



# Stress Echocardiography: Illustrative Cases

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# DISCLOSURE

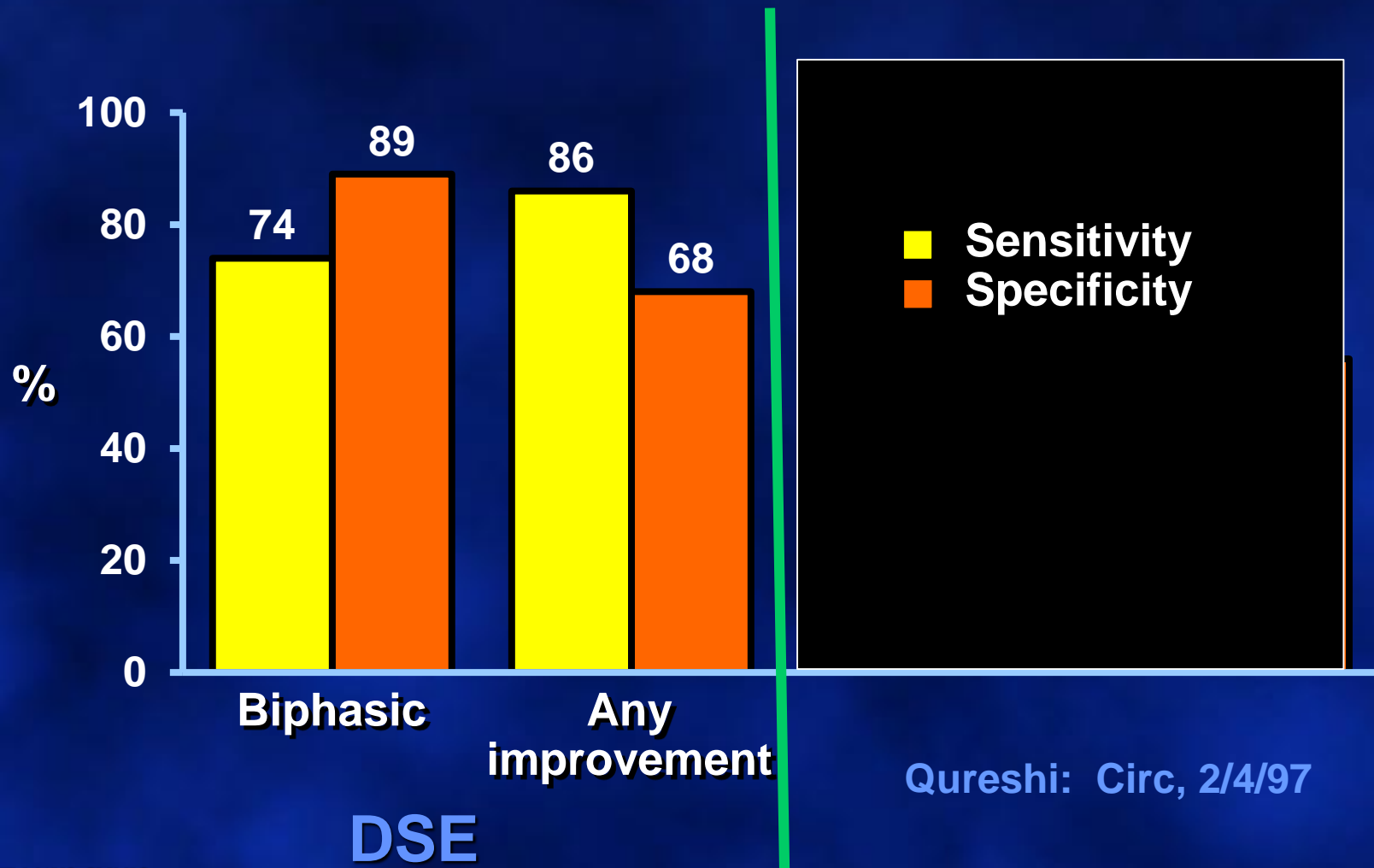
Relevant Financial Relationship(s)

None

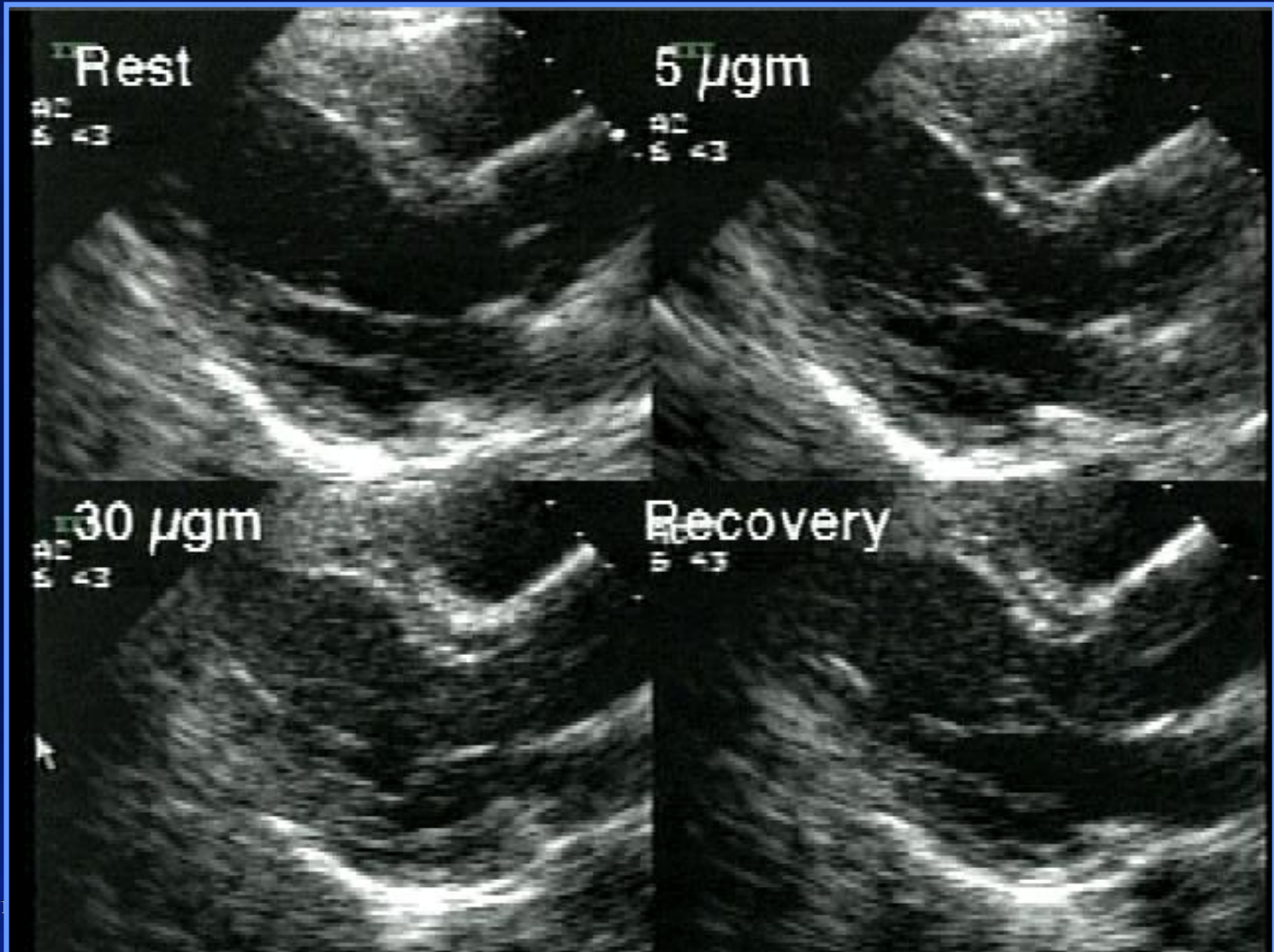
Off Label Usage

None

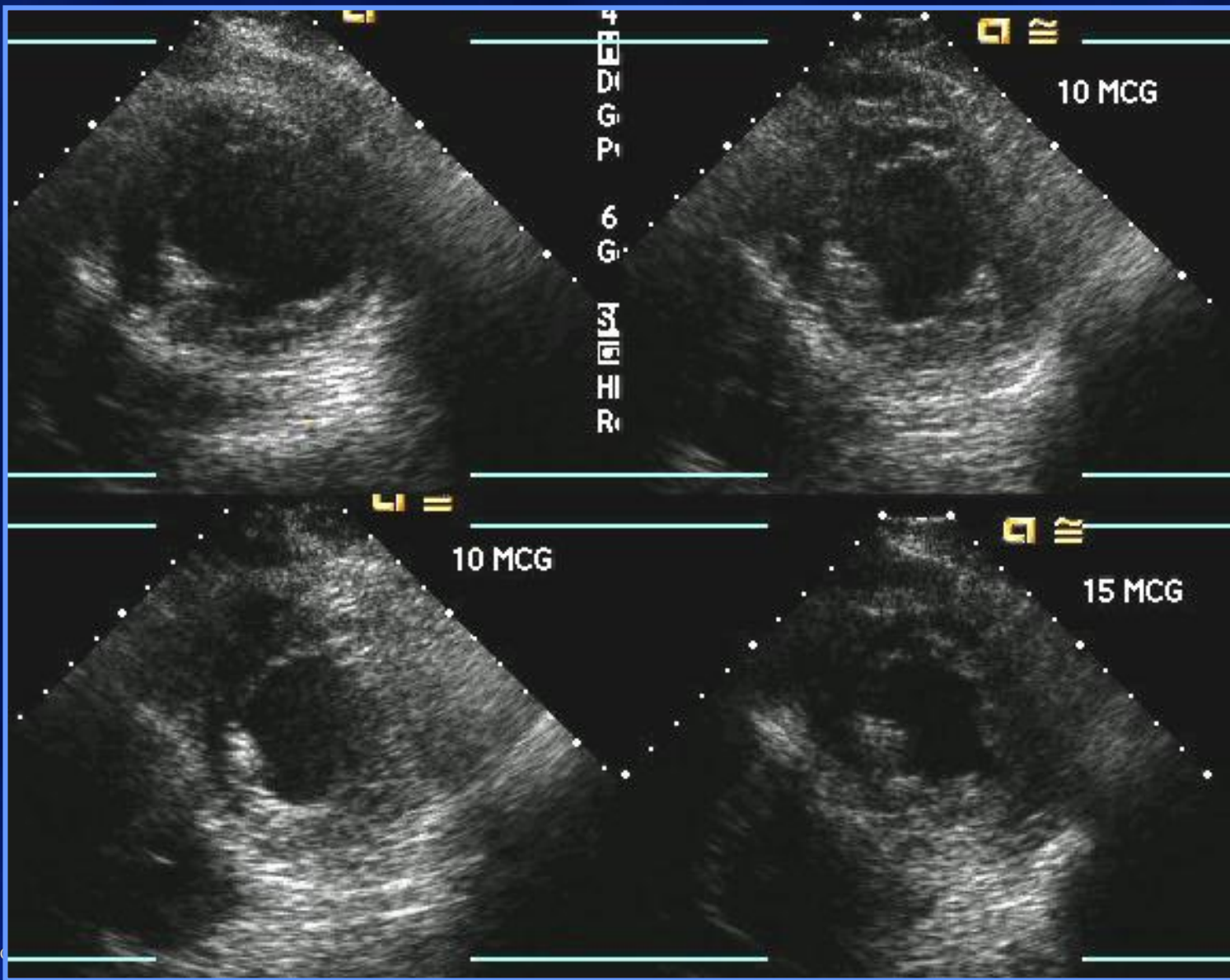
# Dobutamine Echo and Prediction of LV Recovery



# Improvement Throughout Study with Dobutamine



# Biphasic Response with Dobutamine



# Cases

1. Soccer coach receives a “red card”
2. Let Lord Murphy Reign
3. Bigger is not always better
4. Very Tight
5. Two for the price of one
6. Go With the Flow

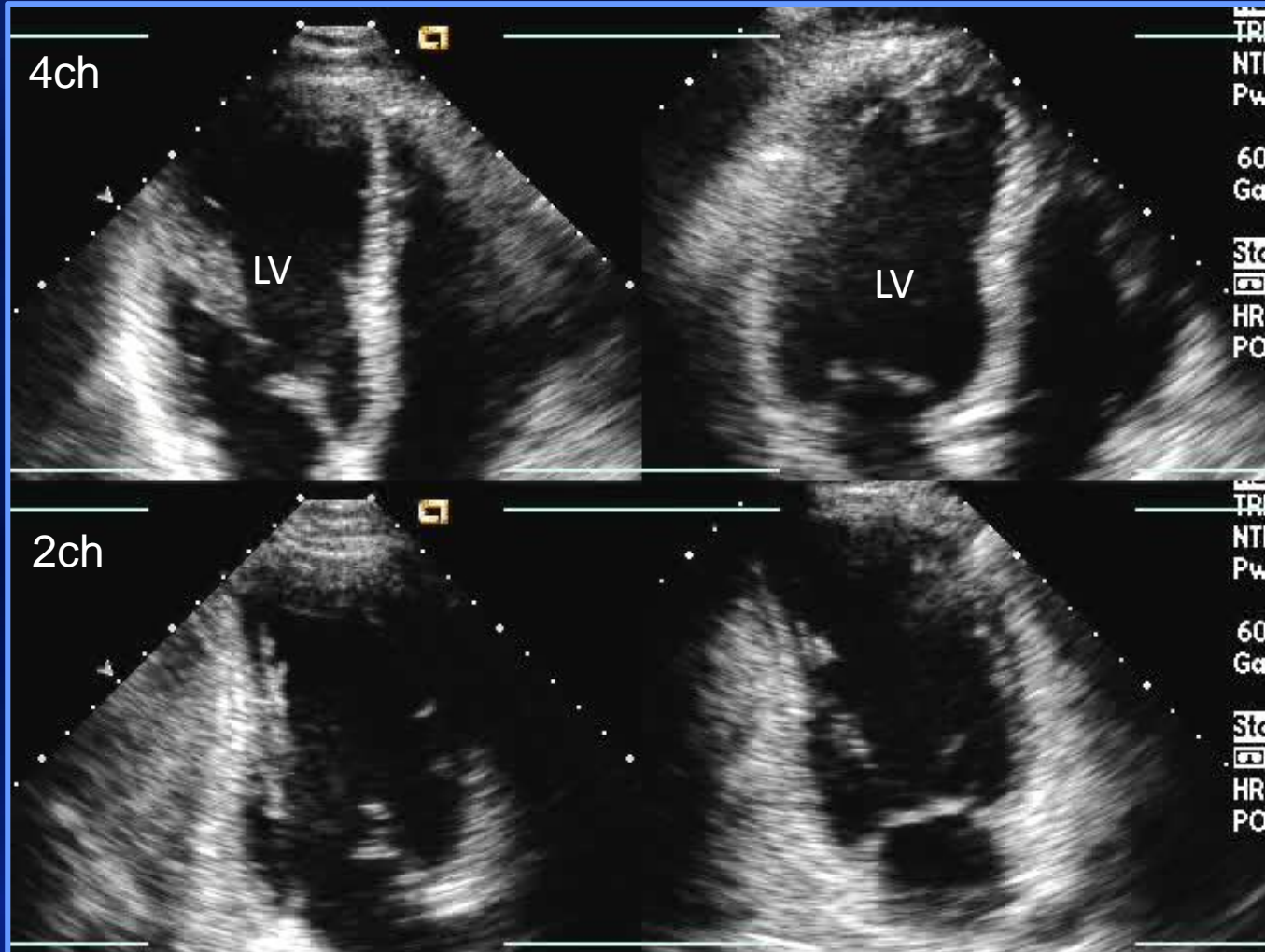
# Case: 51 yo male, soccer coach

- New onset chest pain while biking
- No CV risk factors
- Referred for Exercise Echo →
- 12 minutes on Bruce Protocol
- 118% FAC
- 13 METS
- Fatigue
- Positive ECG
- Flat BP response: 158/92 to 160/84 mmHg

