

Stress Echocardiography and Valvular Heart Disease

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DISCLOSURE

Relevant Financial Relationship(s)

None

Off Label Usage

None

Objectives

- **General indications**
- **Stress modalities**
- **Use in native valve disease**
- **Use in prosthetic heart disease**

General Indications

- 1. Asymptomatic severe valve disease**
- 2. Symptoms with non-severe valve disease**
- 3. Valve disease with LV dysfunction**

Stress Modalities

Exercise Only

Symptomatic

- Nonsevere MR
- Mild MR (CABG)
- Nonsevere AI

Asymptomatic

- Severe MR
- Severe MS
- Severe AS
- Severe AI

Low EF

Exercise or Dobutamine

Symptomatic

- Pulmonary edema
- Nonsevere MS
- Nonsevere AS
- Paradoxical low-flow AS
- Equivocal PPM

Asymptomatic

- Moderate MS

Dobutamine Only

Low EF

- LFLG AS
- Low flow AV prosthesis

ETT vs Bicycle

- Treadmill only pre and post images
- Supine bike: continuous imaging; protocol: 0, 25, 50, 100 Watts
- Predicted max workload (healthy subjects): 2.5 W/kg (women); 3W/kg (men)- 10% for every decade above 30

Asymptomatic Severe Disease

Meta-Analysis of Prognostic Value of Stress Testing in Asymptomatic AS

AJC 2009;104:972

The management strategy in asymptomatic patients with severe aortic stenosis (AS) is controversial. Aortic valve replacement has significant morbidity and mortality, while there

- **N= 491 (50-79 years old)**
- **Safe**
- **Negative test: No SCD; 21 % adverse cardiac events (11-36 months)**
- **Positive test: 5% SCD; 66% adverse cardiac events**

identifies patients at risk for adverse cardiac events and sudden cardiac death. These data suggest that stress tests can be used for risk stratification and for deciding on the timing of aortic valve replacement in asymptomatic patients with severe AS. © 2009 Elsevier Inc. All rights reserved. (Am J Cardiol 2009;104:972-977)

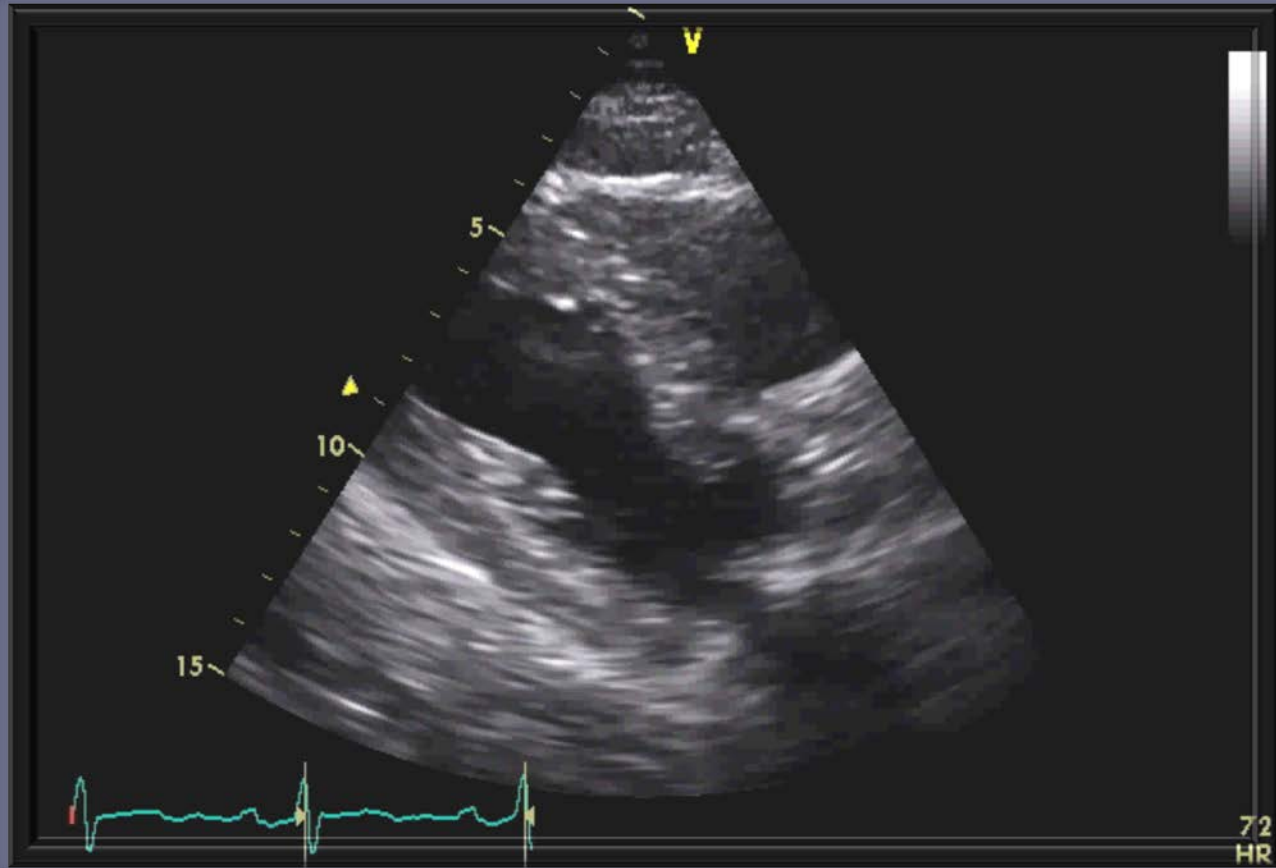
Important echo findings

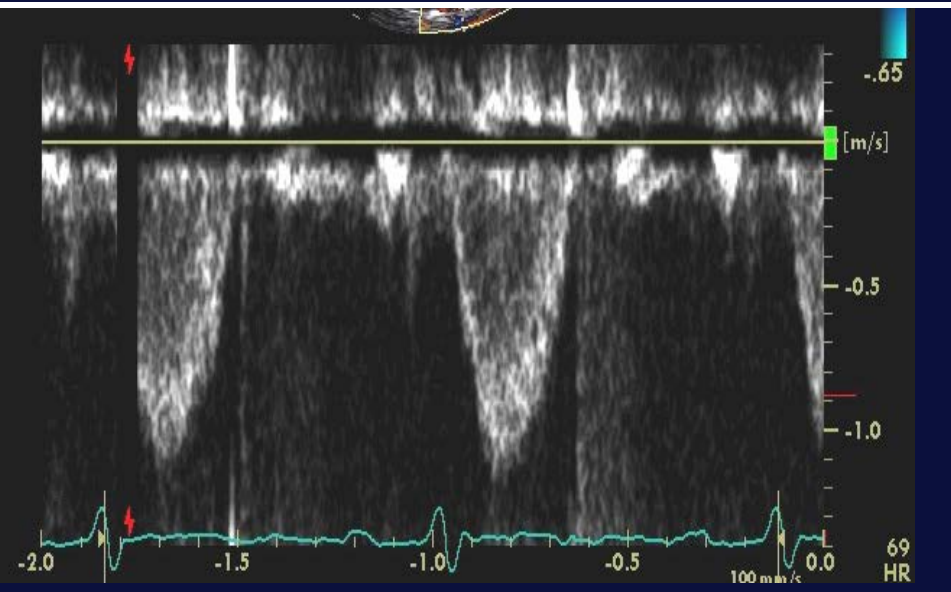
- **New regional WMA's**
- **Decrease in LVEF**
- **Poor prognosis : gradient increases > 18-20 mmHg**
- **PAP >60 mmHg**

Case

- **64 year old male: known heart murmur for 20 years**
- **Hypertension and hyperlipidemia**
- **NYHA Class I: walks 30-40 minutes daily with no symptoms**
- **Needs a TURP**

Septum 15 mm Posterior wall 13 mm
EF 72%



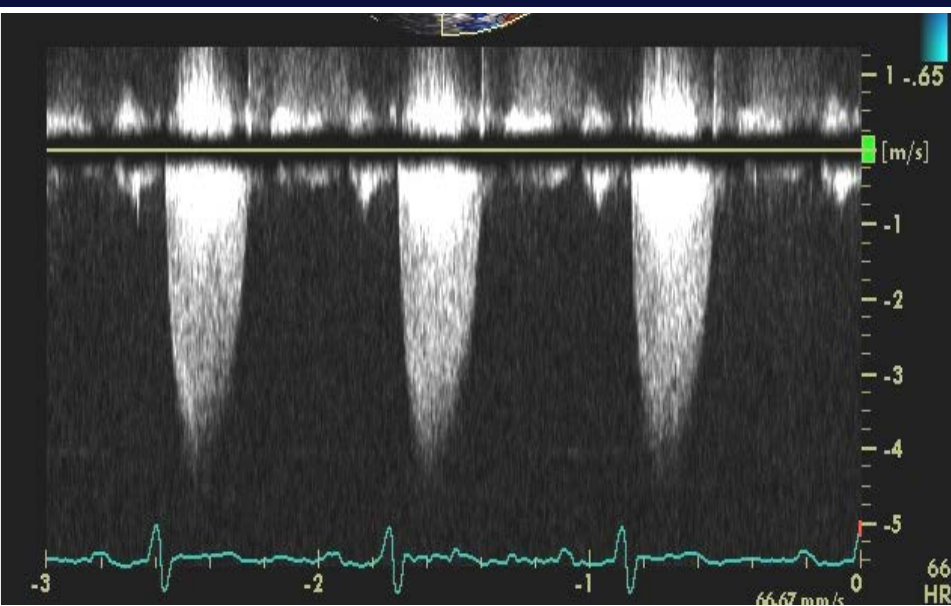


Peak velocity: 4.2 m/s

Mean gradient: 43 mmHg

AVA: 1.04 cm²

Indexed AVA: 0.51 cm²



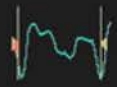
Stress Echo

- Bruce protocol: 6.29 min:sec
- 83% FAC. No symptoms
- BP 128/84 mmHg (rest); 160/ 70 mmHg (peak)
- 85% maximal predicted HR
- 7.5 METS; double product: 26240
- Stress ECG: 1 mm downsloping inferior ST segment depression

Res: APLAX
T1: 0:44

Peak:
T1: 12:08
T2: 0:18

46/190



65
HR

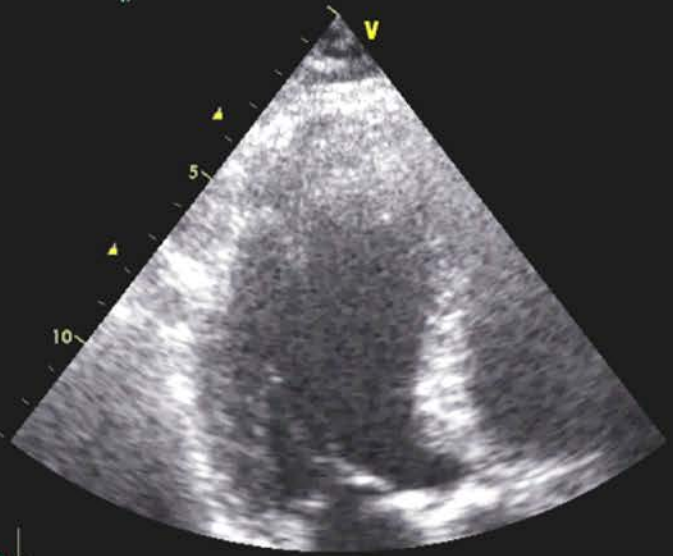
143
HR

Peak:
T1: 12:08
T2: 0:19

47/190

Peak:
T1: 12:09
T2: 0:19

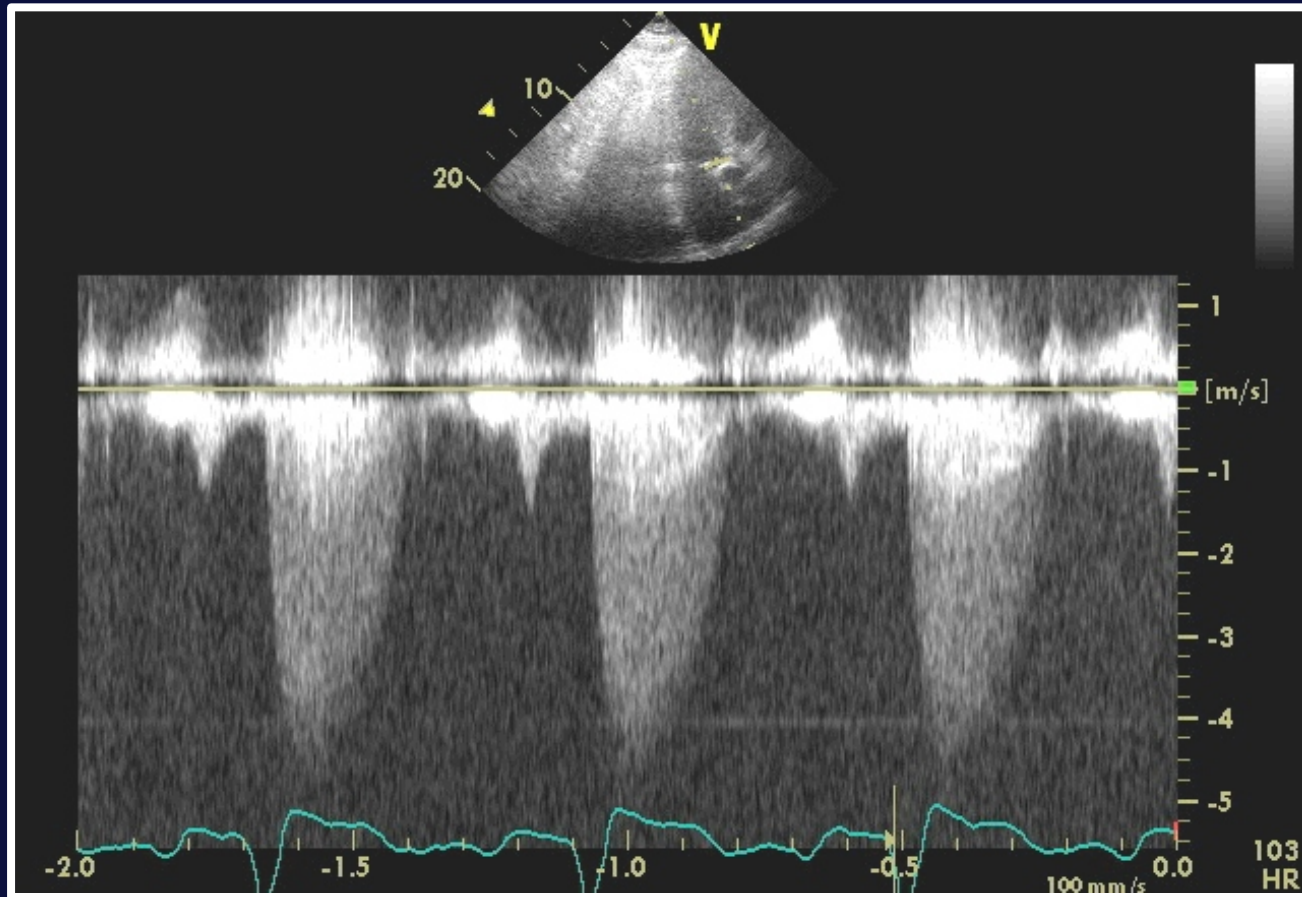
48/190



144
HR

142
HR

Mean gradient: 54 mmHg



What to advise?

