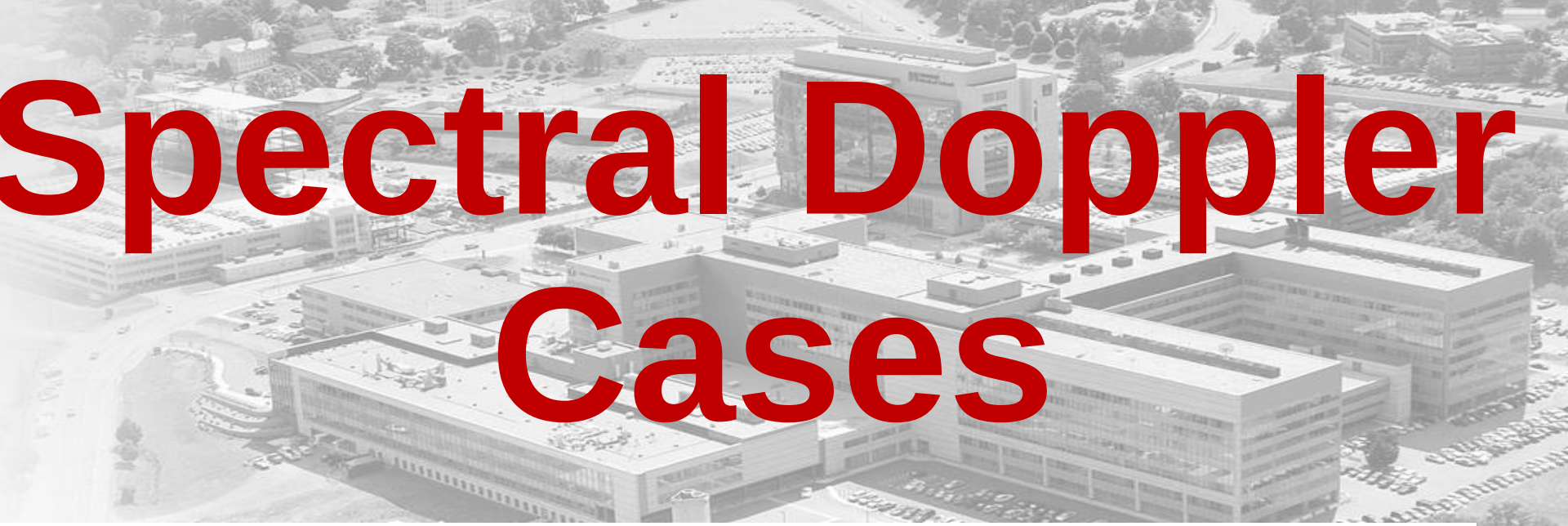


Spectral Doppler Cases

Gerard P. Aurigemma MD

ASE Board Review Course

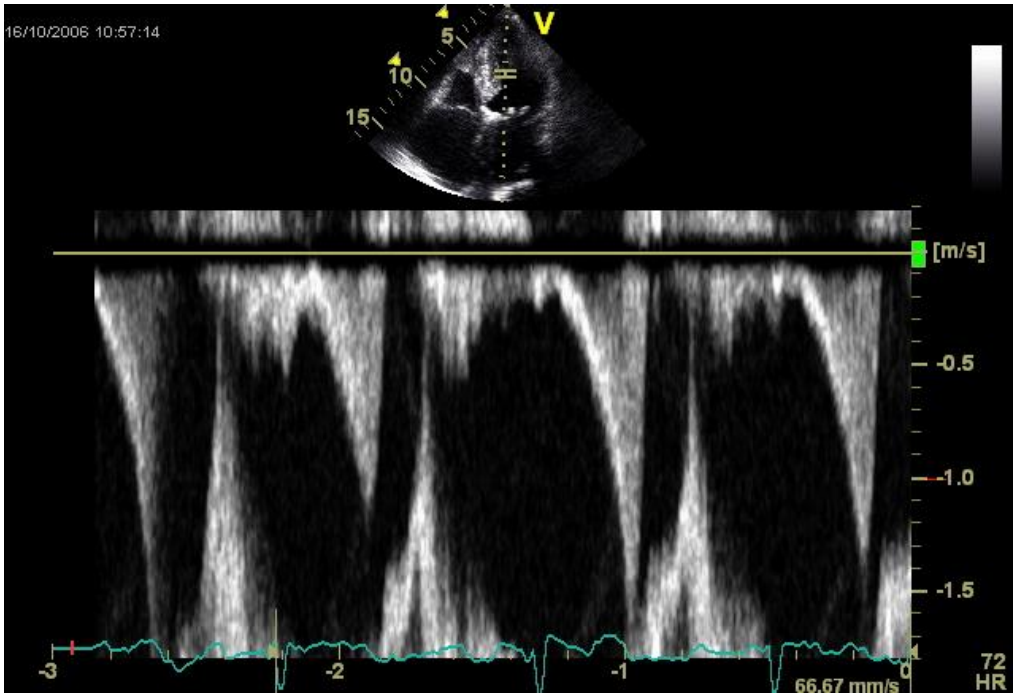
2016

No Relevant Disclosures

University of Massachusetts Medical School
UMASS

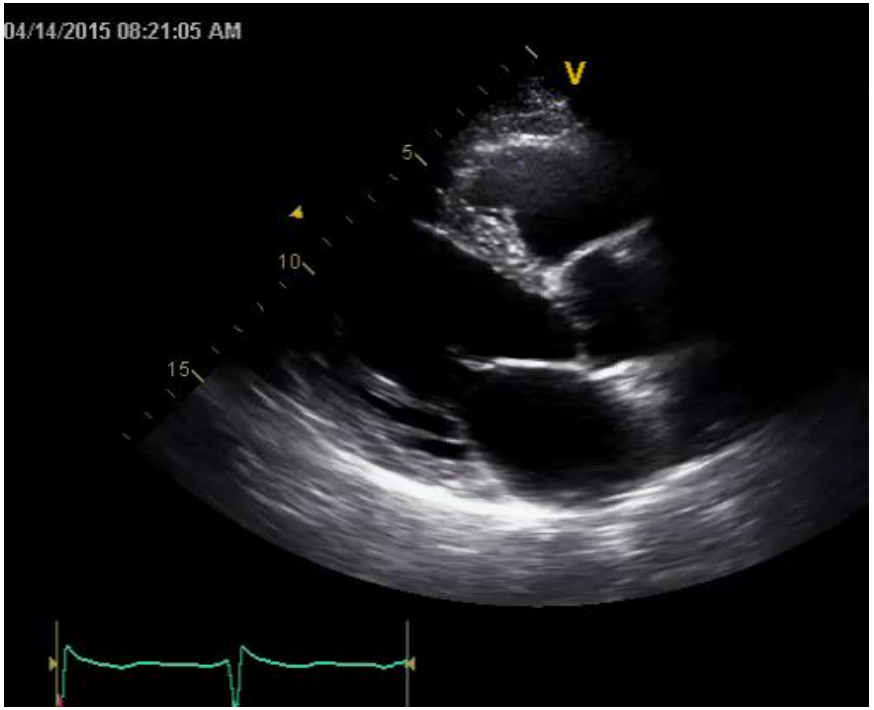
This spectral Doppler profile may be seen in:

1. HCM
2. Hypertensive LVH
3. AS
4. 1-3
5. None of above



42 year old woman with a murmur

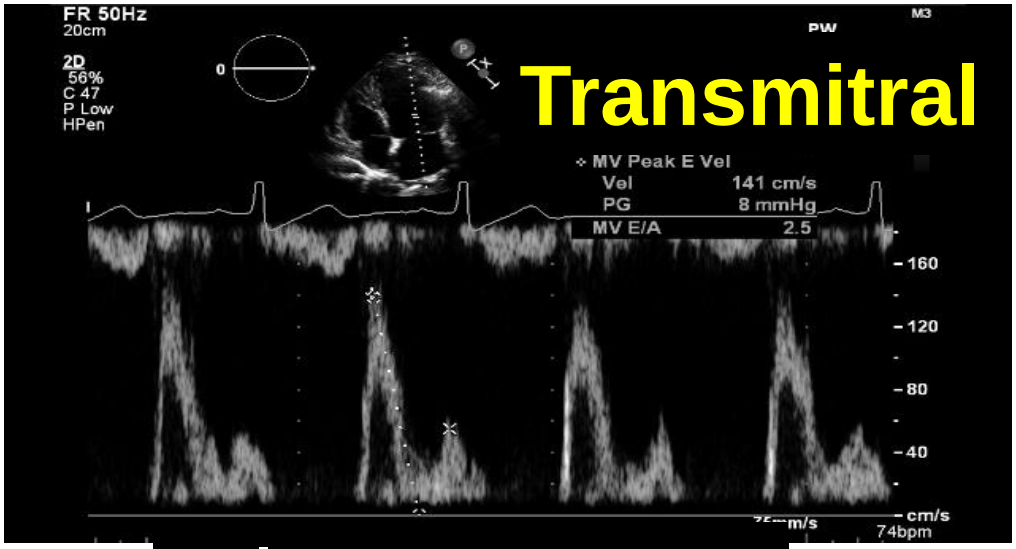
Diagnostic possibilities include all of the following except:

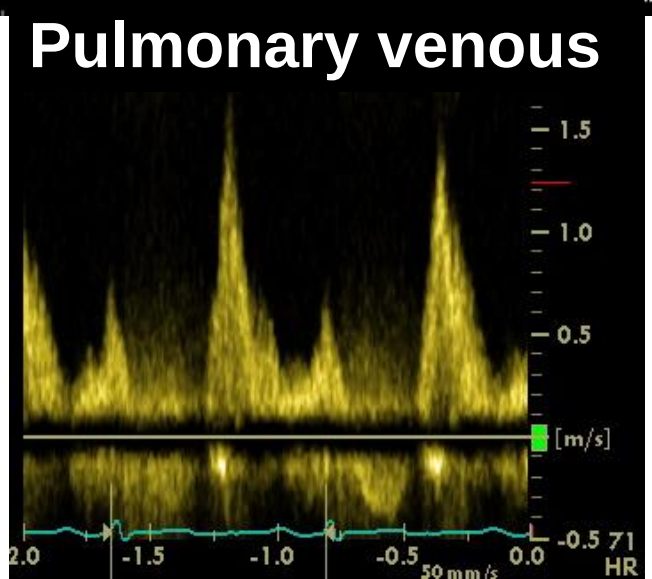


1. **High output heart failure**
2. **PDA**
3. **Severe MR**
4. **Coronary sinus ASD**

A 65 year old with MVP and MR. What do you conclude from these spectral profiles?:

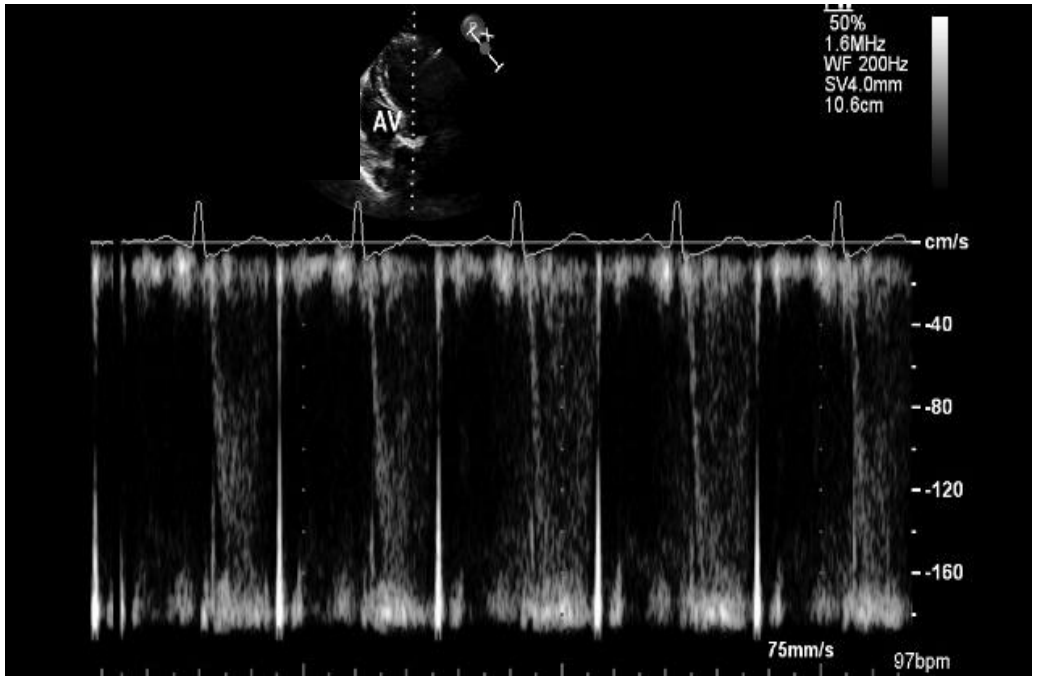
1. He has normal diastolic function
2. The MR is probably not very significant
3. The MR is likely to at least moderate to severe
4. Cannot tell with certainty





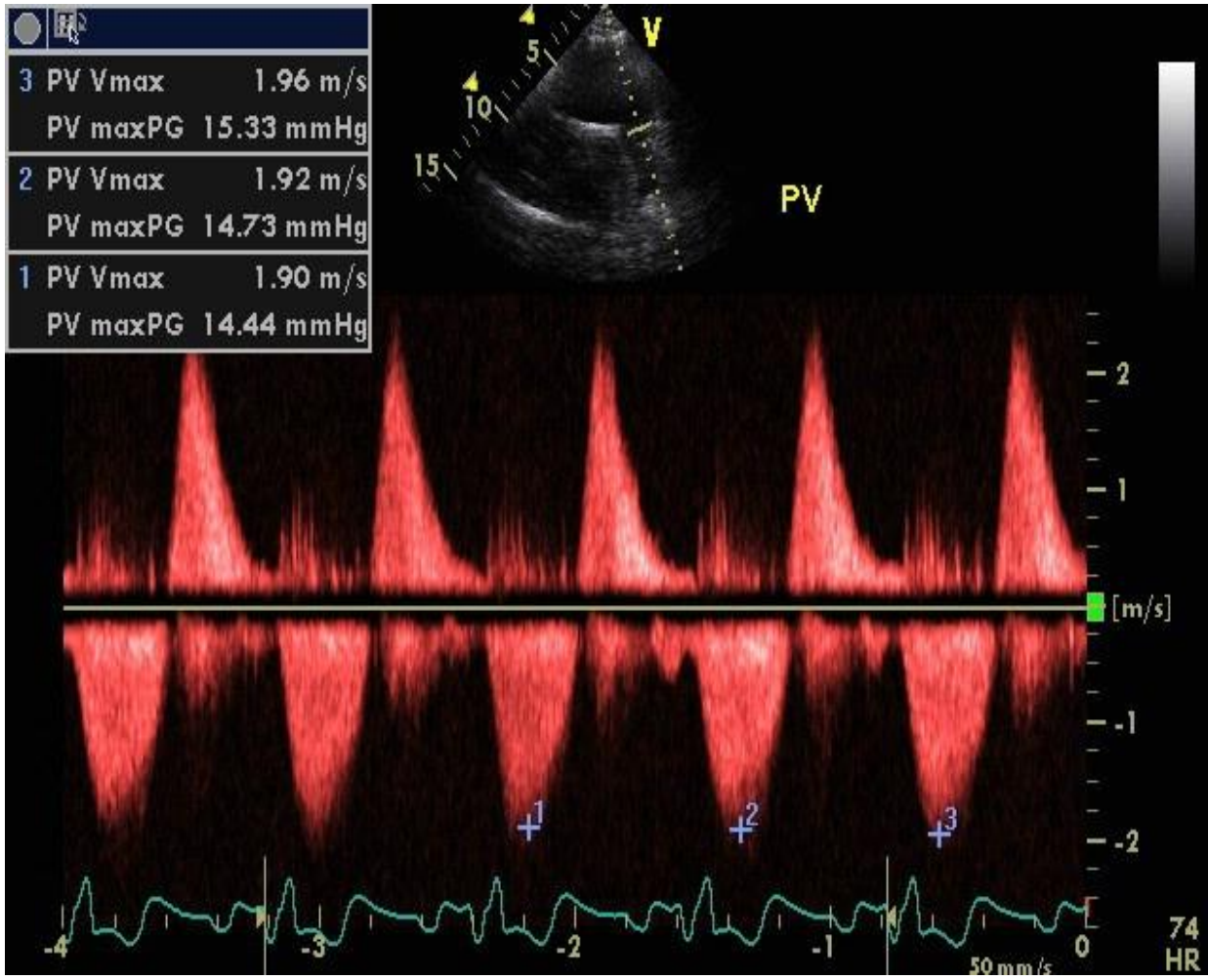
85 year old with known AS to calculate AVA you would:

1. Use 1.6 M/s as your V1
2. Cath the patient
3. Give beta blocker then repeat study
4. Send sonographer back to bedside



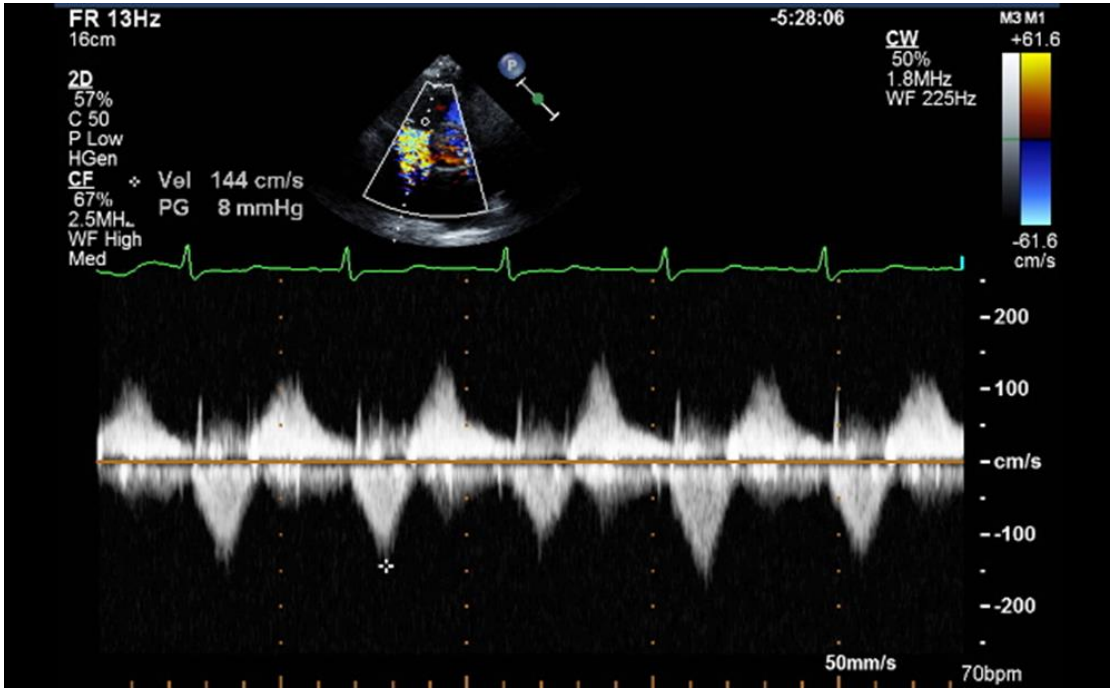
The spectral Doppler indicates

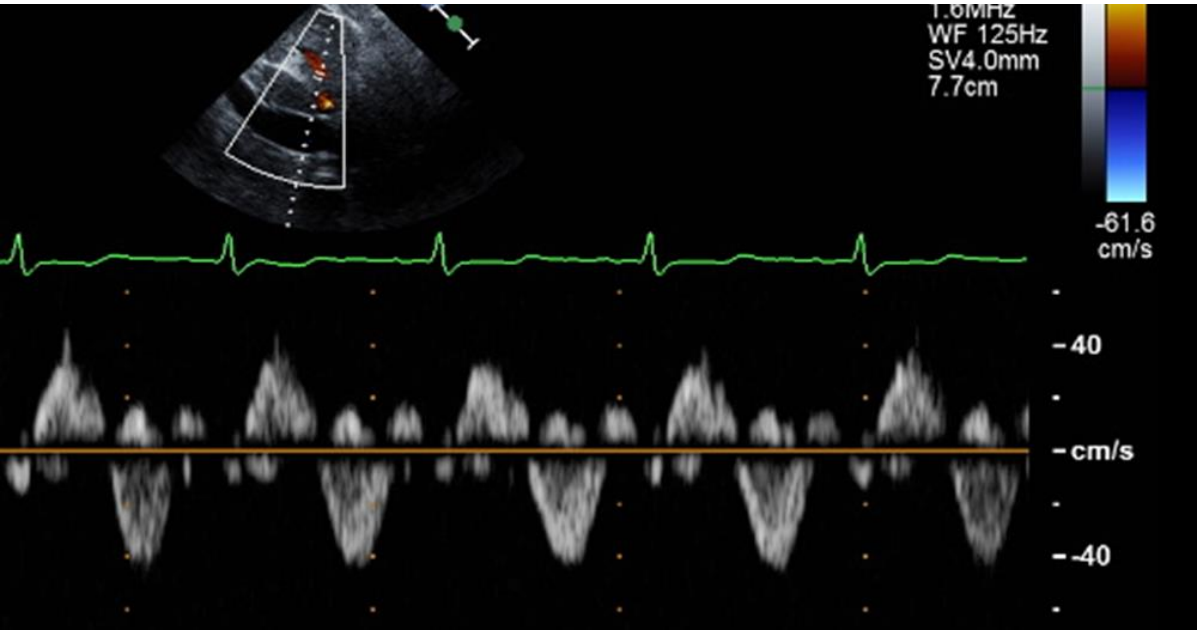
1. Restrictive filling pattern in someone with AF
2. Severe PR
3. RV systolic dysfunction
4. Severe AR



Dx?