# Exercise Echo

Rest

Exercise

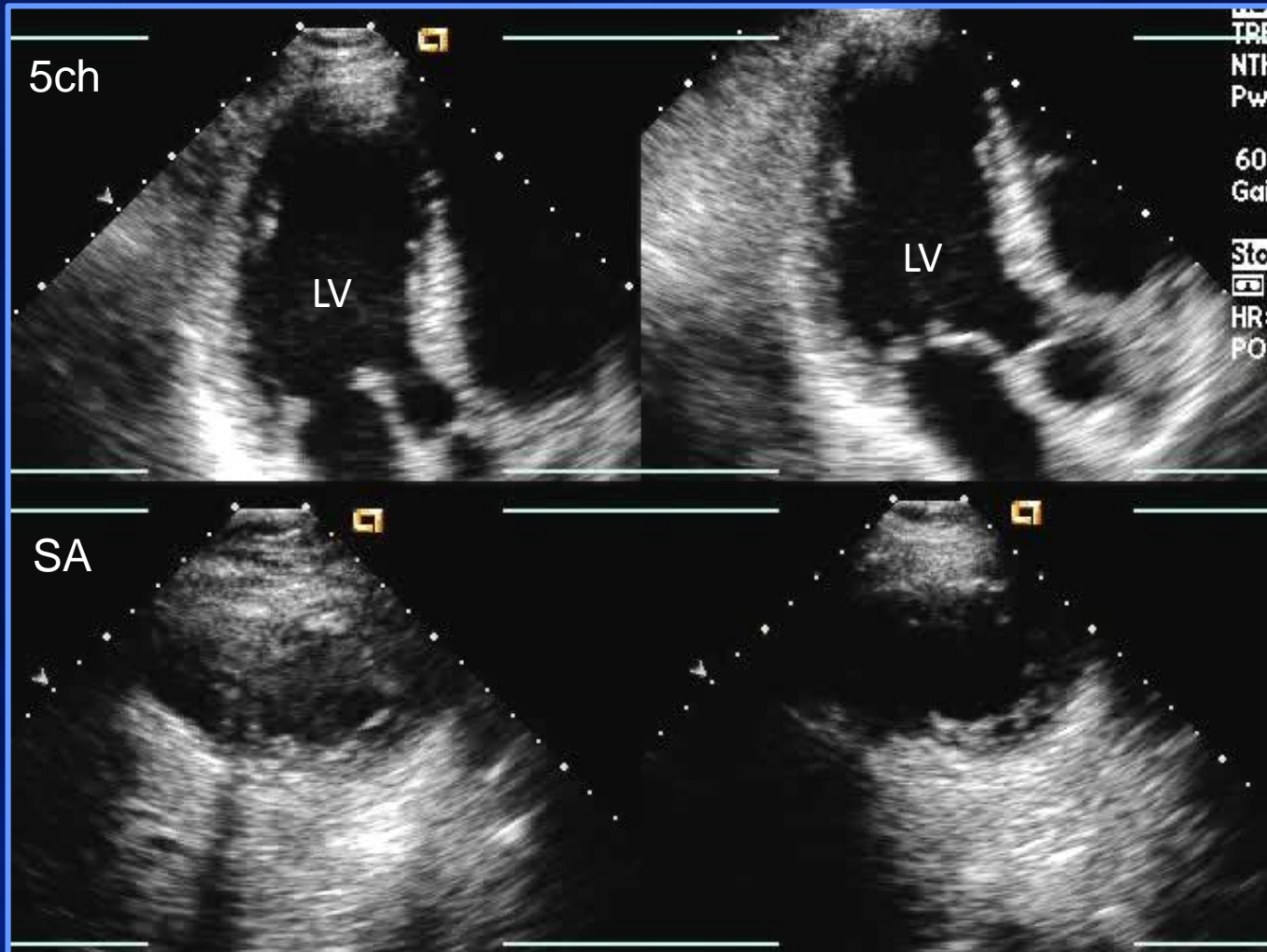




# Exercise Echo

Rest

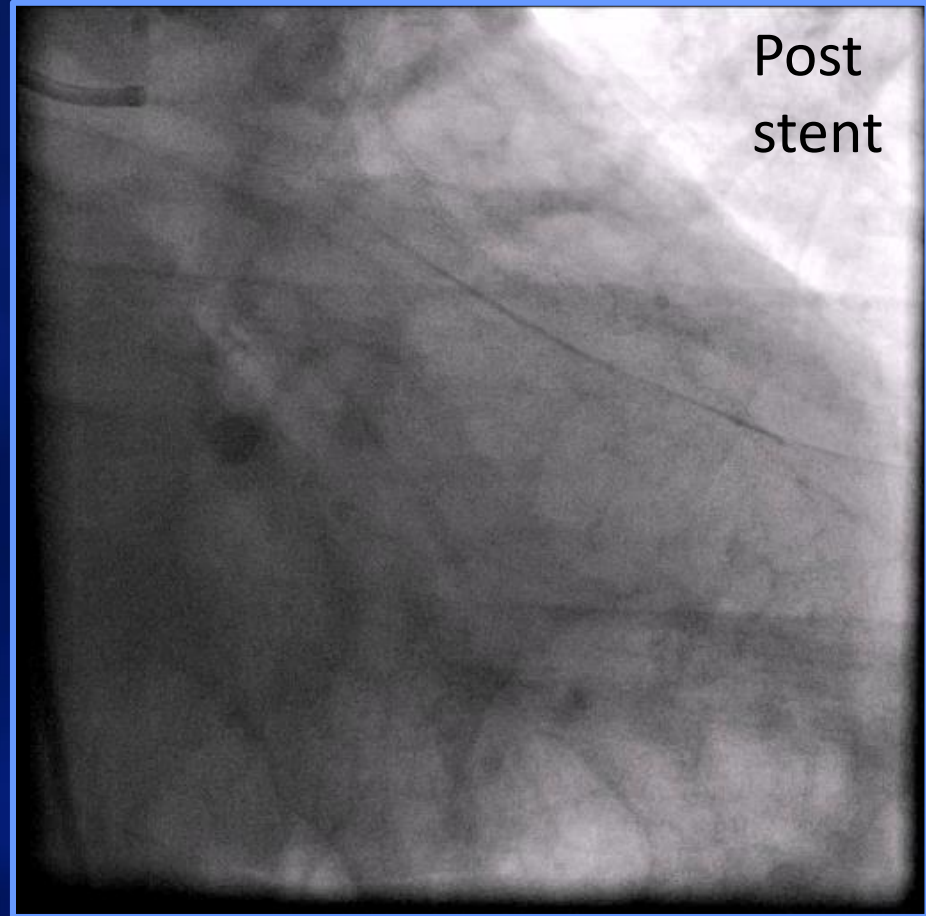
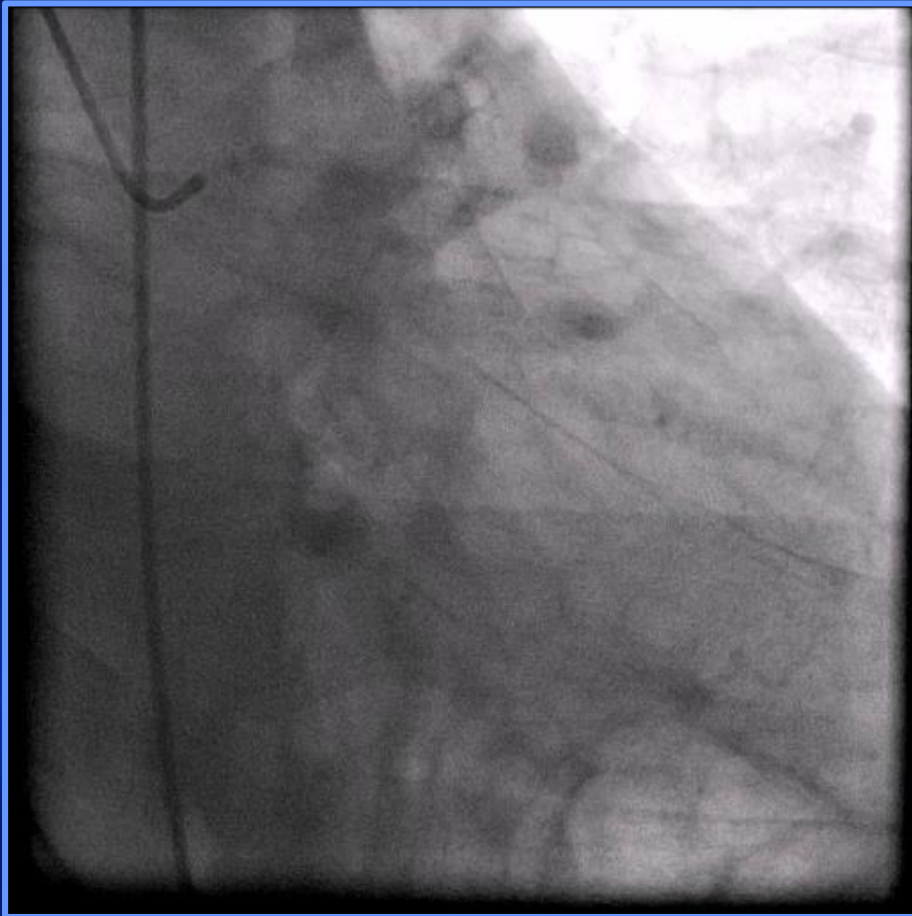
Exercise