1. AVR before TURP
2. TURP then AVR
3. Proceed cautiously with TURP
4. Proceed cautiously with TURP;
then watchful waiting

ACC Guidelines: IIa

Moderate-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable to perform in patients with asymptomatic severe AS

Case

- 33 year old G₀P₀
- Wants to get pregnant
- No cardiac symptoms
- Echo: EF 65%
- MV mean gradient 7 mmHg (HR 65 BPM). MVA 1.4 cm²
- Valvuloplasty score: 3
- PAP: 35 mmHg

Does she need a stress echo?

1. Yes
2. No
3. Consult Dr. Freeman

ACC/AHA Guidelines

MS and pregnancy

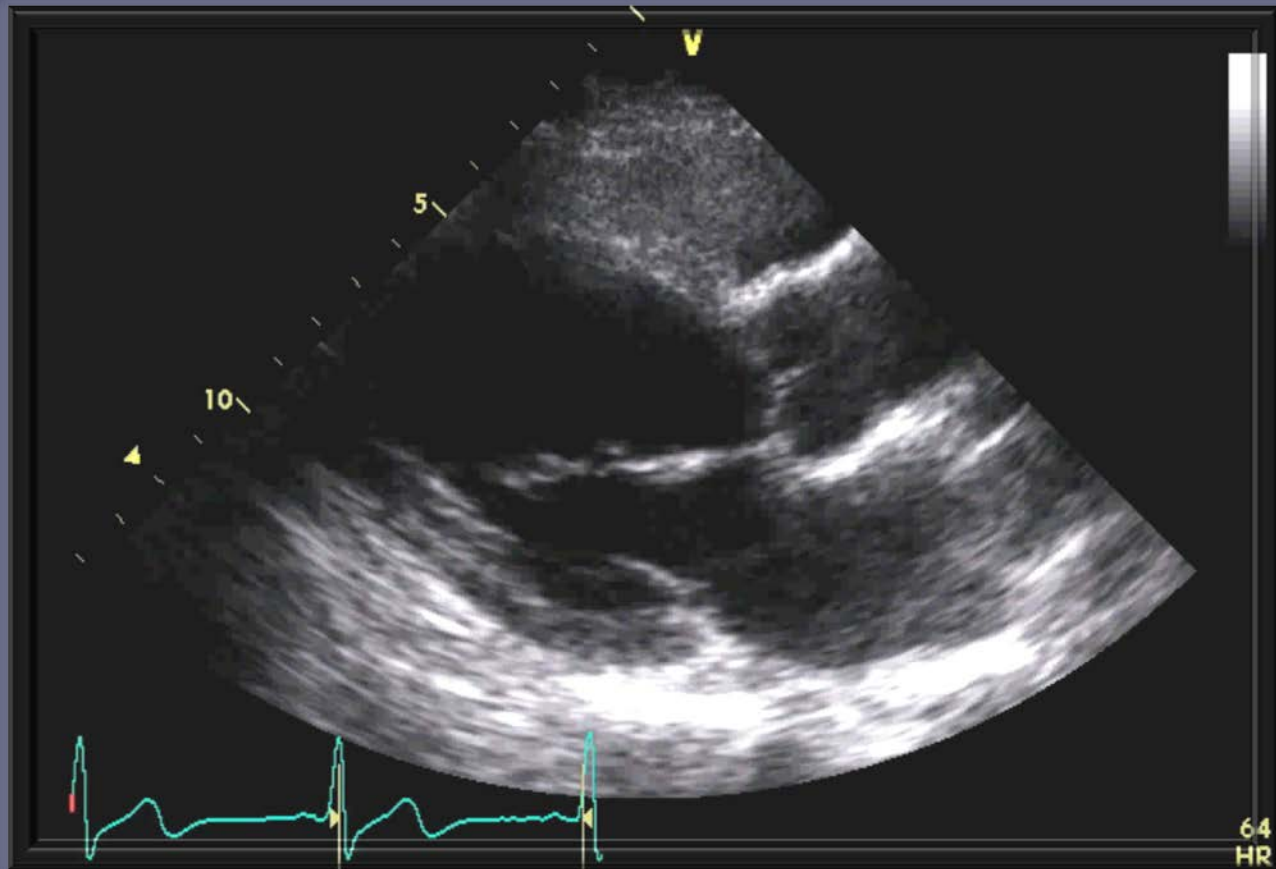
Asymptomatic severe MS and pregnancy

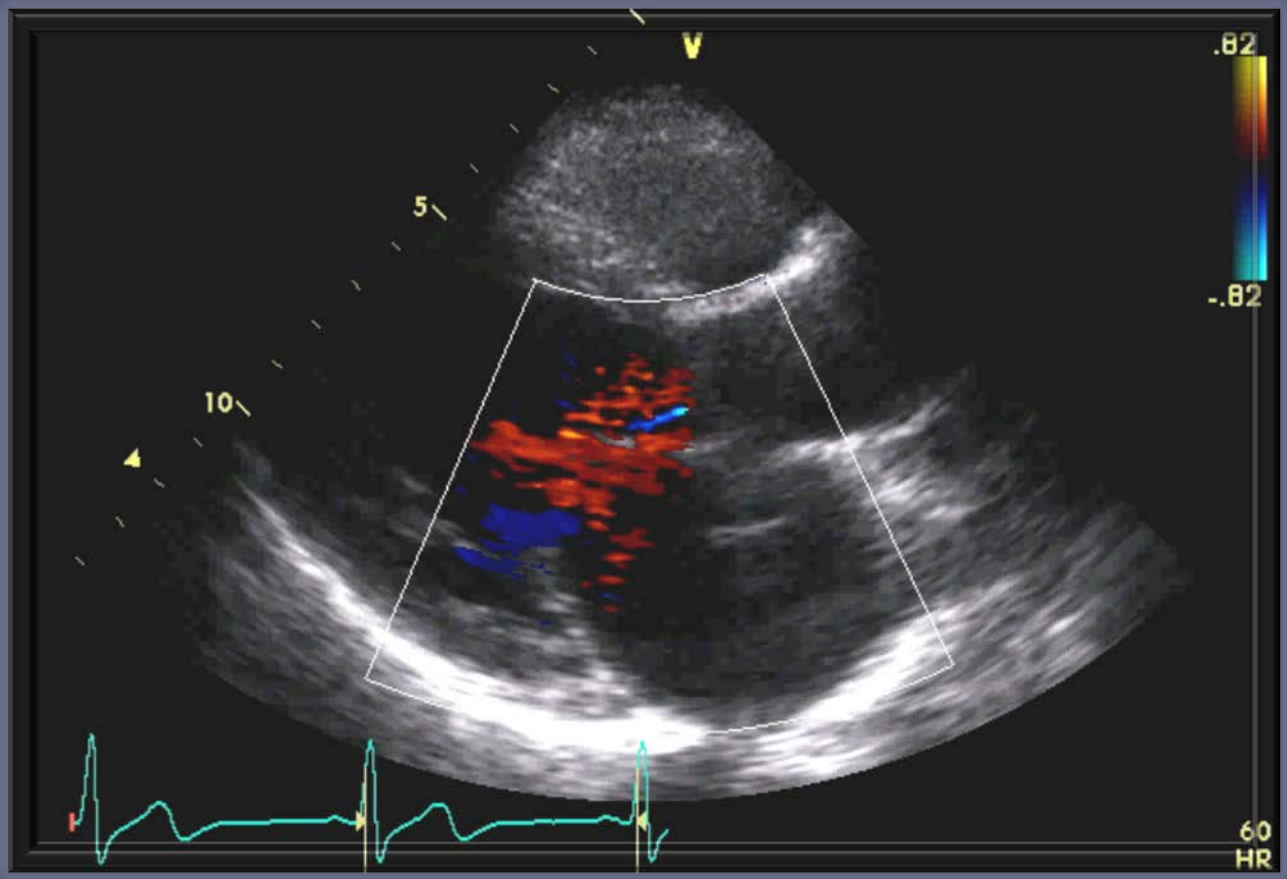
Class I: Percutaneous valvuloplasty is recommended before pregnancy in asymptomatic women with severe MS (MVA ≤ 1.5 cm²) with favorable morphology

Case

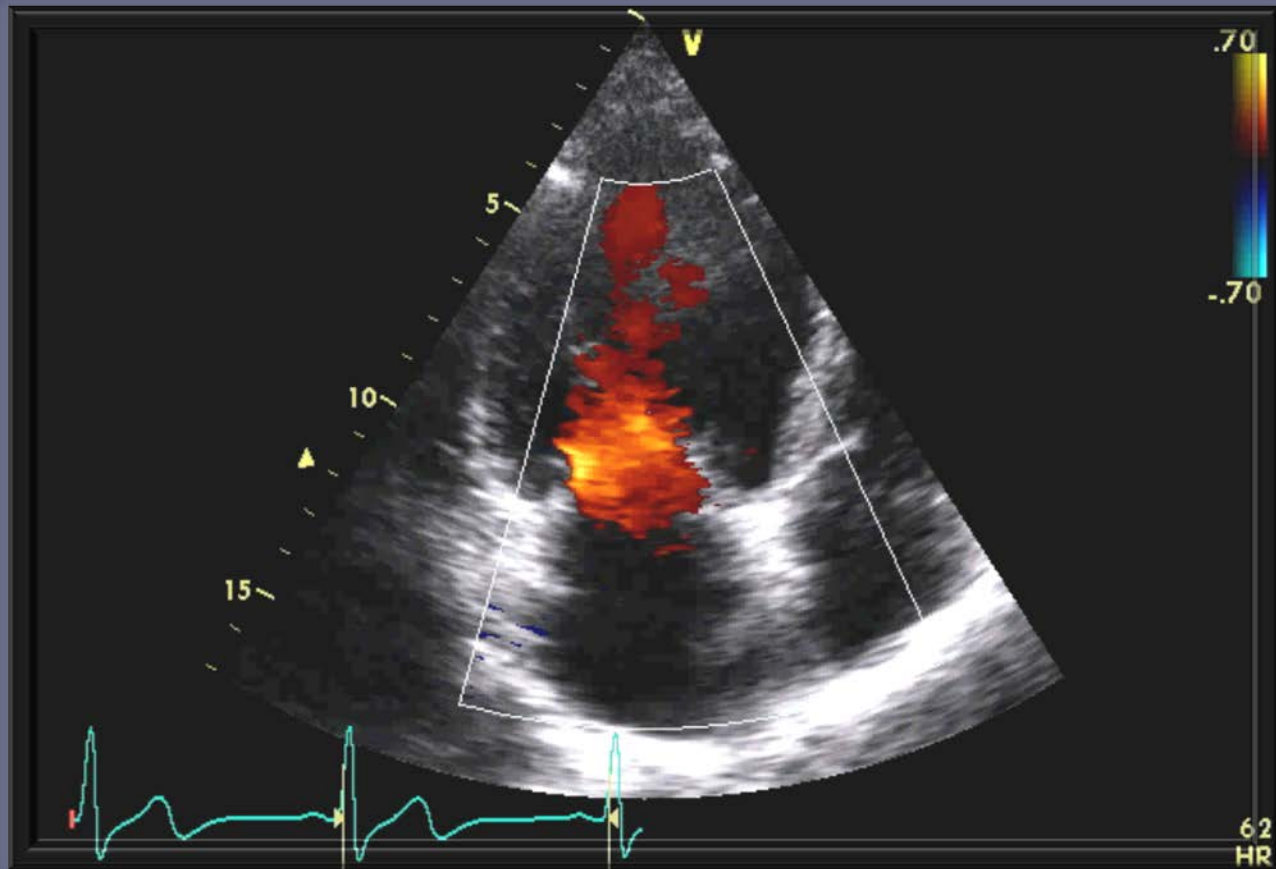
- **58 year old male: known heart murmur**
- **NYHA class I**
- **History of hypertension and hyperlipidemia**

ESD: 37 mm; EDD: 60mm: EF 68%





RV 62 cc ERO: 0.4 cm²



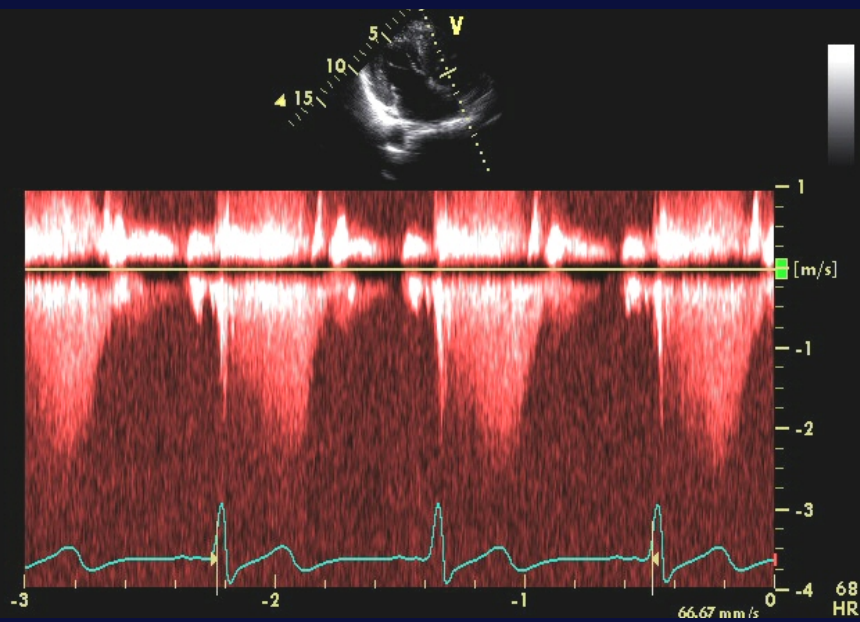
What to do next?