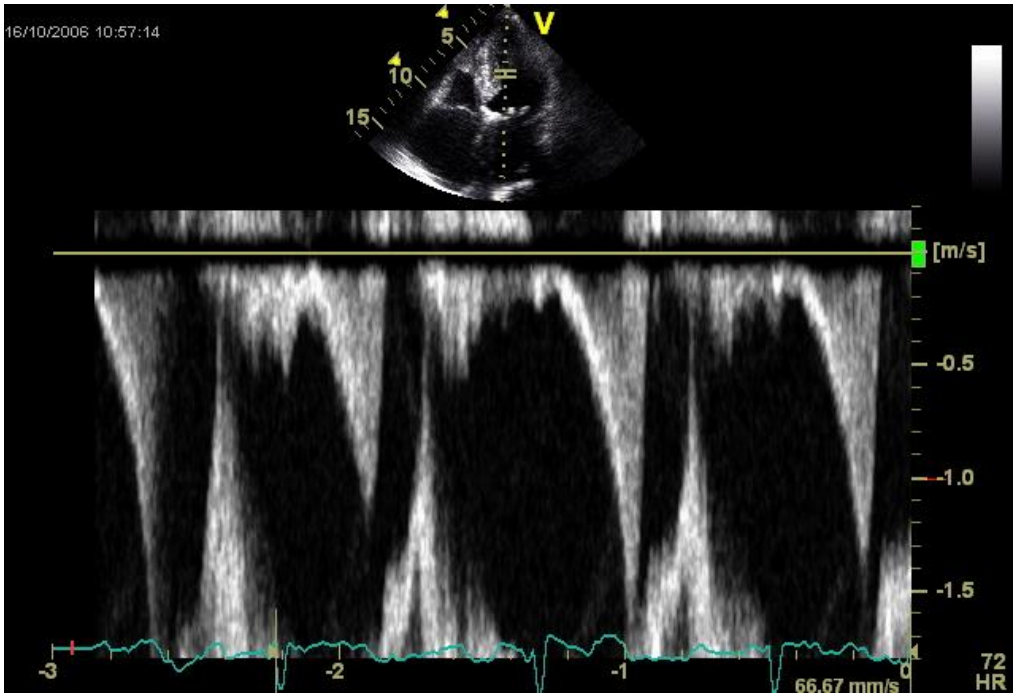
1. Severe TR
2. RV systolic dysfunction
3. both
4. neither

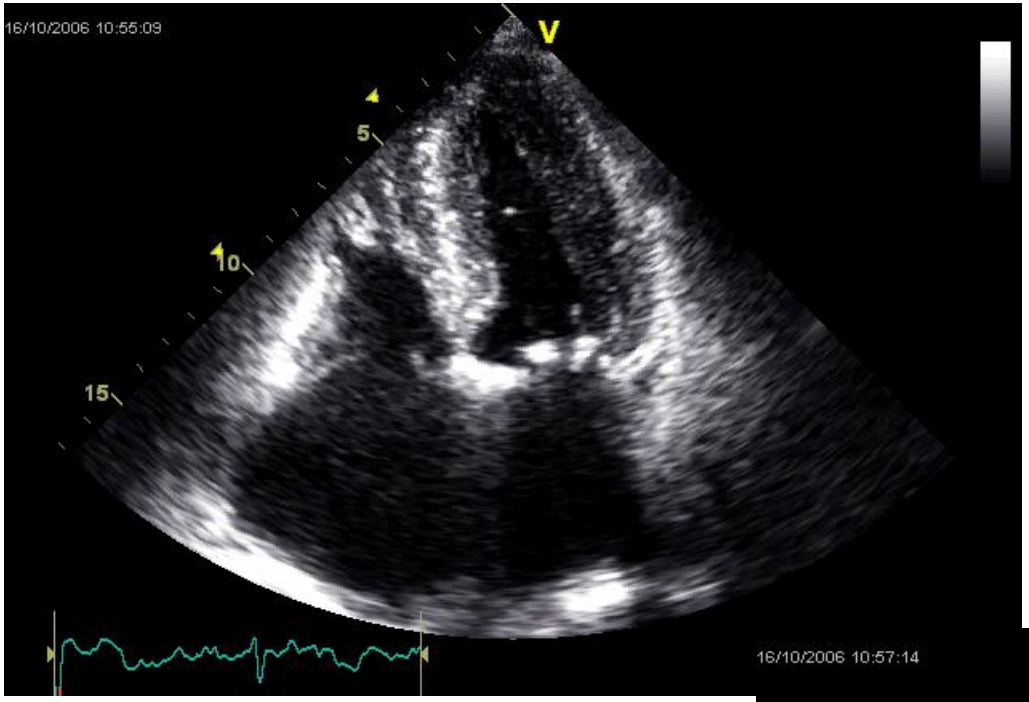


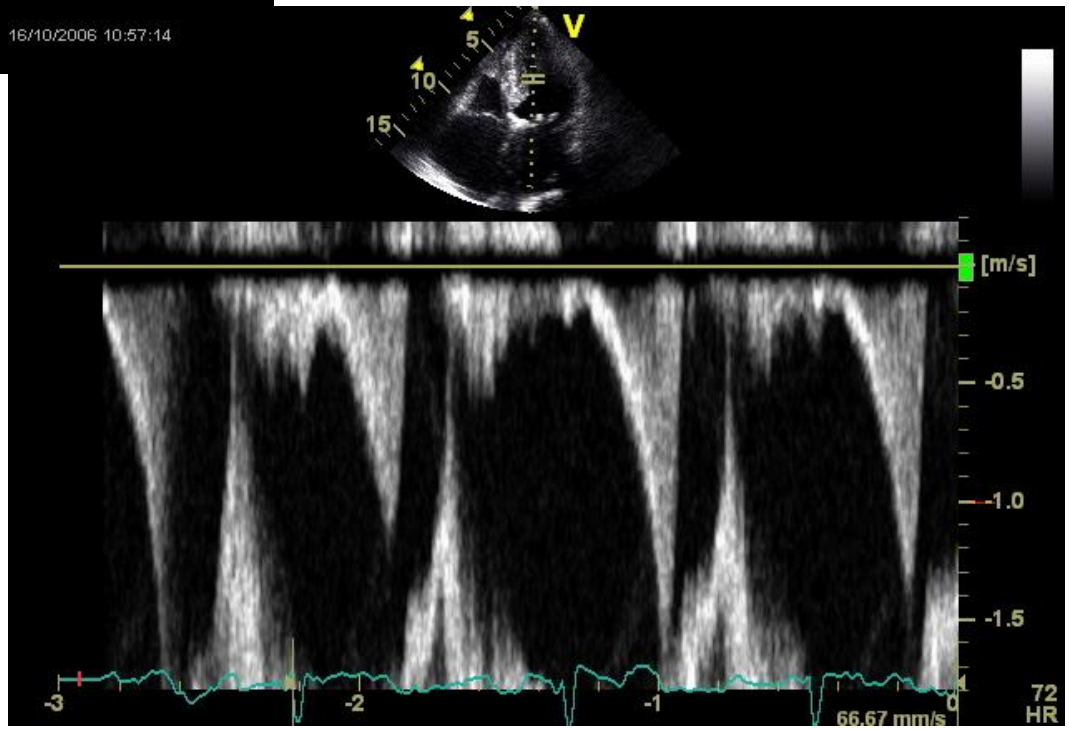


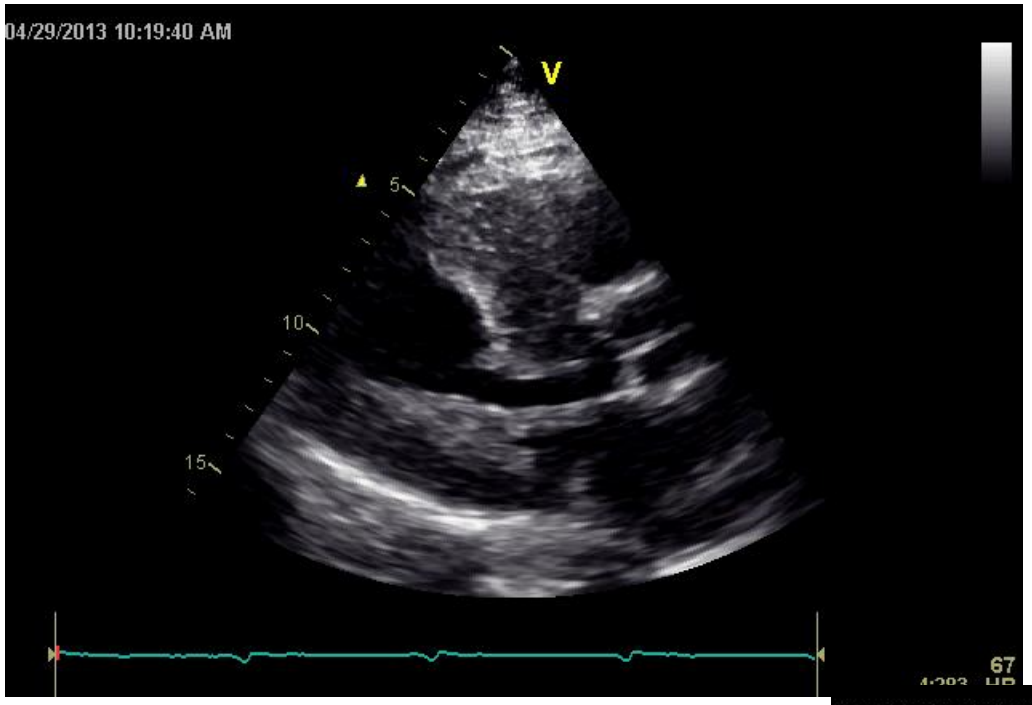
This spectral Doppler profile may be seen in:

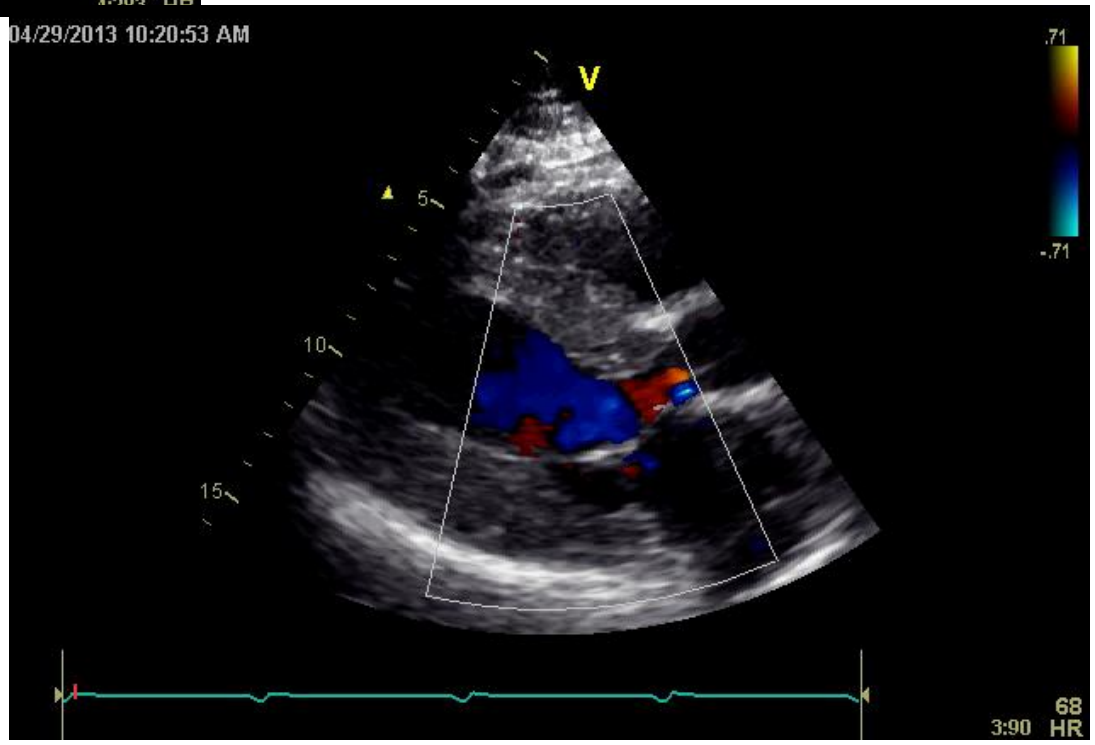
1. HCM
2. Hypertensive LVH
3. AS
4. 1-3
5. None of above

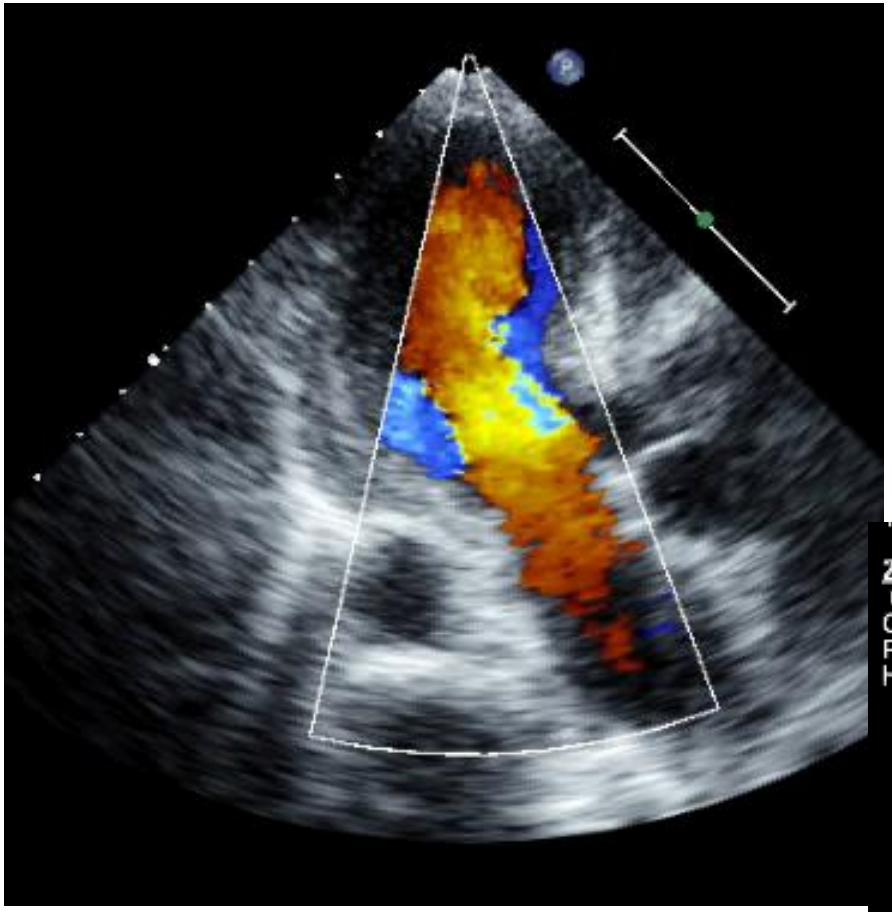


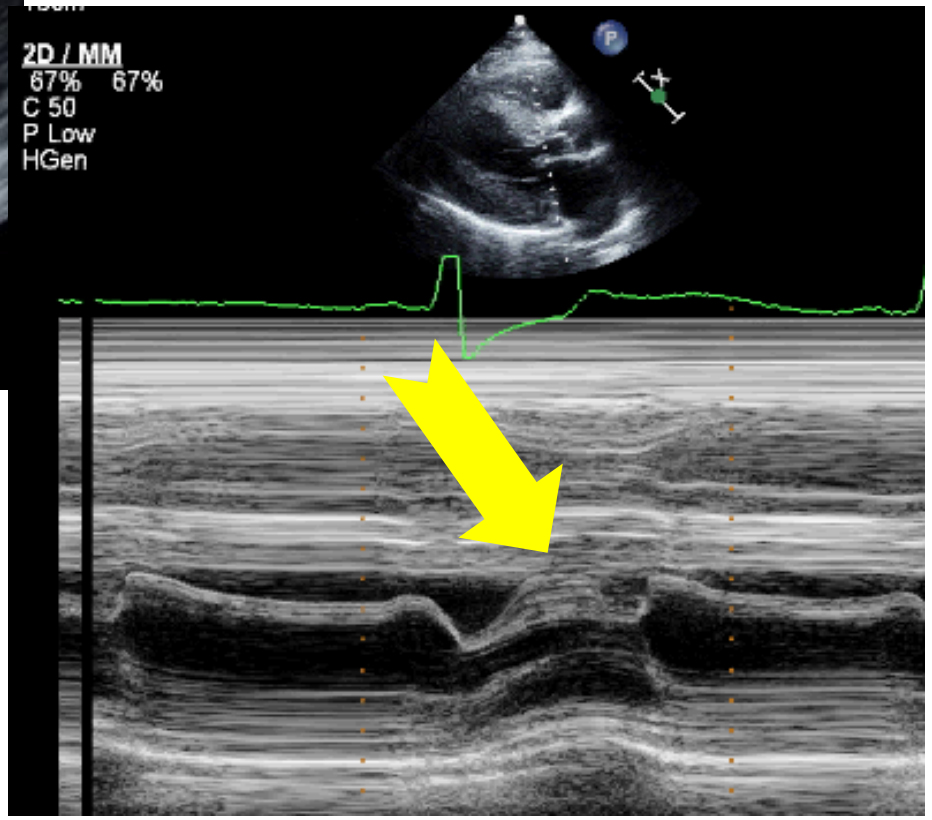

16/10/2006 10:55:09
V
5
10
15

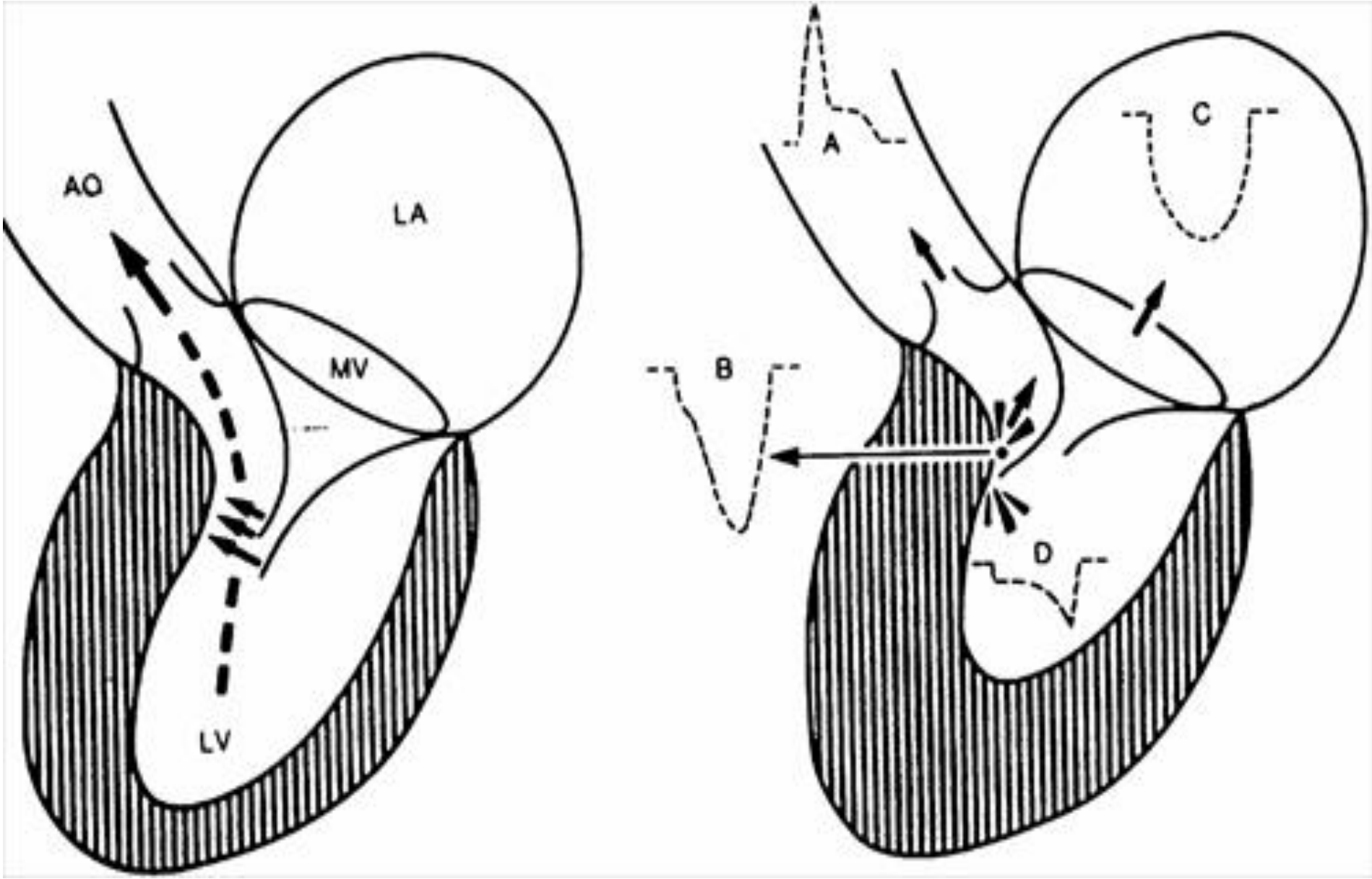

16/10/2006 10:57:14
V
5
10
15
[m/s]
-0.5
-1.0
-1.5
-3
-2
-1
0
66.67 mm/s
72
HR


04/29/2013 10:19:40 AM
V
5
10
15
67

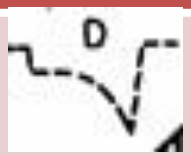
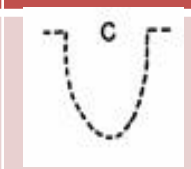

