Cases: Valve Stenosis Quantitation When the Pieces Don't Fit

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No disclosures

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Elevated Gradients Following AVR

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Case

- 81 yo male referred for question of patient-prosthesis mismatch
- Past history of # 23 Mosaic bioprosthetic AVR (2010) for symptomatic aortic stenosis (dyspnea with evidence of CHF).
  - Normal coronaries
- Has remained asymptomatic but has newly moved to NJ where cardiologist has done TTE
  - High gradients
  - EOA = 0.7 cm2

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Case

- Physical exam:
  - 6'1", 220 lbs, BSA =
  - BP = 120/70, HR 72
  - Chest clear
  - 3/6 ESM
  - Carotids normal volume, ? Delayed

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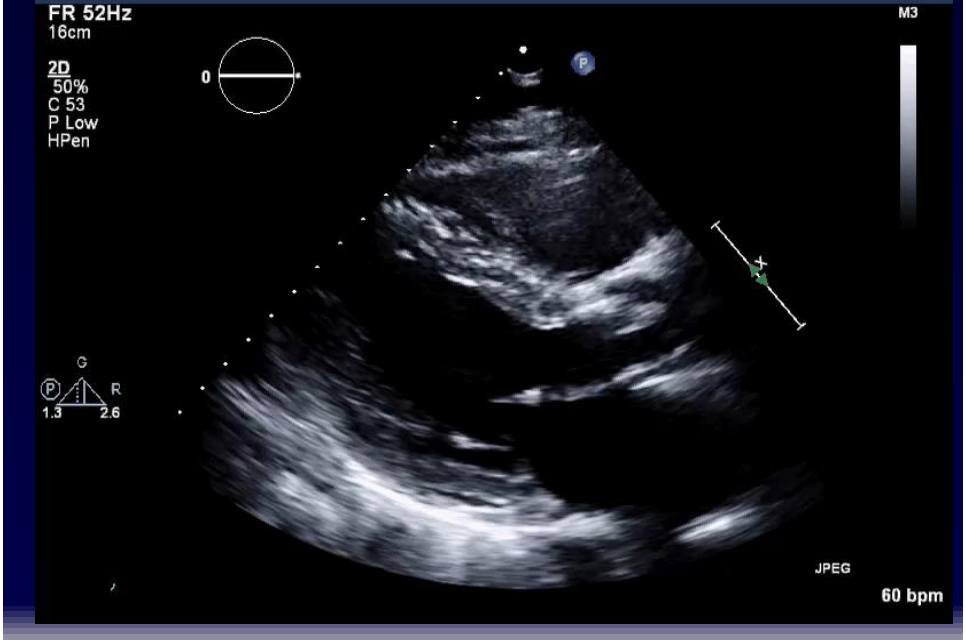