# What does the Exercise Echo show?

1. Normal
2. Inferior ischemia
3. Circumflex ischemia
4. LAD ischemia
5. Multivessel disease

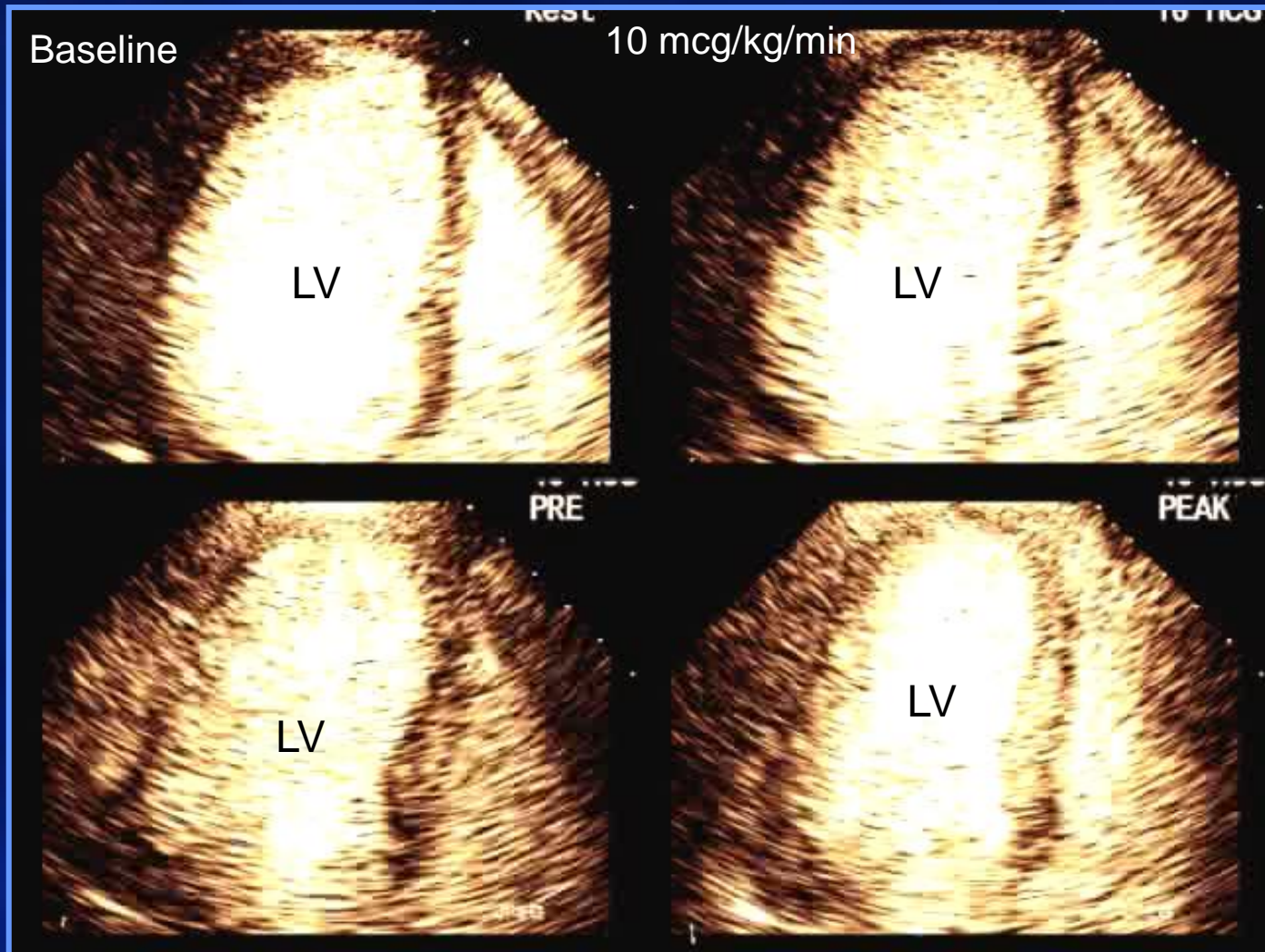
# Catheterization



## Case: 67 yo male

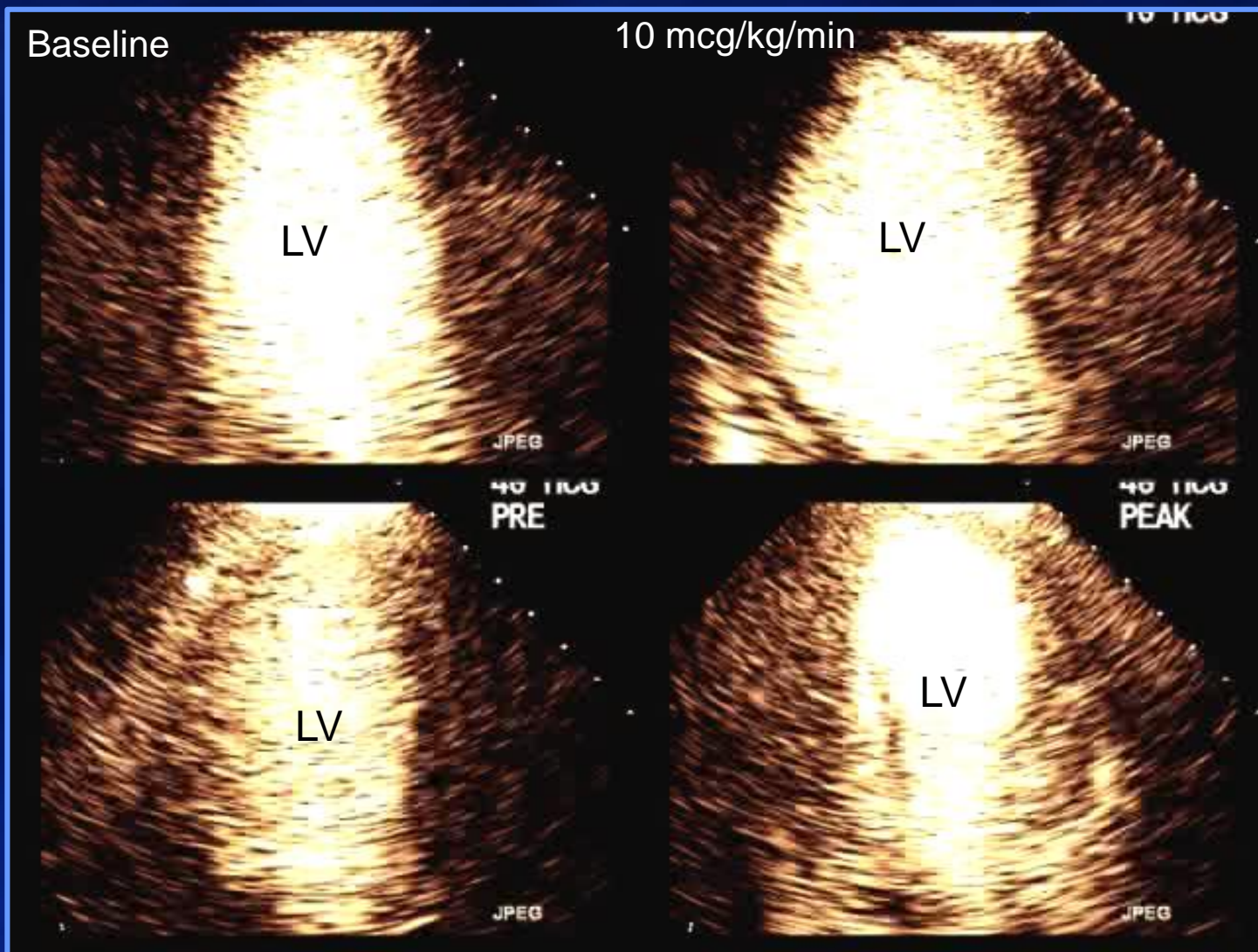
- Referred for pre-op clearance for 7 cm Thoracic Aortic Aneurysm repair
- No cardiac hx (no CP, no dyspnea)
- HTN, hyperlipidemia, obesity, ex-smoker
- Sedentary lifestyle
  - exercise involves getting up from sofa to get TV remote controller
- Referred for dobutamine stress echo

# Dobutamine Stress Echo 4 Ch View

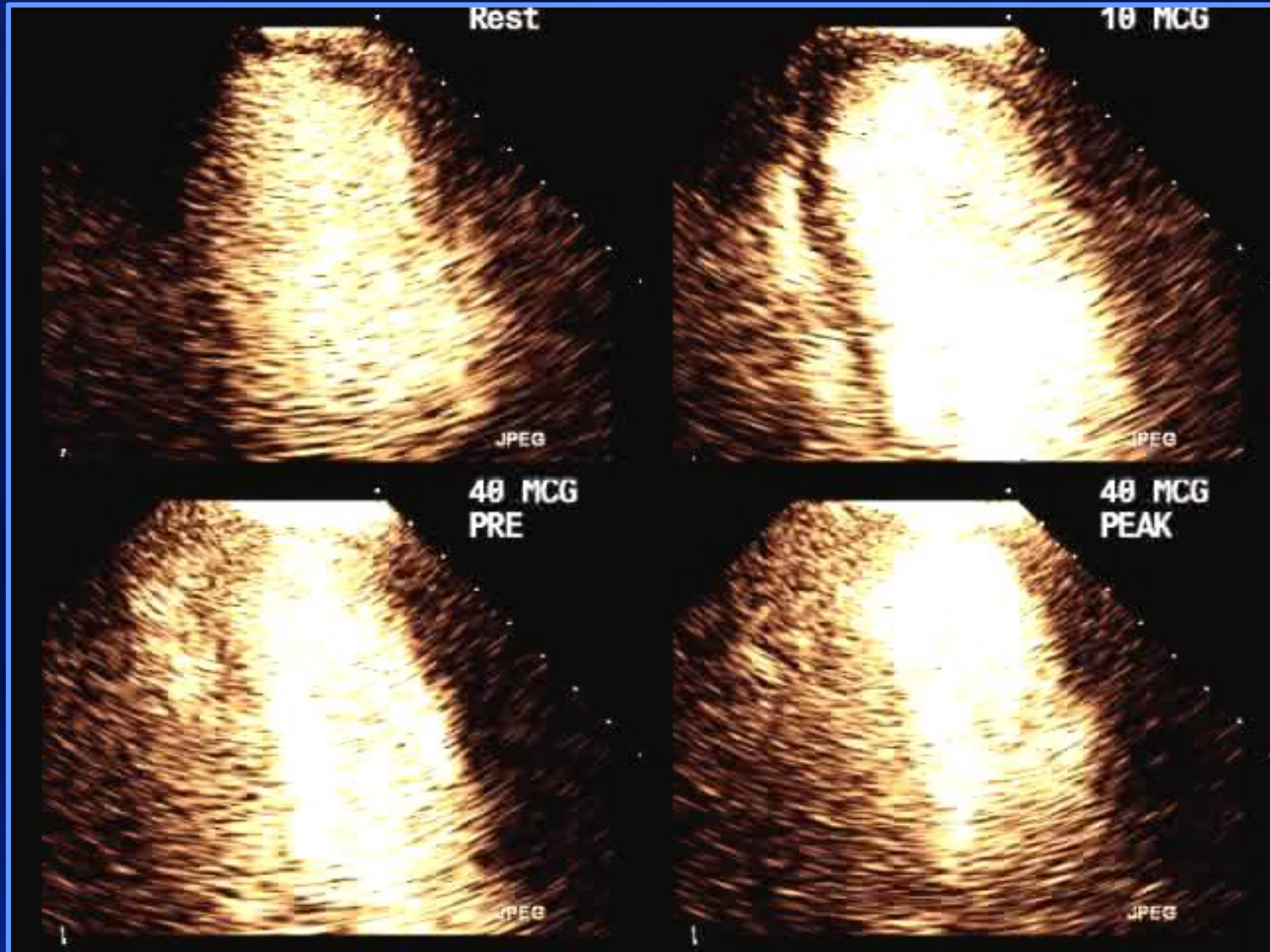


# Dobutamine Stress Echo

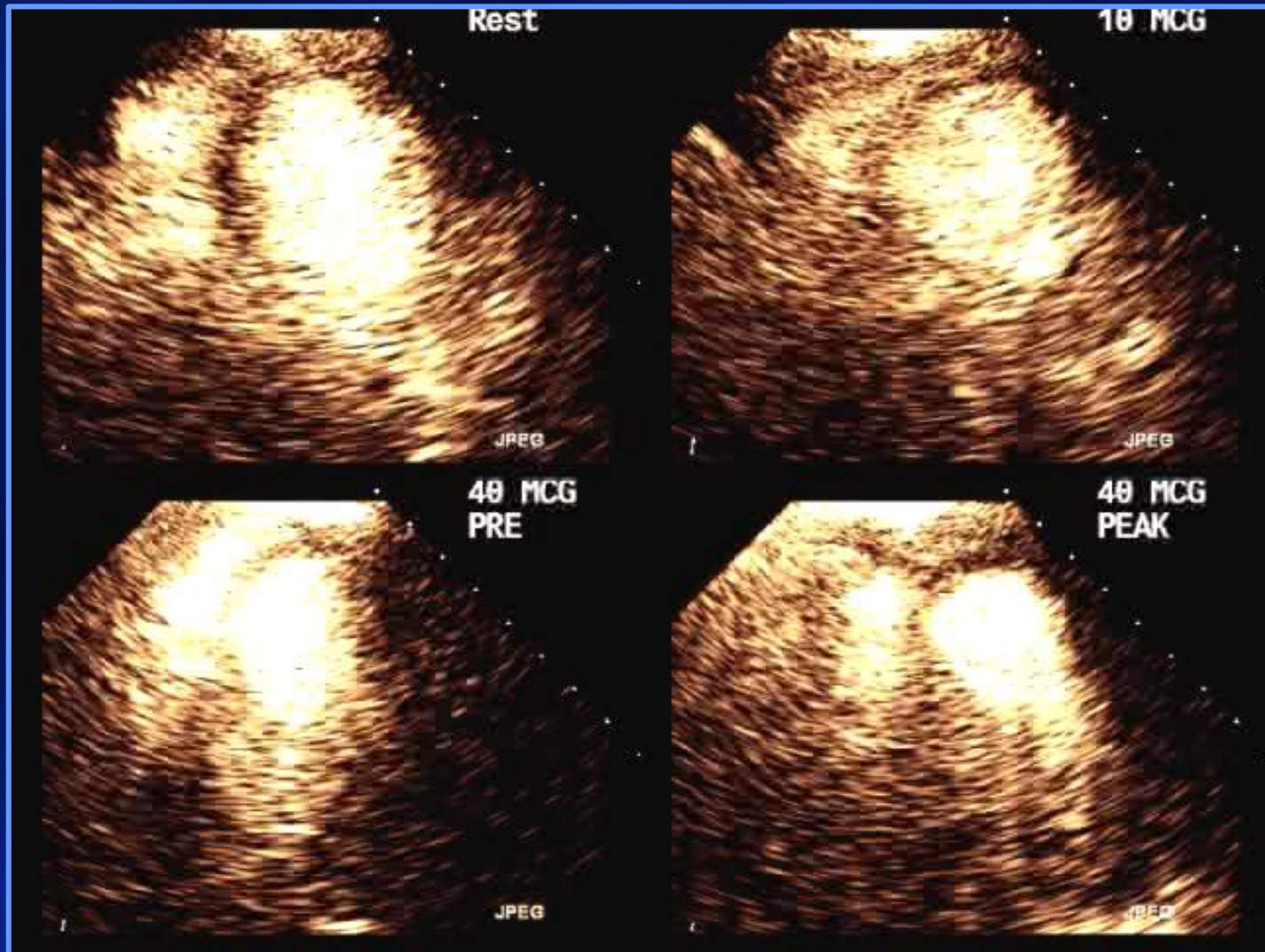
## 3 Ch View



# Dobutamine Stress Echo 2 Ch View



# Dobutamine Stress Echo Short Axis View

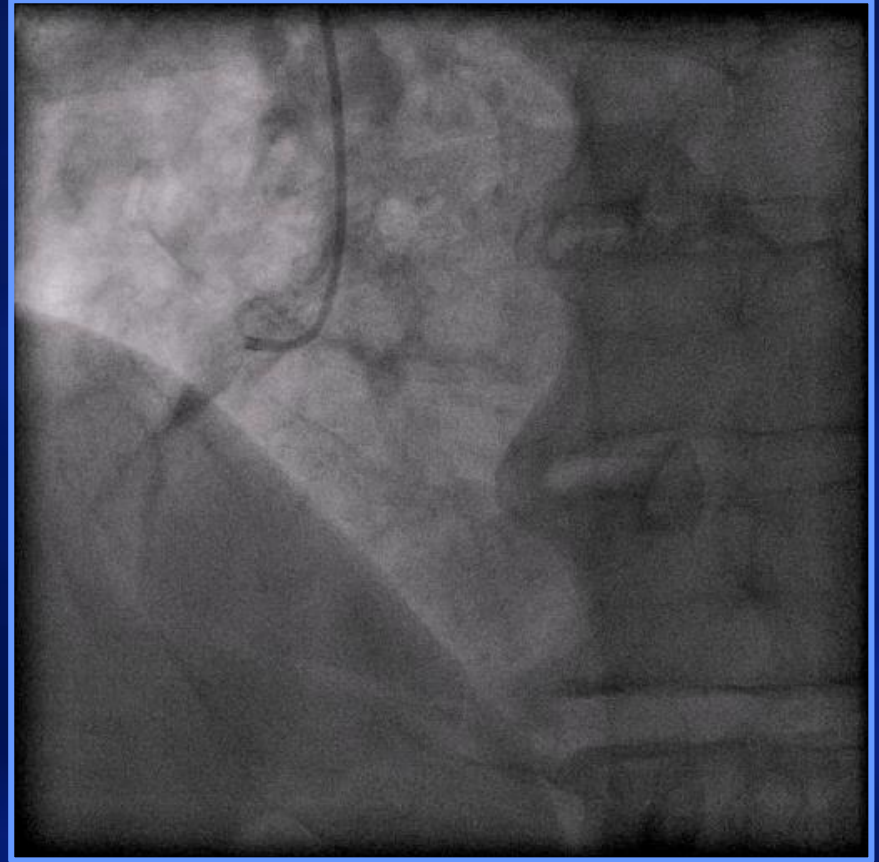
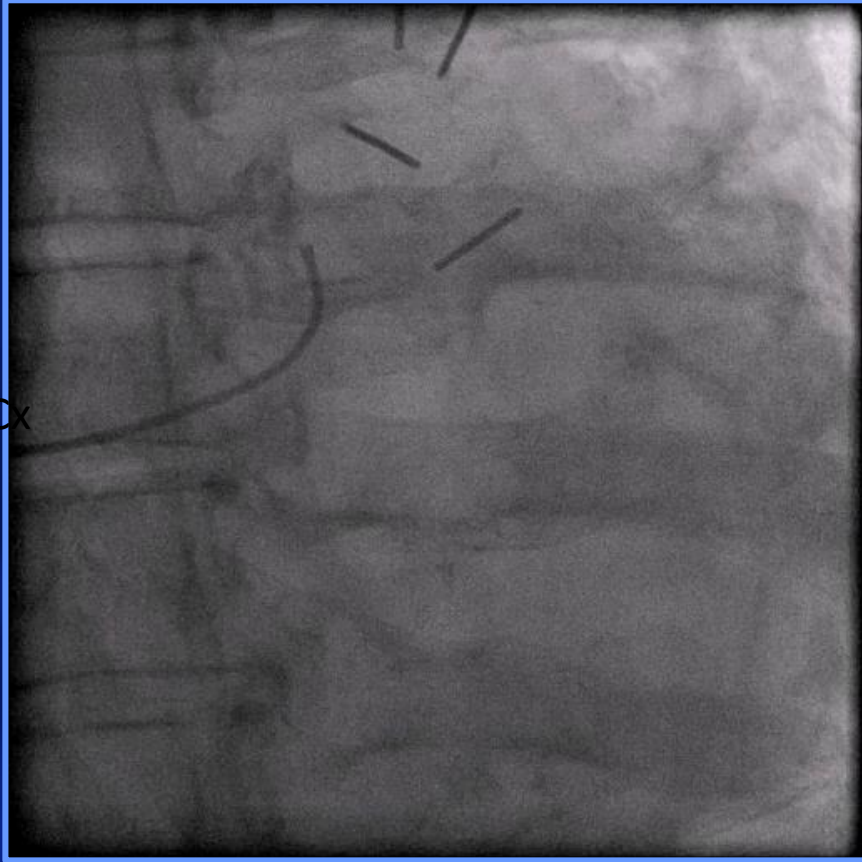