04/29/2013 10:20:53 AM
V
.71
-.71
5
10
15
68
3:90 HR

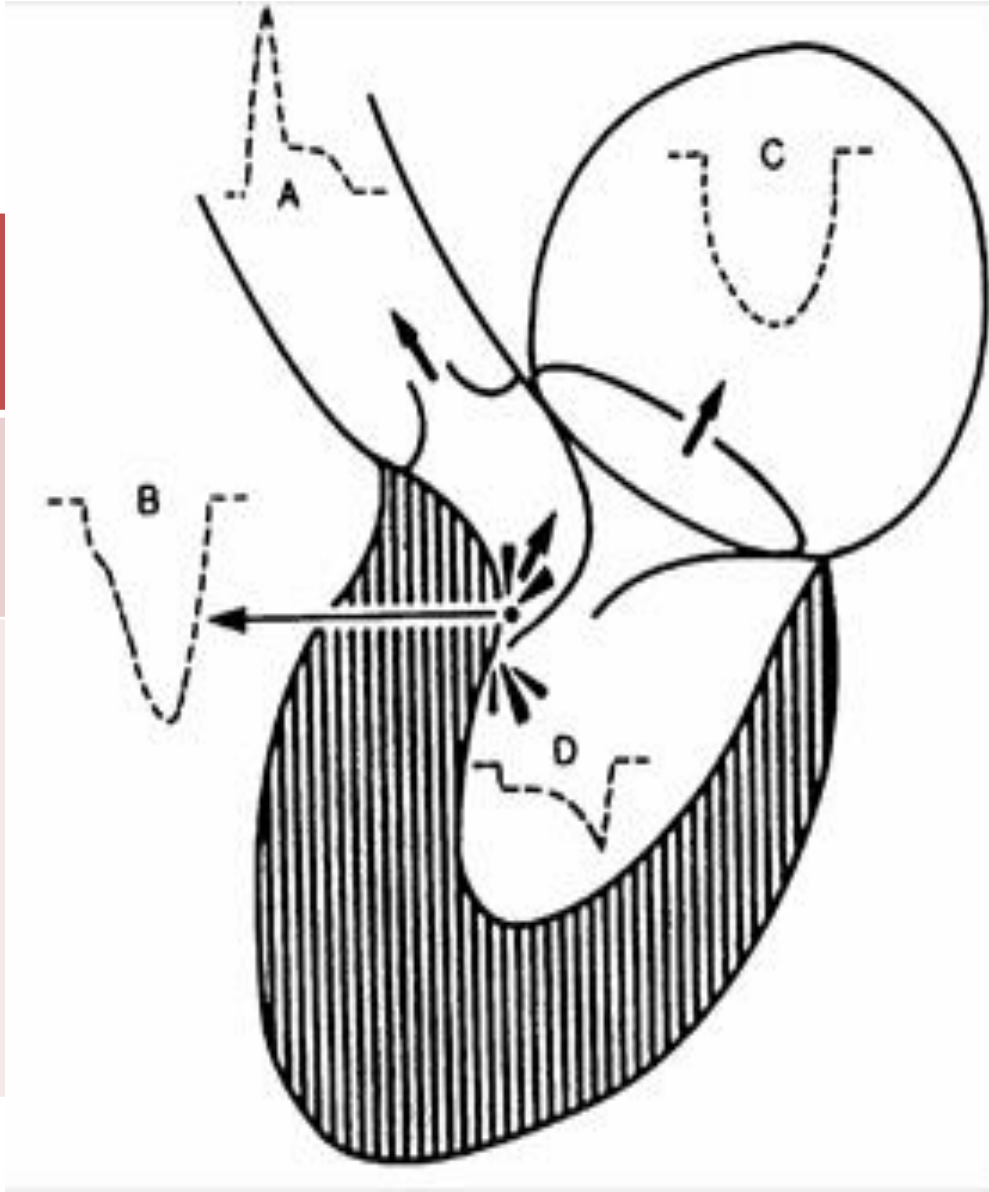


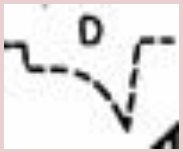
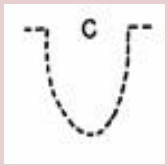

2D / MM
67% 67%
C 50
P Low
HGen



Various Doppler Profiles in HCM

LVOT	Mid cavity	MR
		
Late peaking Gentle slope 4.5 M/s	Late peaking Very sharp Lower velocity than LVOT signal	Starts early Parabolic Can be as high as 8 M/s



LVOT	Mid cavity	MR
		
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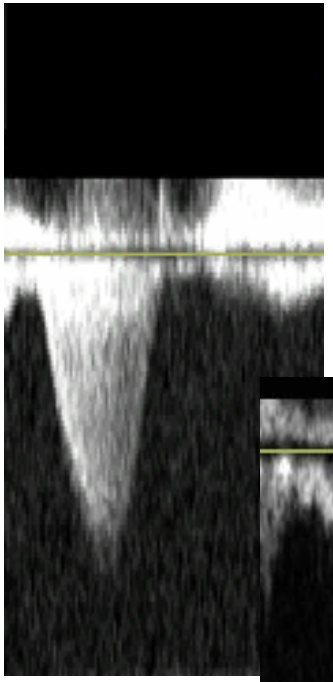
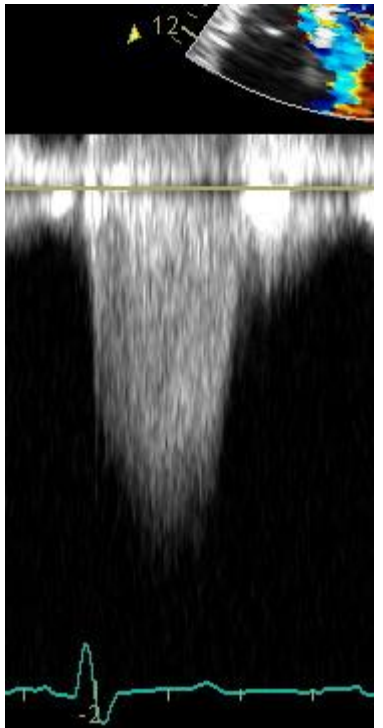
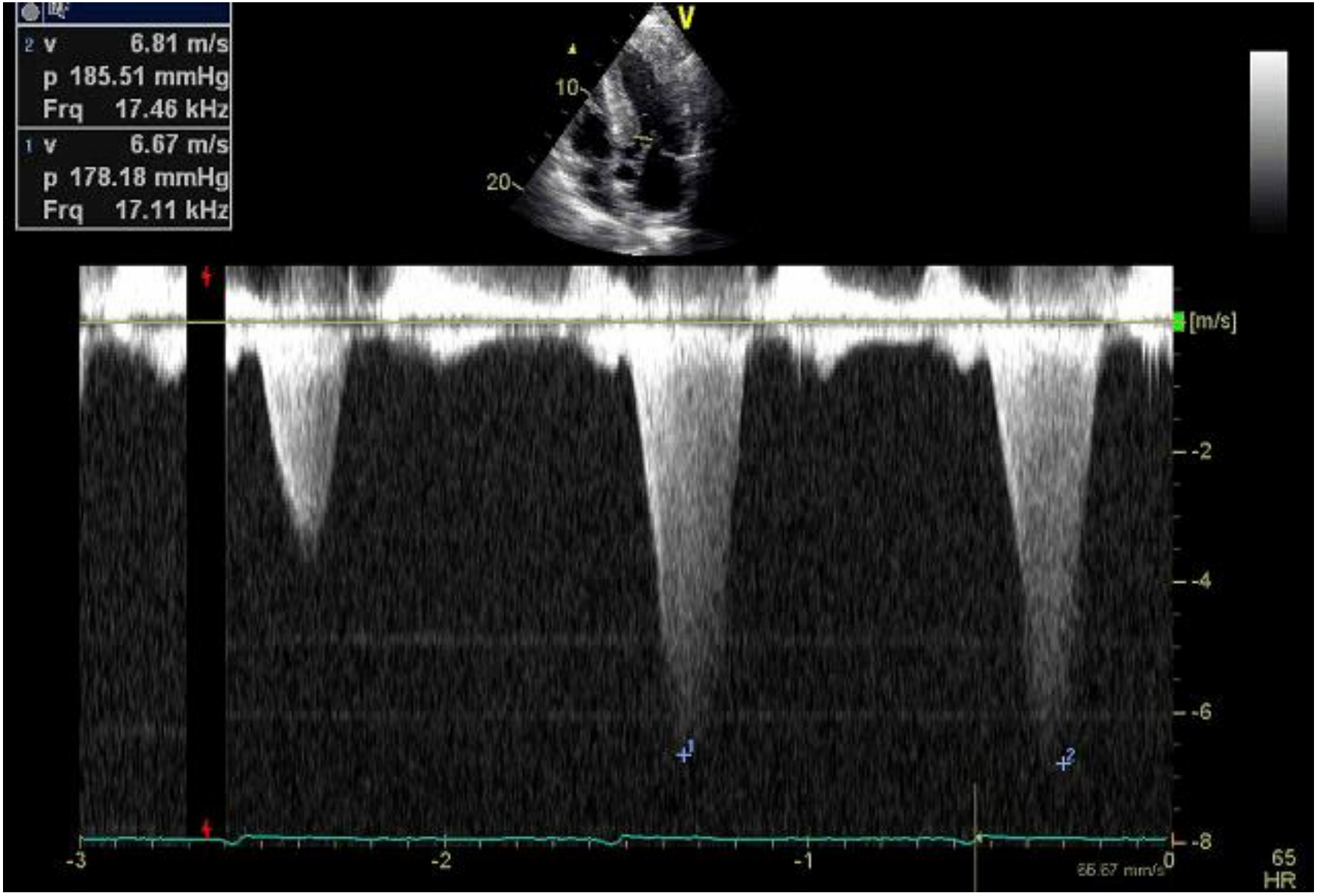
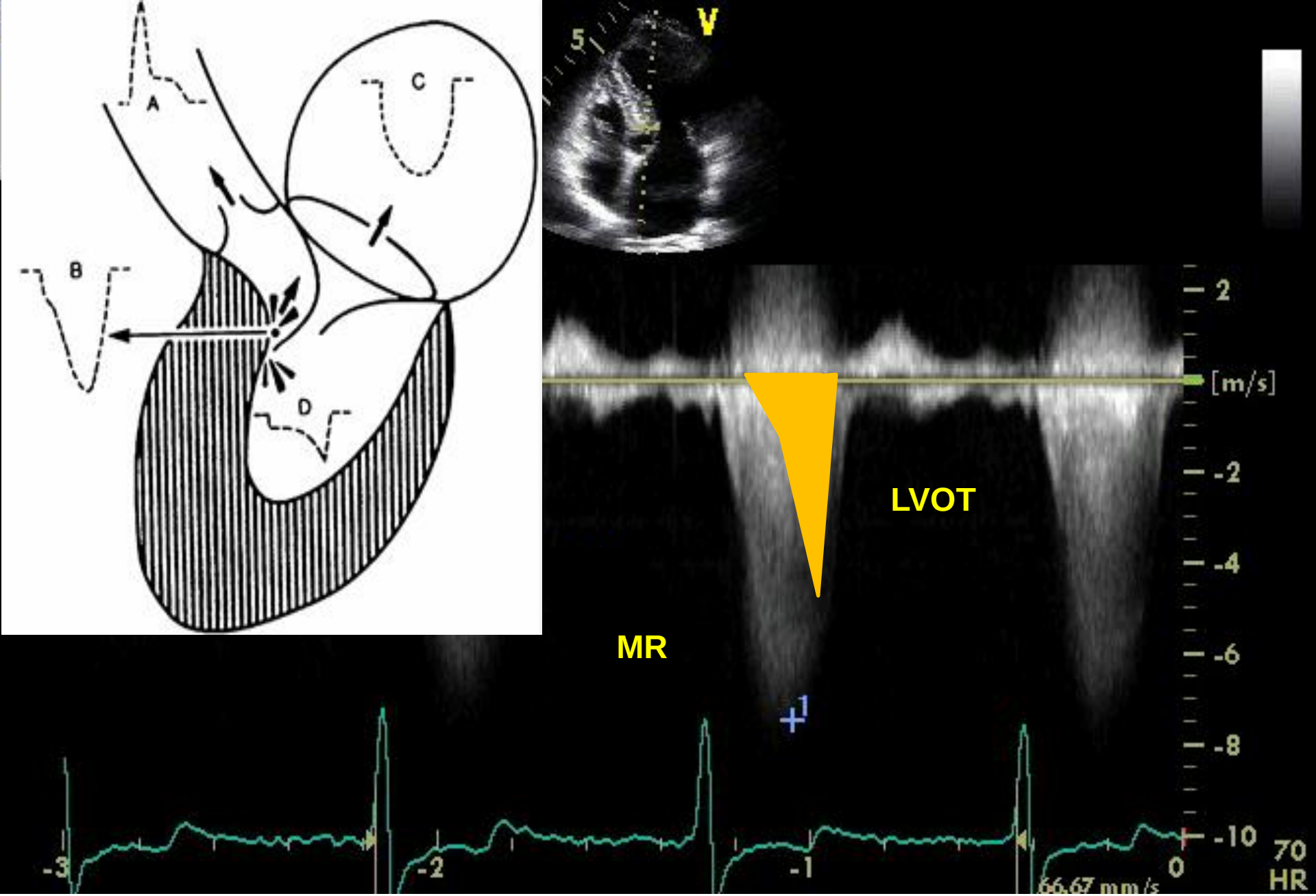


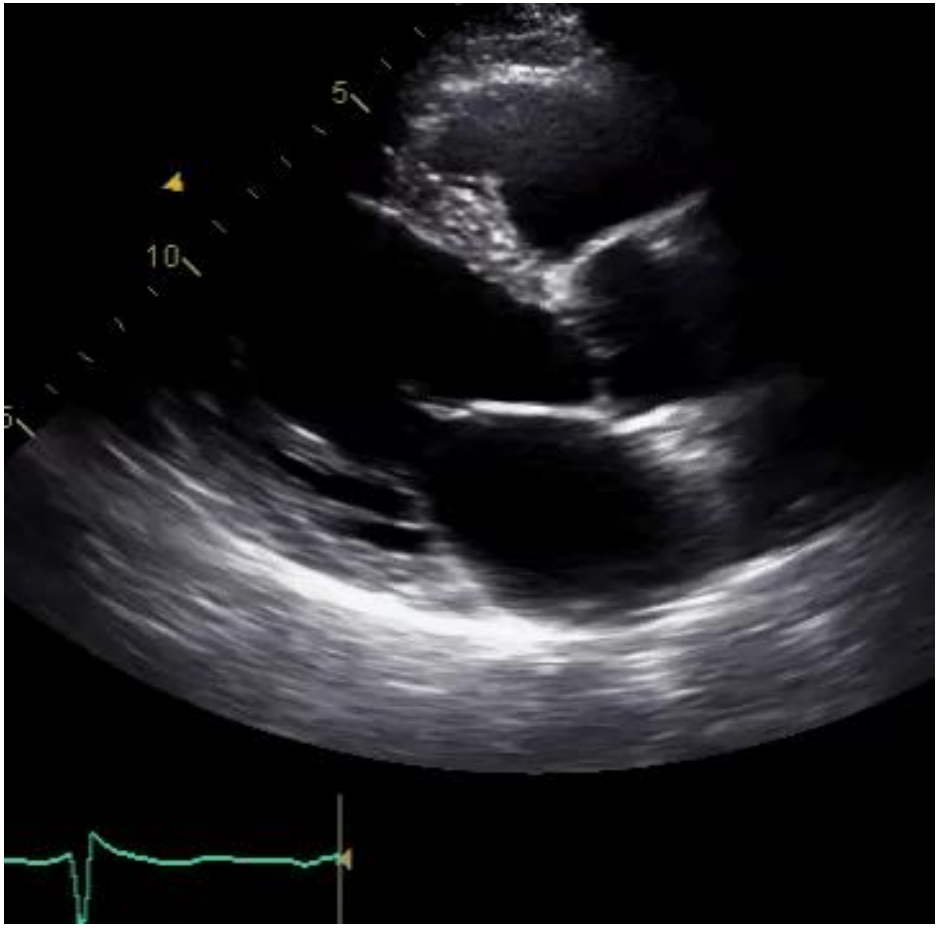


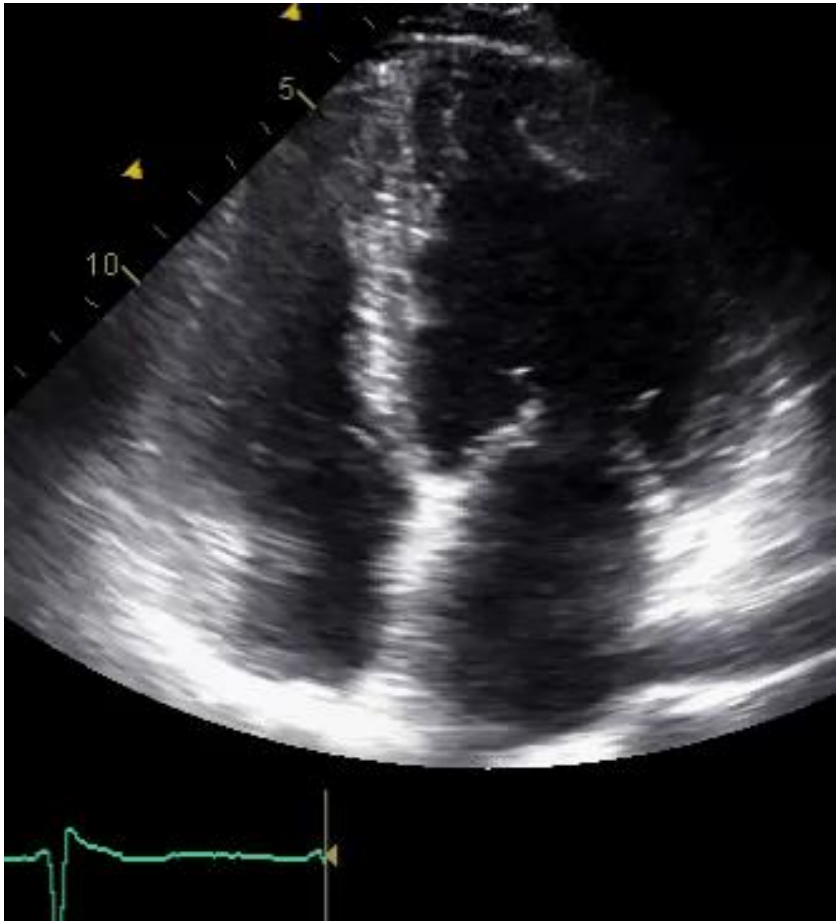

2 v 6.81 m/s
p 185.51 mmHg
Frq 17.46 kHz
1 v 6.67 m/s
p 178.18 mmHg
Frq 17.11 kHz
V
10
20
[m/s]
-2
-4
-6
-8
-3
-2
-1
0
65
HR

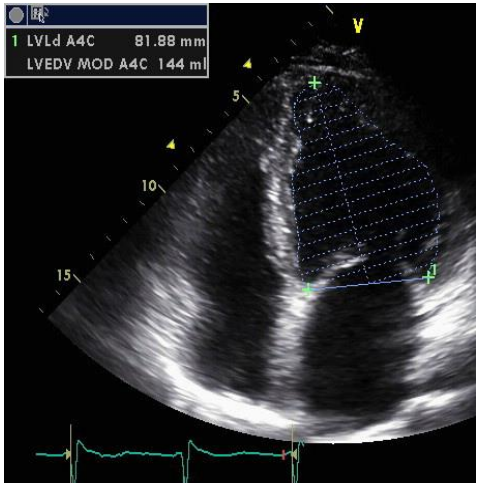

A
B
C
D
V
5
2
[m/s]
-2
-4
-6
-8
-10
LVOT
MR
-3
-2
-1
0
66.67 mm/s
70
HR

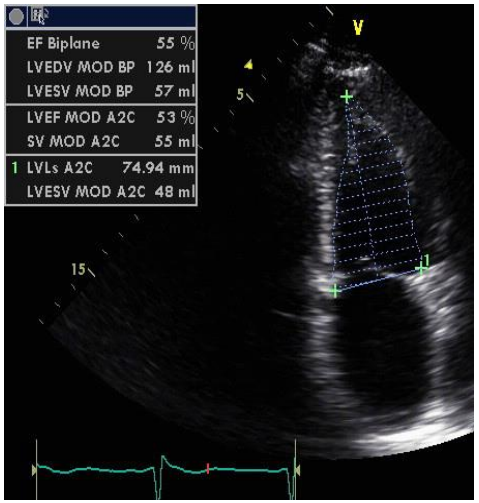
42 year old woman, recently immigrated from Iraq