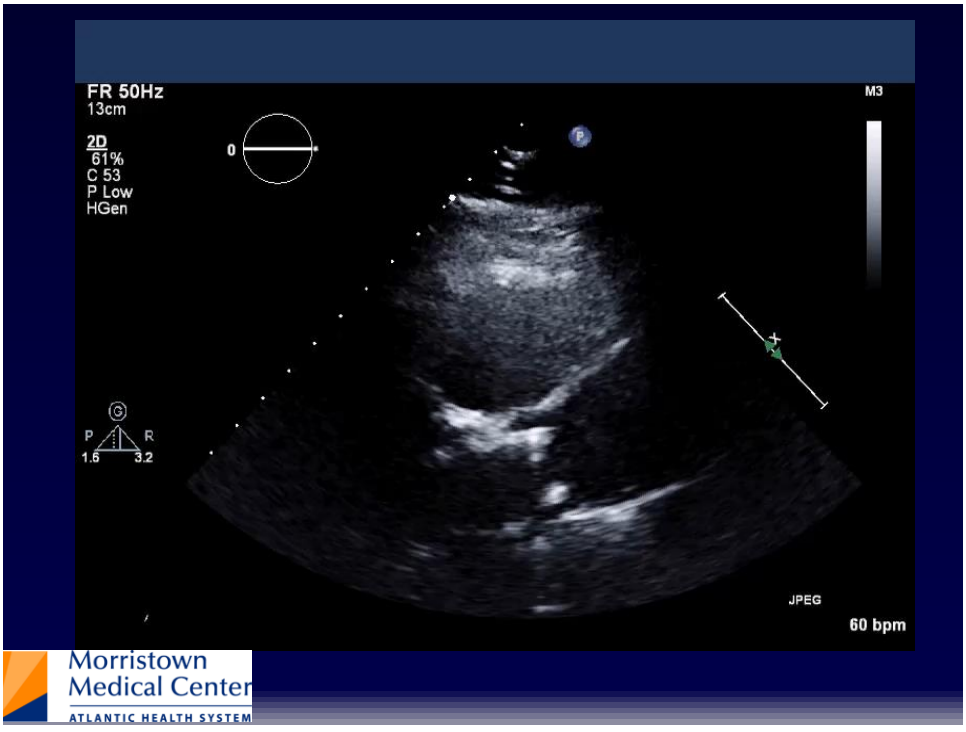
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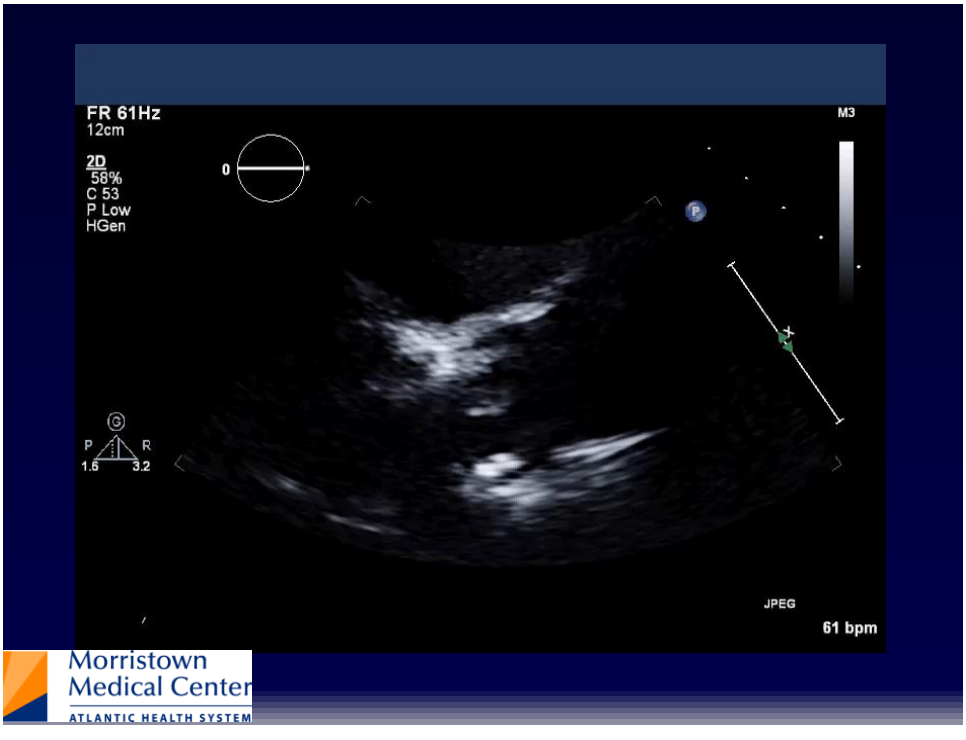
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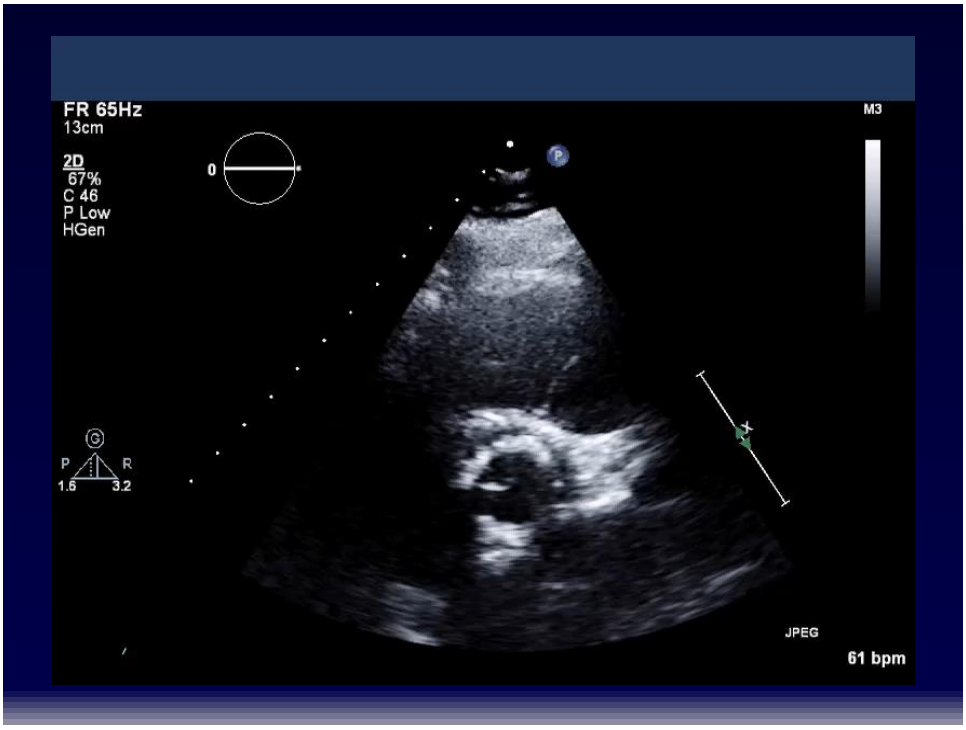
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