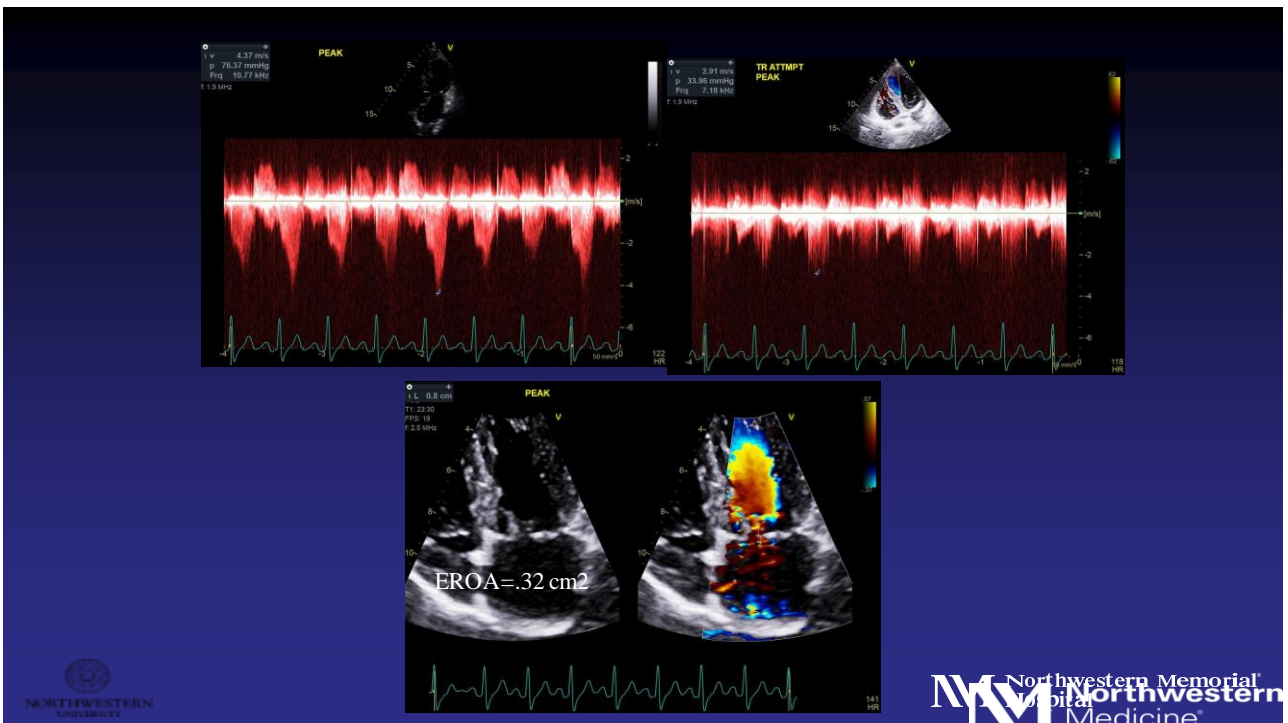
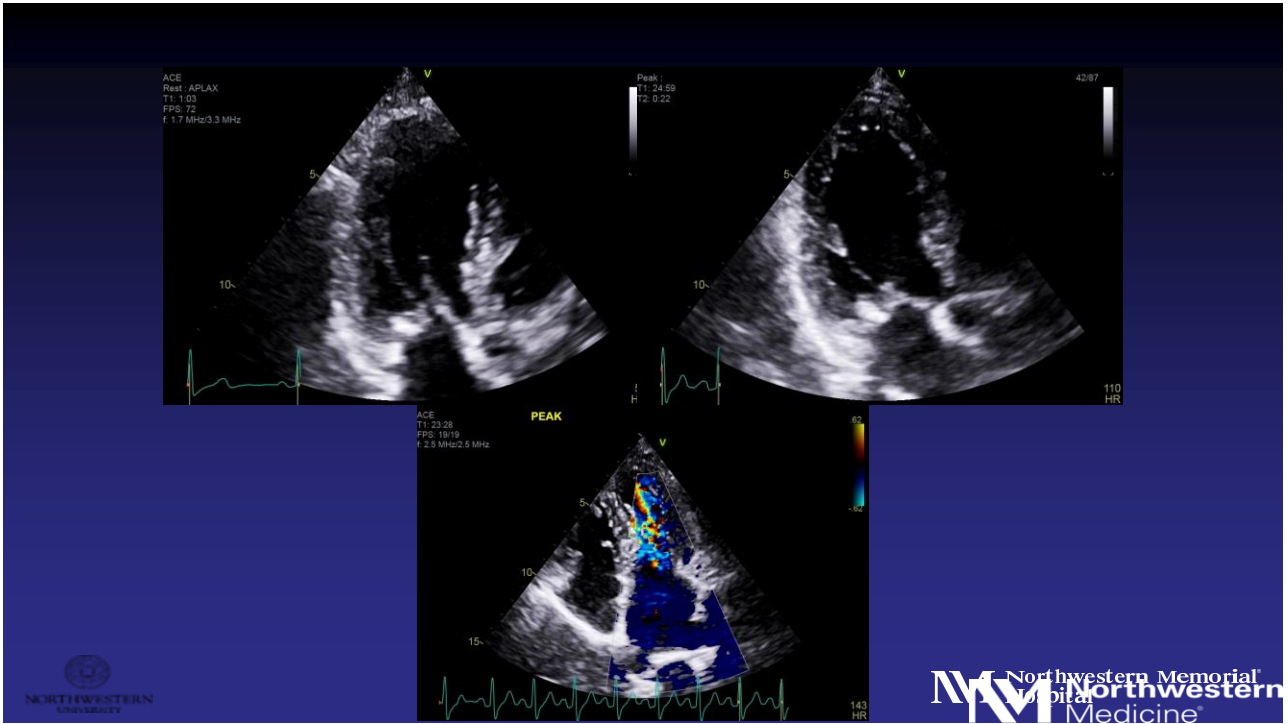
Patrizio Lancellotti, MD, PhD, FESC (Chair), Patricia A. Pellikka, MD, FASE (Co-Chair), Werner Budts, MD, PhD, Farooq A. Chaudhry, MD, FASE, Erwan Donal, MD, PhD, FESC, Raluca Dulgheru, MD, Thor Edvardsen, MD, PhD, FESC, Madalina Garbi, MD, MA, Jong Won Ha, MD, PhD, FESC, Garvan C. Kane, MD, PhD, FASE, Joe Kreeger, ACS, RCCS, RDCS, FASE, Luc Mertens, MD, PhD, FASE, Philippe Pibarot, DVM, PhD, FASE, FESC, Eugenio Picano, MD, PhD, Thomas Ryan, MD, FASE, Jeane M. Tsutsui, MD, PhD, and Albert Varga, MD, PhD, FESC, *Lège, Belgium; Bari and Pisa, Italy; Rochester, Minnesota; Leuven, Belgium; New York, New York; Rennes, France; Oslo, Norway; London, UK; Seoul, South Korea; Atlanta, Georgia; Toronto and Québec, Canada; Columbus, Ohio; São Paulo, Brazil; and Szeged, Hungary*



J Am Soc Echocardiogr 2017;30:101-38.









Thank You