History of Murmur









LVVd= 126 cc
LVVs=55 cc
SV =71 cc

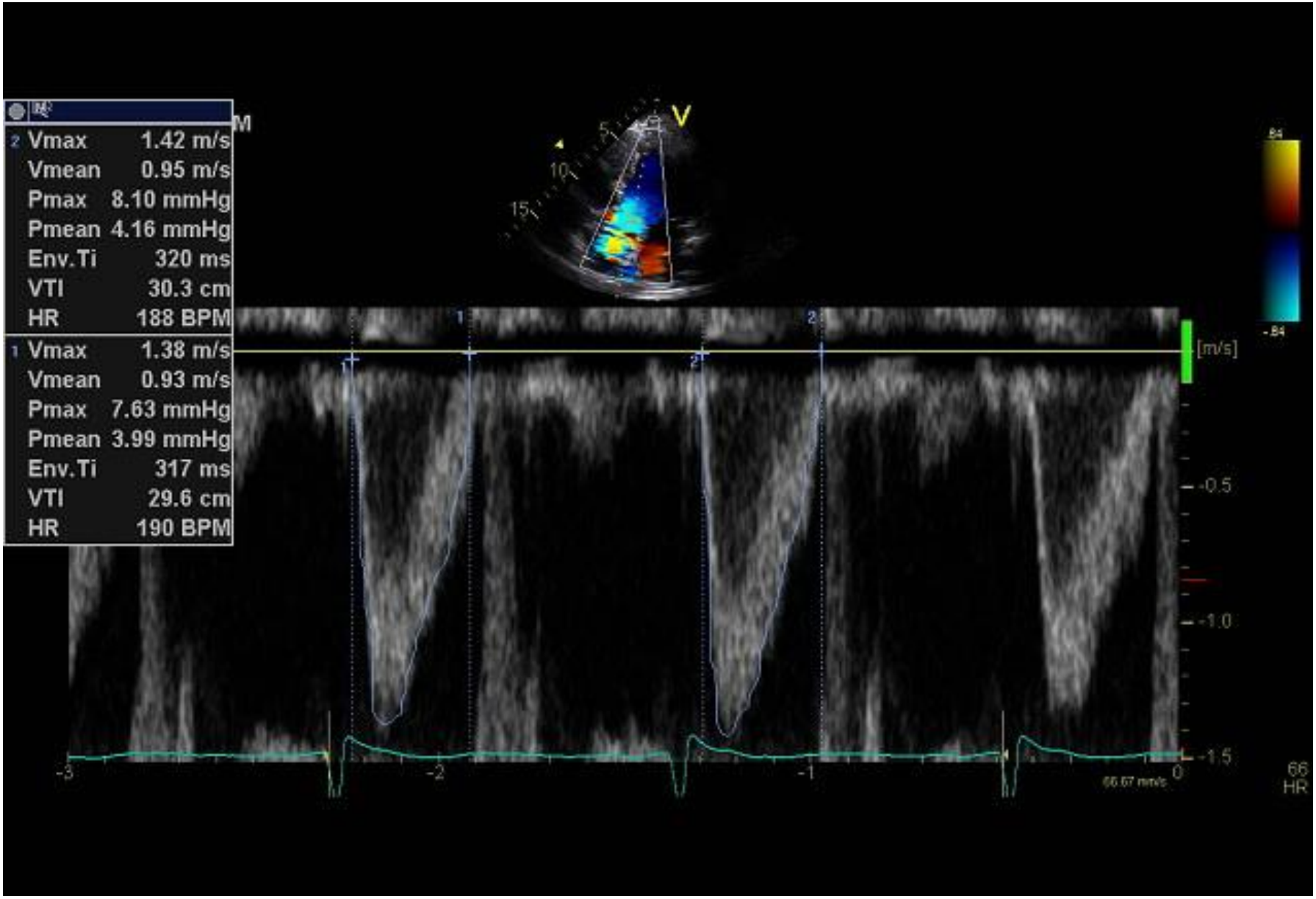
LVVdi=74 cc/M2

ULN (ASE)

Table 2 Normal values for 2D echcording to gender

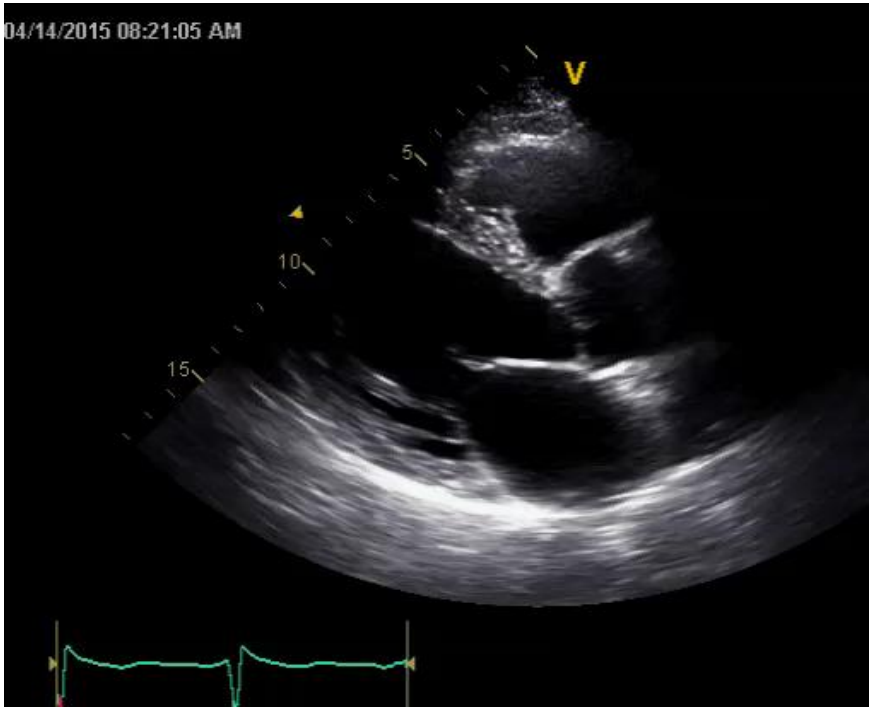
Parameter	Female	
	Mean ± SD	2-SD range
LV internal dimension		
Diastolic dimension (mm)	45.0 ± 3.6	37.8–52.2
Systolic dimension (mm)	28.2 ± 3.3	21.6–34.8
LV volumes (biplane)		
LV EDV (mL)	76 ± 15	46–106
LV ESV (mL)	28 ± 7	14–42
LV volumes normalized by BSA		
LV EDV (mL/m^2)	45 ± 8	29–61
LV ESV (mL/m^2)	16 ± 4	8–24
LV EF (biplane)	64 ± 5	54–74

BSA, body surface area; *EDV,* end-dias *LV,* left ventricular; *SD,* standard deviation.

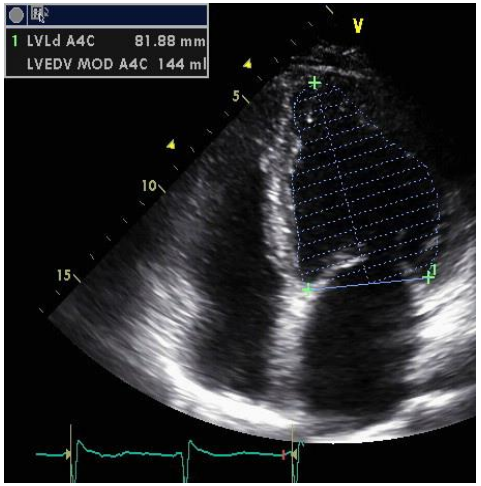

M
2 Vmax 1.42 m/s
Vmean 0.95 m/s
Pmax 8.10 mmHg
Pmean 4.16 mmHg
Env.Ti 320 ms
VTI 30.3 cm
HR 188 BPM
1 Vmax 1.38 m/s
Vmean 0.93 m/s
Pmax 7.63 mmHg
Pmean 3.99 mmHg
Env.Ti 317 ms
VTI 29.6 cm
HR 190 BPM
V
5
10
15
84
-84
[m/s]
-0.5
-1.0
-1.5
-3
-2
-1
0
66
HR

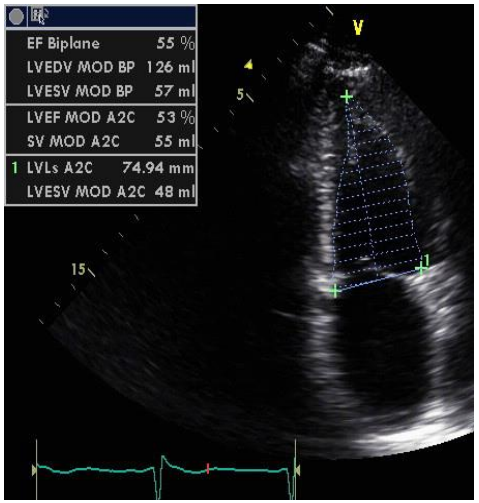
42 year old woman with a murmur

Diagnostic possibilities include all of the following except:



1. **High output heart failure**
2. **PDA**
3. **Severe MR**
4. **Coronary sinus ASD**





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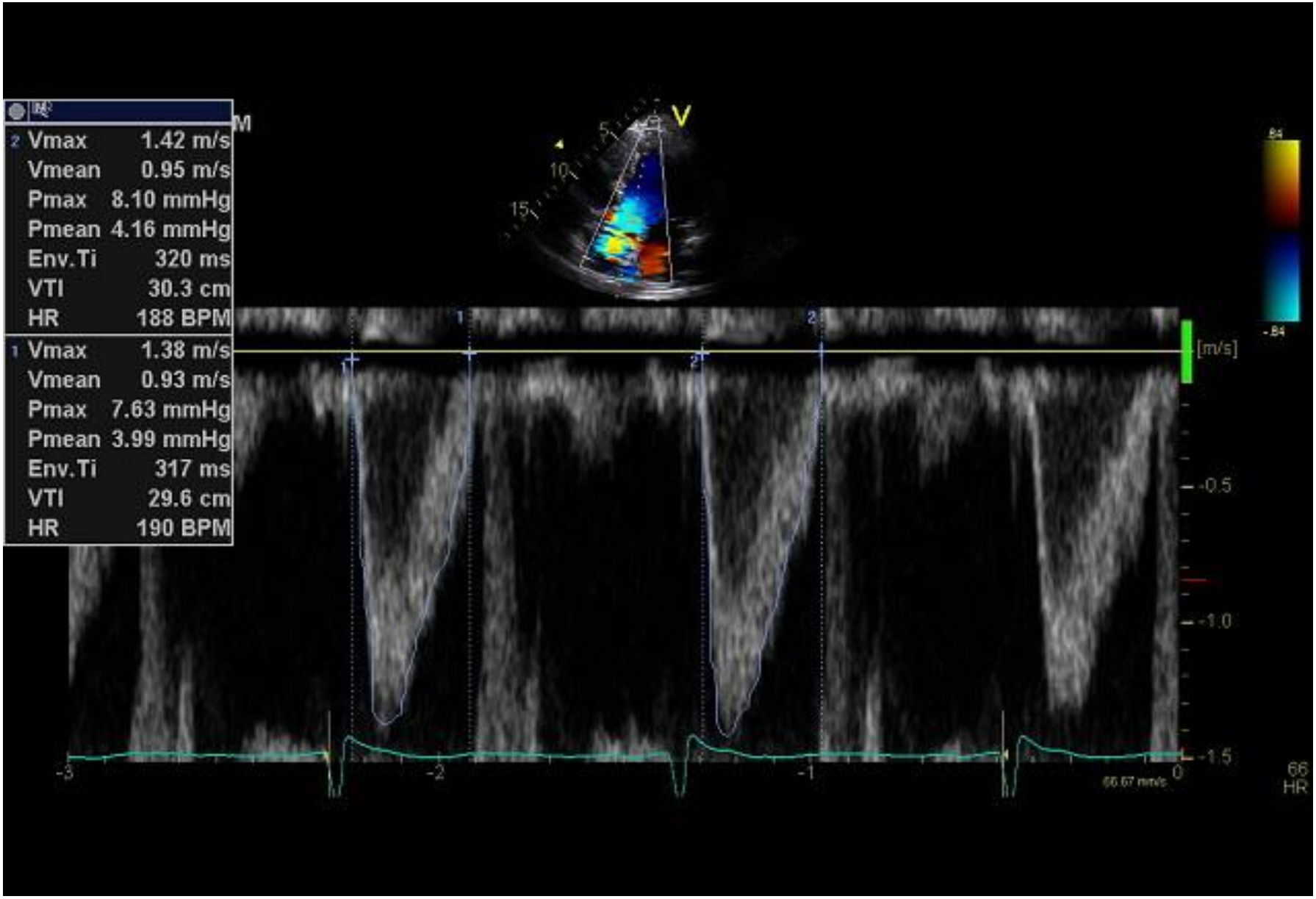
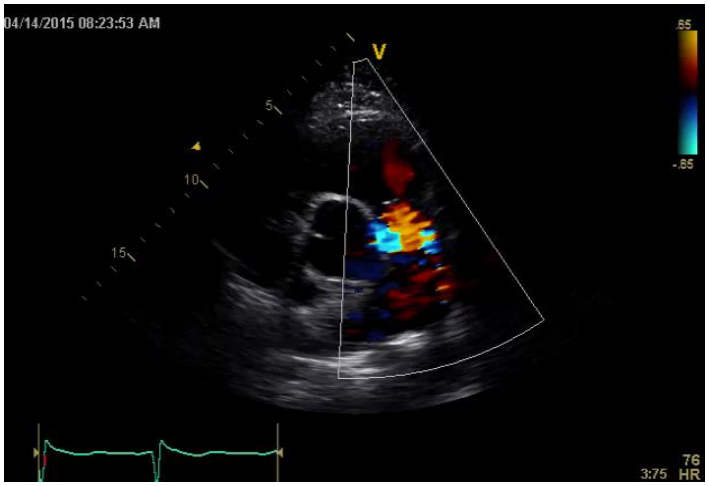
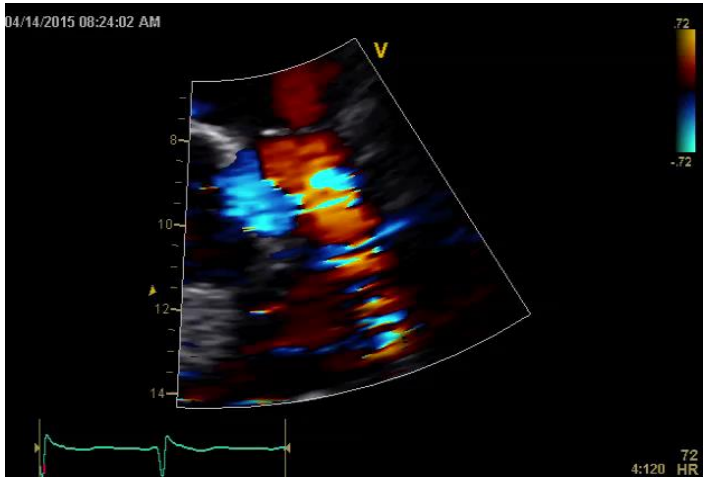
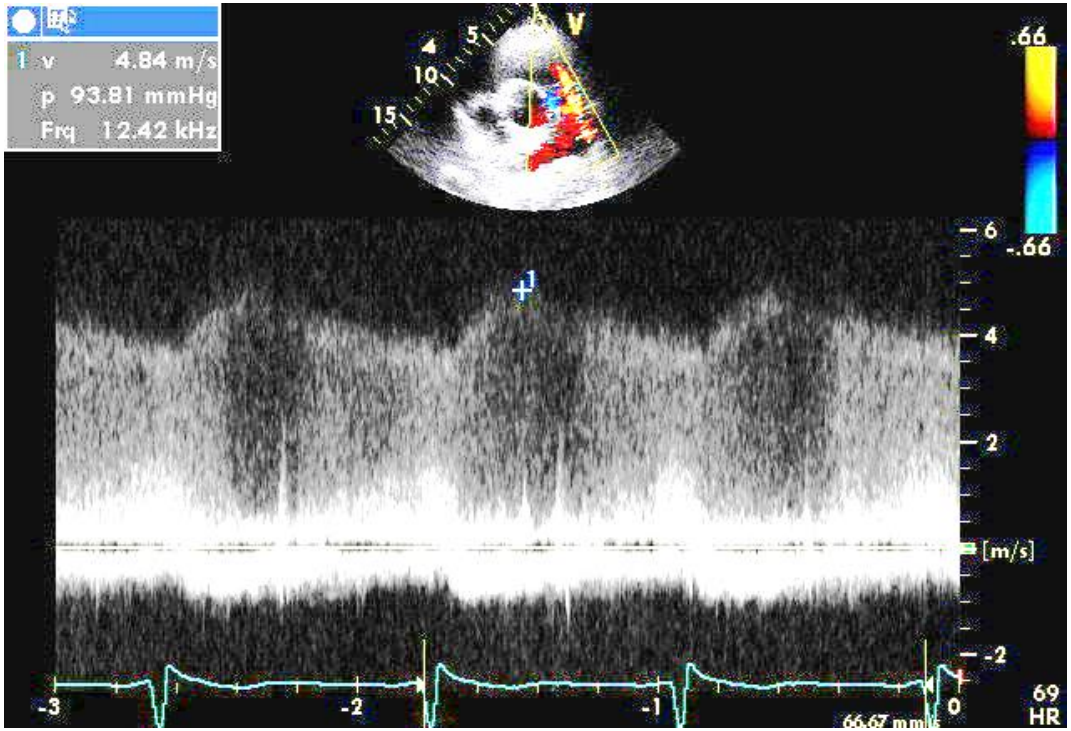

M
2 Vmax 1.42 m/s
Vmean 0.95 m/s
Pmax 8.10 mmHg
Pmean 4.16 mmHg
Env.Ti 320 ms
VTI 30.3 cm
HR 188 BPM
1 Vmax 1.38 m/s
Vmean 0.93 m/s
Pmax 7.63 mmHg
Pmean 3.99 mmHg
Env.Ti 317 ms
VTI 29.6 cm
HR 190 BPM
V
5
10
15
84
-84
[m/s]
-0.5
-1.0
-1.5
-3
-2
-1
0
66
HR