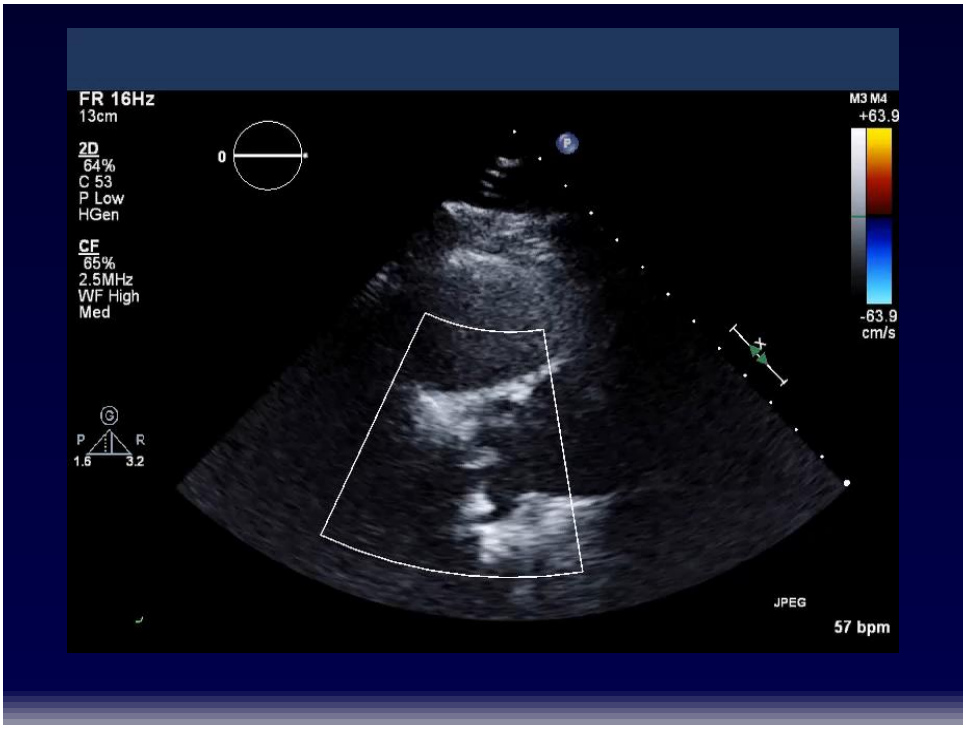
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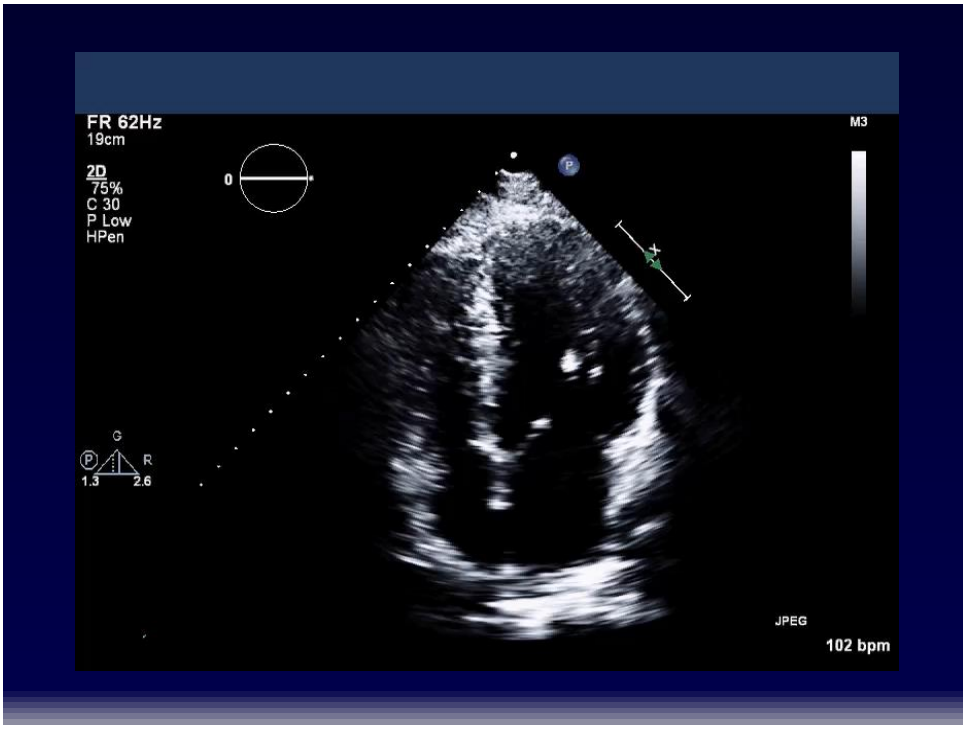
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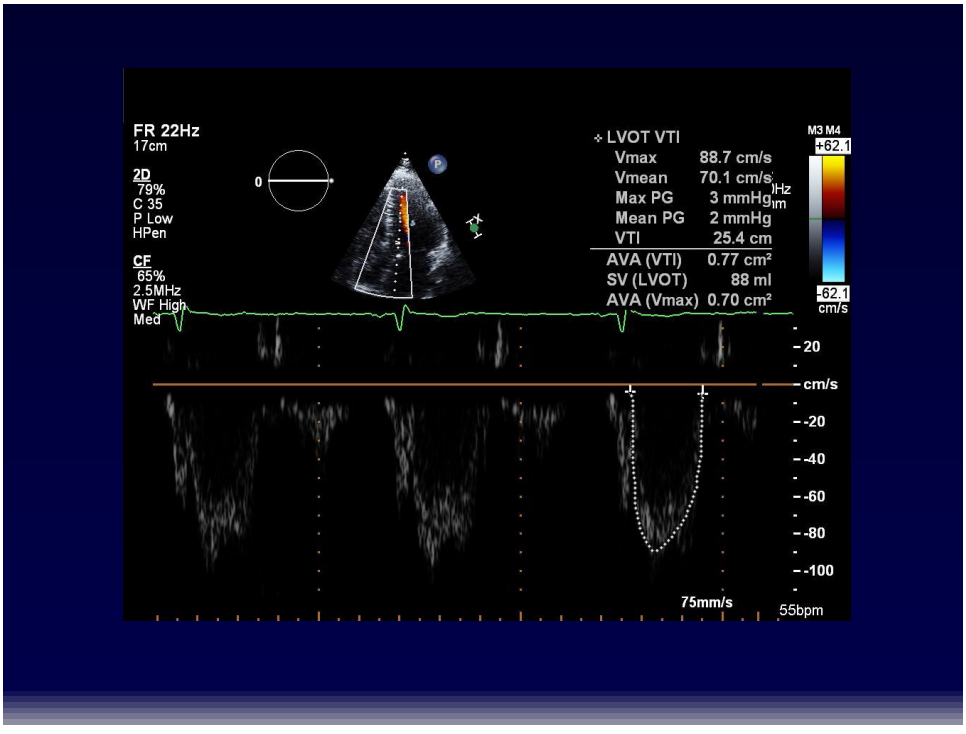
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Vmean 70.1 cm/s