# What does the DSE show?

1. Normal
2. Inferior, Inferolateral Ischemia
3. Anterior ischemia
4. Apical ischemia

# Cath



# 67 yo male pre-op for TAA repair

- Multivessel CAD, diffuse disease
  - Medical Rx
- TAA repair → 28-mm woven Hemashield graft
- Rocky post-op course; delayed extubation, afib, elevated troponin, worsening of inferolateral RWMA on echo
- d/c'd after 16 day hospitalization
- 1 yr later: dx'd with metastatic stomach CA → Hospice



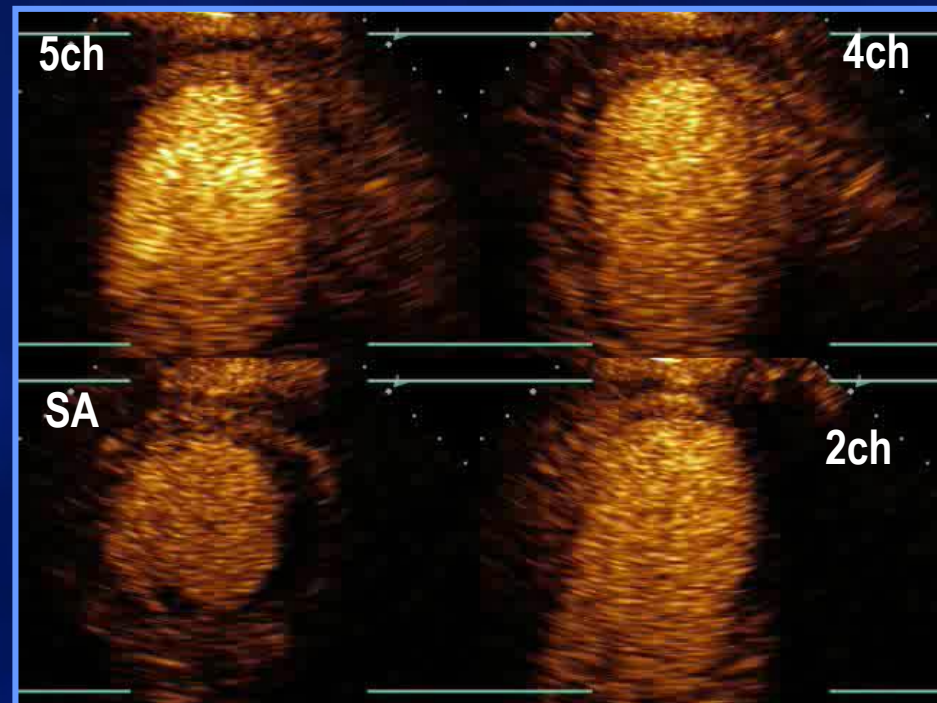
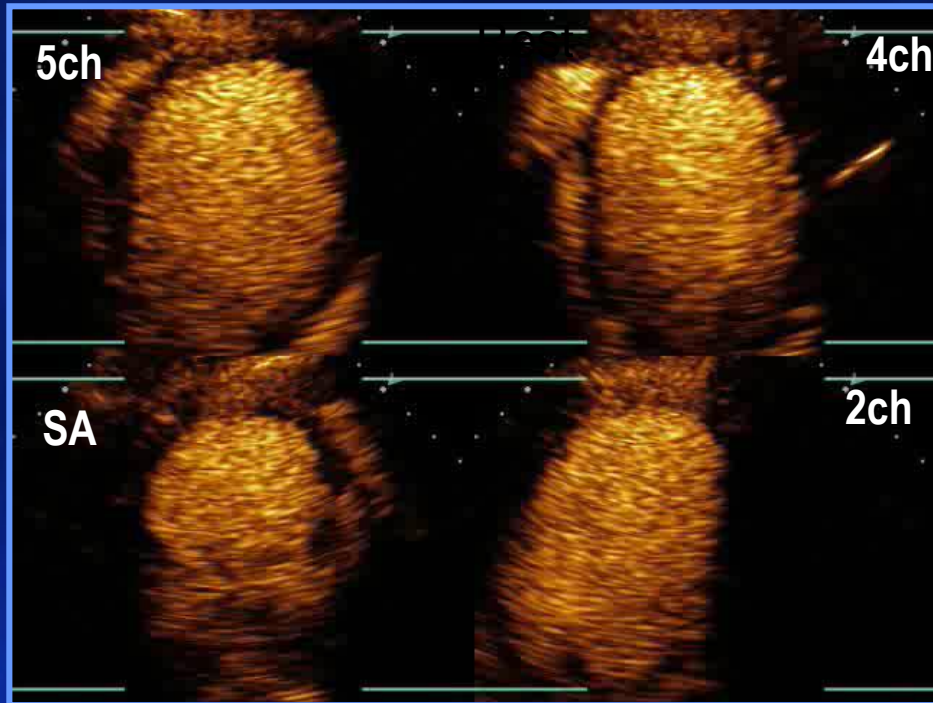
# 70 year old male with dyspnea on exertion

- PMH
  - DM
  - HTN
  - Hyperlipidemia
- Referred for exercise echo

# Exercise Echocardiogram

Immediately Post-exercise

Rest



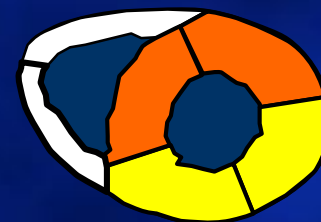
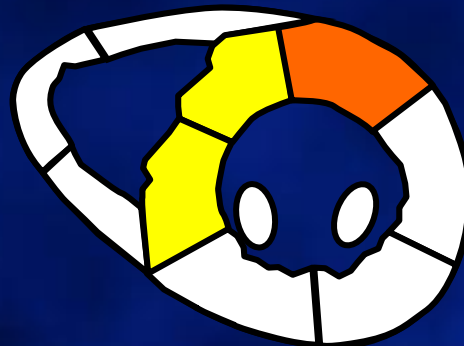
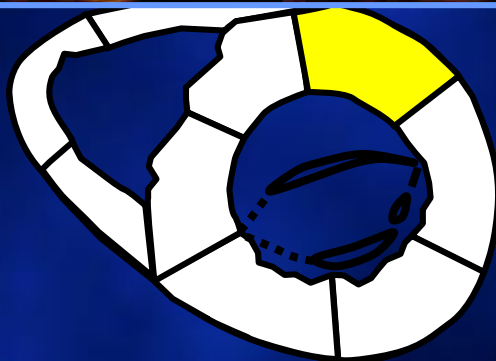
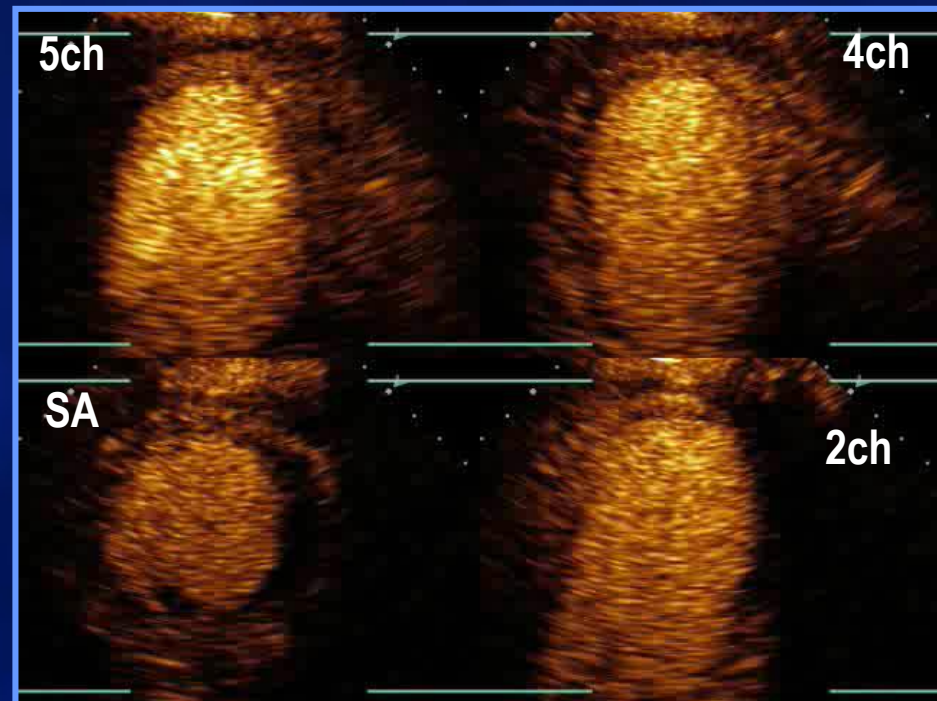
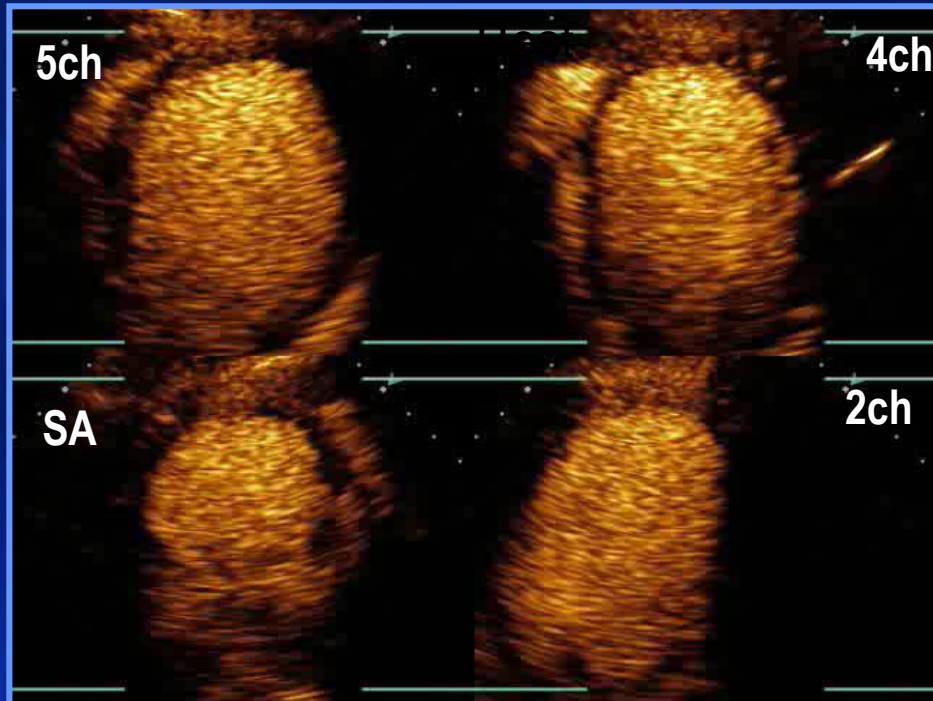
# What does the DSE show?