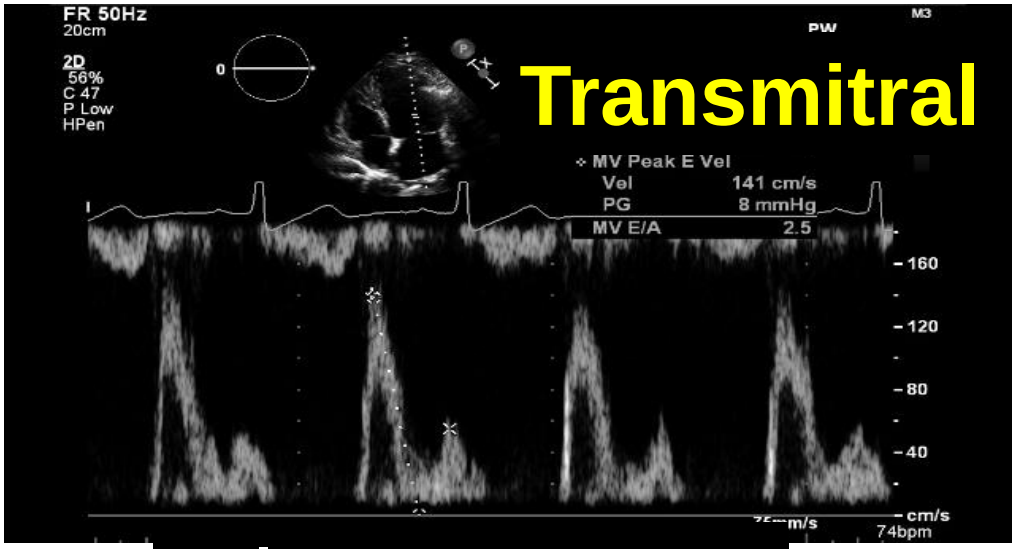

04/14/2015 08:23:53 AM
.85
-.85
76
3:75 HR

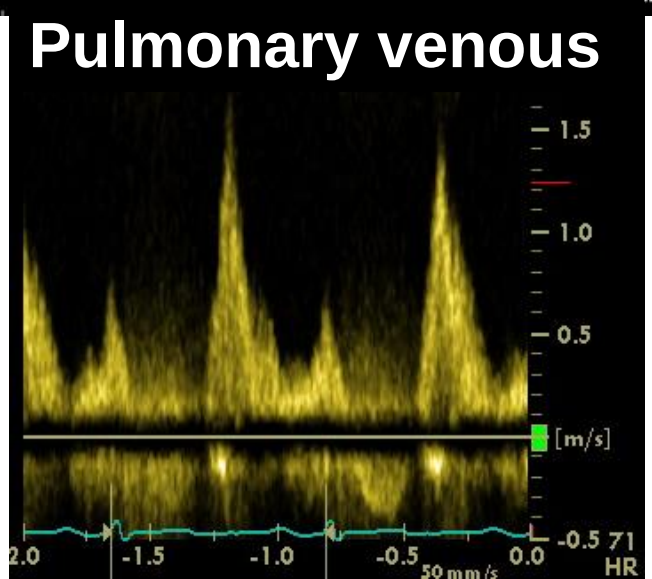

04/14/2015 08:24:02 AM
.72
-.72
72
4:120 HR

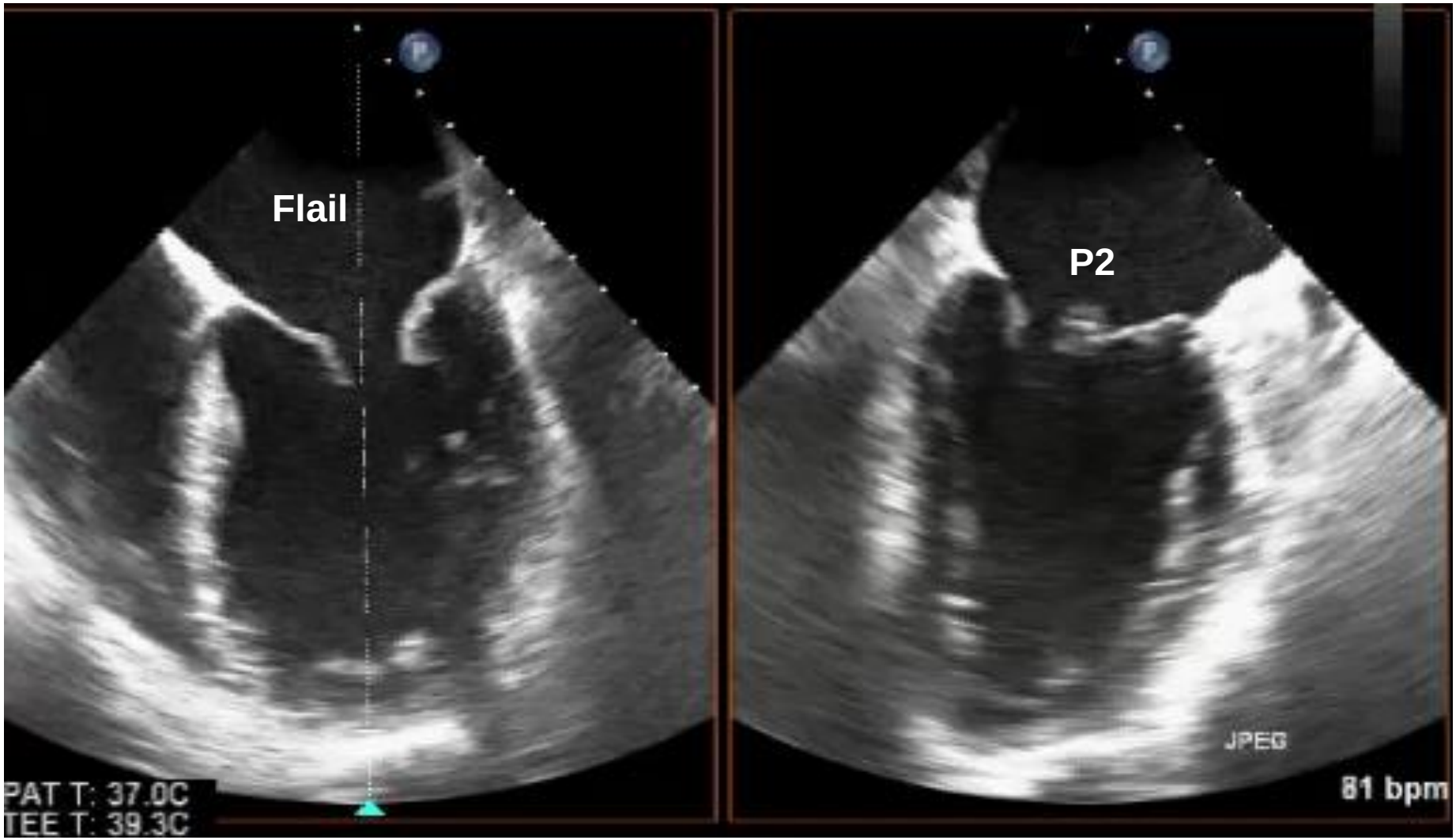

v 4.84 m/s
p 93.81 mmHg
Frq 12.42 kHz
.66
-.66
[m/s]
69
HR

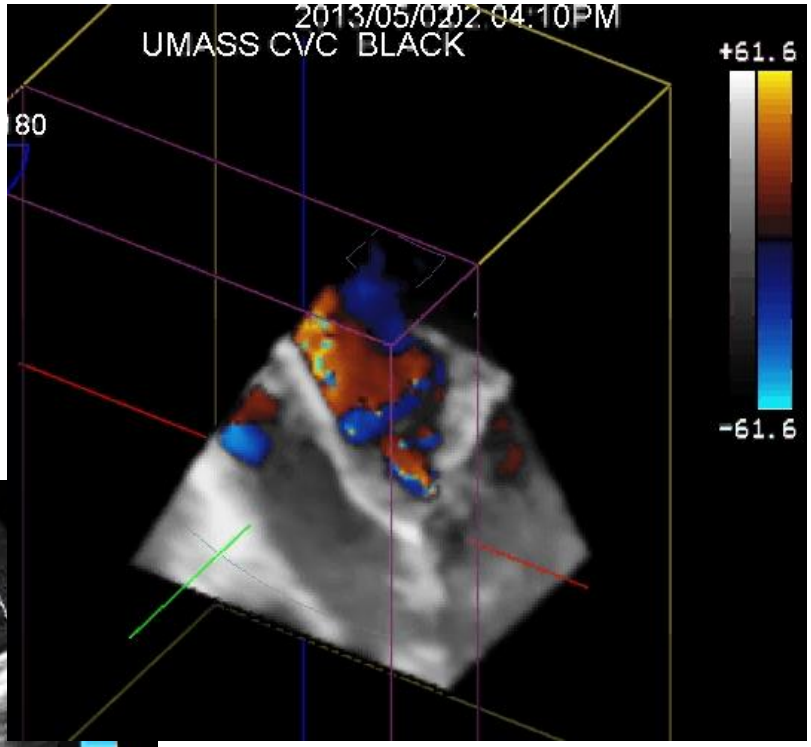
A 65 year old with MVP and MR. What do you conclude from these spectral profiles?:

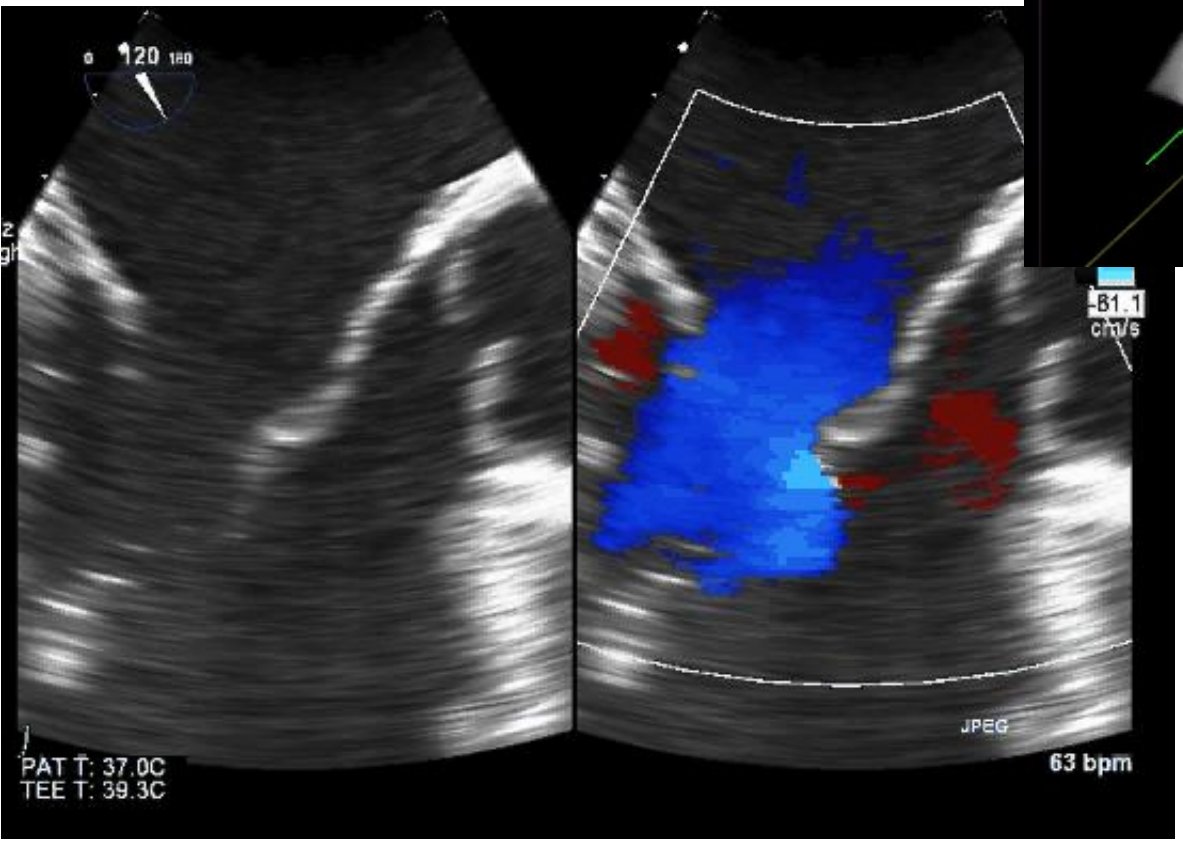
1. He has normal diastolic function
2. The MR is probably not very significant
3. The MR is likely to at least moderate to severe
4. Cannot tell with certainty



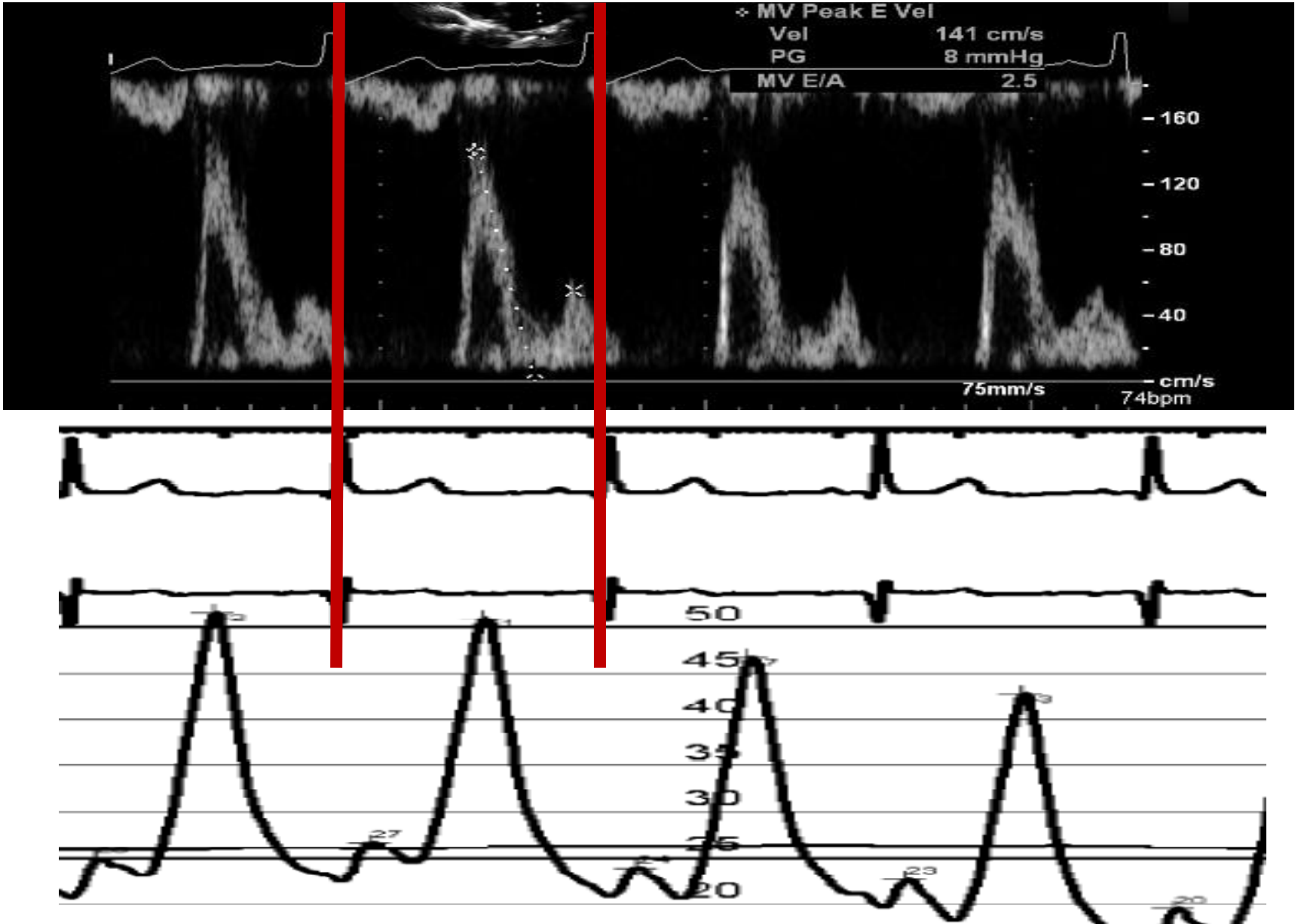



Flail
P2
PAT T: 37.0C
TEE T: 39.3C
JPEG
81 bpm


2013/05/02 04:10PM
UMASS CVC BLACK
80
+61.6
-61.6


0 120 180
81.1
cm/s
JPEG
63 bpm
PAT T: 37.0C
TEE T: 39.3C

Doppler + Haemodynamics



A 65 year old with MVP and MR. What do you conclude from these spectral profiles?:

1. He has normal diastolic function
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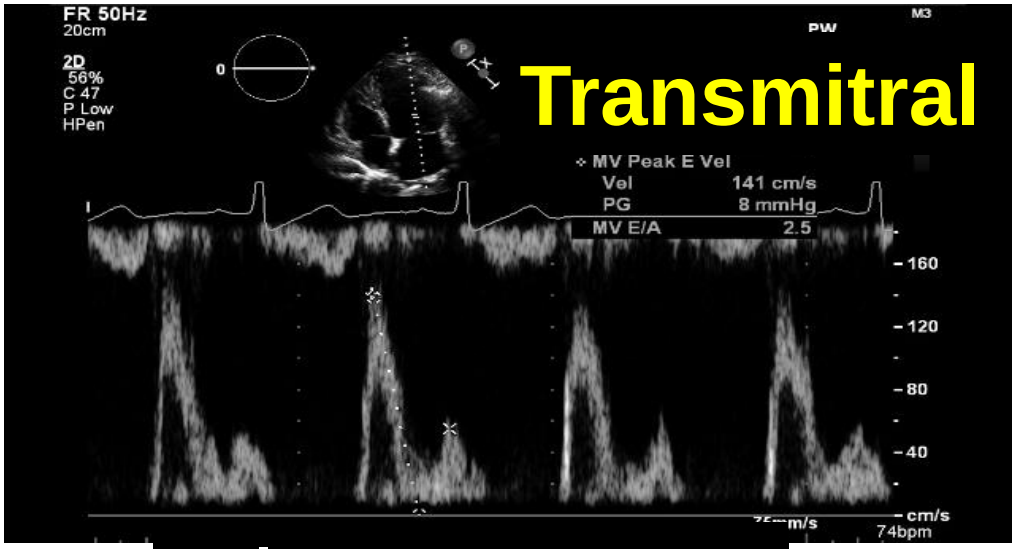
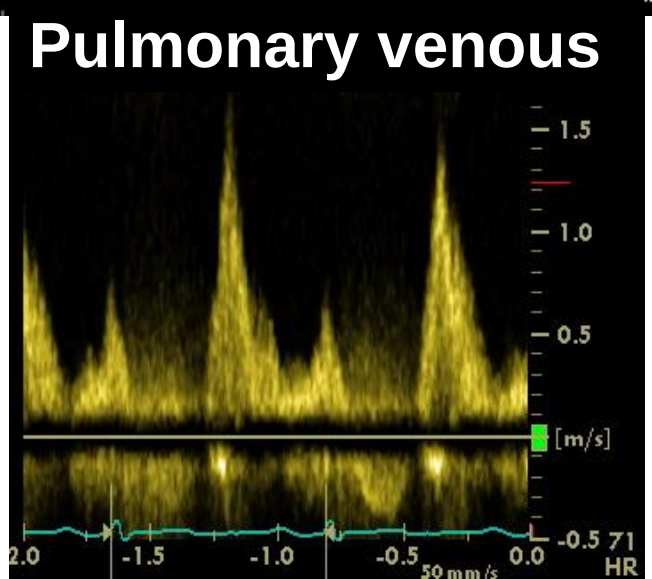
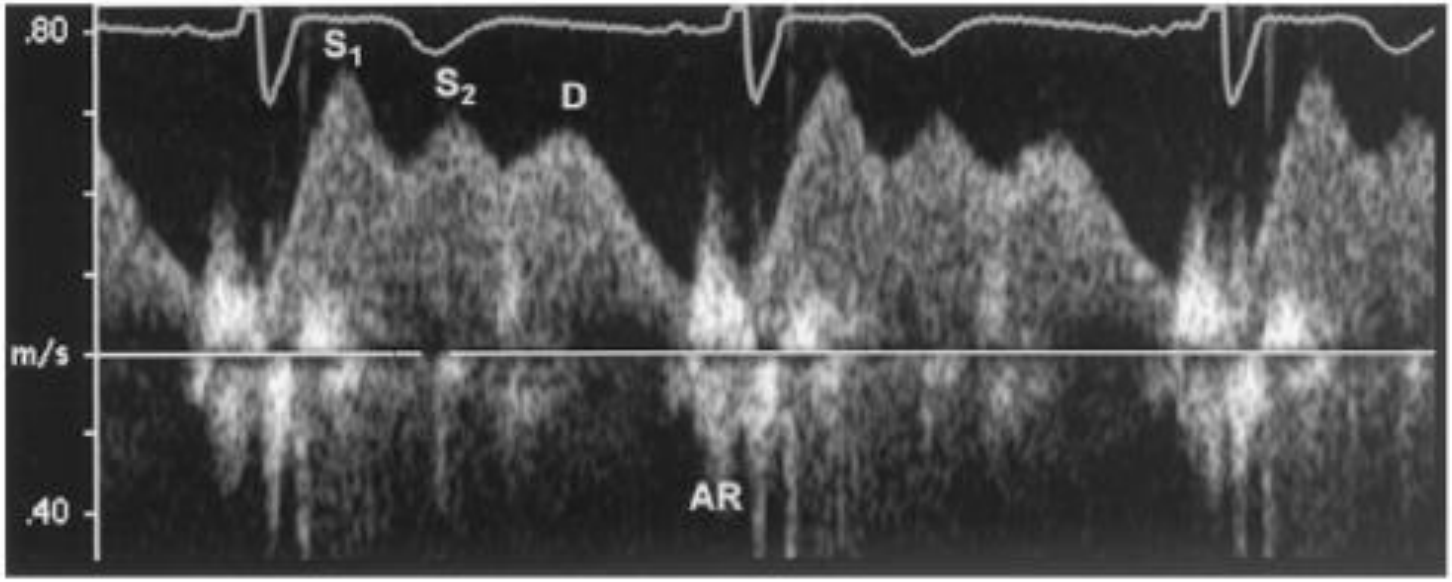
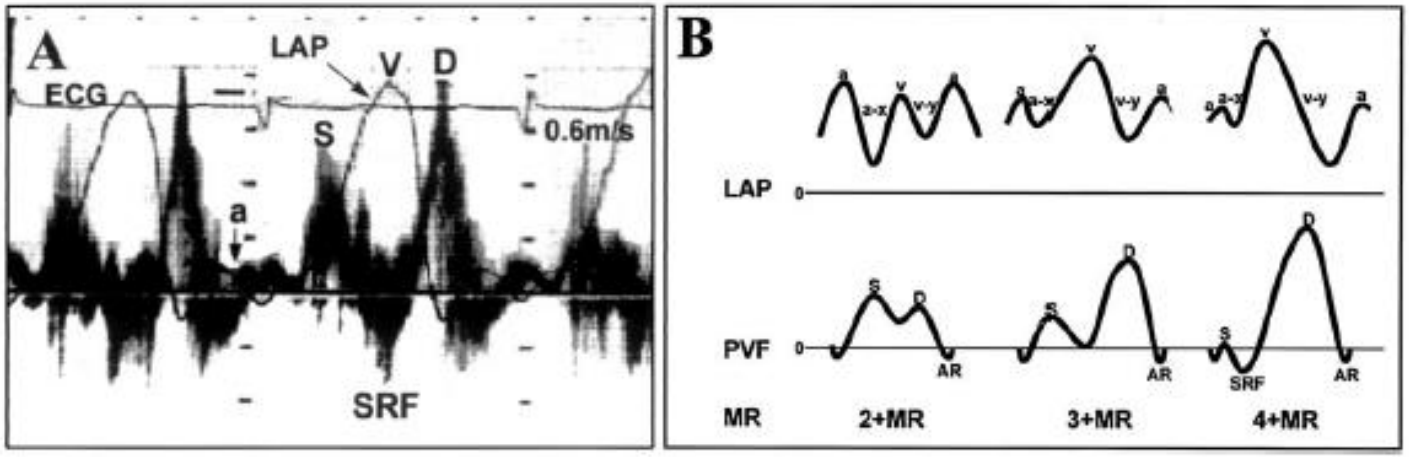
3. The MR is likely to be significant
4. Cannot tell with certainty







Normal

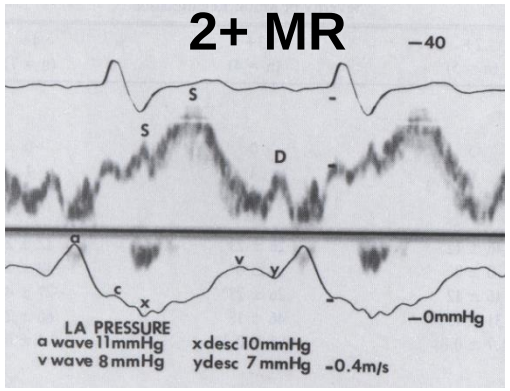


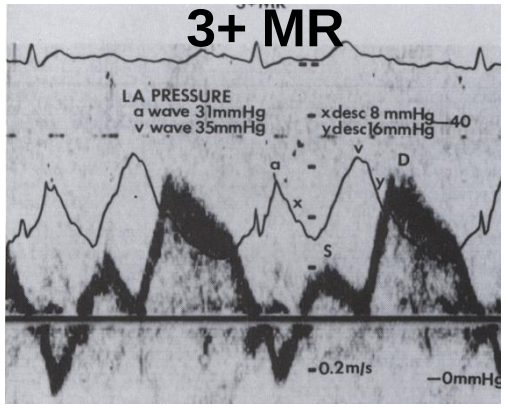
MR

Tabata et al. J Am Coll Cardiol 1992;20:1345

Pulmonary Vein Flow Profiles in MR

Tabata et al. J Am Coll Cardiol 1992;20:1345





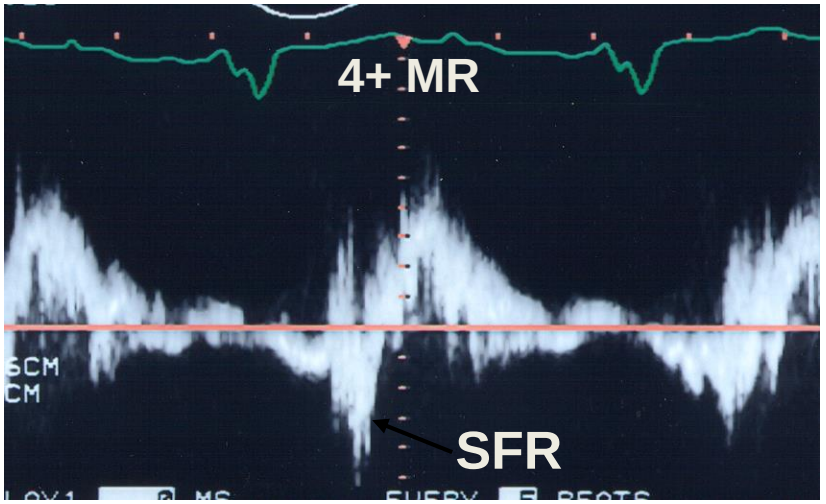
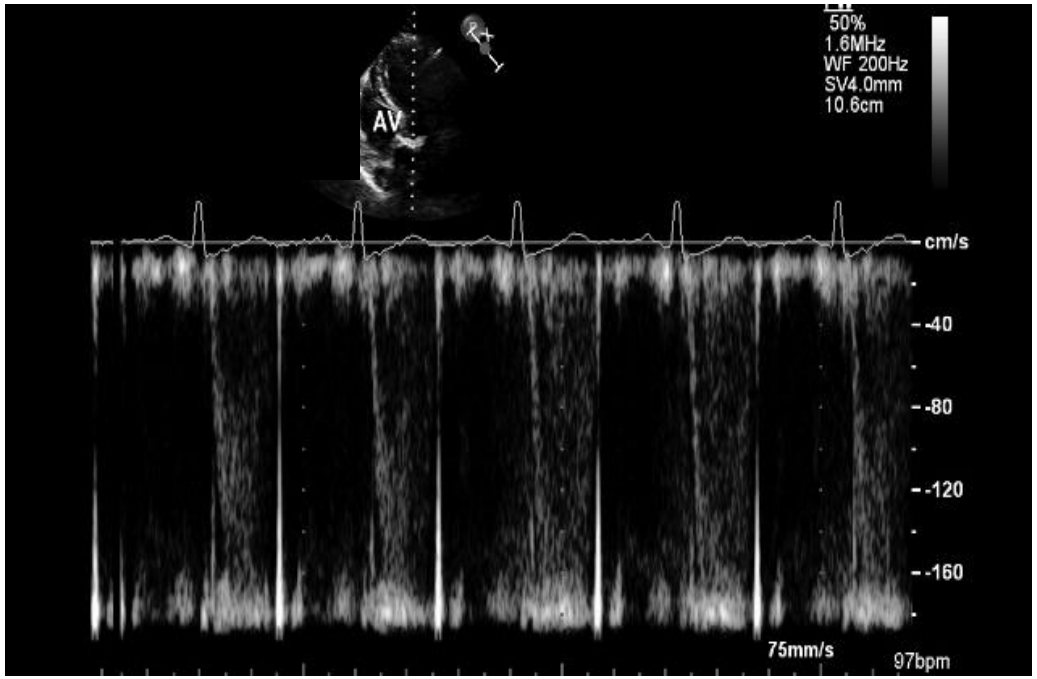