Max PG 3 mmHg
Mean PG 2 mmHg
VTI 25.4 cm
AVA (VTI) 0.77 cm²
SV (LVOT) 88 ml
AVA (Vmax) 0.70 cm²
M3 M4
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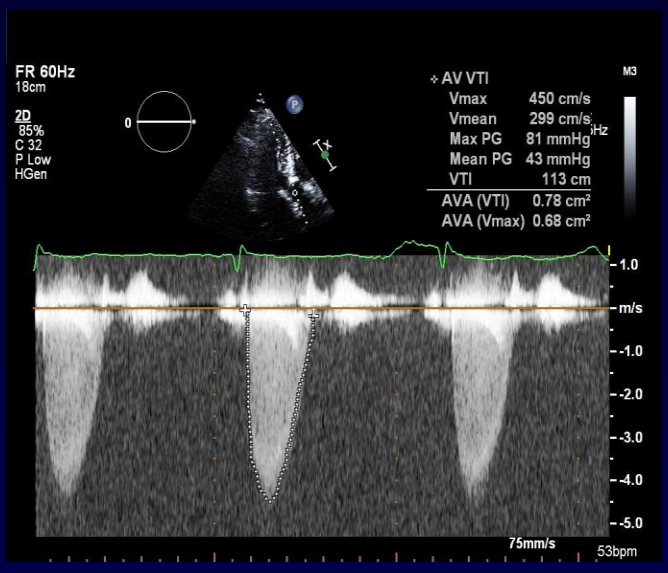
-62.1
cm/s
20
cm/s
-20
-40
-60
-80
-100
75mm/s
55bpm