1. Cardiac cath
2. Bicycle echo
3. TEE
4. Follow up 6 months

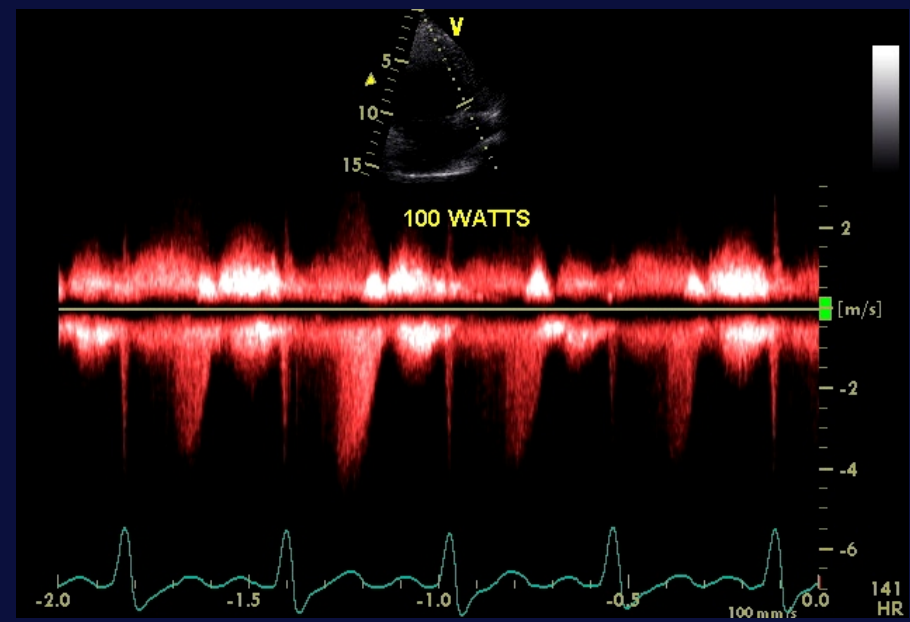
Bicycle echo

- Exercise time: 10 min
- 87% maximal predicted heart rate
- 100 Watts
- 6.8 METS
- BP (rest): 144/80 mmHg
- BP (stress): 190/70 mmHg
- Dyspnea at peak

PAP (rest)
34 mmHg



PAP (stress)
66 mmHg



What to advise next?

1. TEE
2. MV repair
3. Watchful waiting
4. TEE/MV repair

ACC/AHA Guidelines for VHD 2014

Indications for Mitral Operation

Chronic Severe Primary MR

Symptoms

Class I

LV size (LVESD > 40mm)

Class I

LV dysfunction
EF >30%-60%

Class I

>95% chance of repair

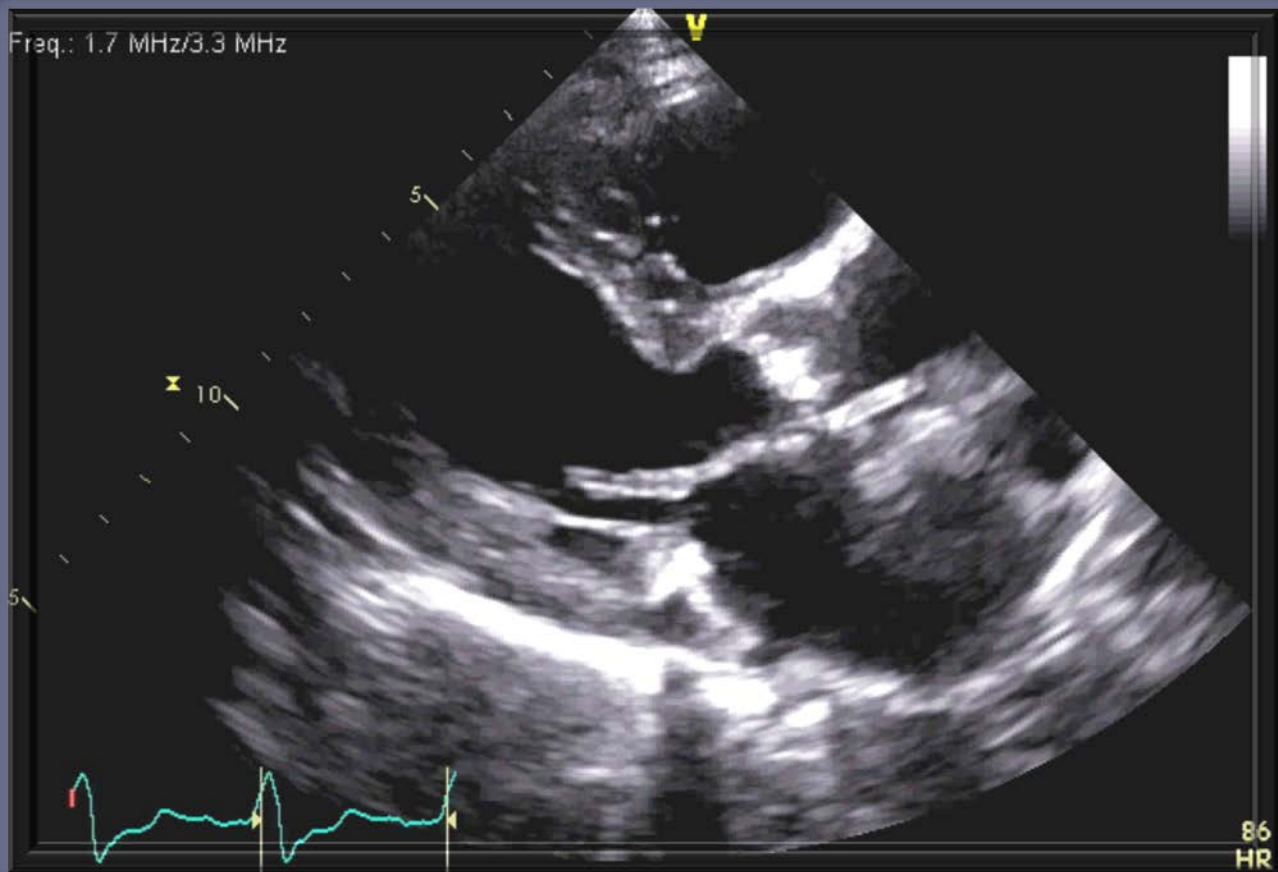
Class IIa

Valve Disease with LV dysfunction

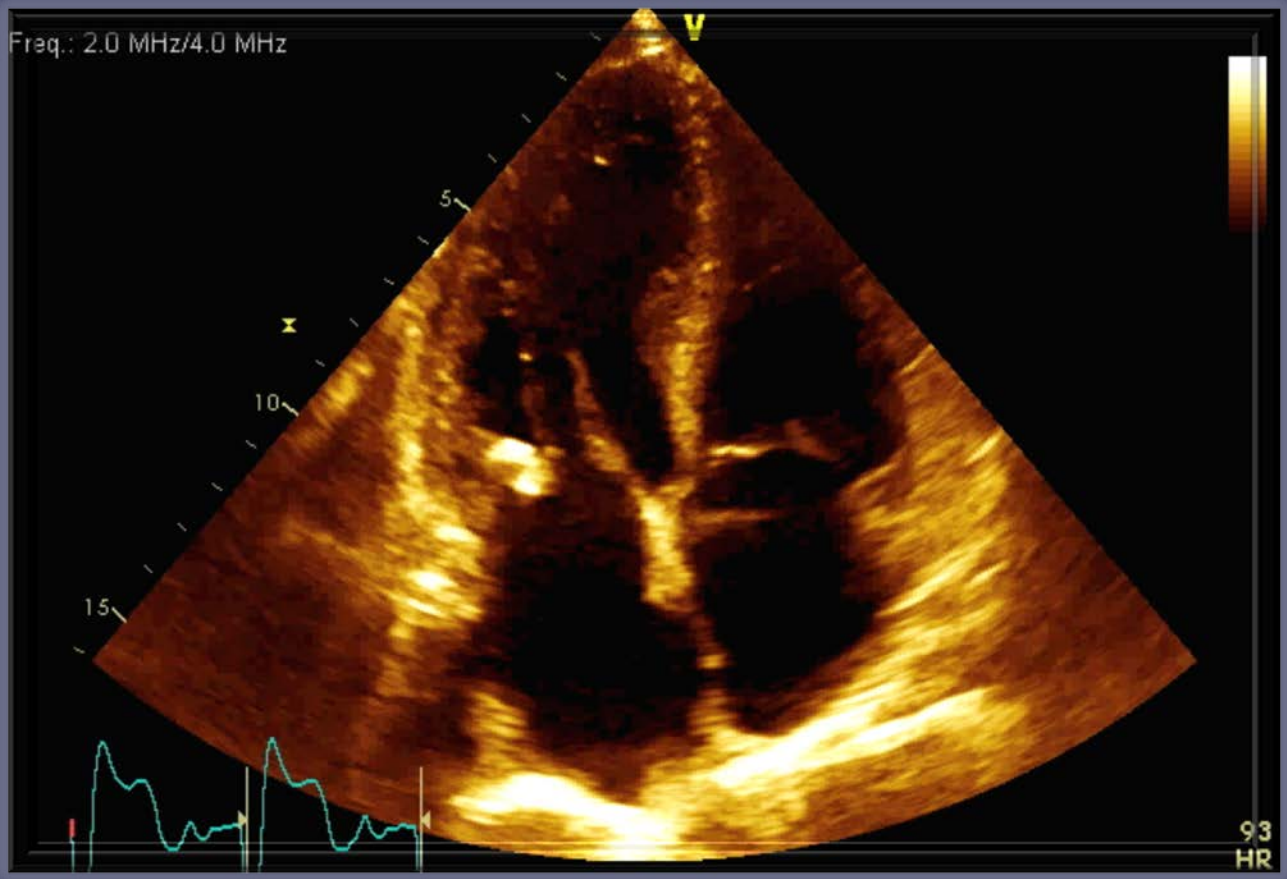
Case

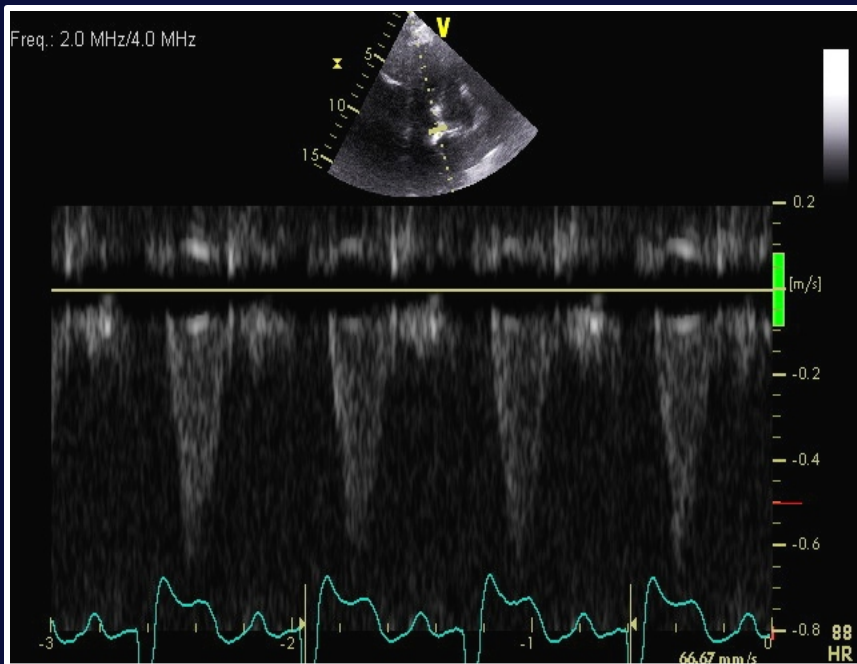
- **87 year old woman**
- **NHYA class II**
- **Weight loss and anorexia**
- **New fall in EF**