Table 3 Application of specific and supportive signs, and quantitative parameters in the grading of mitral regurgitation severity

	Mild	Moderate		Severe
Specific signs of severity	• Small central jet $< 4\ cm^2$ or $< 20\%$ of LA area$^{\psi}$ • Vena contracta width <0.3 cm • No or minimal flow convergence$^{\xi}$	Signs of MR>mild present, but no criteria for severe MR		• Vena contracta width ≥ 0.7cm *with* large central MR jet (area $> 40\%$ of LA) or *with* a wall-impinging jet of any size, swirling in LA$^{\psi}$ • Large flow convergence$^{\xi}$ • Systolic reversal in pulmonary veins • Prominent flail MV leaflet or ruptured papillary muscle
Supportive signs	• Systolic dominant flow in pulmonary veins • A-wave dominant mitral inflow$^{\Phi}$ • Soft density, parabolic CW Doppler MR signal • Normal LV size*	Intermediate signs/findings		• Dense, triangular CW Doppler MR jet • E-wave dominant mitral inflow (E >1.2 m/s)$^{\Phi}$ Enlarged LV and LA size**, (particularly when normal LV function is present).
Quantitative parameters$^{\varphi}$				
R Vol (ml/beat)	< 30	30-44	45-59	≥ 60
RF (%)	< 30	30-39	40-49	≥ 50
EROA (cm^2)	< 0.20	0.20-0.29	0.30-0.39	≥ 0.40

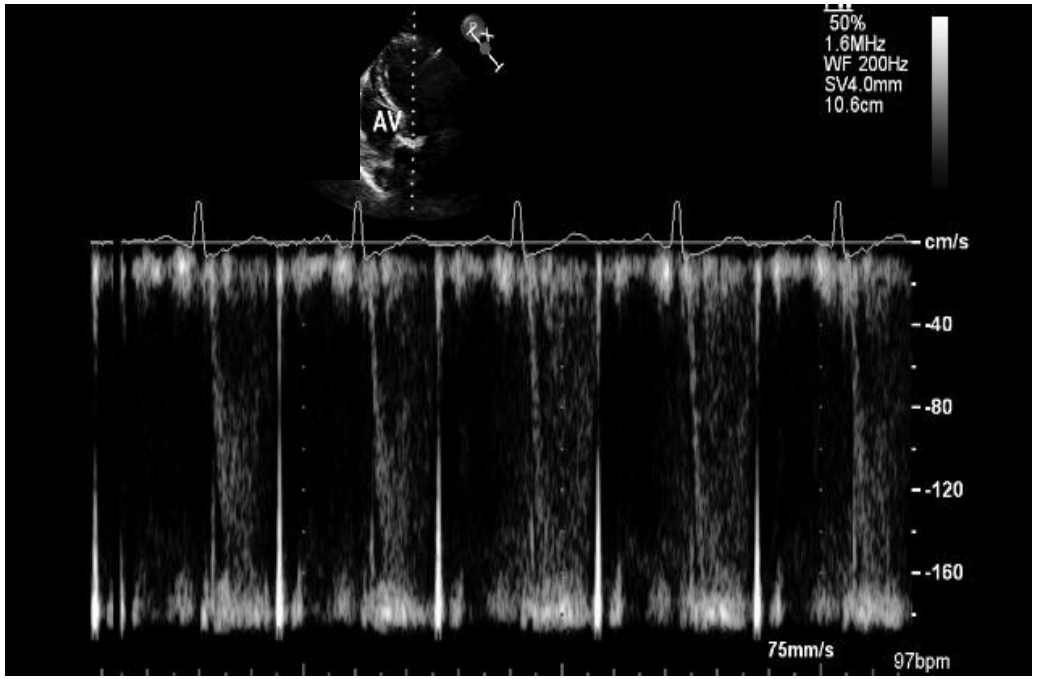
Zoghbi et al, JASE, 2003

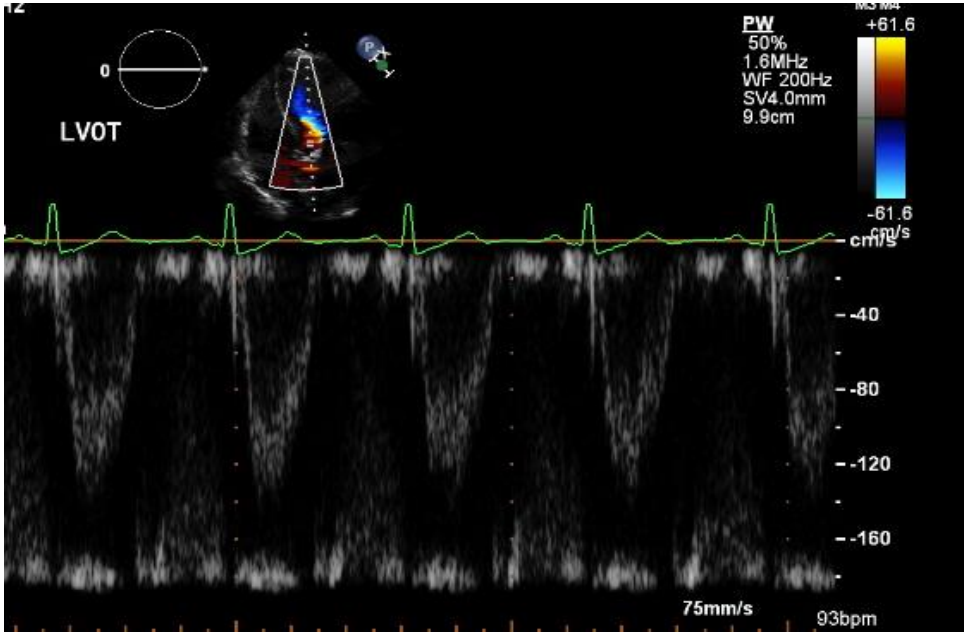
85 year old with known AS, now is being referred for TAVR

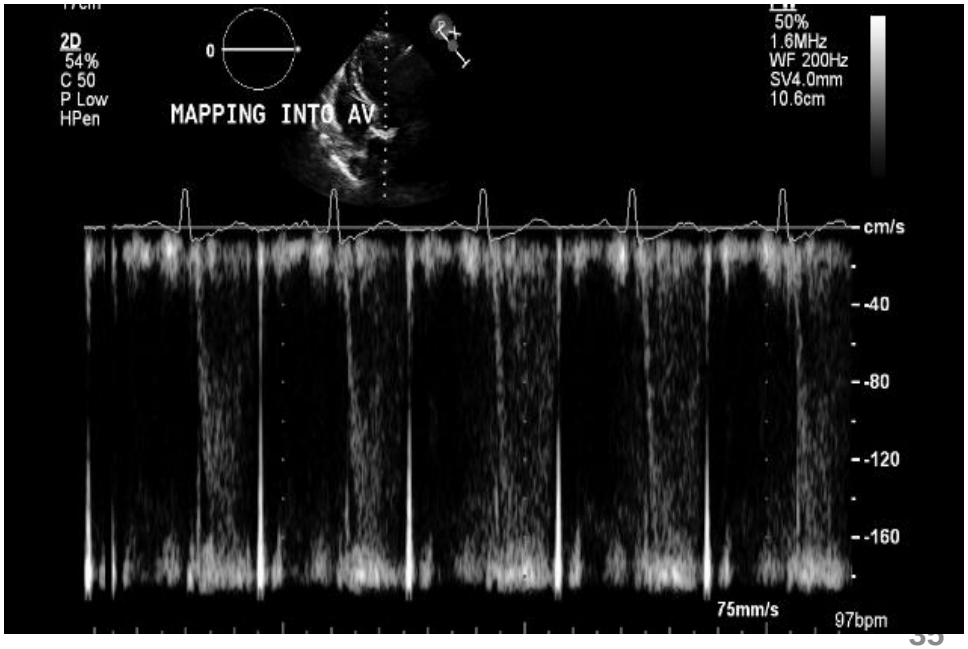


85 year old with known AS to calculate AVA you would:

1. Use 1.6 M/s as your V1
2. Cath the patient
3. Give beta blocker then repeat study
4. Send sonographer back to bedside




PW
50%
1.6MHz
WF 200Hz
SV4.0mm
9.9cm
+61.6
-61.6
cm/s
LVOT
-40
-80
-120
-160
75mm/s
93bpm


2D
54%
C 50
P Low
HPen
50%
1.6MHz
WF 200Hz
SV4.0mm
10.6cm
MAPPING INTO AV
cm/s
-40
-80
-120
-160
75mm/s
97bpm