1. Normal
2. RCA ischemia
3. Circumflex ischemia
4. Multivessel ischemia

# Exercise Echocardiogram

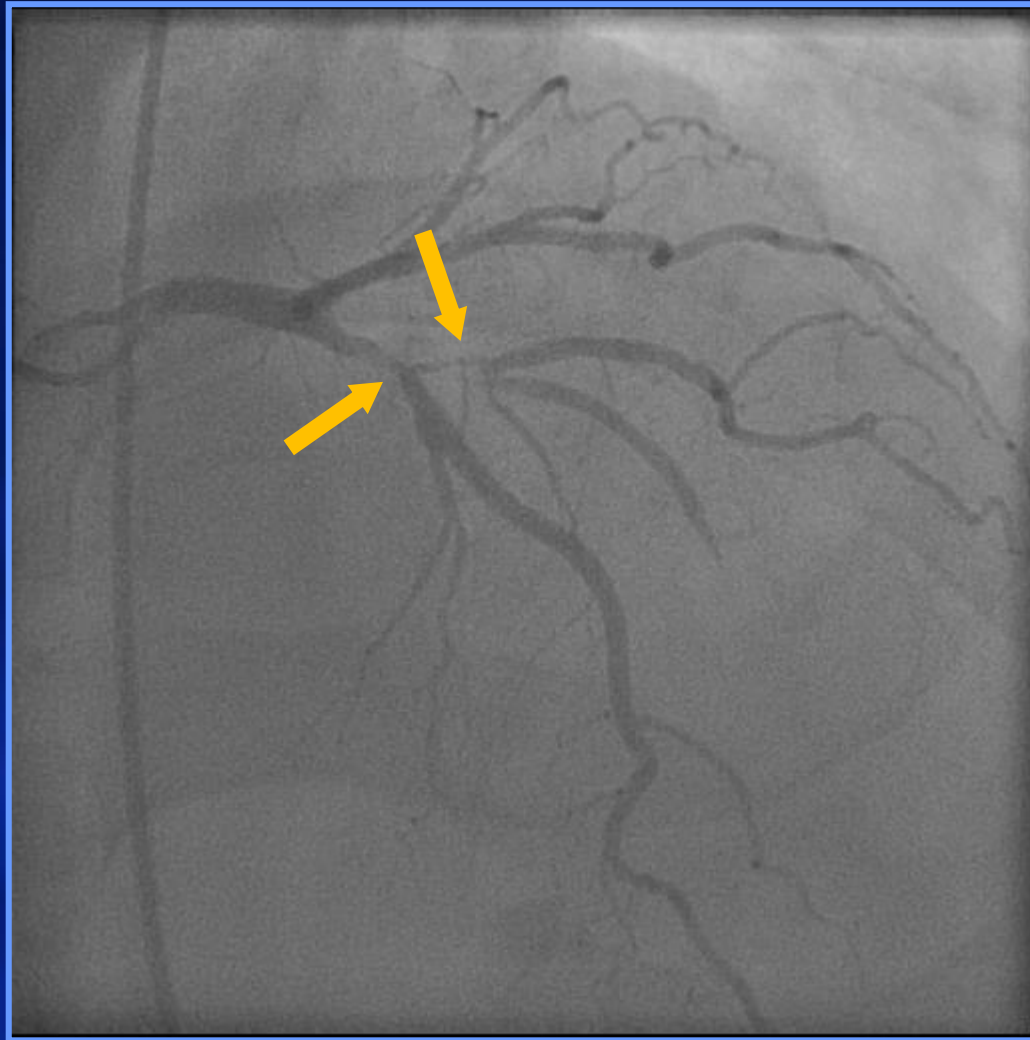
Immediately Post-exercise

Rest



LVEF: 60 to 50%  
LV size: Dilatation

# High grade stenosis of the left anterior descending and 1st diagonal coronary arteries

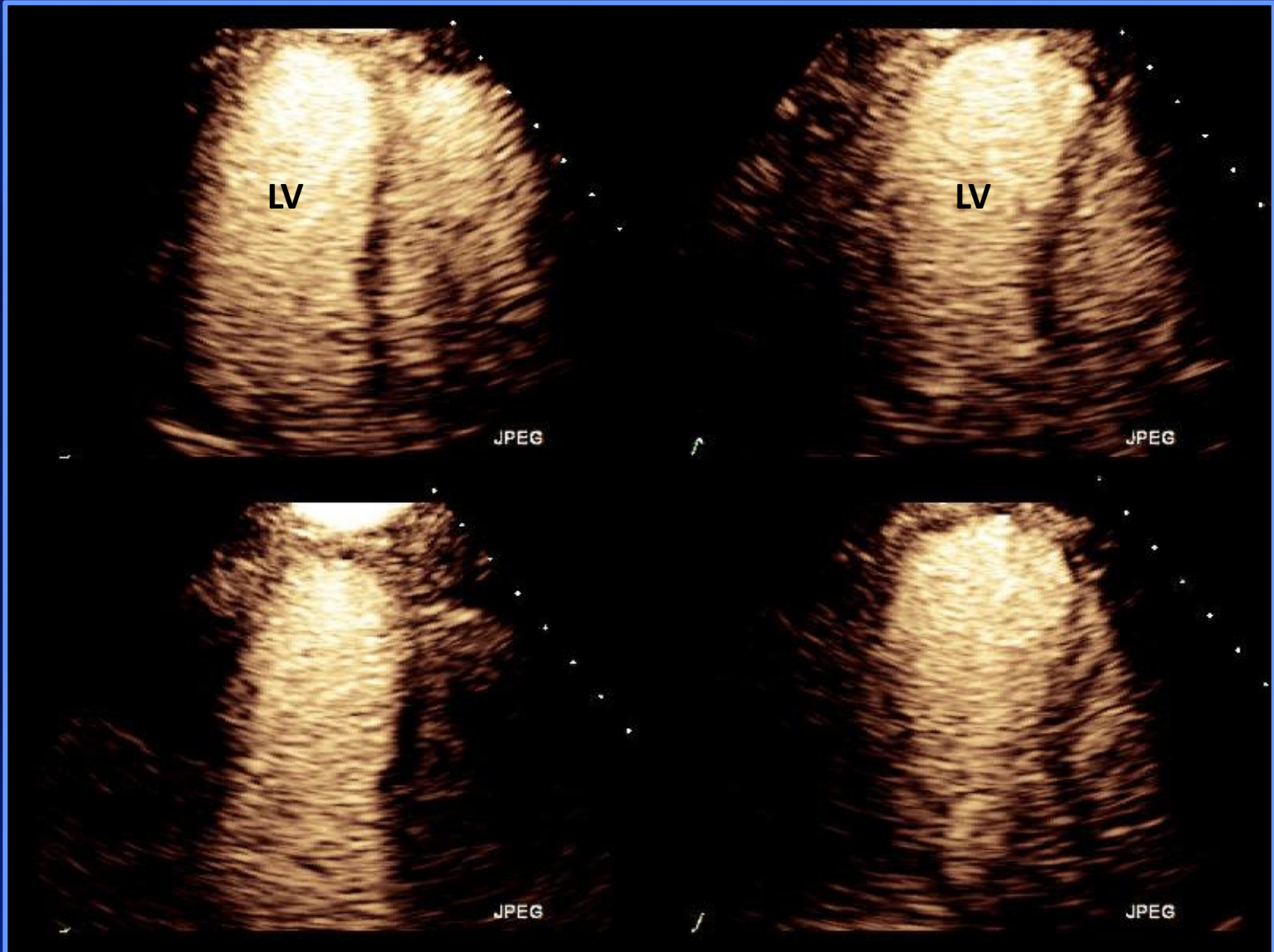




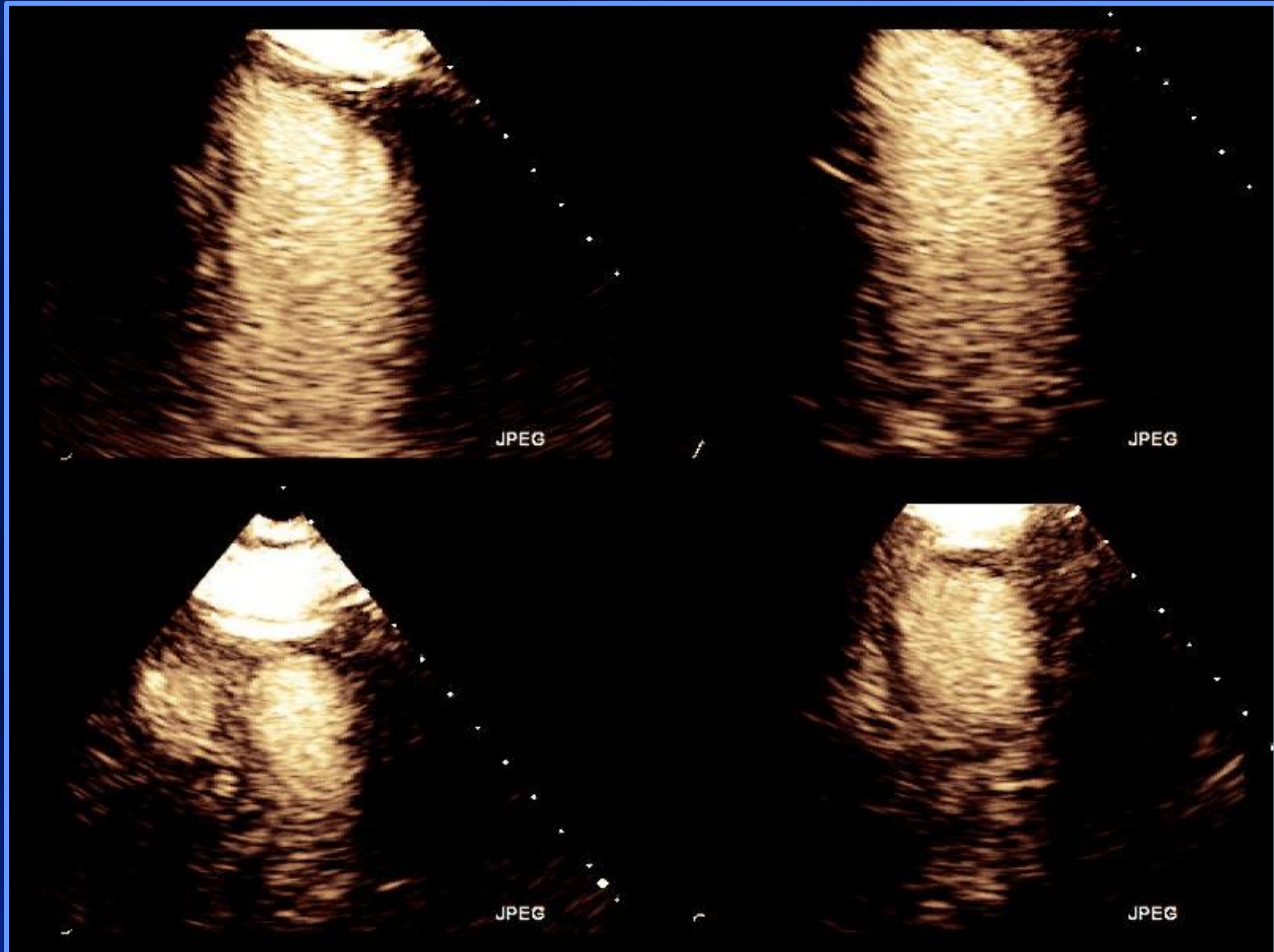
# 40 Year Old Executive Male

- “Heartburn” and eructation with exertion
- HTN
- Hyperlipidemia
- Smoker
- Referred for exercise echo
  - 6 minutes on Bruce Protocol
  - “heartburn” and positive EKG changes

# Exercise Echocardiogram



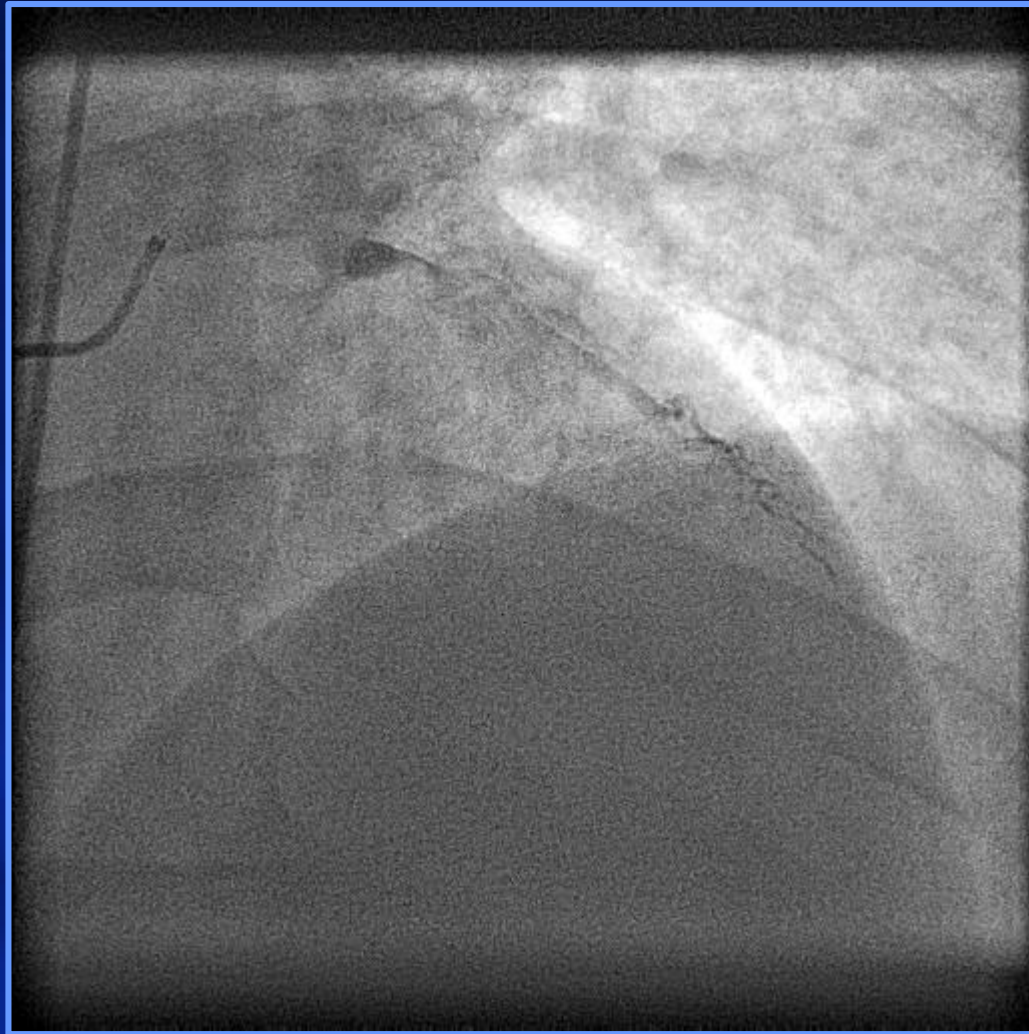
# Exercise Echocardiogram



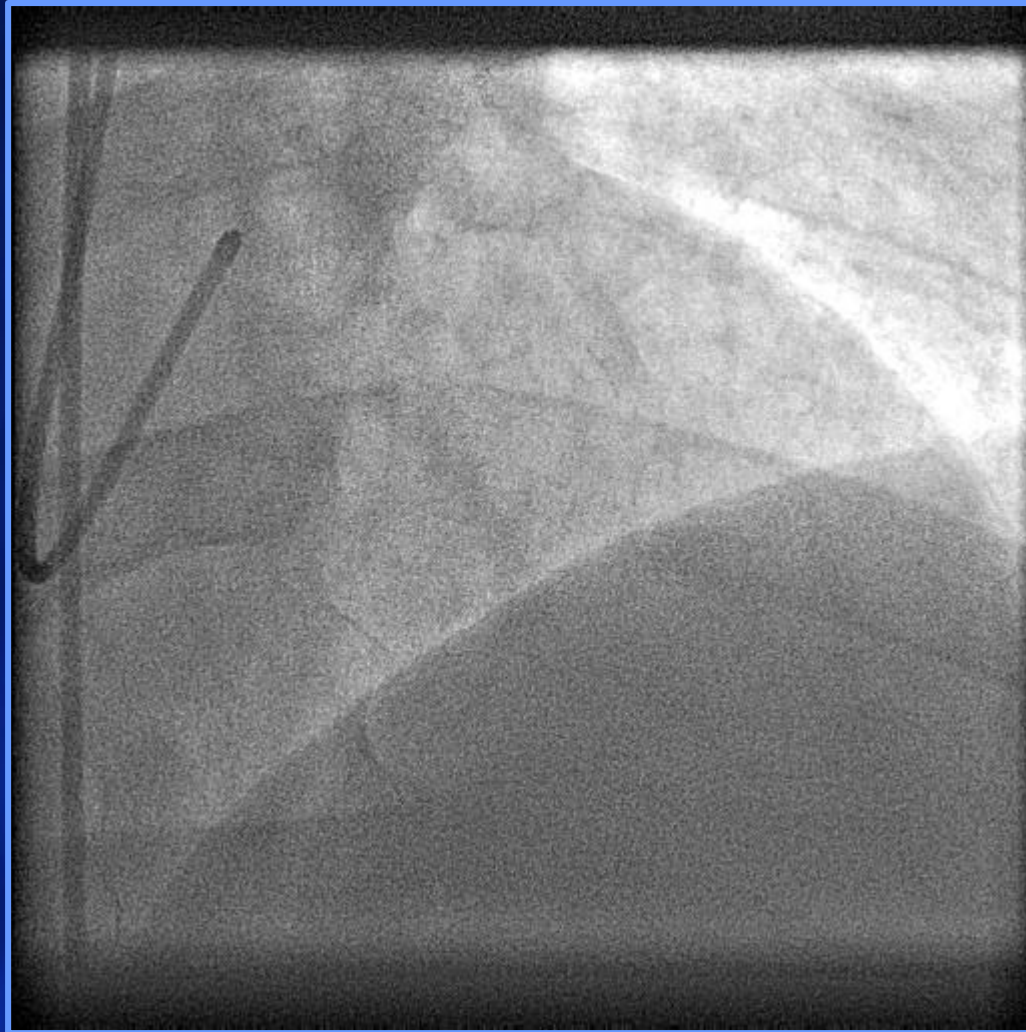
# What does the DSE show?