Freq.: 1.7 MHz/3.3 MHz



86
HR





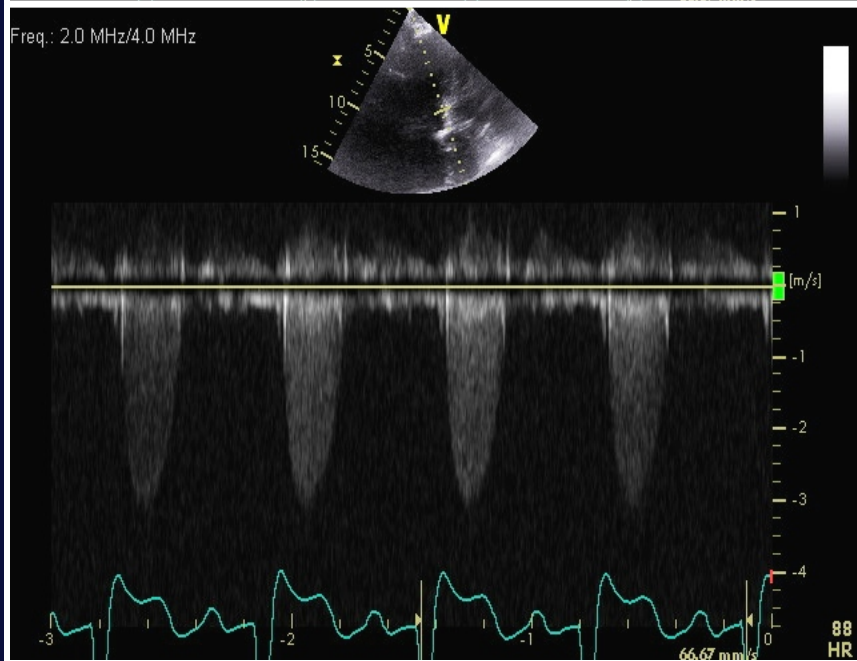
SV: 28 cc

SV indexed: 19 cc

Peak velocity: 3.1 m/s

Mean gradient: 24 mmHg

AVA 0.44 cm²



Cardiac cath

- 90% proximal LAD (long)
- 70% ostial OM
- Totally occluded RCA
- Stent LAD and OM
- Persistent LV dysfunction
- Dobutamine echo ordered

Aortic Stenosis

Low EF < 50%
Low cardiac output

Low pressure gradient
Mean gradient < 40 mmHg

Baseline Doppler hemodynamics

Dobutamine stress

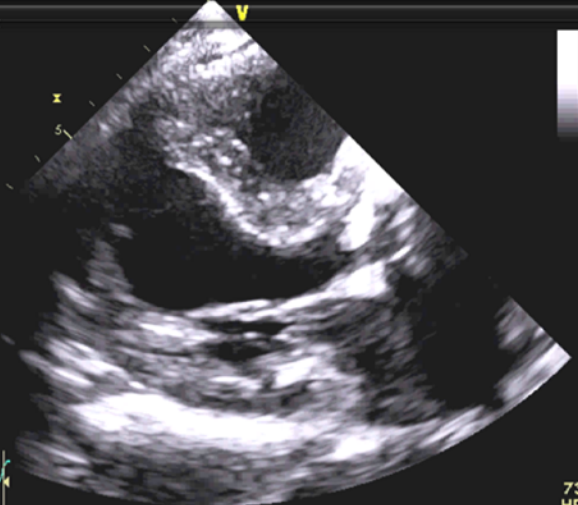
↑↑ Gradient
←↓ AVA

Severe AS

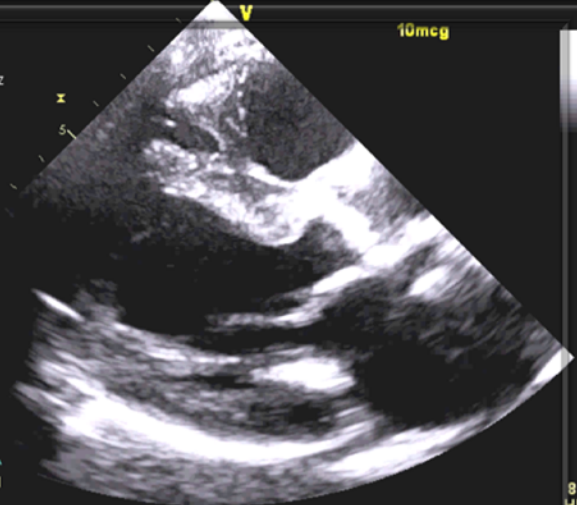
←↑ Gradient
↑ AVA

Not severe AS

Freq.: 1.7 MHz/3.3 MHz



Low dose : PLAX
T1: 31.57
T2: 4.24
Freq.: 1.7 MHz/3.3 MHz

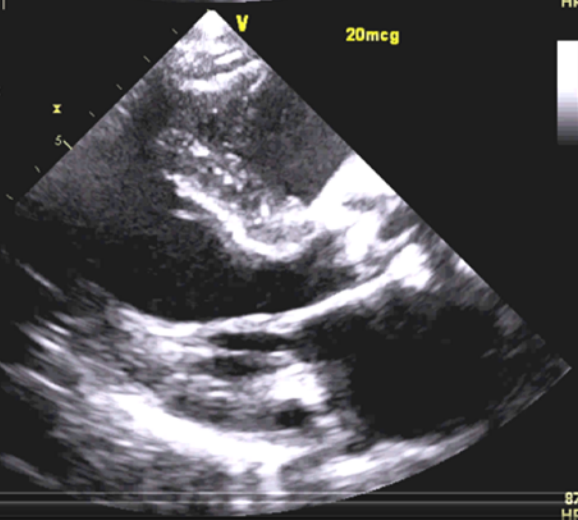


10mcg

73
HR

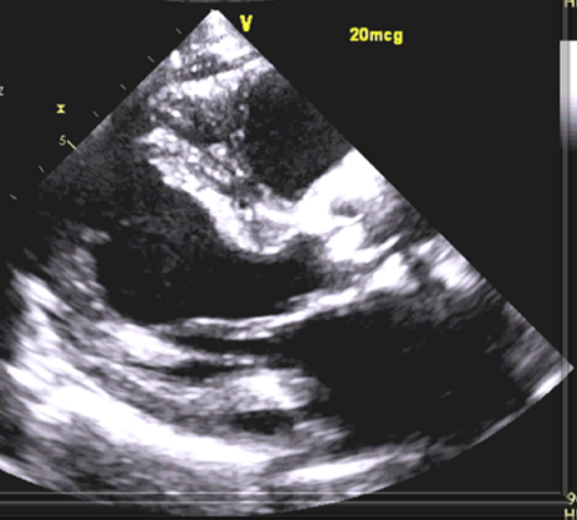
81
HR

Pre Peak : PLAX
T1: 37.10
T2: 9.37
Freq.: 1.7 MHz/3.3 MHz



20mcg

Peak : PLAX
T1: 39.20
T2: 11.47
Freq.: 1.7 MHz/3.3 MHz



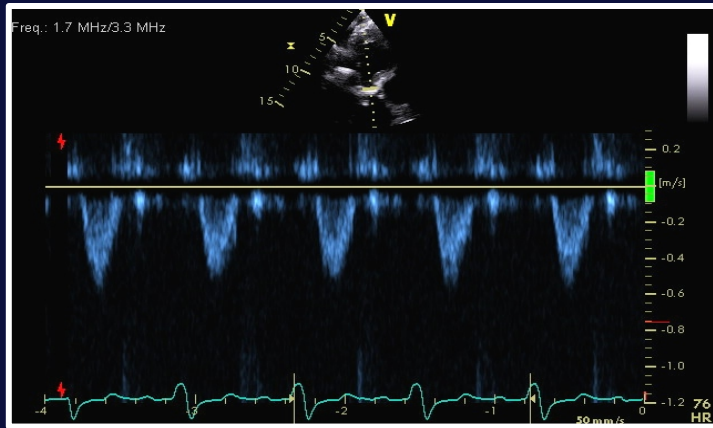
20mcg

87
HR

96
HR

REST

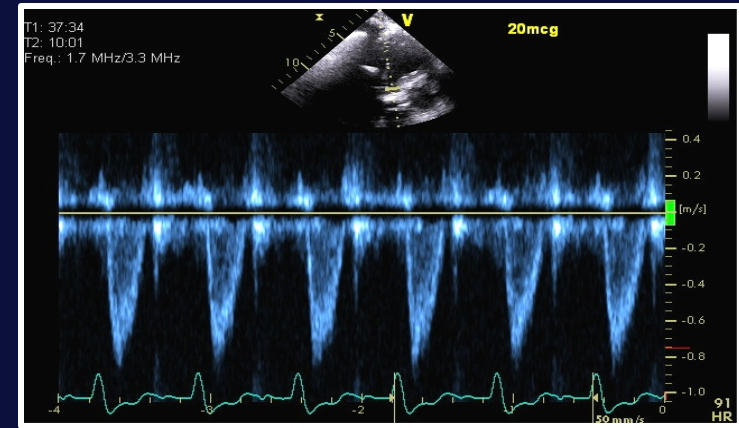
SV: 28 cc



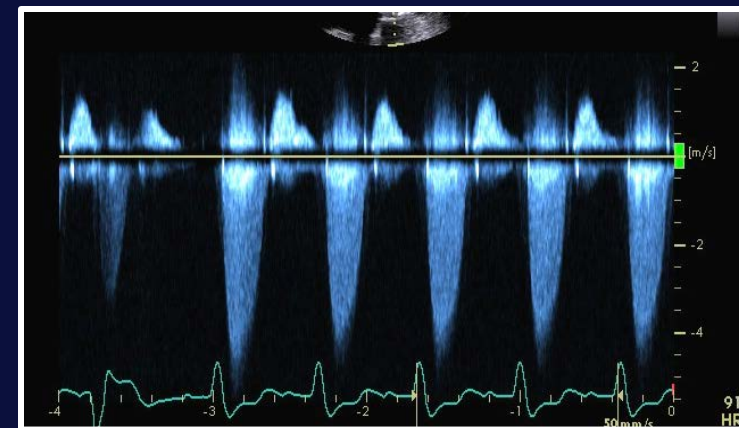
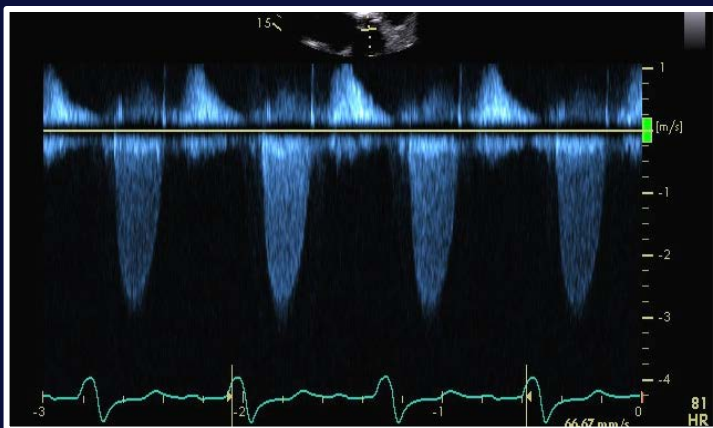
Peak velocity 3 m/s
Mean gradient 22 mmHg
AVA 0.46 cm²

PEAK

SV: 44 cc



Peak velocity 4.2 m/s
Mean gradient 50 mmHg
AVA 0.48 cm²

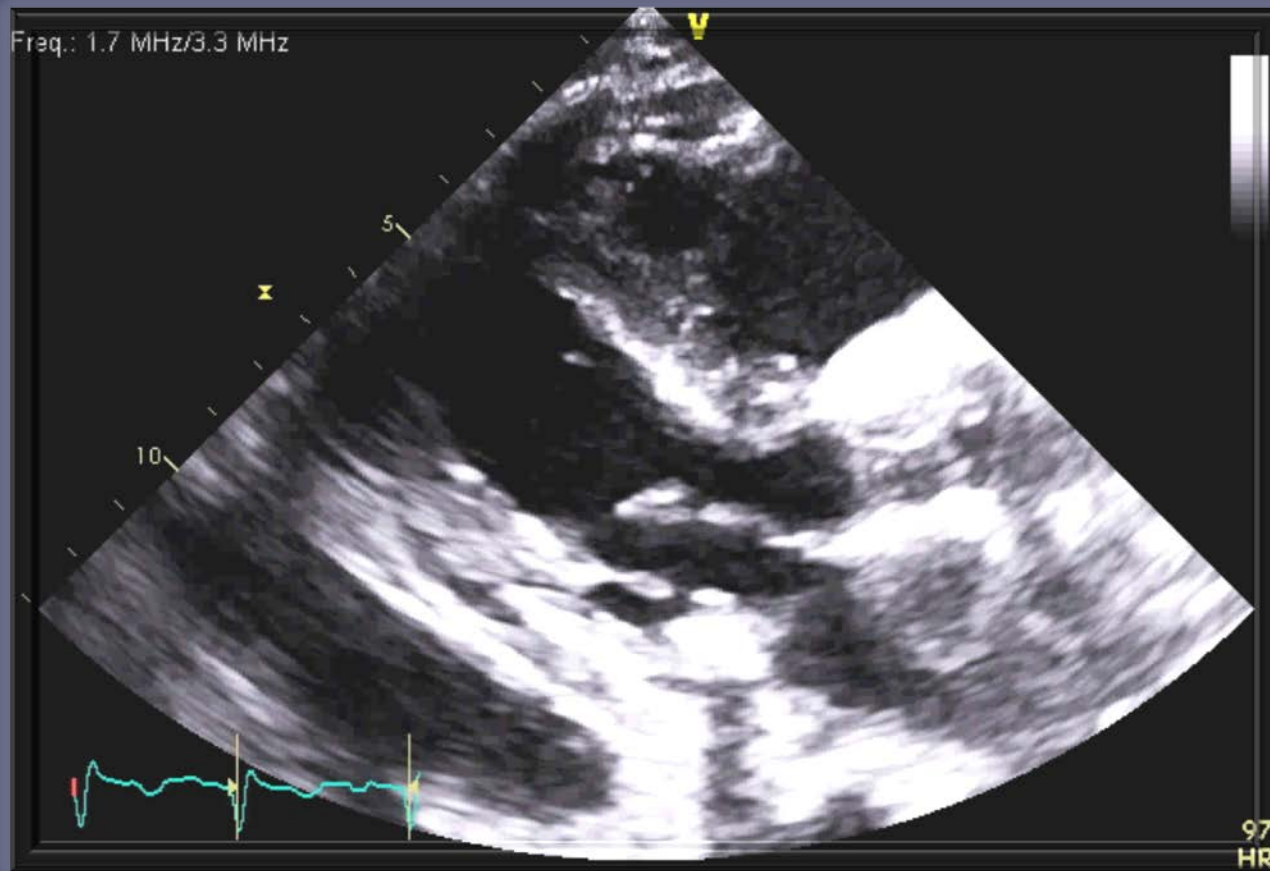


What to advise?