Technical Considerations

Continuity Equation

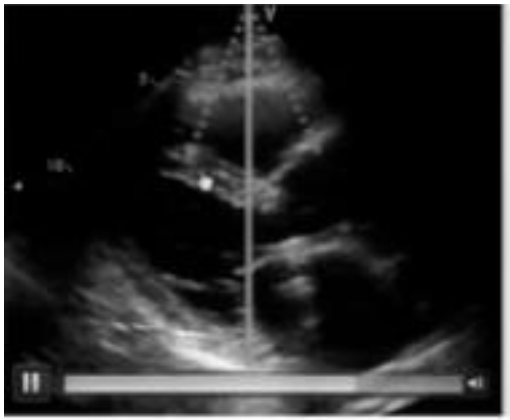
- **Accuracy of LVOT diameter**

  measure just apical to valve

  largest diameter

  avoid basal septal hypertrophy

  virtues of low parasternal window



On-axis Parasternal

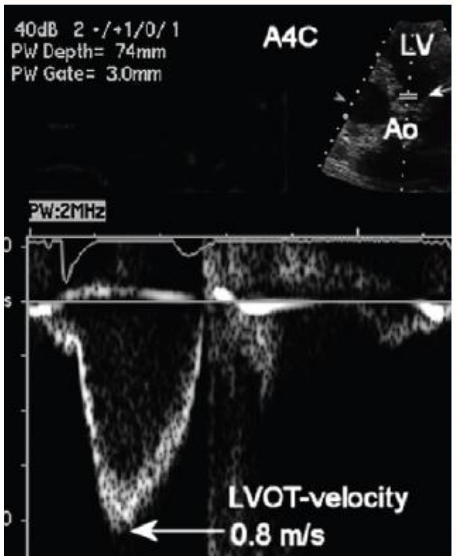
Low window Parasternal

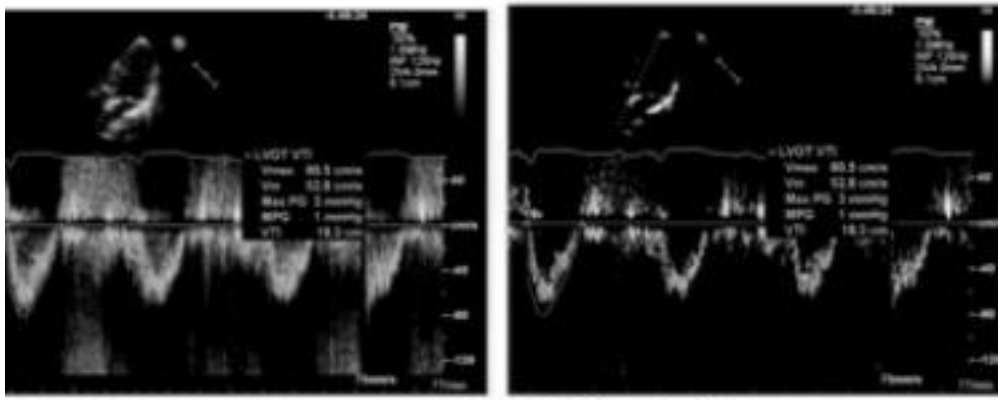
Technical Considerations

Continuity Equation

- **LVOT velocity**

  must use laminar flow pre use modal velocity

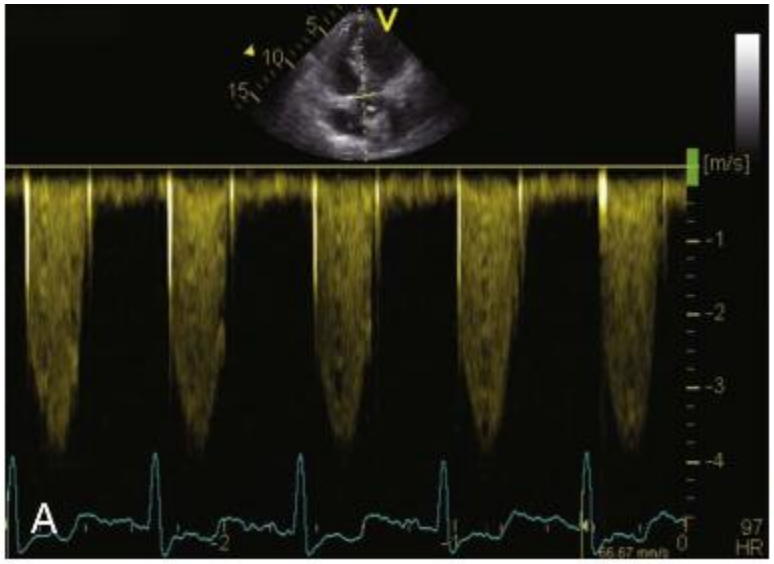


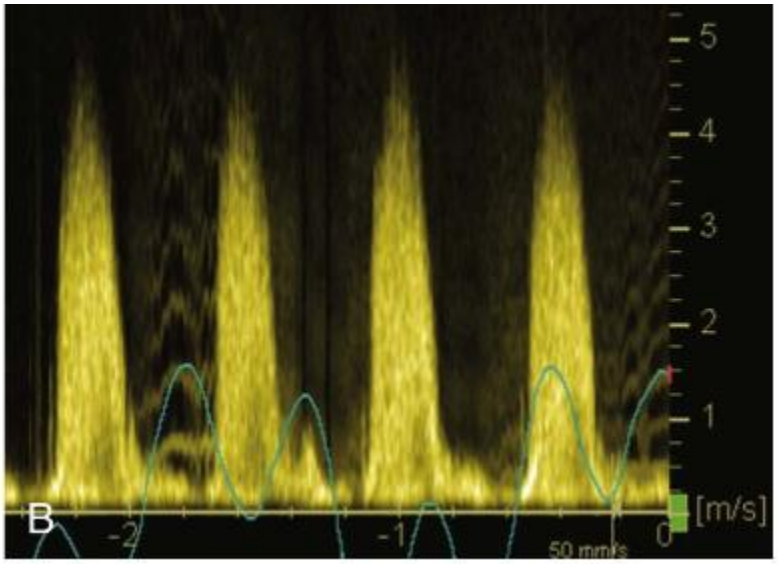


Technical Considerations

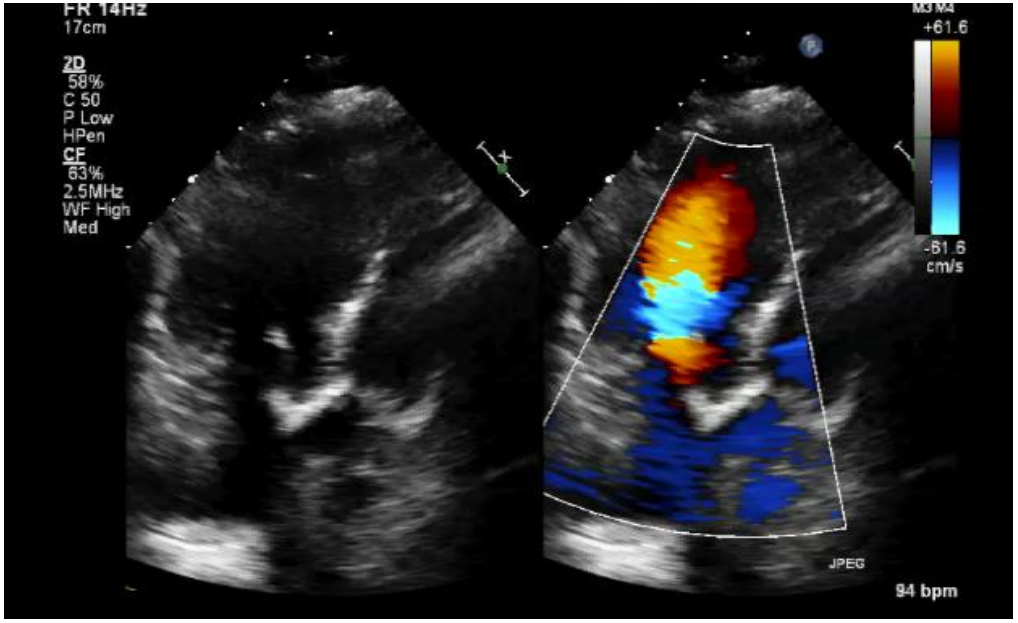
Continuity Equation

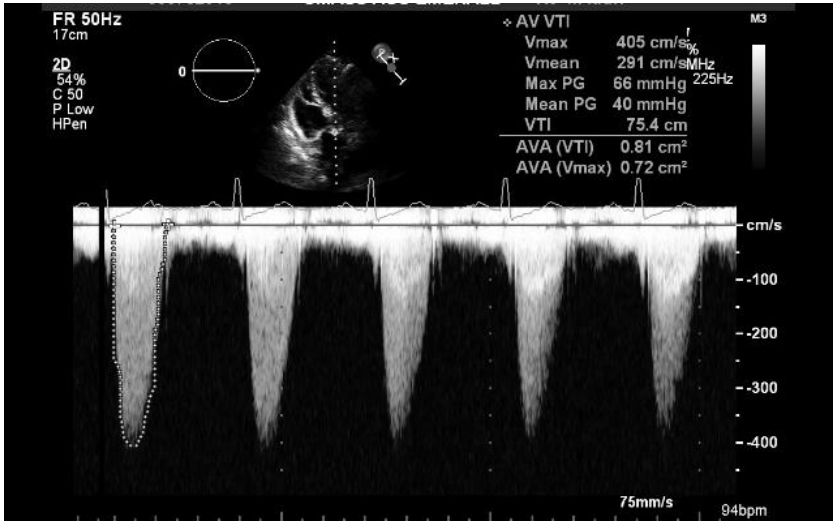
- **CW signal**

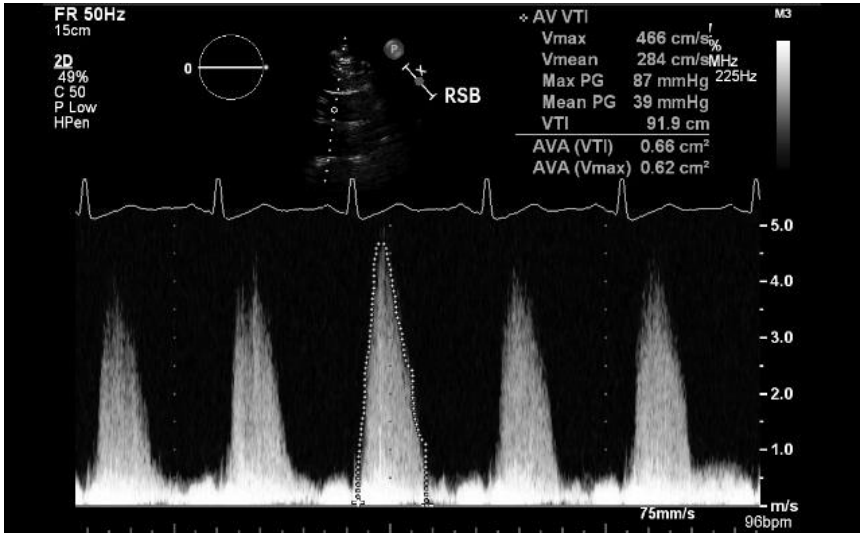


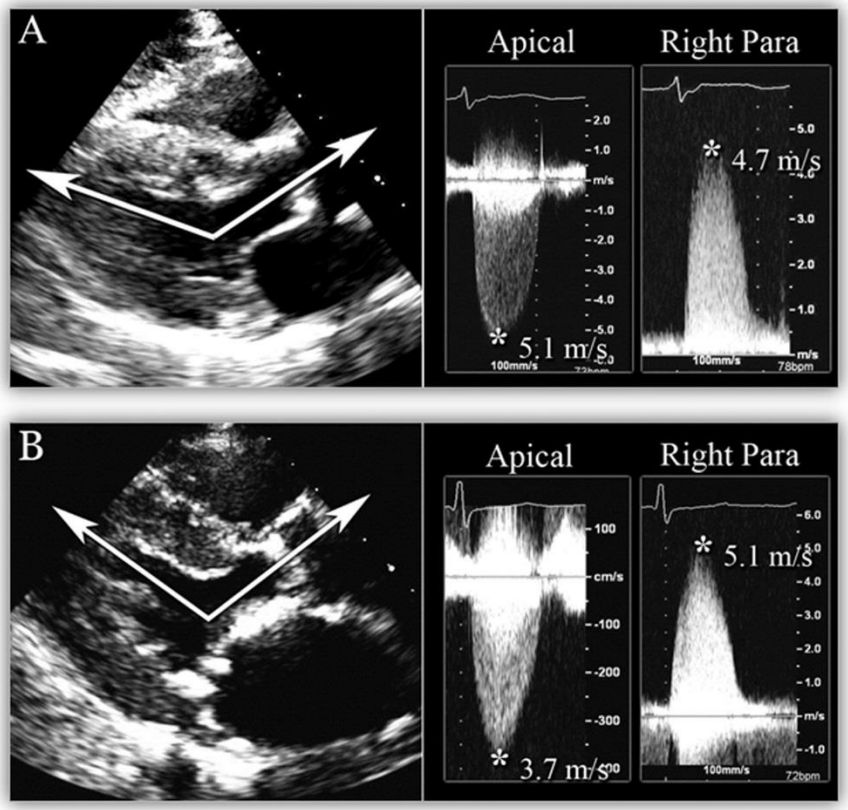


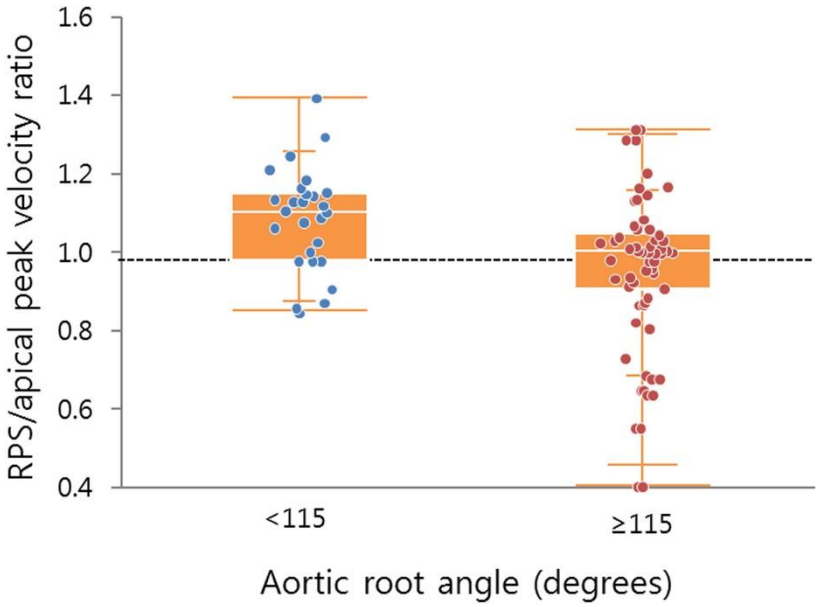
Apical **RPS**


FR 14Hz
17cm
2D
58%
C 50
P Low
HPen
CF
63%
2.5MHz
WF High
Med
+61.6
-61.6
cm/s
JPEG
94 bpm


FR 50Hz
17cm
2D
54%
C 50
P Low
HPen
AV VTI
Vmax 405 cm/s
Vmean 291 cm/s
Max PG 66 mmHg
Mean PG 40 mmHg
VTI 75.4 cm
AVA (VTI) 0.81 cm²
AVA (Vmax) 0.72 cm²
M3
MHz
225Hz
cm/s
-100
-200
-300
-400
75mm/s
94bpm


FR 50Hz
15cm
2D
49%
C 50
P Low
HPen
RSB
AV VTI
Vmax 466 cm/s
Vmean 284 cm/s
Max PG 87 mmHg
Mean PG 39 mmHg
VTI 91.9 cm
AVA (VTI) 0.66 cm²
AVA (Vmax) 0.62 cm²
M3
MHz
225Hz
5.0
4.0
3.0
2.0
1.0
m/s
75mm/s
96bpm



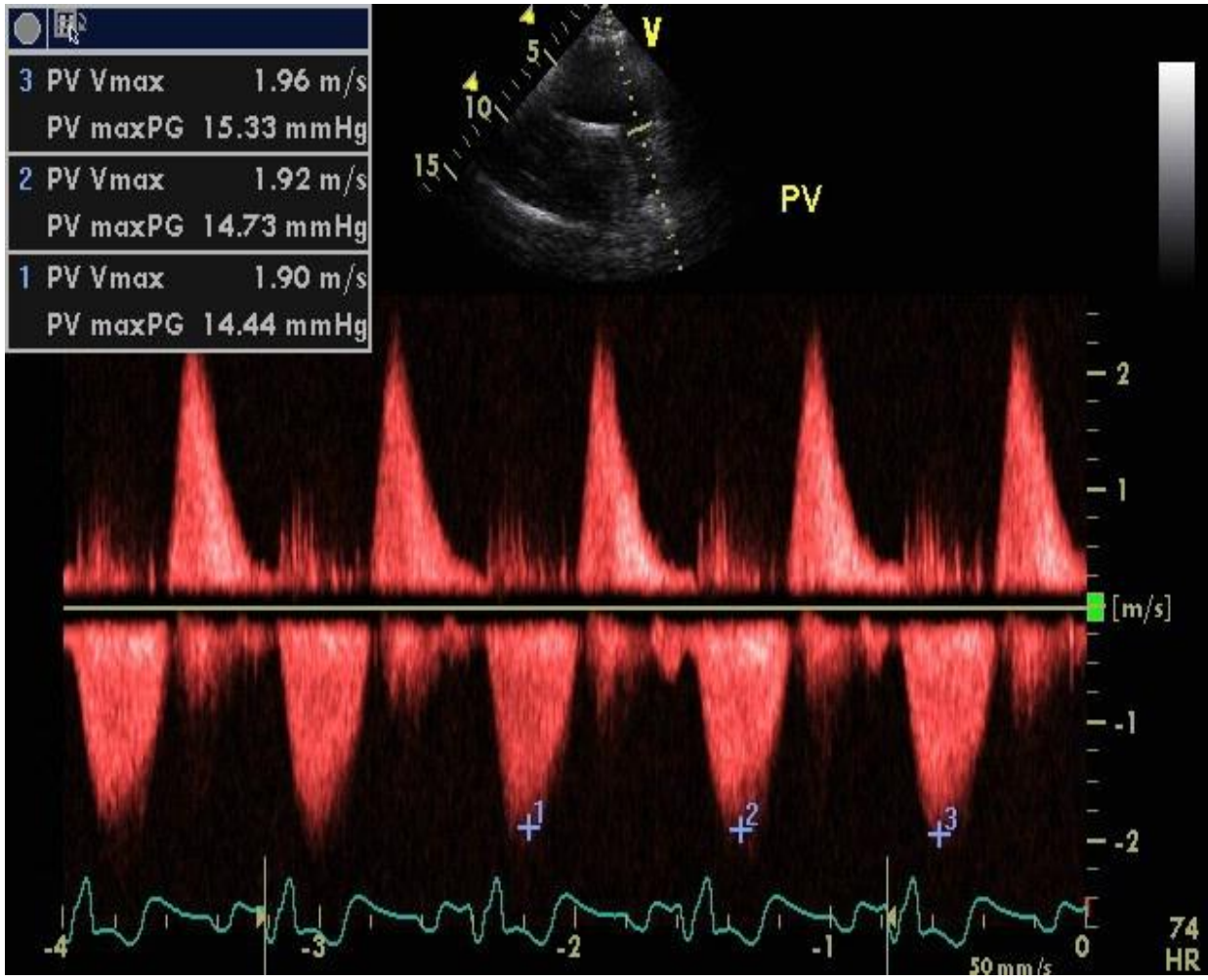


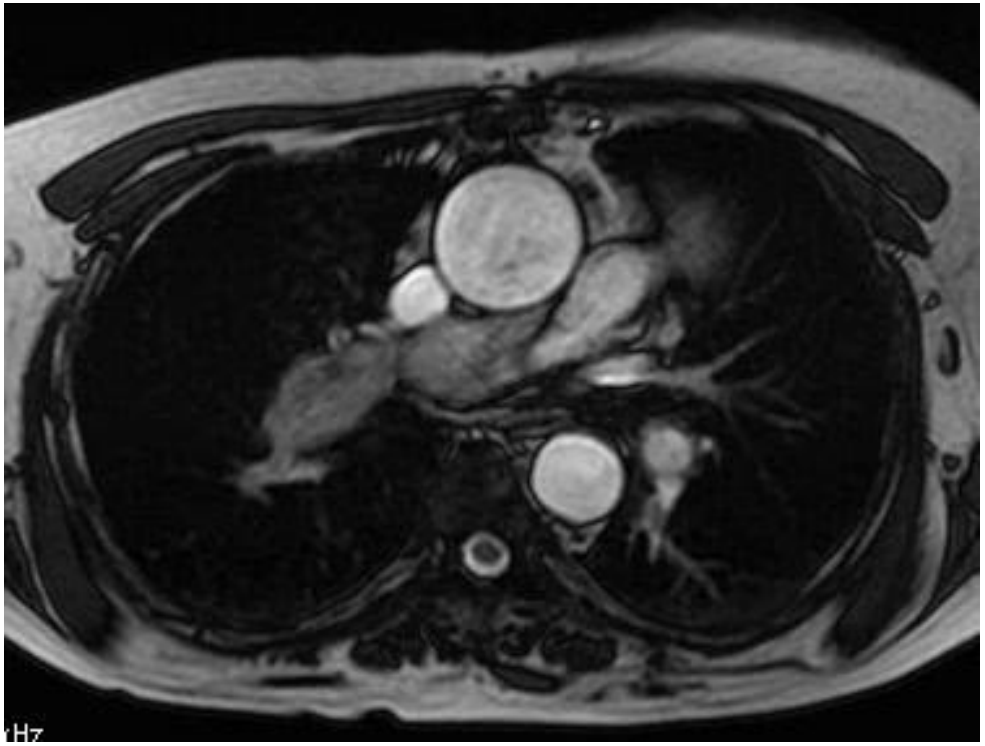
Doppler Imaging in Aortic Stenosis: The Importance of the Nonapical Imaging Windows to Determine Severity in a Contemporary Cohort

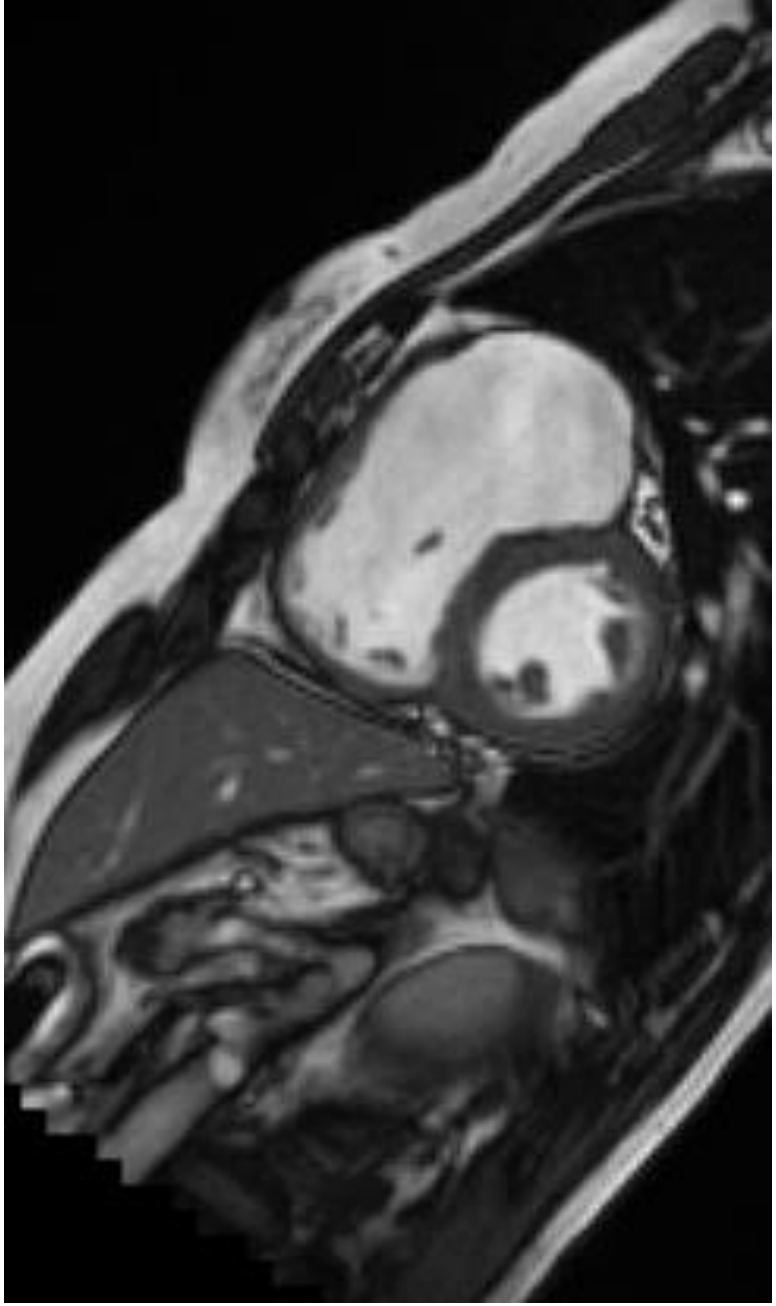
Jeremy J. Thaden, MD, Vuyisile T. Nkomo, MD, MPH, Kwang Je Lee, MD, PhD, and Jae K. Oh, MD, *Rochester, Minnesota and Seoul, Korea*

The spectral Doppler indicates

1. Restrictive filling pattern in someone with AF
2. Severe PR
3. RV systolic dysfunction
4. Severe AR

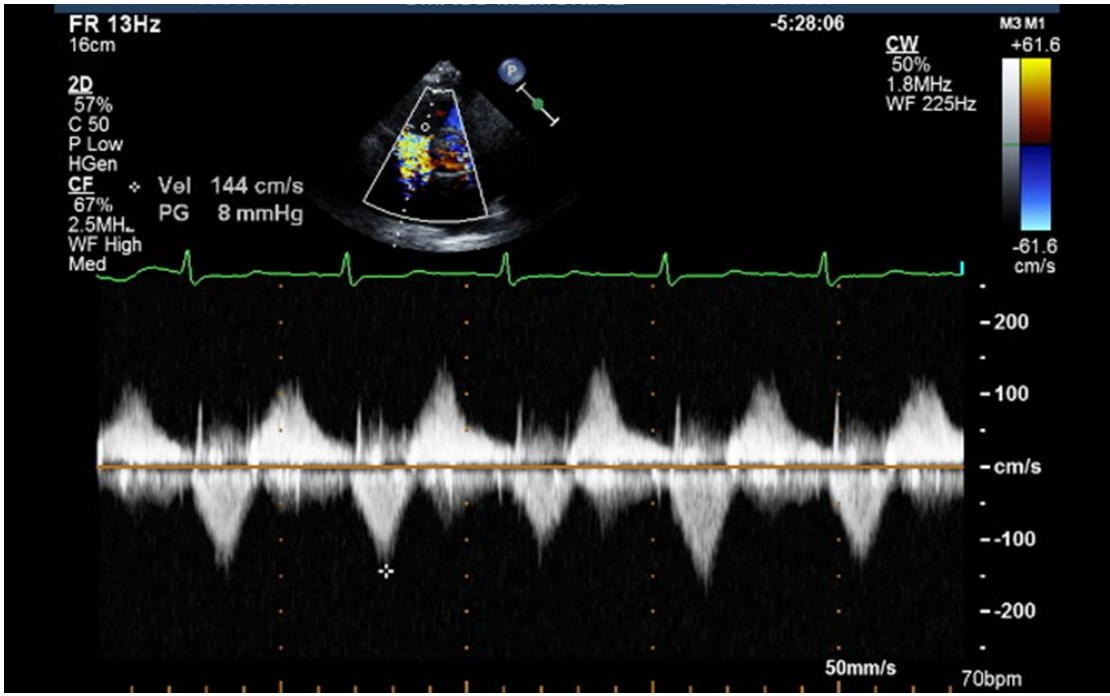


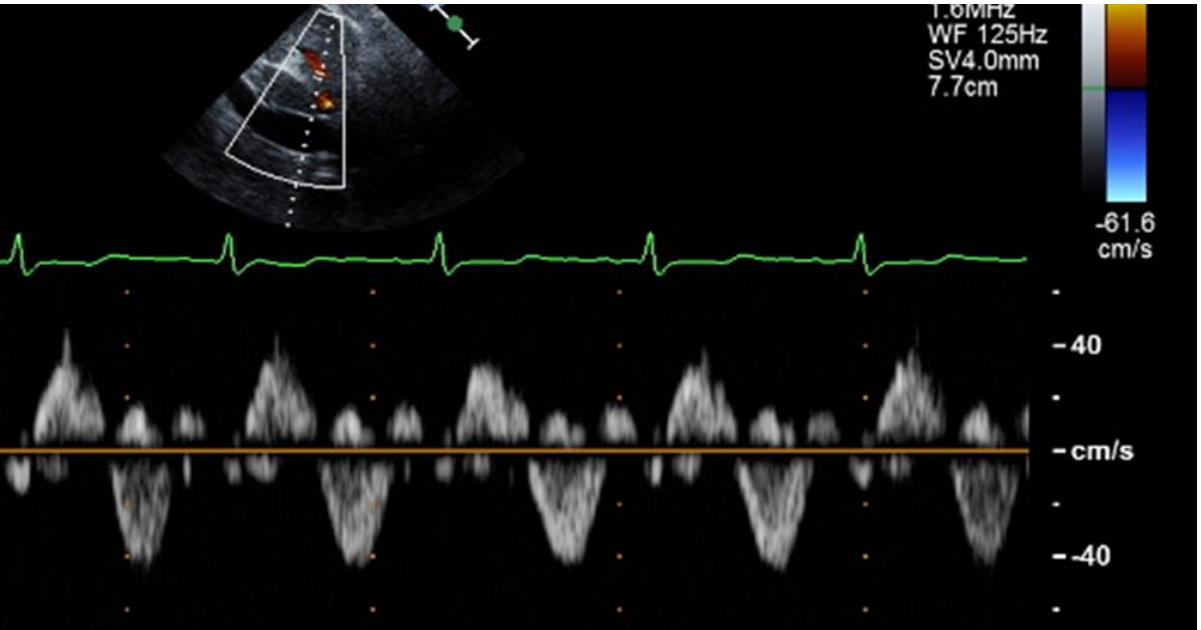


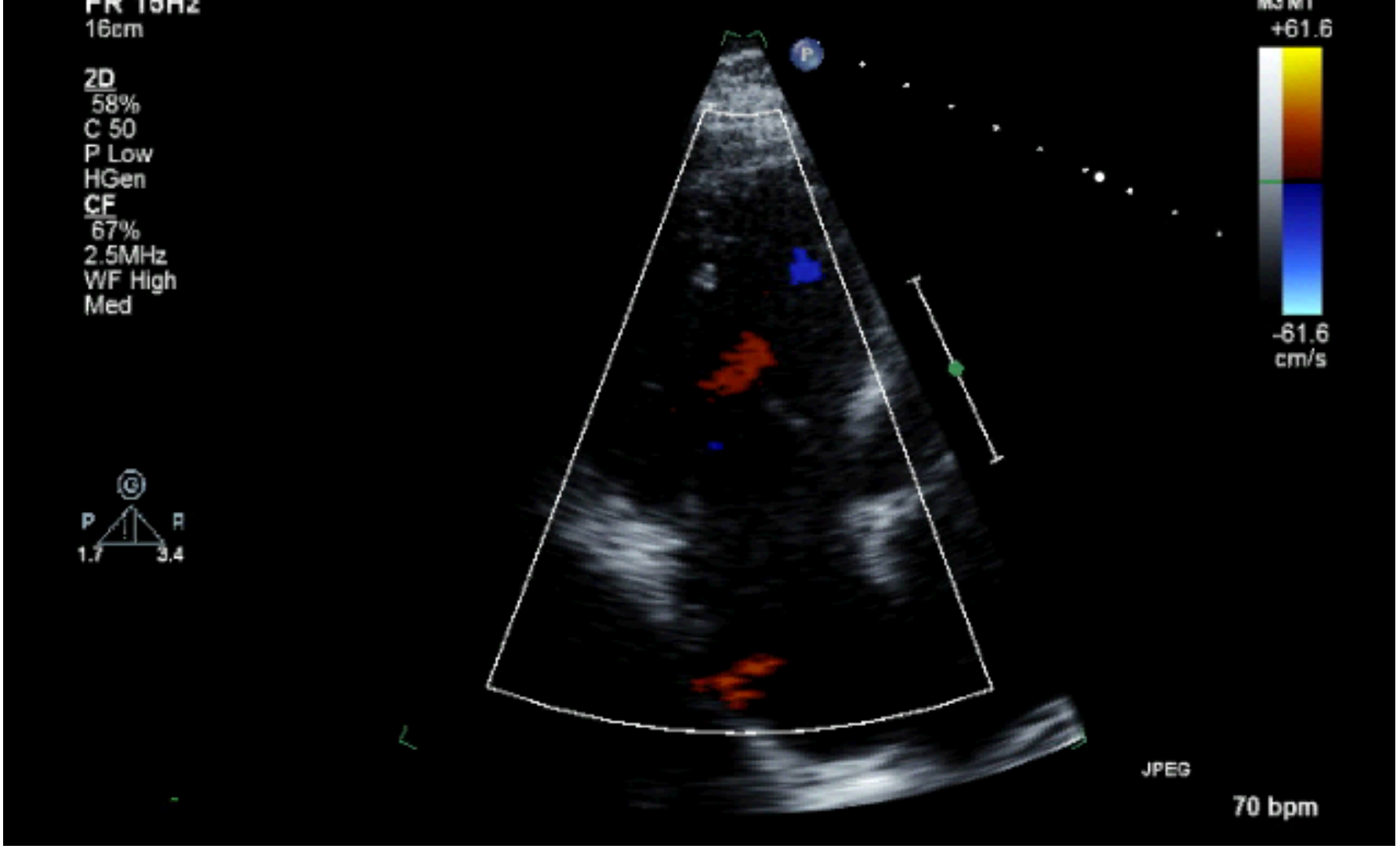


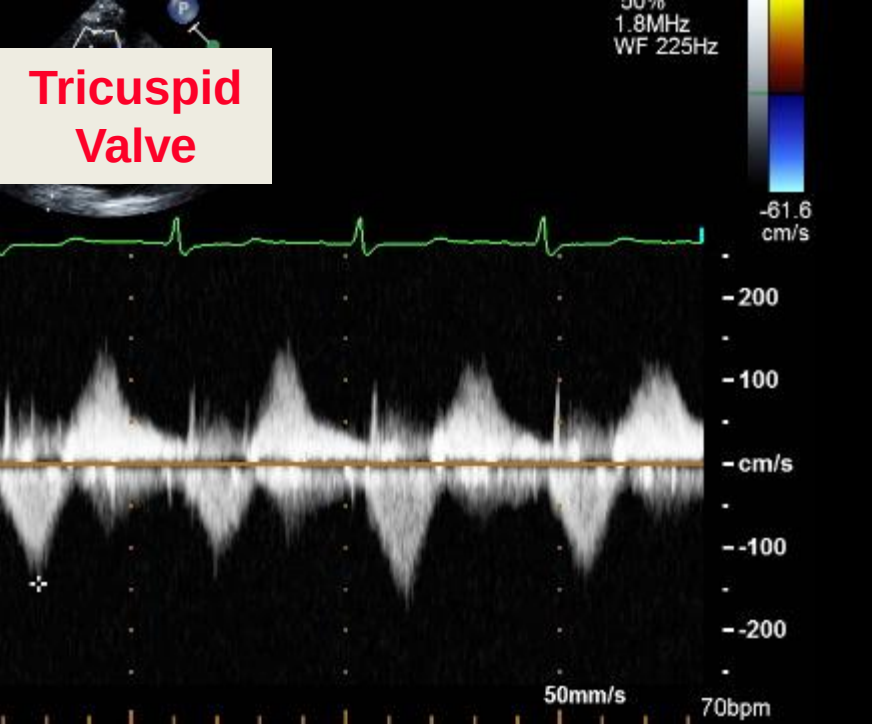
Dx?