1. Normal
2. RCA ischemia
3. Circumflex ischemia
4. LAD ischemia

# Cath



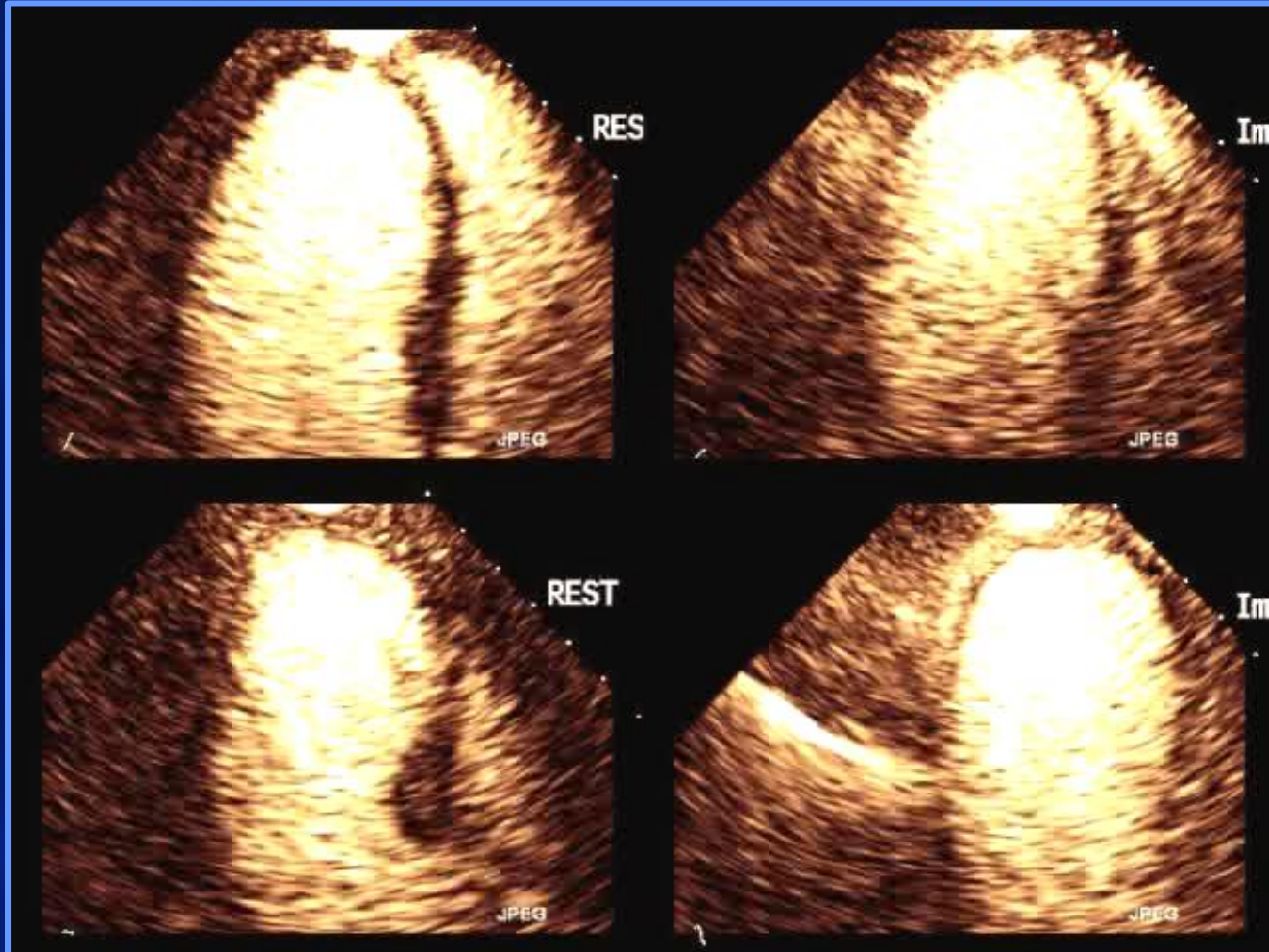
# Cath: Post Stenting



# 64 yo male, engineer from Bagdad with chest pain

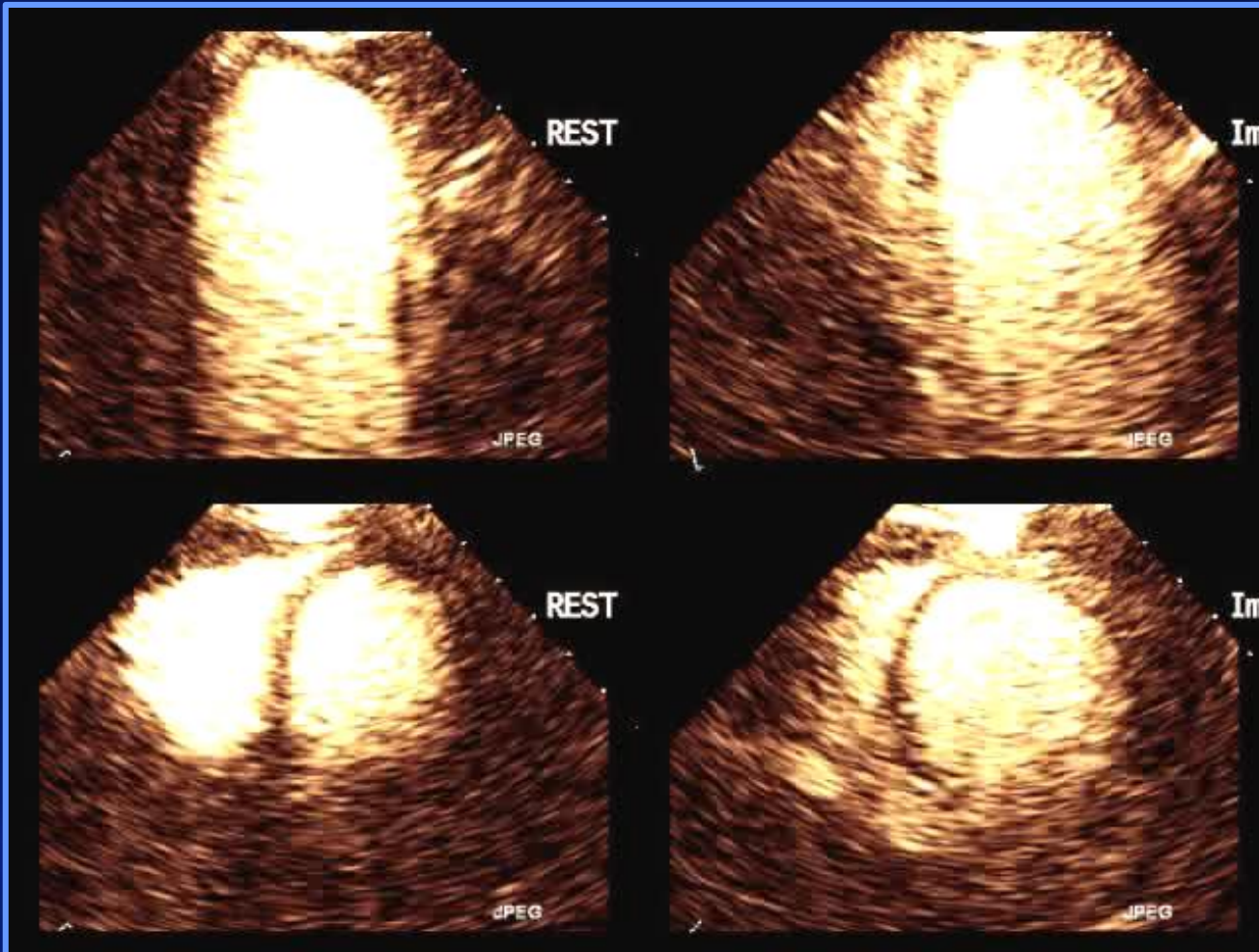
- Hx PTCA, DES to D1 and LAD
- ASA, Plavix, Cardiac rehab
- Returns 1 yr later; asymptomatic, but sedentary, “wants” ex echo
- ? Medication compliance

# 64 yo male, engineer, Hx stent to D1/LAD





# 64 yo male, engineer with chest pain



# What does the DSE show?

1. Normal
2. RCA ischemia
3. Circumflex ischemia
4. LAD/D1 ischemia
5. Non-diagnostic study

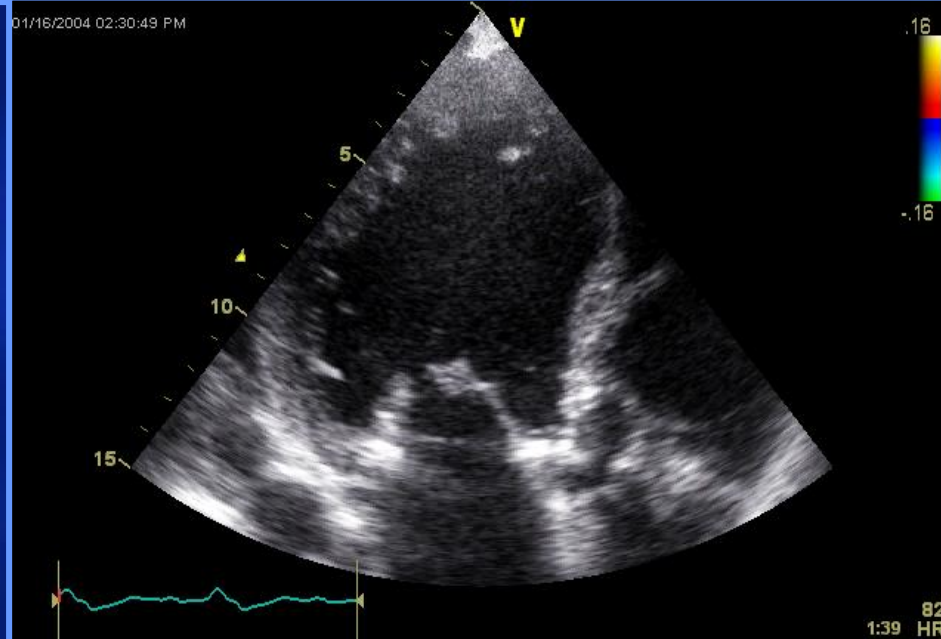
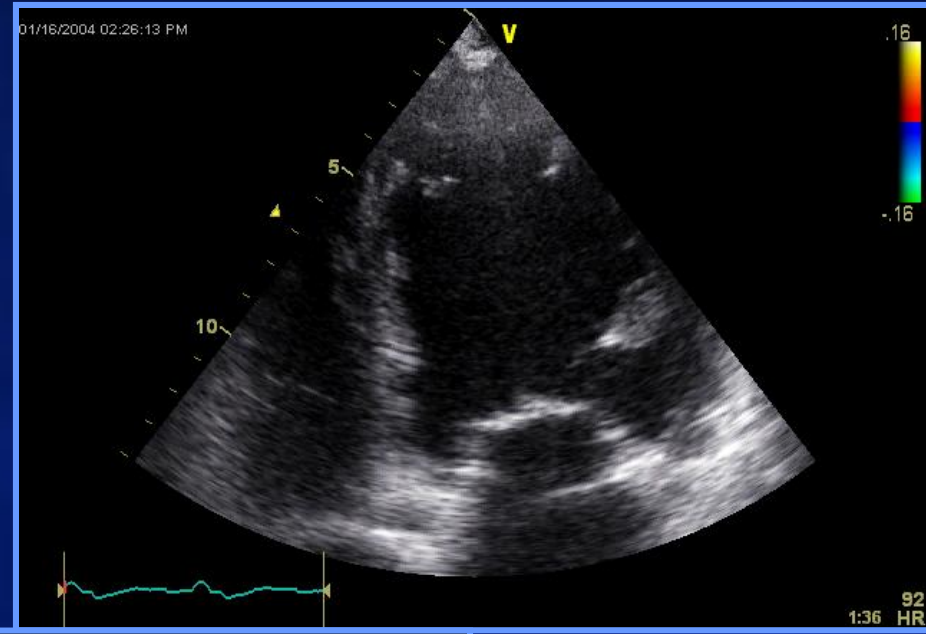
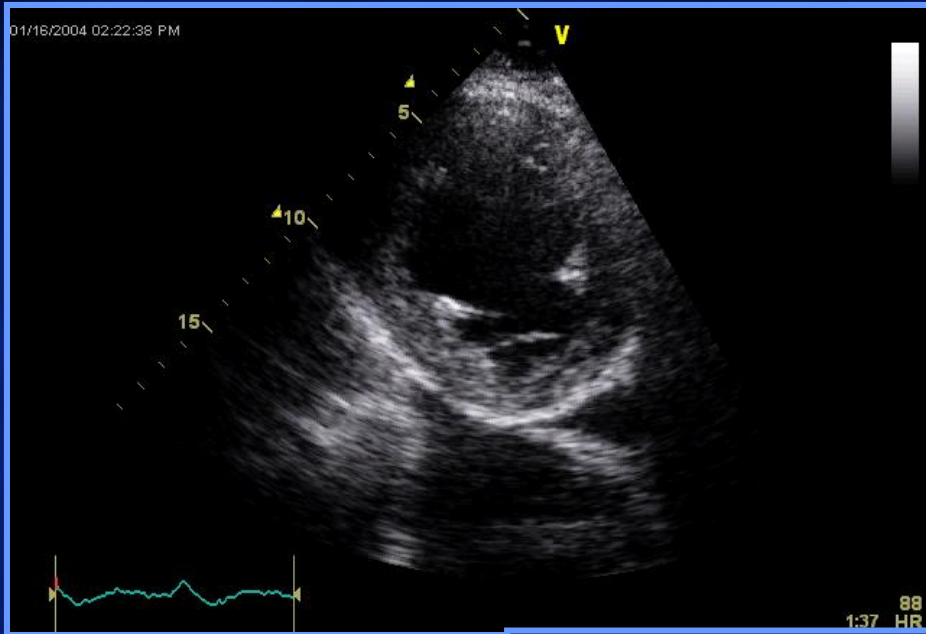
# What does the cath show?



# Case

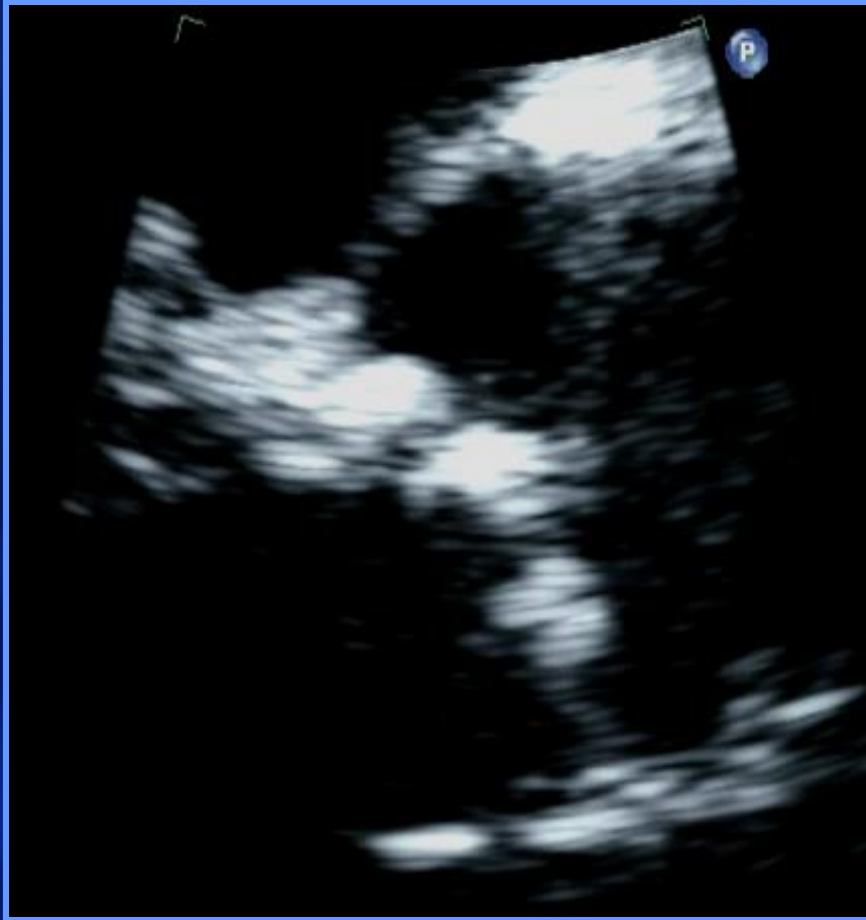
- 70 year old male
- PMH: Anteroapical MI, CABG after MI
- ICD placed: NSVT, EF 30%
- Asymptomatic for 5 years
- Now presents with CHF, NYHA class III
- Physical Exam:
  - Grade 3/6 late peaking SEM
  - Diminished carotid upstroke
  - Single component S2