1. AVR
2. Watchful waiting
3. TAVR
4. Hospice

Follow up

Surgeon declined for OR



Symptoms

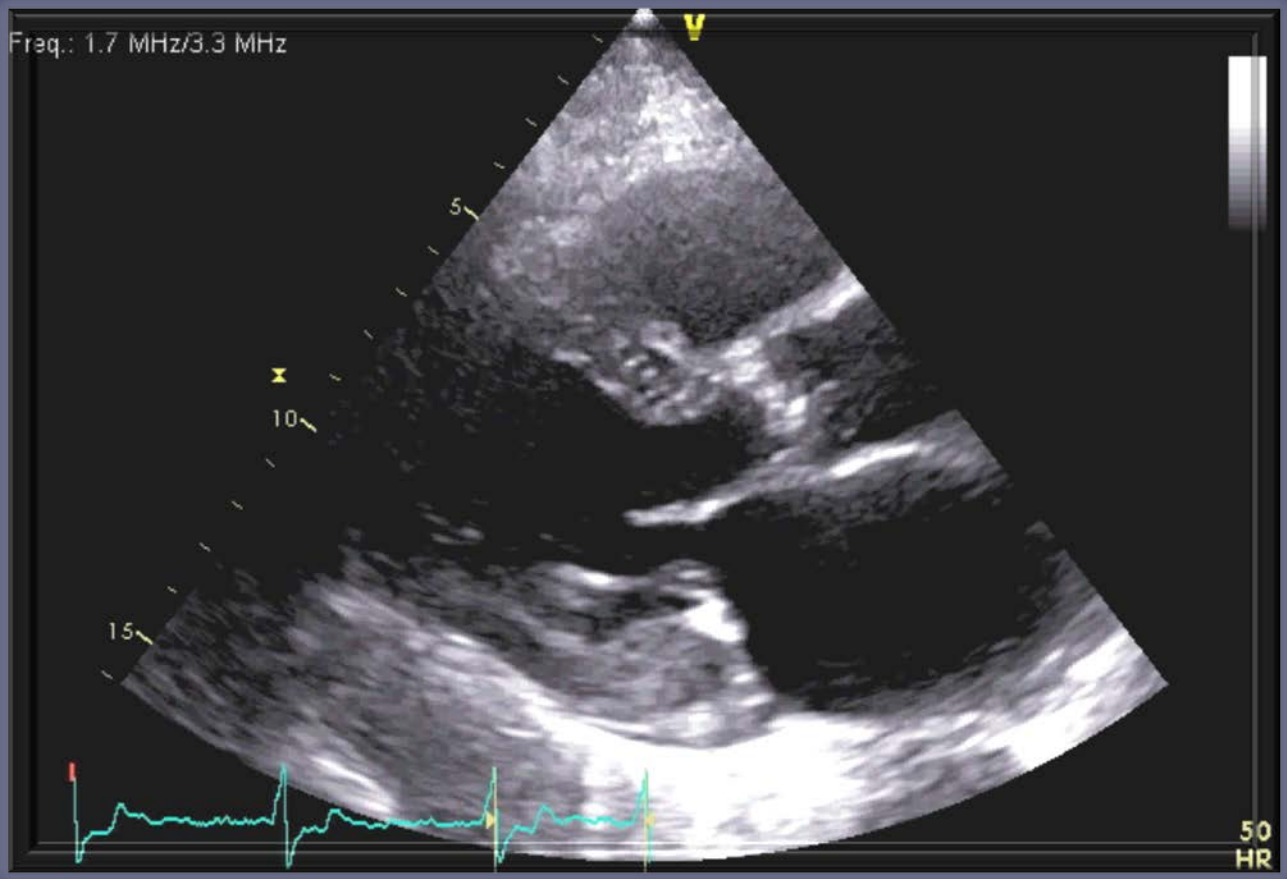
Preserved EF

?Lesion severity?

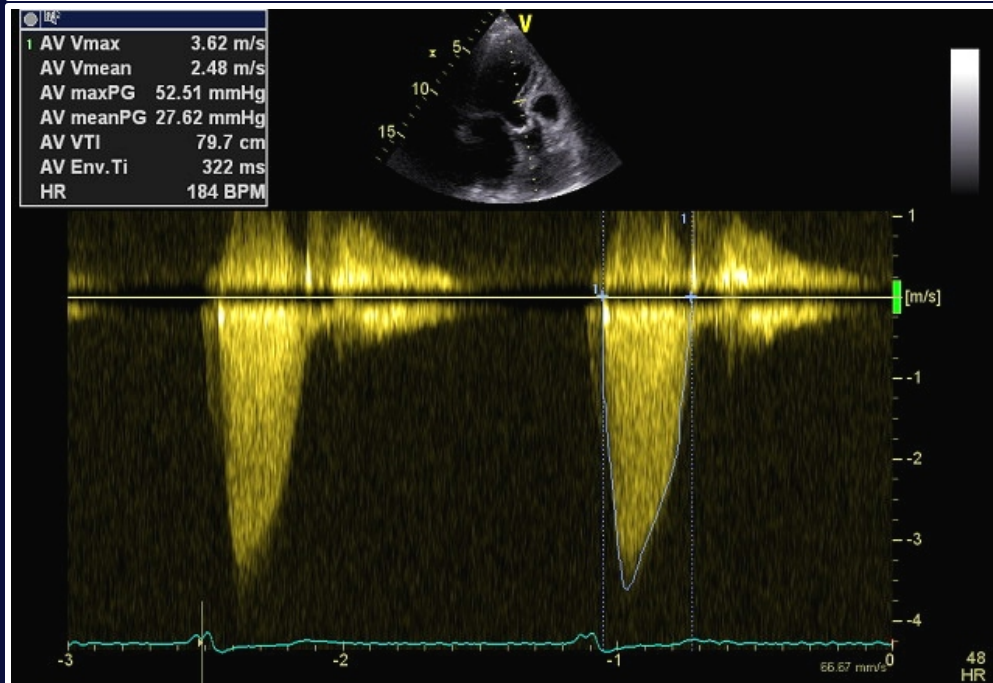
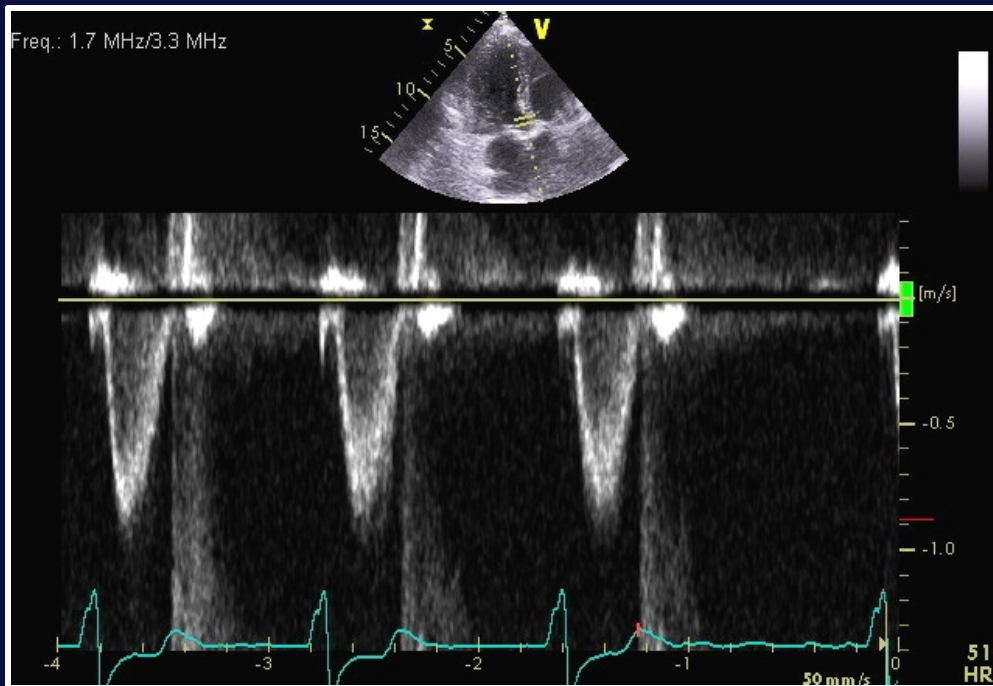
Case

- **74 year old woman: SOBOE
NYHA Class III**
- **Recurrent CHF admissions**
- **Persistent atrial fibrillation**
- **Long standing hypertension**
- **“Frail”**

Freq.: 1.7 MHz/3.3 MHz



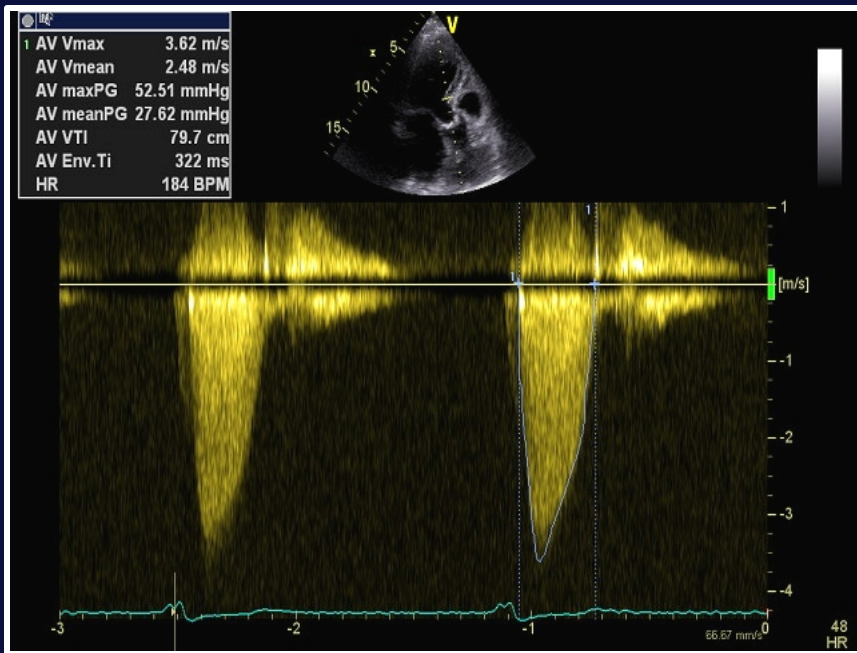
50
HR



SV: 62 cc
Indexed SV: 31 cc
Peak AV velocity:
3.6 m/s
Mean AV gradient:
28 mmHg
DI: 0.23
AVA: 0.72 cm²