GUIDELINES AND STANDARDS

Recommendations for Evaluation of Prosthetic Valves With Echocardiography and Doppler Ultrasound

A Report From the American Society of Echocardiography's Guidelines and Standards Committee and the Task Force on Prosthetic Valves, Developed in Conjunction With the American College of Cardiology Cardiovascular Imaging Committee, Cardiac Imaging Committee of the American Heart Association, the European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography and the Canadian Society of Echocardiography, Endorsed by the American College of Cardiology Foundation, American Heart Association, European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography, and Canadian Society of Echocardiography

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EOA Reference Values for Most Currently Used Aortic Prostheses

Table 3 Normal reference values of EOAs* for prosthetic valves

Valve type	Prosthetic valve size (mm) 19	21	23	25	27	29	Reference
Stented bioprosthetic valves							
Medtronic Mosaic	1.20	1.22	1.38	1.65	1.80	2.00	6
Hancock II	NA	1.18	1.33	1.46	1.55	1.60	6
Carpentier-Edwards Perimount	1.10	1.30	1.50	1.80	1.80	NA	6
Stentless bioprosthetic valves							
Medtronic Freestyle	1.15	1.35	1.48	2.00	2.32	NA	6
St Jude Medical Toronto SPV	–	1.30	1.50	1.70	2.00	2.50	6
Prima Edwards	0.80	1.10	1.50	1.80	2.30	2.80	6
Mechanical valves							
Medtronic-Hall	1.19	1.34	NA	NA	NA	NA	6
St Jude Medical Standard	1.04	1.38	1.52	2.08	2.65	3.23	6
St Jude Medical Regent	1.60	2.00	2.20	2.50	3.60	4.40	40
MCRI On-X	1.50	1.70	2.00	2.40	3.20	3.20	41
Carbomedics	1.00	1.54	1.63	1.98	2.41	2.63	6
Sorin Bicarbon	NA	1.66	1.96	NA	NA	NA	42

*Expressed as mean values available in the literature.

Pibarot and Dumesnil, Heart. 2006; 92(8):1022-9.