# 2D Echo: Severe LV Dysfunction



EF: 20%

# Aortic Valve

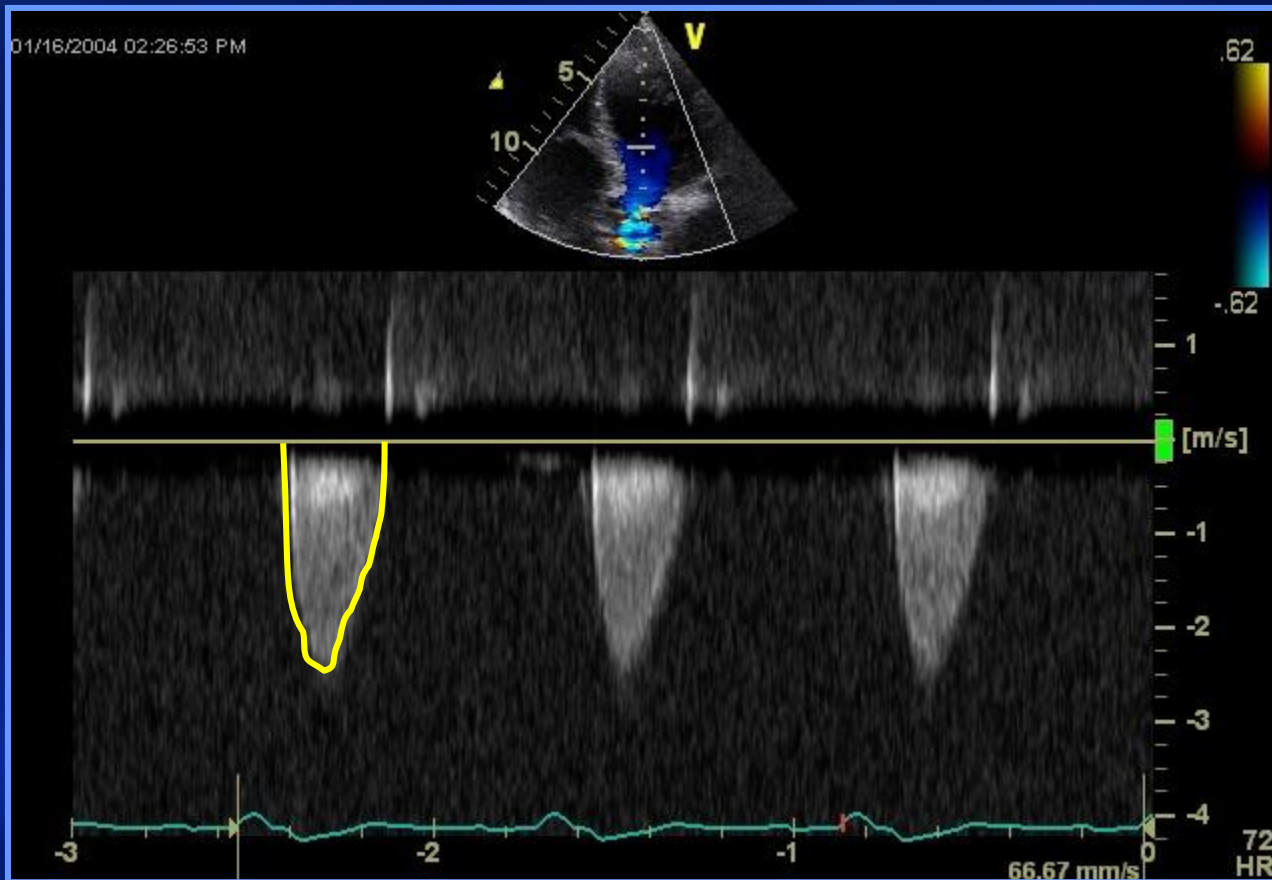


Parasternal Long-Axis



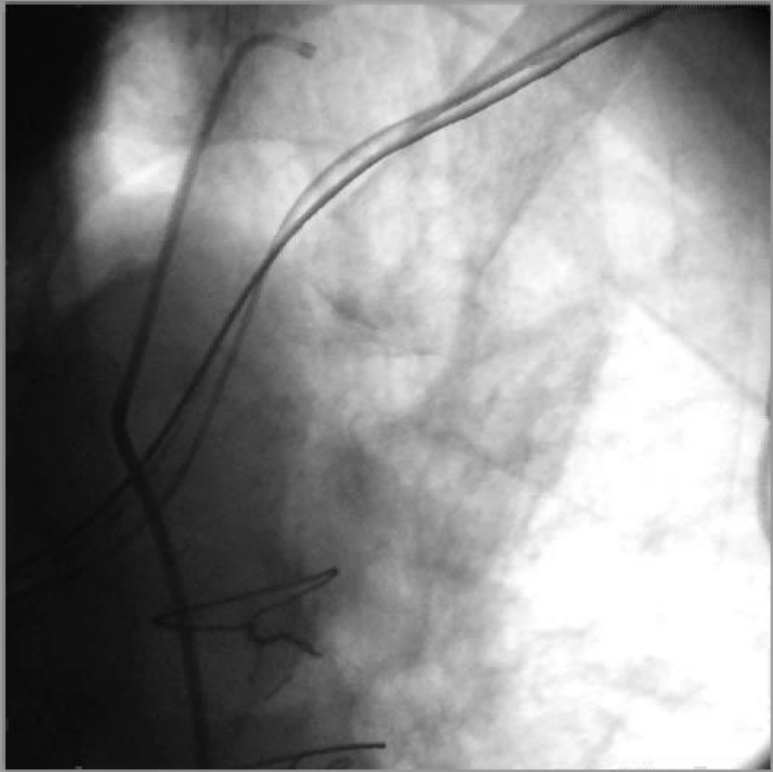
Parasternal Short-Axis

# Aortic Valve Gradient



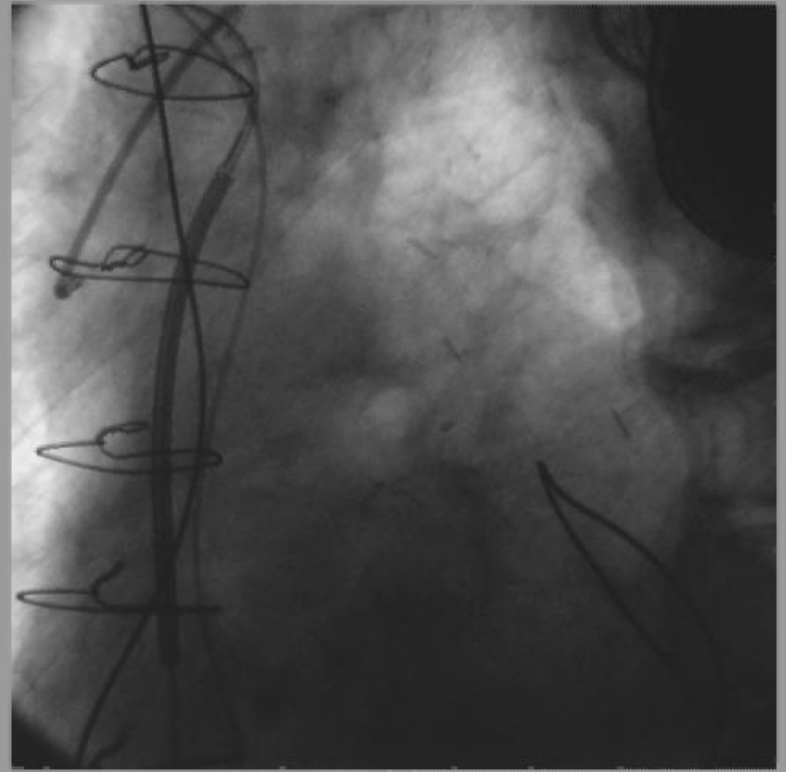
Pk Gr = 27 mmHg  
Mn Gr = 14 mmHg  
AVA = 0.8 cm<sup>2</sup>

# Coronary Angiogram



## Patent LIMA

- Occluded LAD
- 90% proximal Left Circumflex stenosis
- No significant disease in RCA
- **Viability Study:** Apical scar, all other areas viable



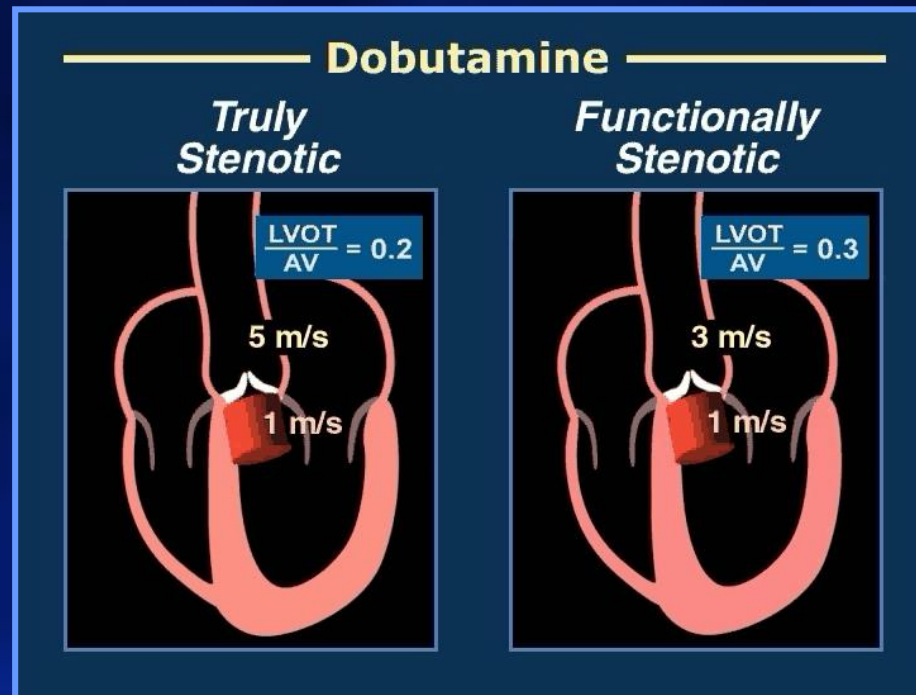
## Patent SVG to OM1



# Question

- **What would you do next?**
  - A. Aortic valvuloplasty
  - B. Refer to CT Surgery for AVR
  - C. Dobutamine stress study
  - D. Prayer

# Dobutamine in Low Gradient-Low EF Aortic Stenosis



- “True” severe AS
  - $\uparrow$  SV,  $\uparrow$  transvalvular gradient; No change in calculated AVA
    - remains in severe range
- “Pseudo” severe AS
  - $\uparrow$  SV and  $\uparrow$  AVA; No significant  $\Delta$  transvalvular gradient