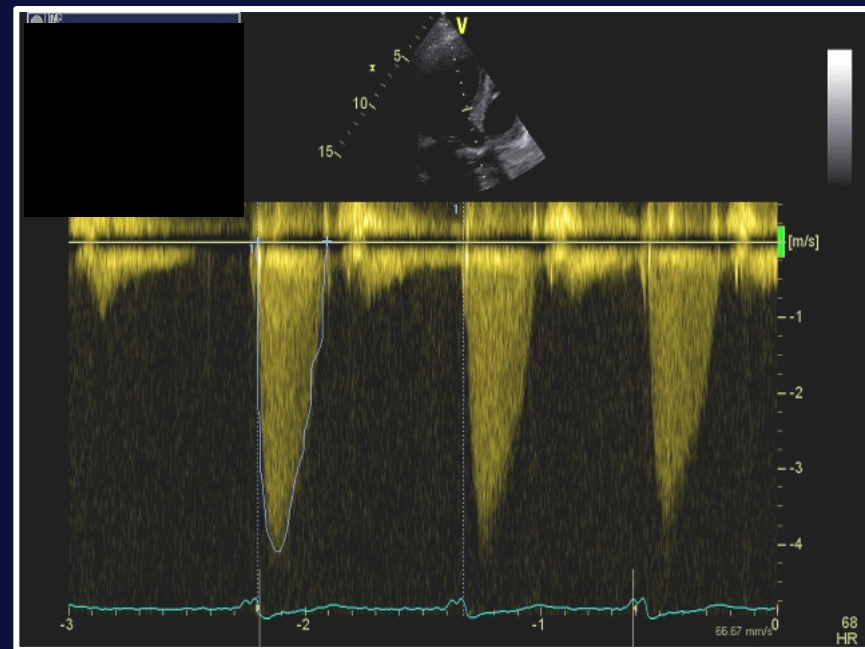
REST

Peak vel: 3.6 m/s;
Mean grad: 27 mmHg

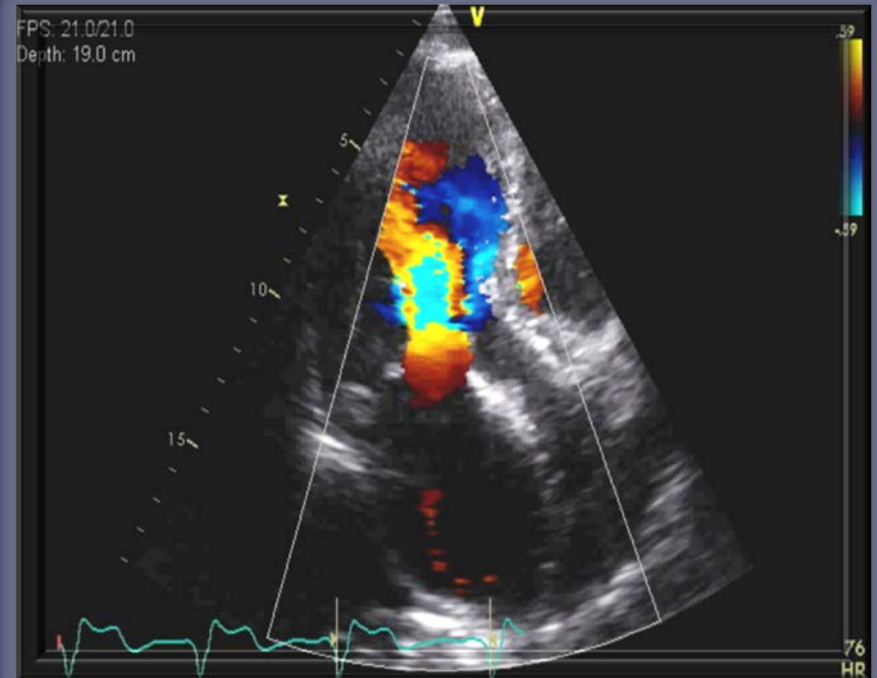
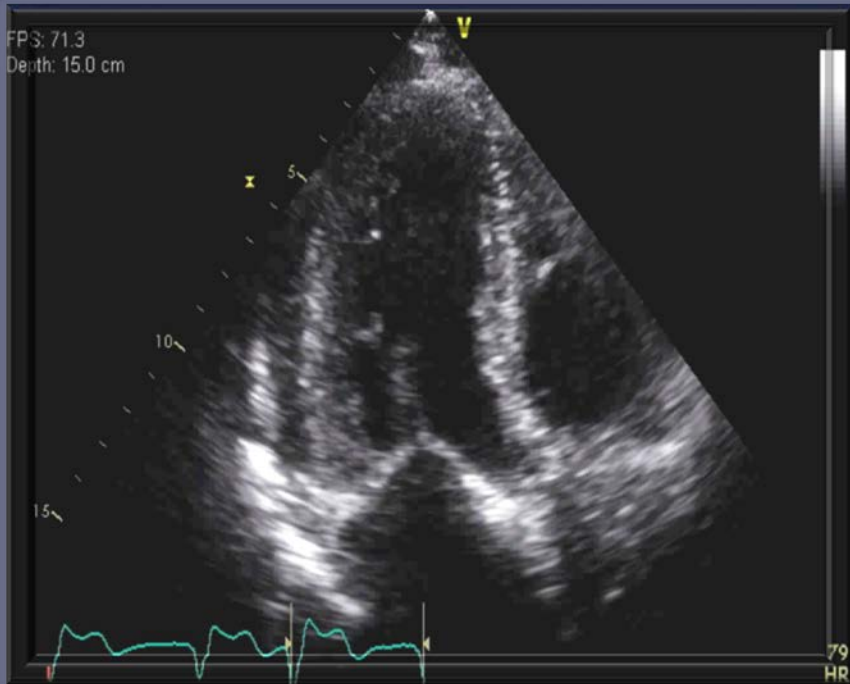


STRESS

Peak vel: 4.1 m/s
Mean grad: 40 mmHg



S/P TAVR (#26 Core Valve) Average mean gradient 4 mmHg



Curr Cardiol Rep (2015) 17: 42

DOI 10.1007/s11886-015-0601-0

Evaluation of AS: an Update

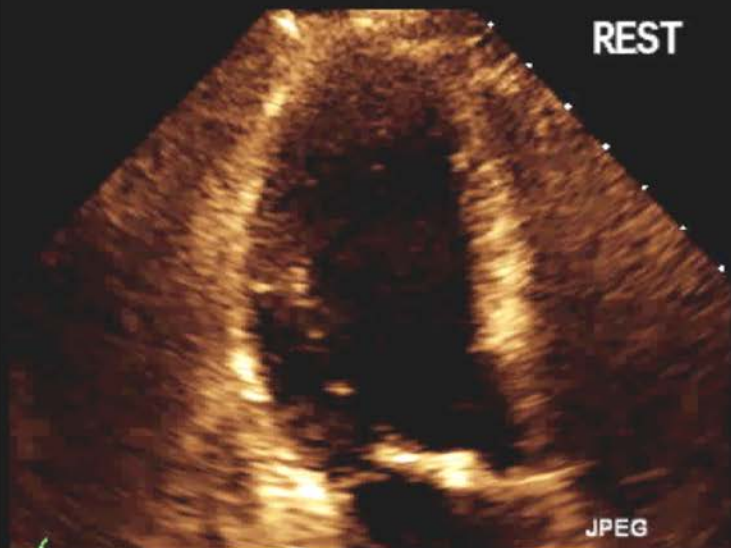
Current Card Rep (2015);17:42

Evaluation of Aortic Stenosis: an Update—Including Low-Flow

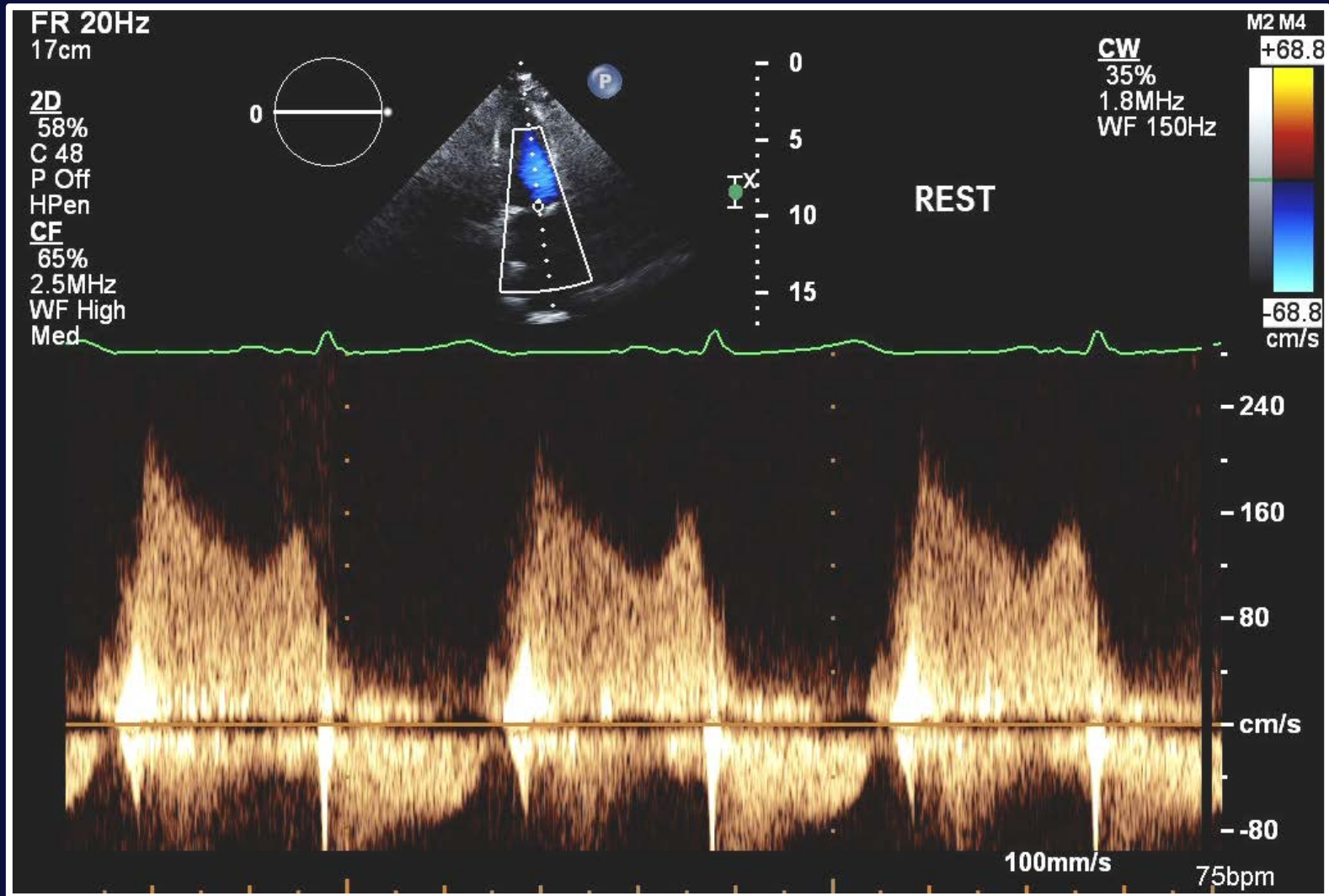
Exercise echocardiography, in asymptomatic patients or DSE in symptomatic patients, may be useful to distinguish true severe from pseudo-severe paradoxical LF/LG AS.

Case

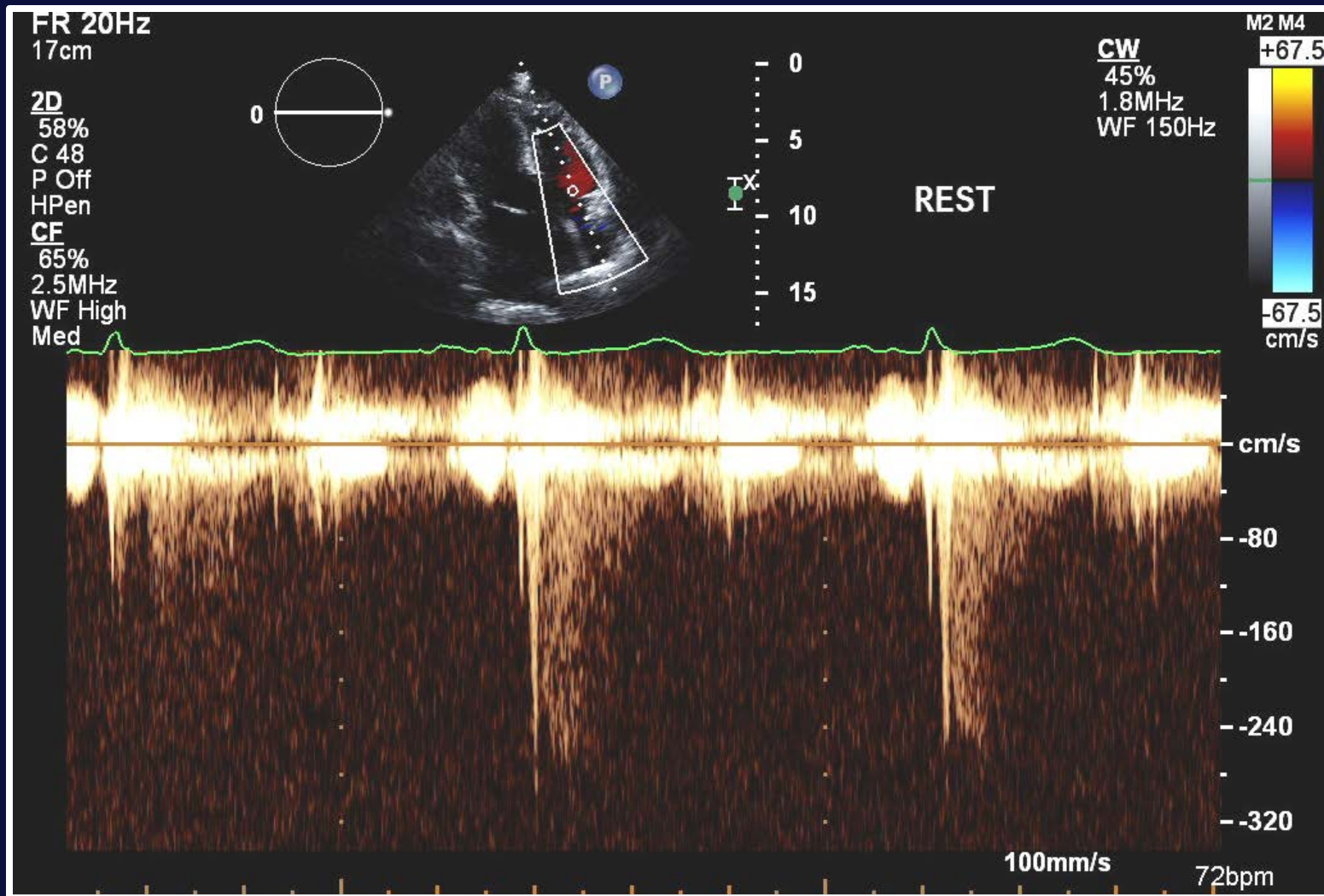
- **60 year old woman:
progressive DOE**
- **Currently NYHA Class III**
- **S/P percutaneous mitral
valvuloplasty 2004**