Can you explain the gradients with Patient Prosthesis Mismatch?

A) Yes

B) No

C) Don't know

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Is this Patient Prosthesis Mismatch

A)Yes

B) No

C) Don't know

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Prosthesis-Patient Mismatch

Indexed EOA (cm^2/m^2)	P-PM
>0.85	No P-PM
0.66-0.85	Moderate
≤0.65	Severe

Algorithm for Interpretation of High Gradients in Valve Prosthesis

- Calculate EOA and compare with reference value for same type and size of prosthesis
- Compare with previous echoes if available
- If EOA = ± reference value, suspect PPM and confirm by calculating indexed EOA (present if < 1.2 cm^2/m^2 for mitral <0.85 cm^2/m^2 for aortic, not validated for tricuspid)
- If EOA significantly < reference value, consider pressure recovery in bi-leaflet prosthesis and/or intrinsic dysfunction
- If dysfunction suspected, evaluate leaflet mobility and integrity using TEE and/or fluoroscopy

TEE

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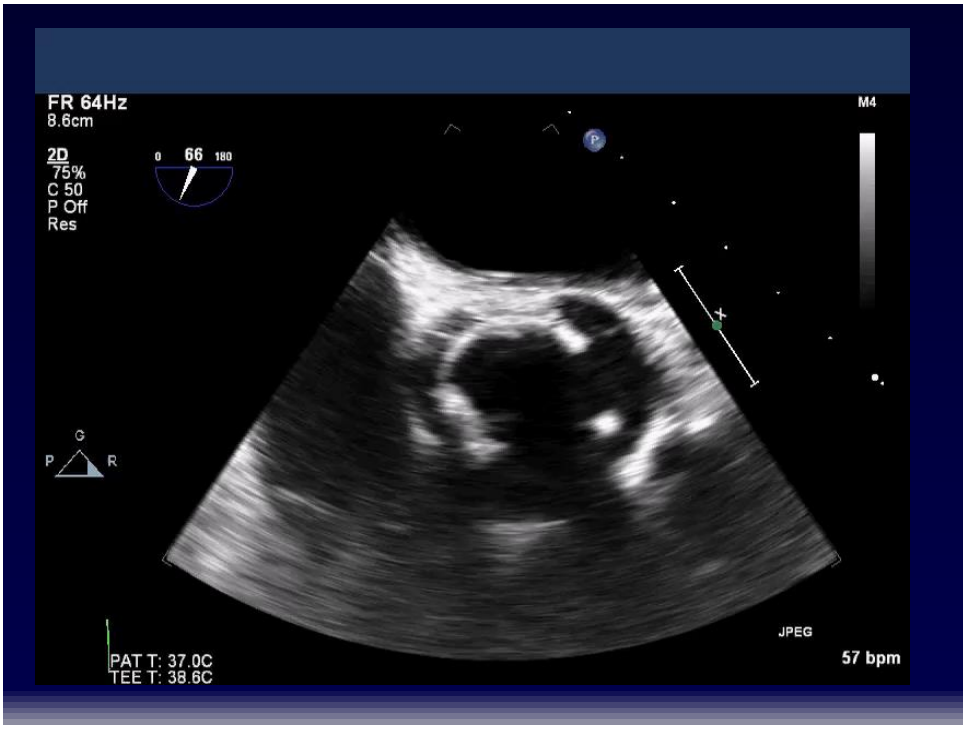