# Pseudo Aortic Stenosis

Baseline

Dobutamine

AVA

$0.8 \text{ cm}^2 \rightarrow 1.3 \text{ cm}^2$

Stroke volume

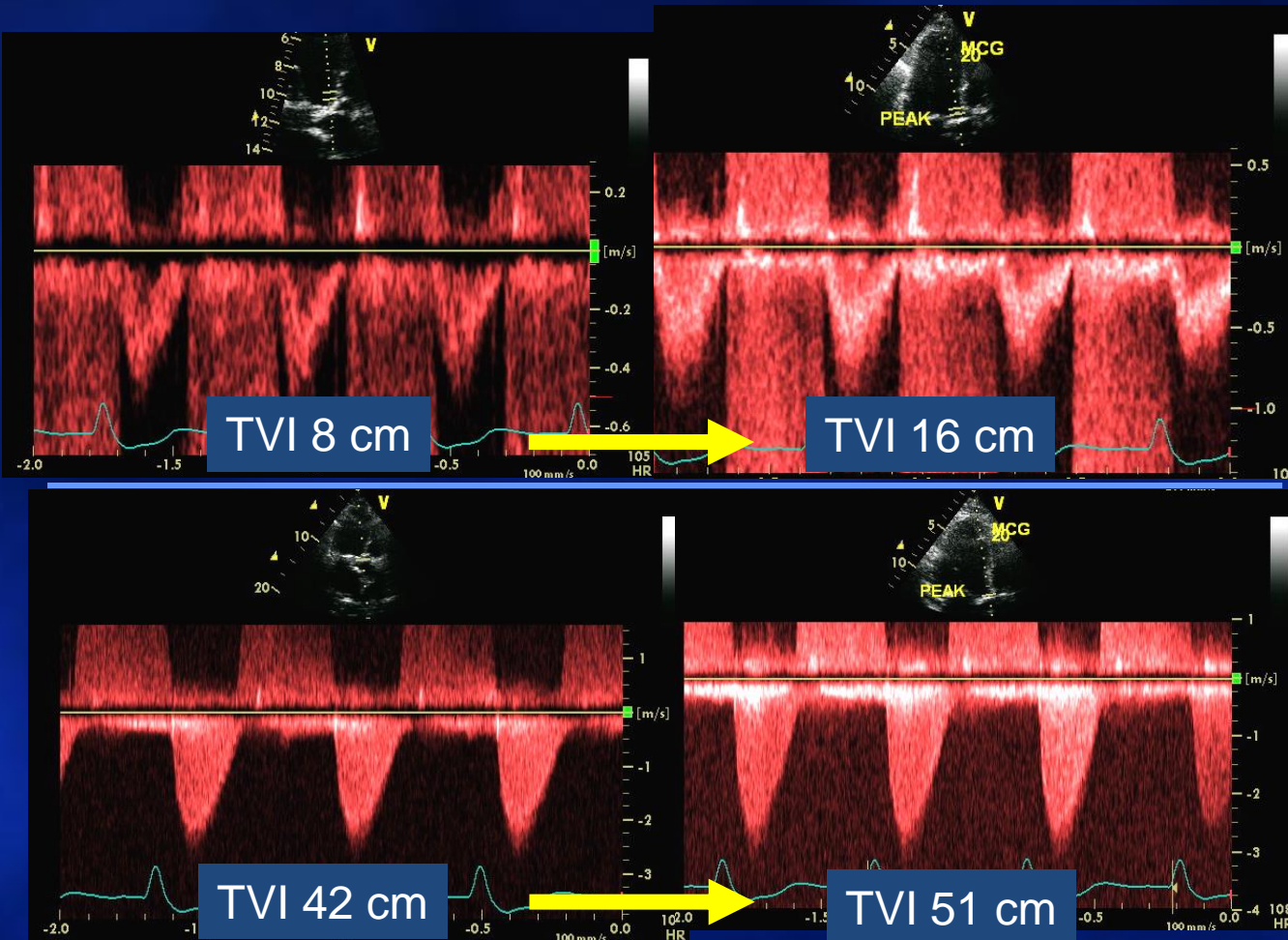
$30 \rightarrow 60 \text{ cc}$

Mean gradient

$13 \rightarrow 19 \text{ mmHg}$

Dimensionless  
Index = 0.19

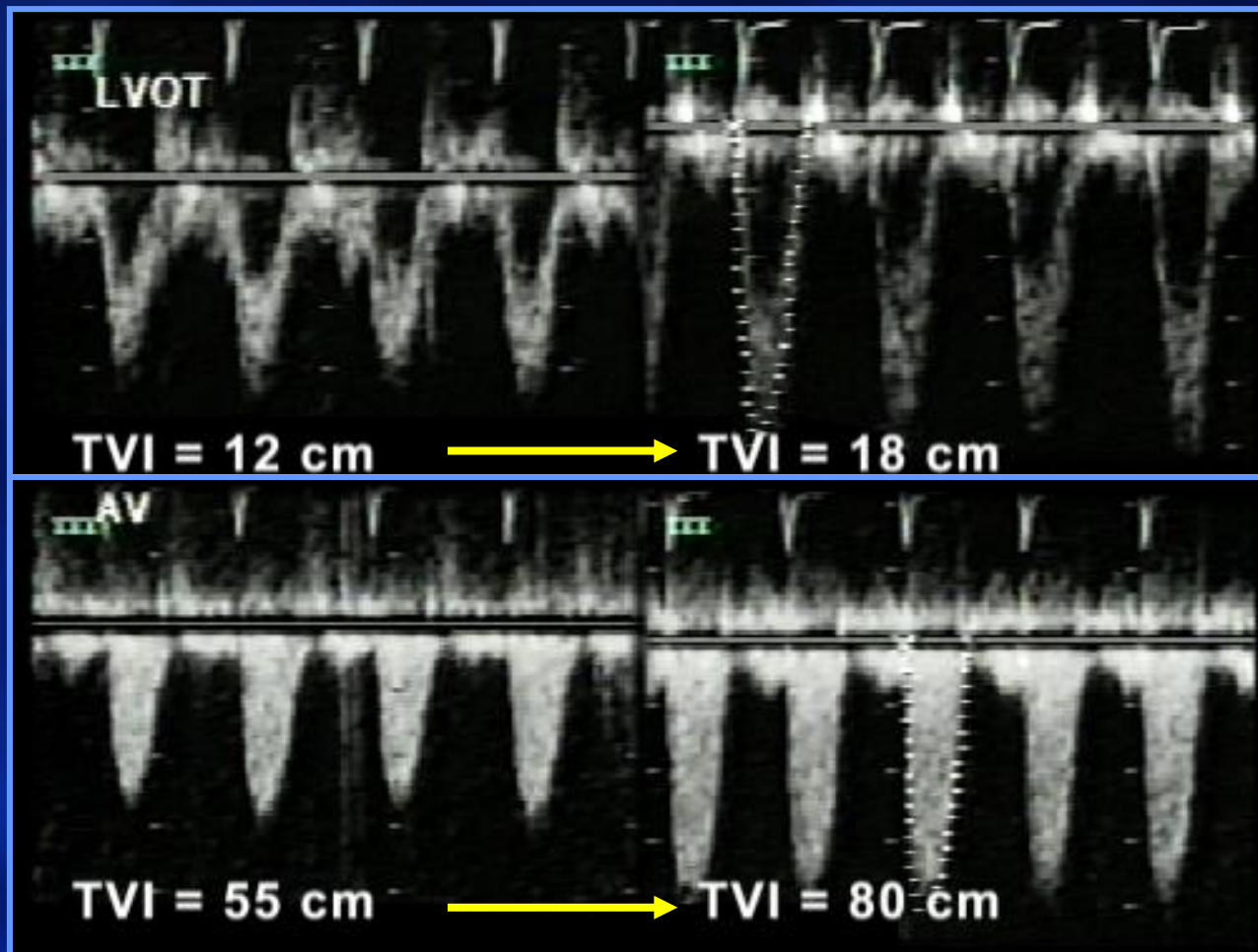
Dimensionless  
Index = 0.31



# True Low Gradient/Low EF Aortic Stenosis

Baseline

Dobutamine



Stroke volume

40 → 60 cc

Mean gradient

25 → 40 mmHg

AVA = 0.7 cm<sup>2</sup>

Dimensionless  
Index = 0.22

Dimensionless  
Index = 0.23

# Low-Output, Low-Gradient Aortic Stenosis in Patients With Depressed Left Ventricular Systolic Function

## The Clinical Utility of the Dobutamine Challenge in the Catheterization Laboratory

Rick A. Nishimura, MD; J. Aaron Grantham, MD; Heidi M. Connolly, MD; Hartzell V. Schaff, MD; Stuart T. Higano, MD; David R. Holmes, Jr, MD

**Background**—Although aortic valve replacement can be performed at an acceptable risk level in selected patients with left ventricular systolic dysfunction and low-output, low-gradient aortic stenosis, not all patients presenting with these hemodynamics will benefit from the operation. Some patients may have only mild aortic stenosis, despite a small calculated valve area. We report on the clinical utility of diagnostic dobutamine stimulation during cardiac catheterization in these diagnostically challenging patients.

**Methods and Results**—Thirty-two patients with low-output, low-gradient aortic stenosis and an ejection fraction <40% had dobutamine infusion in the catheterization laboratory. On the basis of the results of the dobutamine test, 21 patients underwent aortic valve replacement. All patients with a final aortic valve area  $\leq 1.2$  cm<sup>2</sup> at peak dobutamine infusion and a mean gradient of >30 mm Hg were found to have severe calcific aortic stenosis at operation. In the 15 patients in whom contractile reserve was identified during dobutamine challenge (increase in stroke volume >20%), 1 patient died perioperatively (7% mortality) and 12 patients were alive in New York Heart Association class I or II status at follow-up.

**Conclusions**—In patients with left ventricular systolic dysfunction and aortic stenosis with a low output and a low mean gradient, dobutamine challenge may aid in selecting those who would benefit from an aortic valve operation. (*Circulation*. 2002;106:809-813.)



In pt with LV systolic dysfunction and AS with a low output and a low MG, dobutamine challenge may aid in selecting those who would benefit from an AV operation.  
Circulation 2002; 106: 809-813

12 survive  
Class I-II

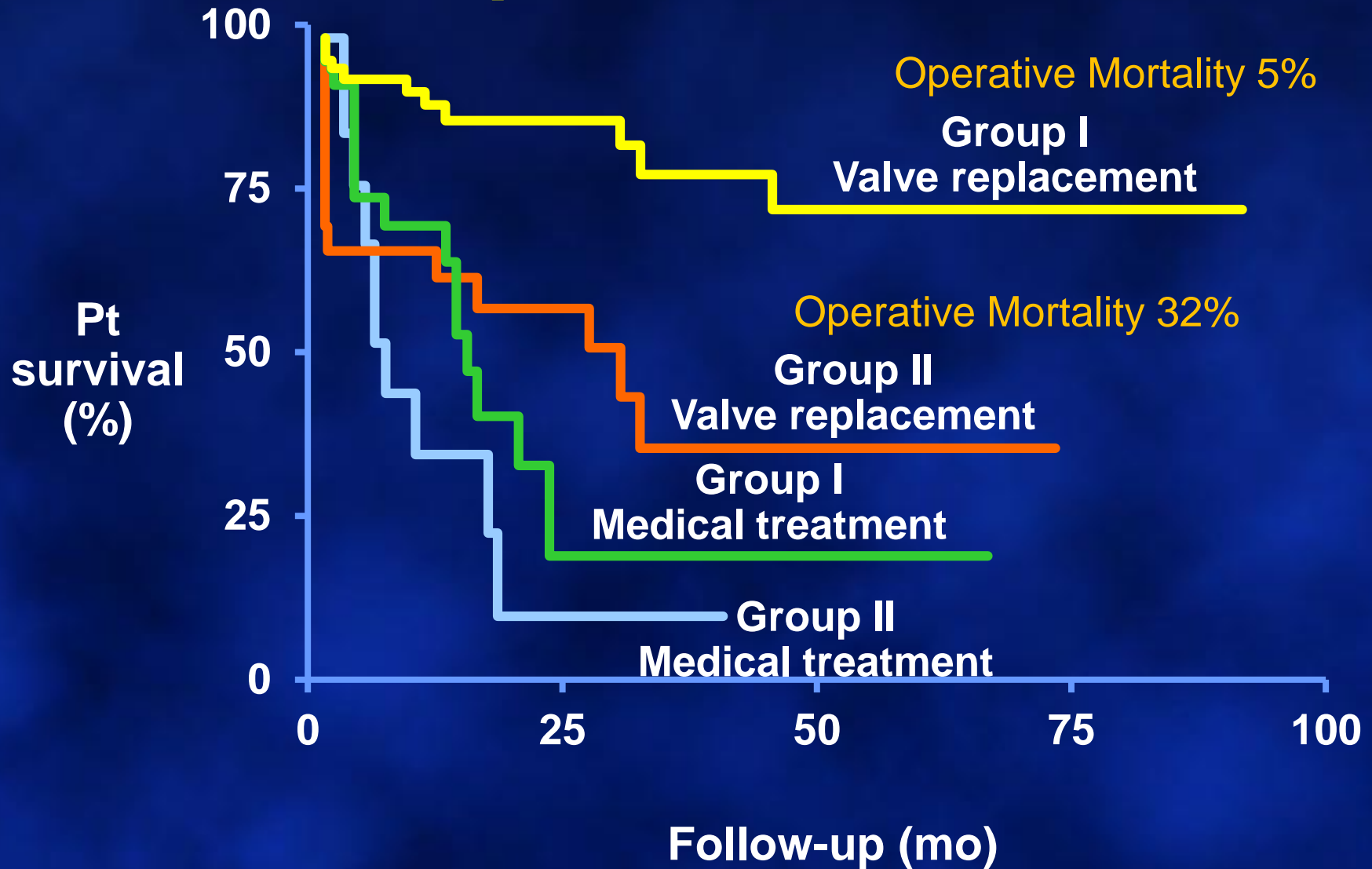
2 survive  
Class I-II

# Low Gradient Aortic Stenosis

Monin et al - Circulation 2003; 108:319-24

- 136 AS pt - AVA 0.7, MG 29 mmHg
- LV contractile reserve assessed by DSE
  - Present in 92 (Group I)
  - Absent in 44 (Group II)

# Kaplan-Meier Survival Estimates by Group and Treatment





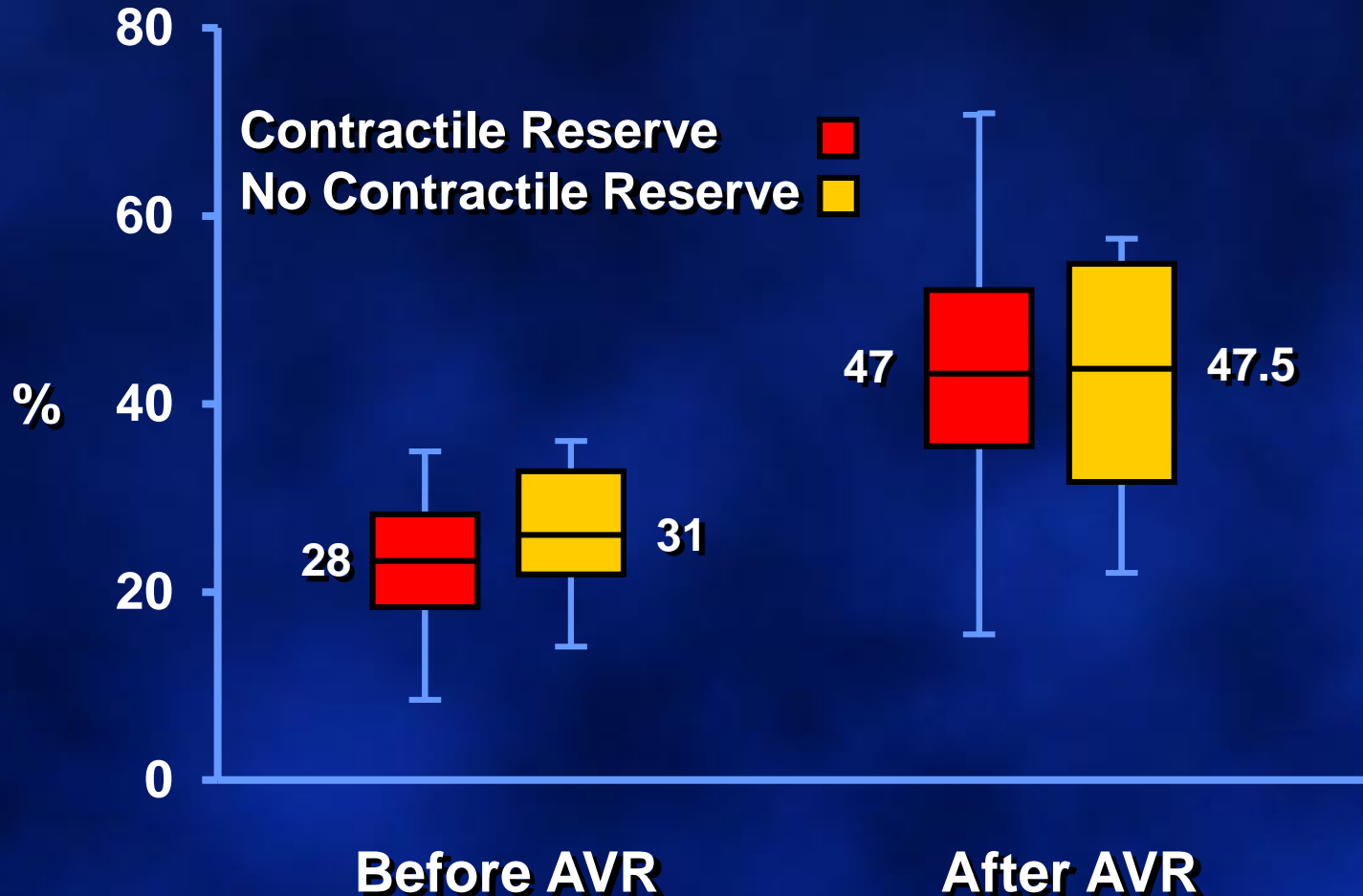
# Case:

## Results of Dobutamine Stress Echo

	V1 TVI (cm)	V2 TVI (cm)	AVA (cm <sup>2</sup> )	Peak/Mean AV Gradient (mmHg)
Baseline	13	47	0.86	25/14
5 mcg/kg/min dobutamine	14	47	0.93	25/14
10 mcg/kg/min dobutamine	15	53	0.88	31/16
20 mcg/kg/min dobutamine	15	53	0.88	33/17

# Change in LVEF after AVR

## *Severe AS with low EF*



Quere, J.-P. et al. *Circulation* 2006;113:1738-1744

# Influence of Contractile Reserve in Low-gradient AS

- Absence of CR related to  $\uparrow$  operative mortality, but it does not predict the absence of LVEF recovery in pt surviving AVR
- These data further support the concept that surgery should not be contraindicated on the basis of absence of CR alone

# Take Home Points

- **Dobutamine stress testing is helpful in low gradient-low EF AS**
  - Importance of contractile reserve
  - “True AS” vs “Pseudo” AS
- **Absence of contractile reserve substantially increases operative mortality with AVR in low EF-low gradient AS**
  - But if patients survive, EF improves and outcome good





# Thank You!

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