Mean gradient 8 mmHg (HR 75 BPM) MVA 1.4 cm²



PAP: 28 mmHg



Stress data

Bruce protocol: 9:26 min/sec

91% maximal predicted HR

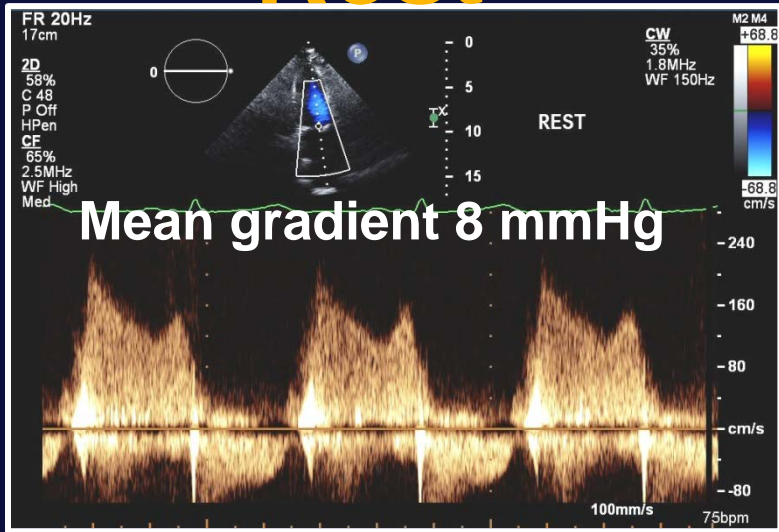
86% FAC

Test stopped for dyspnea

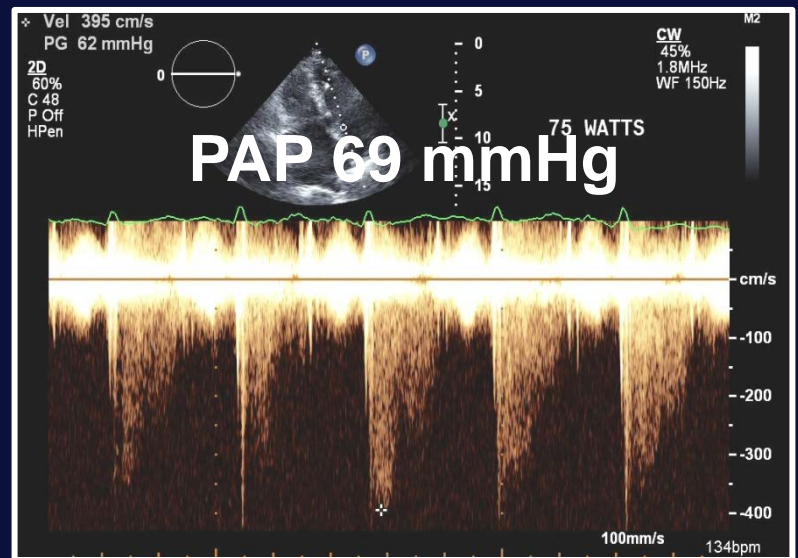
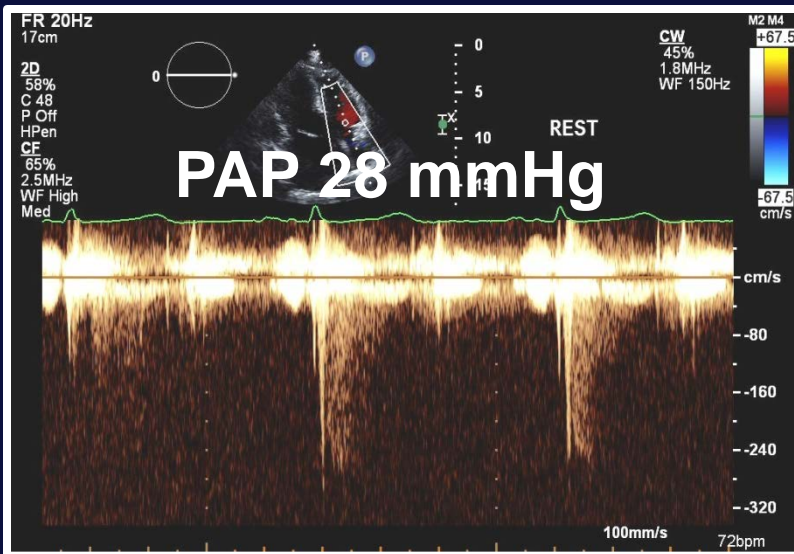
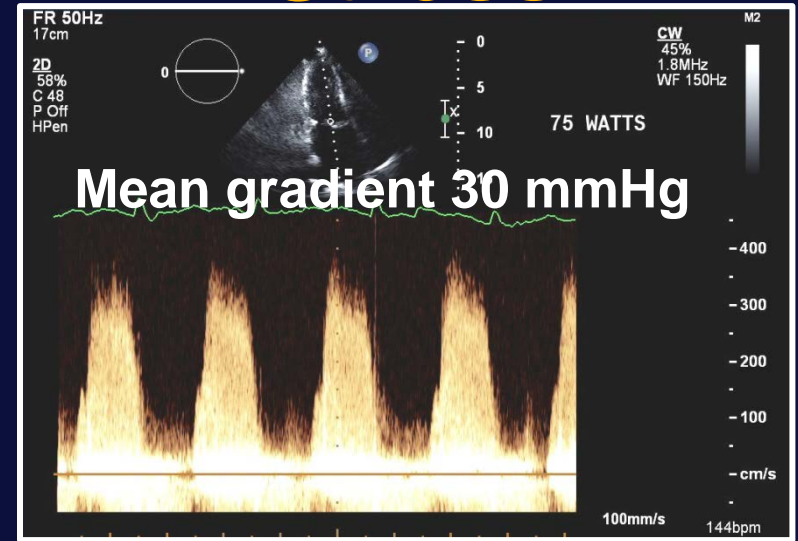
BP (rest): 116/88 mmHg

BP (stress): 194/80 mmHg

Rest



Stress

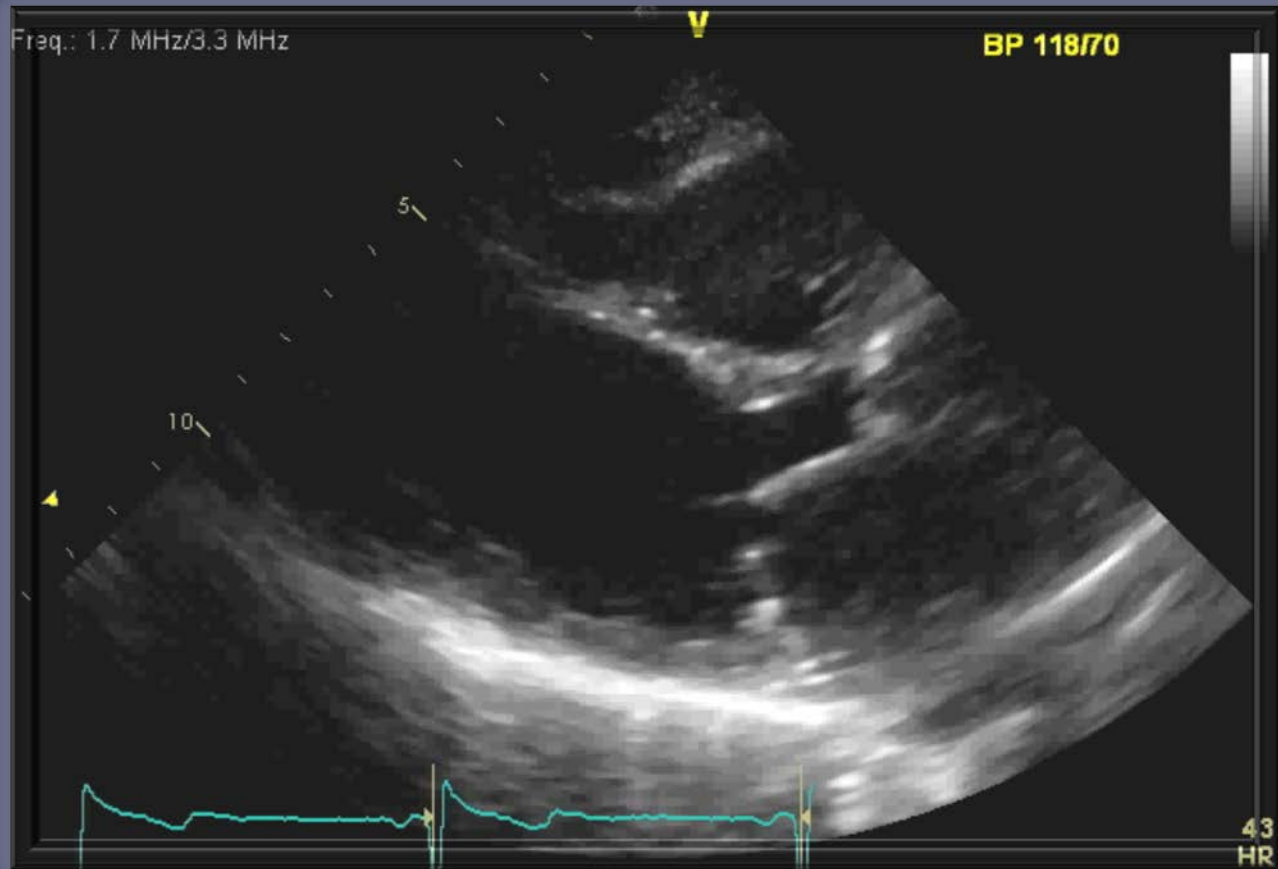


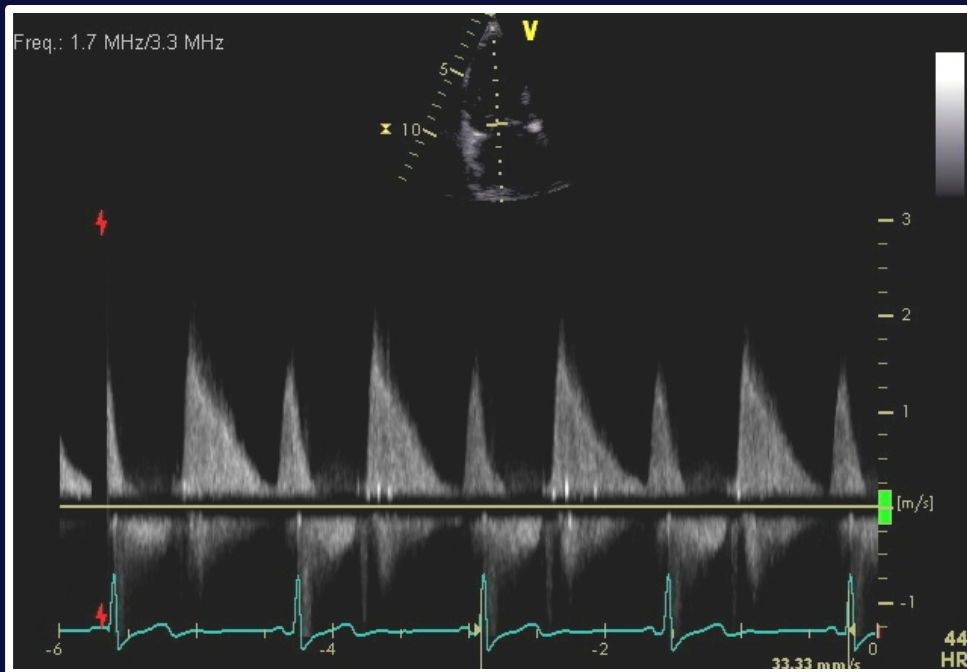
What to do next?

1. EVO_2
2. Percutaneous valvuloplasty
3. MVR
4. Watchful waiting

A Diagnostic Dilemma

**68 year old female: SOBOE. S/P AVR 3 years prior.
20 year history migraine medicine**





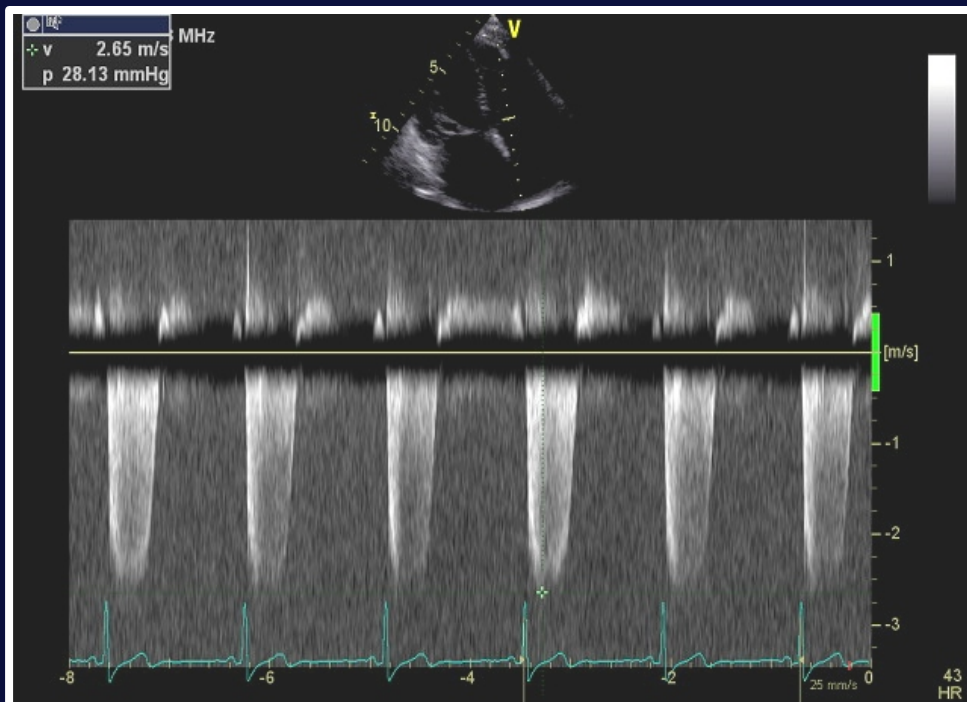
**Mean gradient:
 4 mmHg (HR
 44 BPM)**

$T_{1/2}$: 158 ms

**MVA ($t_{1/2}$): 1.39
 cm²**

**MVA (cont. eq)
 1.25 cm²**

PAP: 35 mmHg



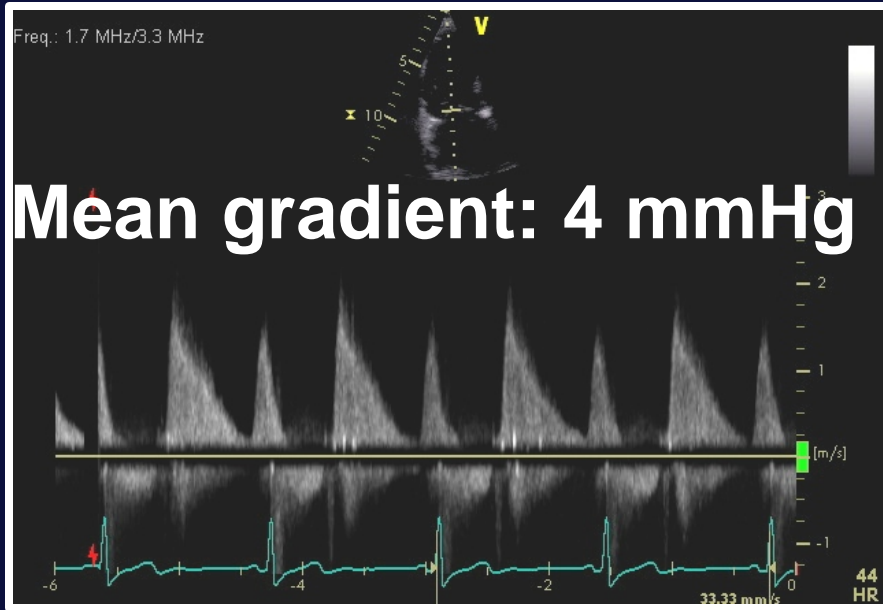
How severe is the MS?