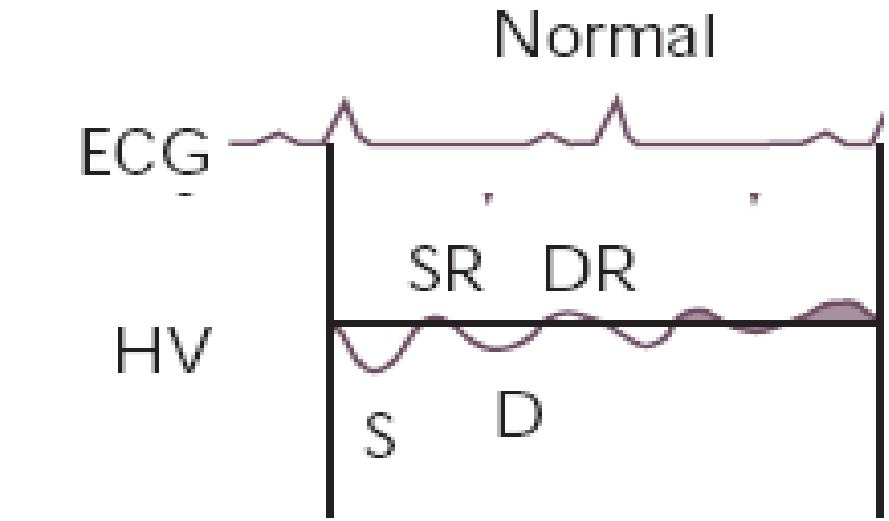
1. Severe TR
2. RV systolic dysfunction
3. both
4. neither

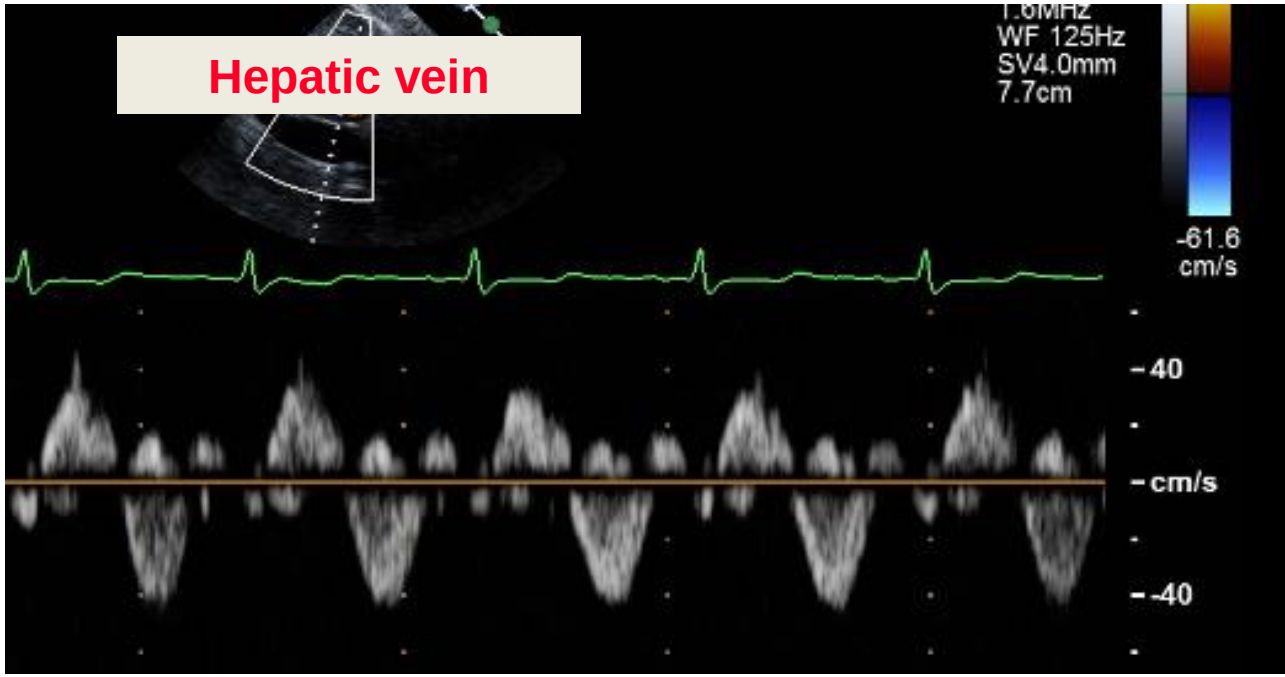





FR 15Hz
16cm
2D
58%
C 50
P Low
HGen
CF
67%
2.5MHz
WF High
Med
+61.6
-61.6
cm/s
P
R
1.7
3.4
JPEG
70 bpm

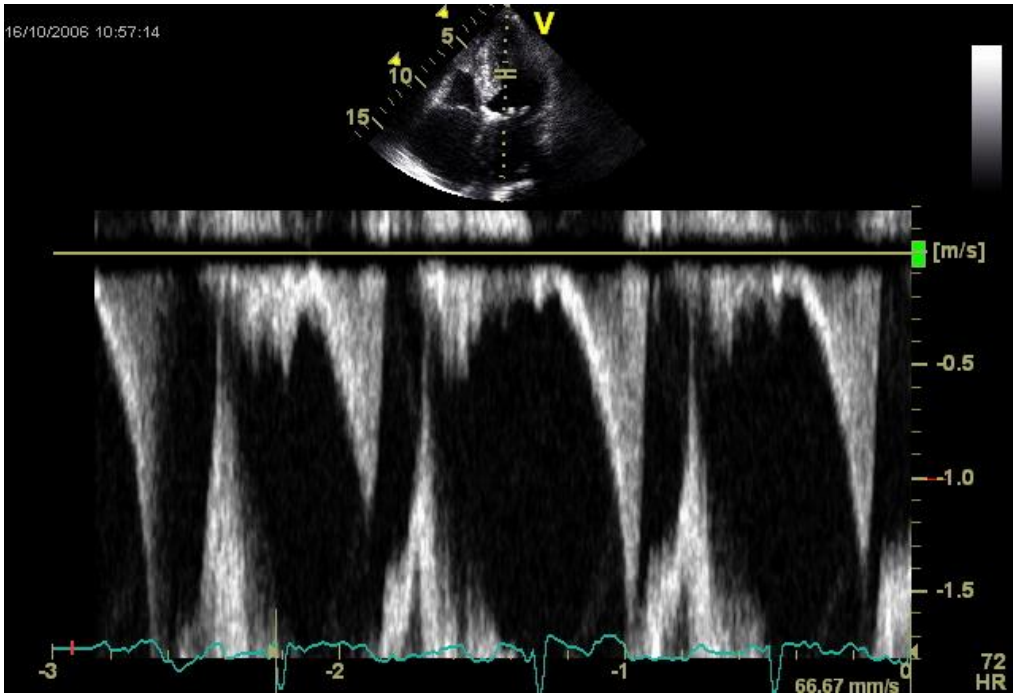

Tricuspid Valve
1.8MHz
WF 225Hz
-61.6
cm/s
200
100
cm/s
-100
-200
50mm/s
70bpm


Normal
ECG
SR
DR
HV
S
D


Hepatic vein
WF 125Hz
SV4.0mm
7.7cm
-61.6
cm/s
40
cm/s
-40

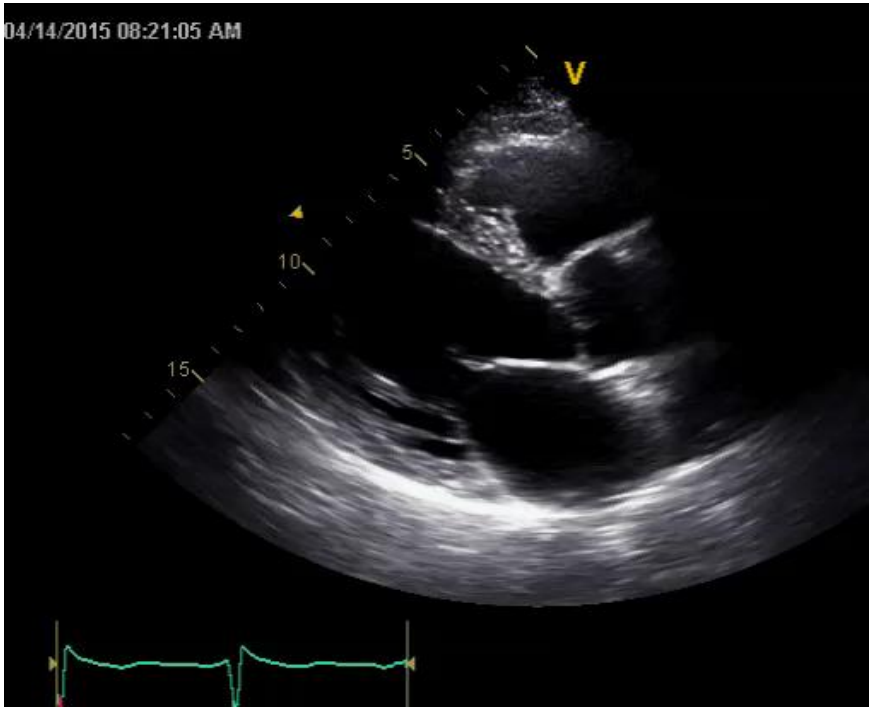
This spectral Doppler profile may be seen in:

1. HCM
2. Hypertensive LVH
3. AS
4. 1-3
5. None of above



42 year old woman with a murmur

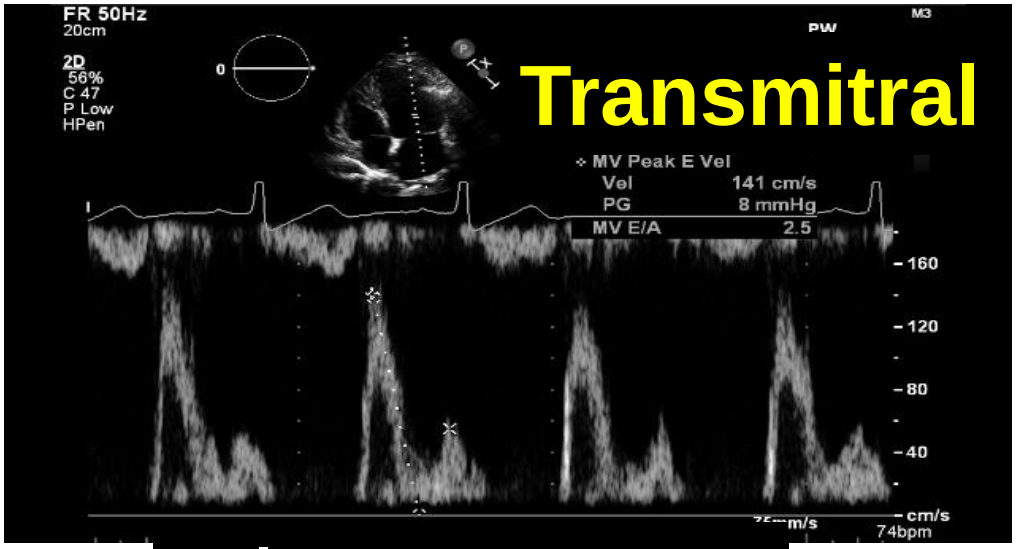
Diagnostic possibilities include all of the following except:

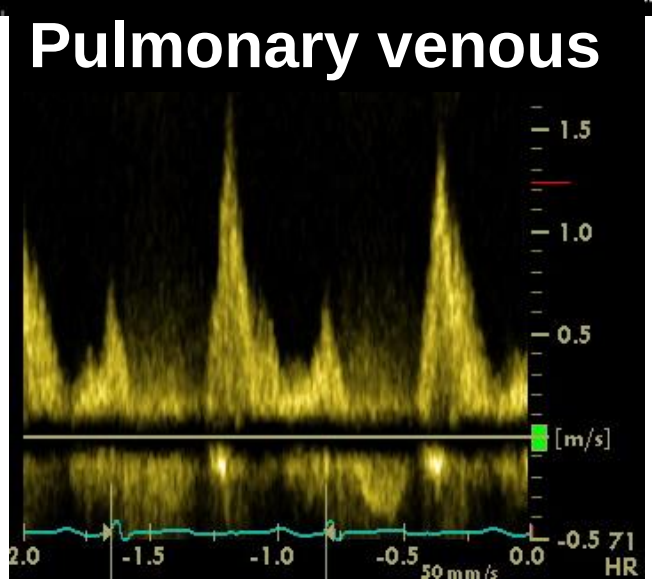


1. **High output heart failure**
2. **PDA**
3. **Severe MR**
4. **Coronary sinus ASD**

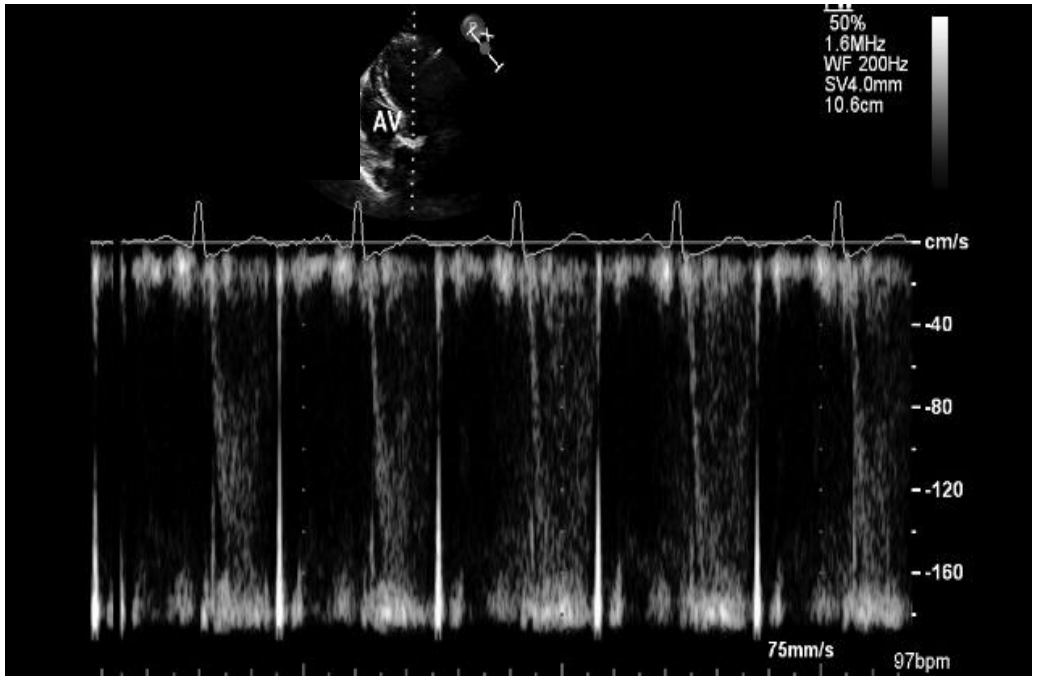
A 65 year old with MVP and MR. What do you conclude from these spectral profiles?:

1. He has normal diastolic function
2. The MR is probably not very significant
3. The MR is likely to at least moderate to severe
4. Cannot tell with certainty



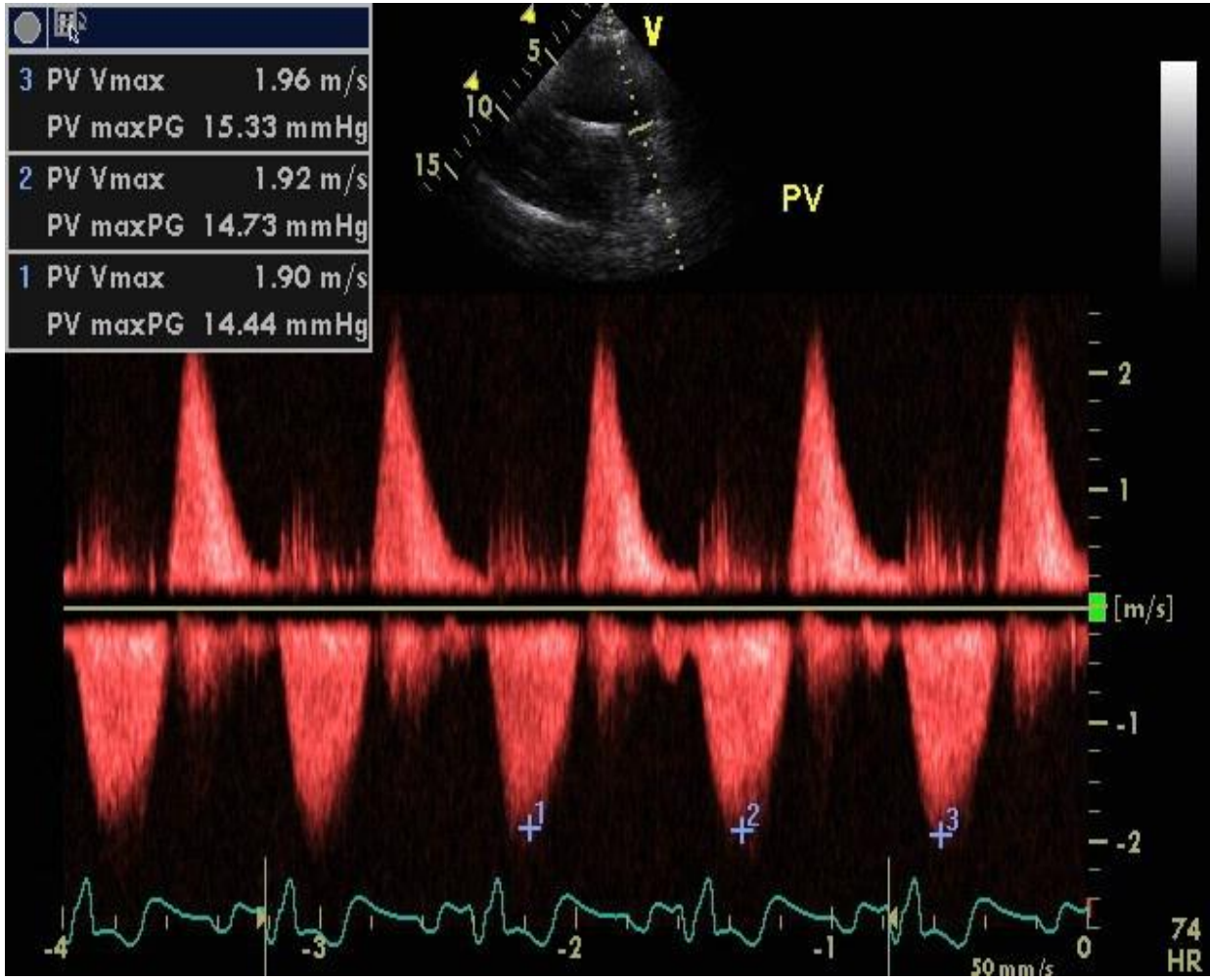


85 year old with known AS, now is being referred for TAVR



The spectral Doppler indicates

1. Restrictive filling pattern in someone with AF
2. Severe PR
3. RV systolic dysfunction
4. Severe AR



Dx?

1. Severe TR
2. RV systolic dysfunction
3. both
4. neither