1. Mild
2. Mild-moderate
3. Moderate
4. Severe
5. Difficult to tell

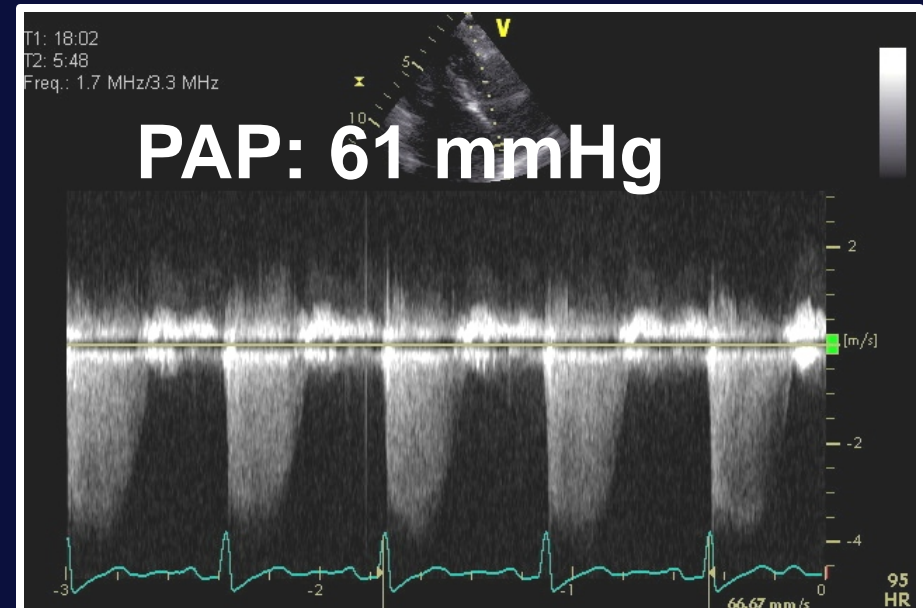
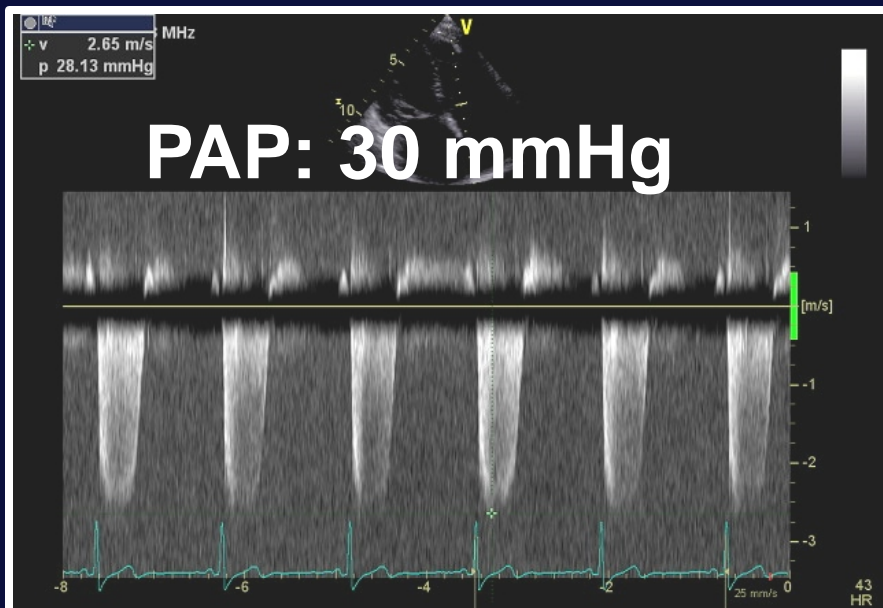
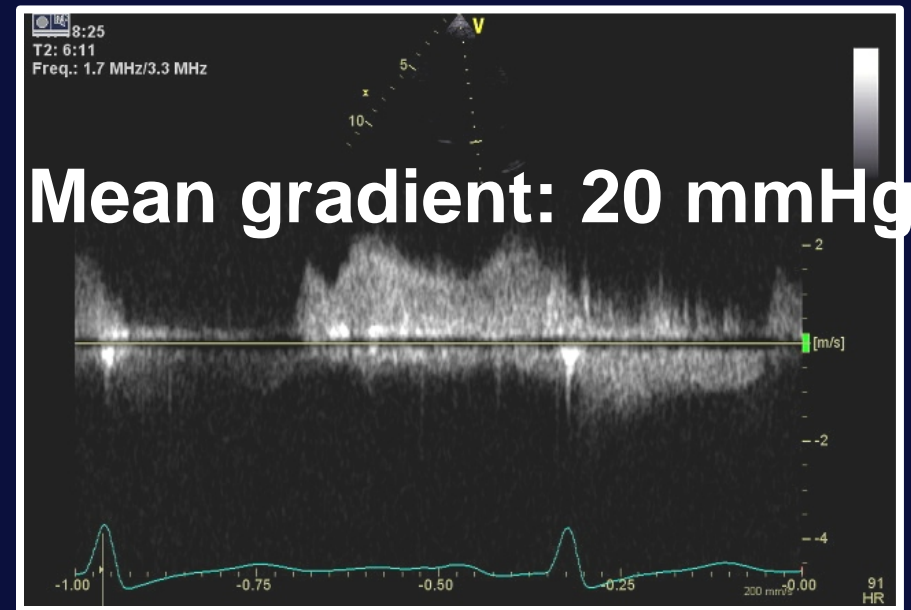
Stress Echocardiogram

- **Supine bike: 6 minutes; 75 watts**
- **76% max predicted HR**
- **BP (rest): 146/56 mmHg**
- **BP (stress): 198/108 mmHg**
- **Stopped for leg fatigue/dyspnea**

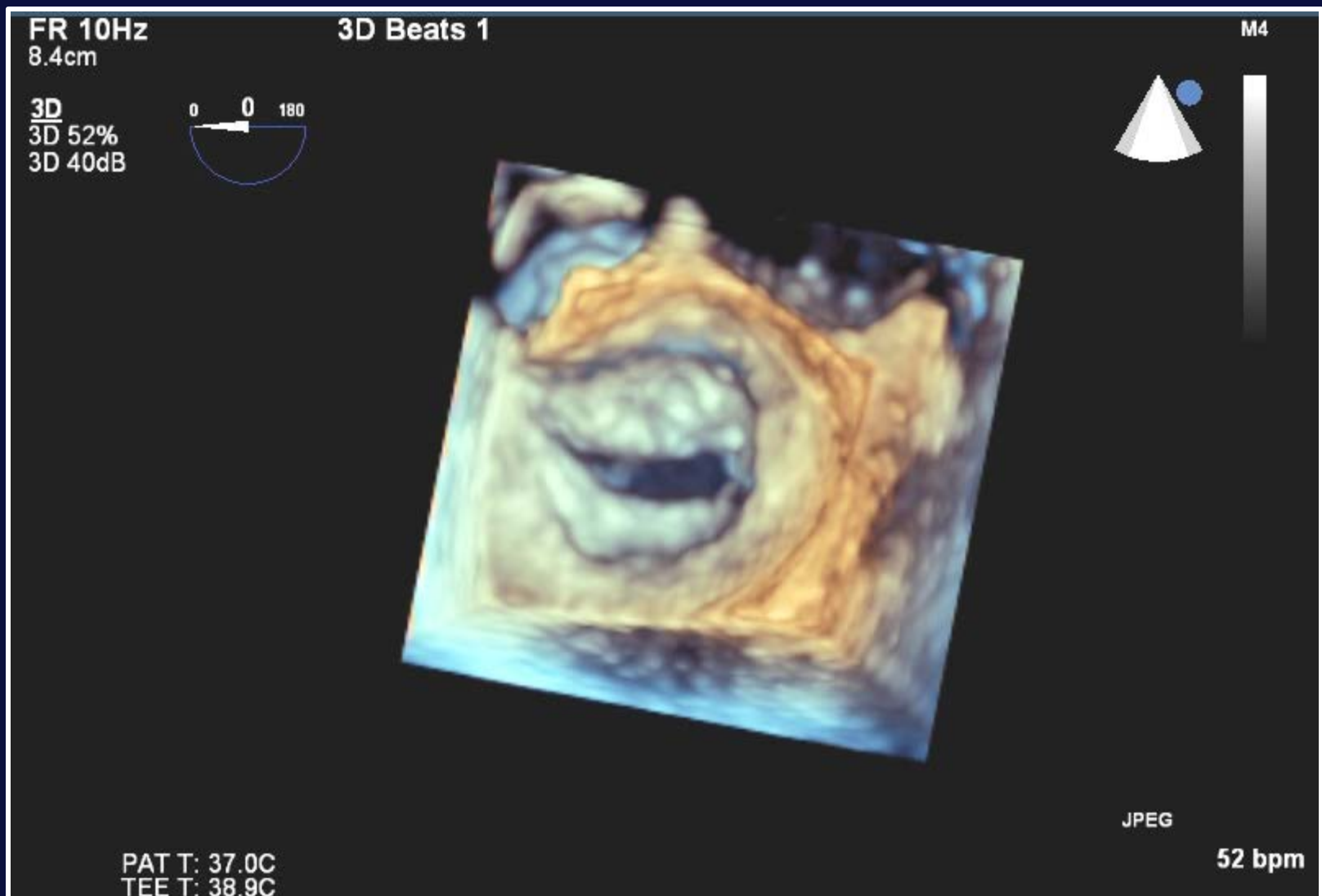
Rest



Stress



MVA (planimetry): 1.4 cm²



FR 50Hz

10cm

M5

2D

56%

C 50

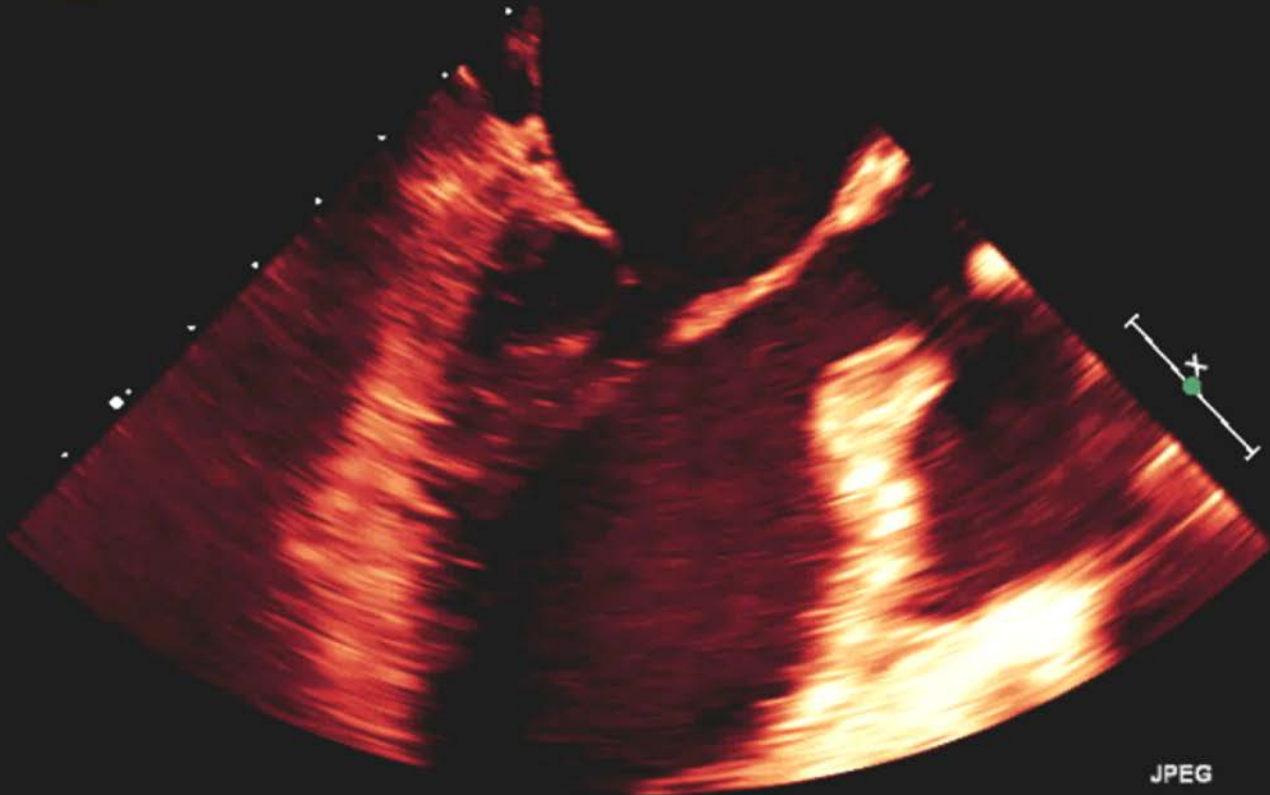
P Off

Gen

0 125 180



P



JPEG

PAT T: 37.0C
TEE T: 39.5C

49 bpm

What to advise?

1. Watchful waiting
2. Pulmonary work up
3. MVR
4. Percutaneous valvuloplasty

Exercise Response in Severe MS

- Mean gradient > 15 mmHg (stress)
- Mean gradient > 18 mmHg (Dob)
- +/- SPAP > 60 mmHg

ACC/AHA Guidelines: Symptomatic severe MS

Class I: MV OR recommended for severely symptomatic (Class III/IV) with severe MS who are not high risk for OR and who are not candidates for or failed previous PBMC

Prosthetic Valves

- **Aortic**: mean gradient increase at least >20 mmHg and failure for valve area to increase
- **Mitral**: mean gradient increase at least > 12 mmHg often associated with PHT (≥ 60 mmHg)

mayo