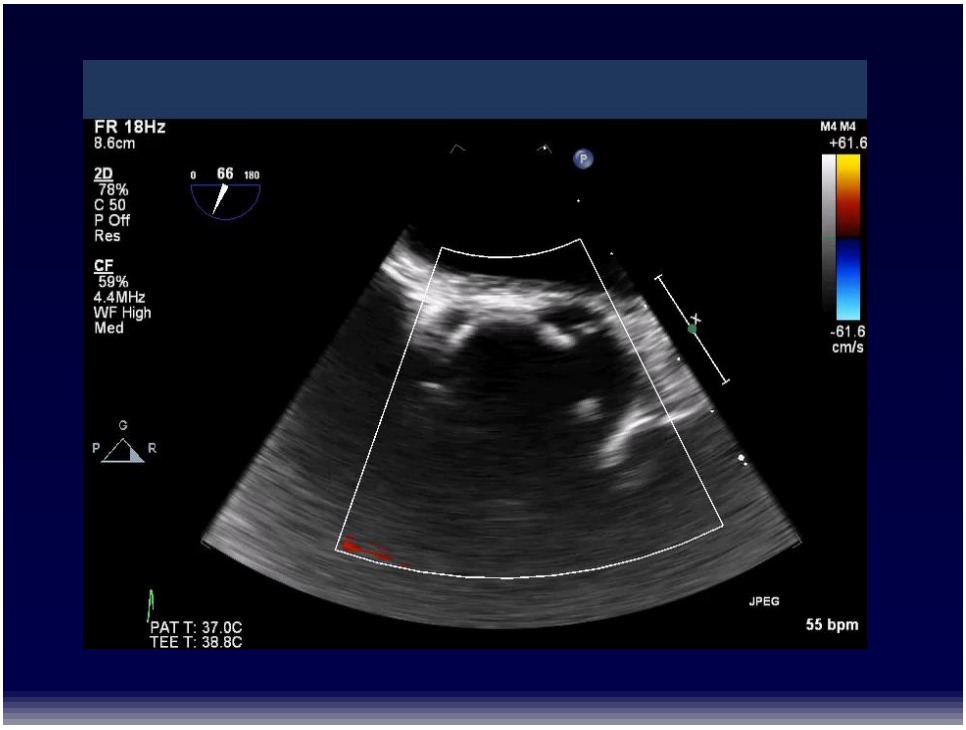
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CF
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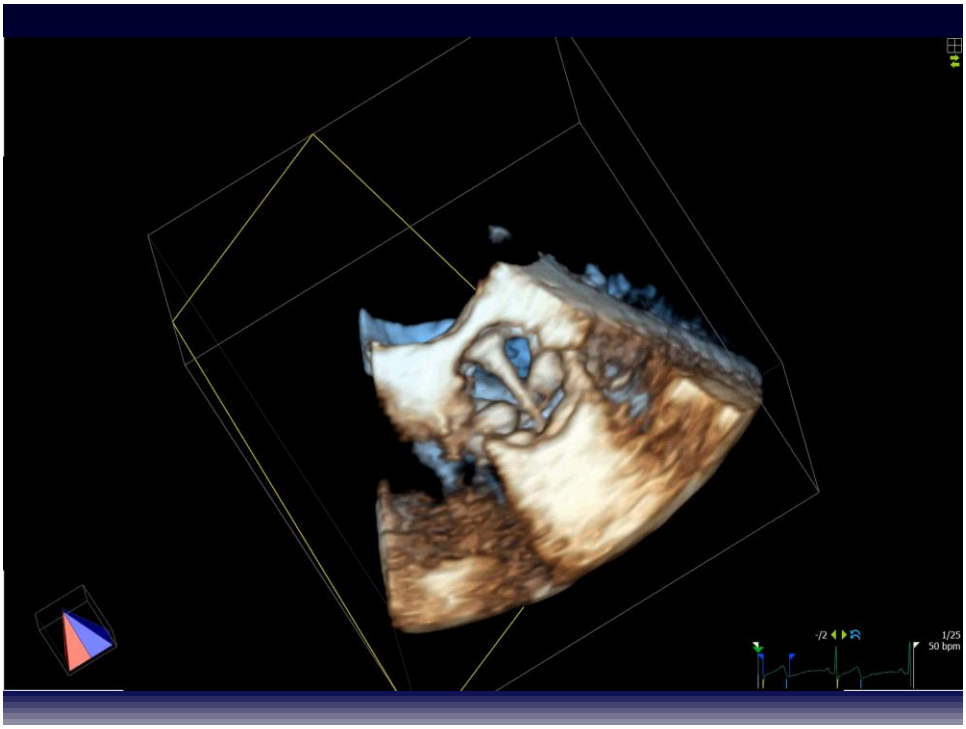
-61.6
cm/s
G
P
R
JPEG
PAT T: 37.0C
TEE T: 38.8C
55 bpm


1/25
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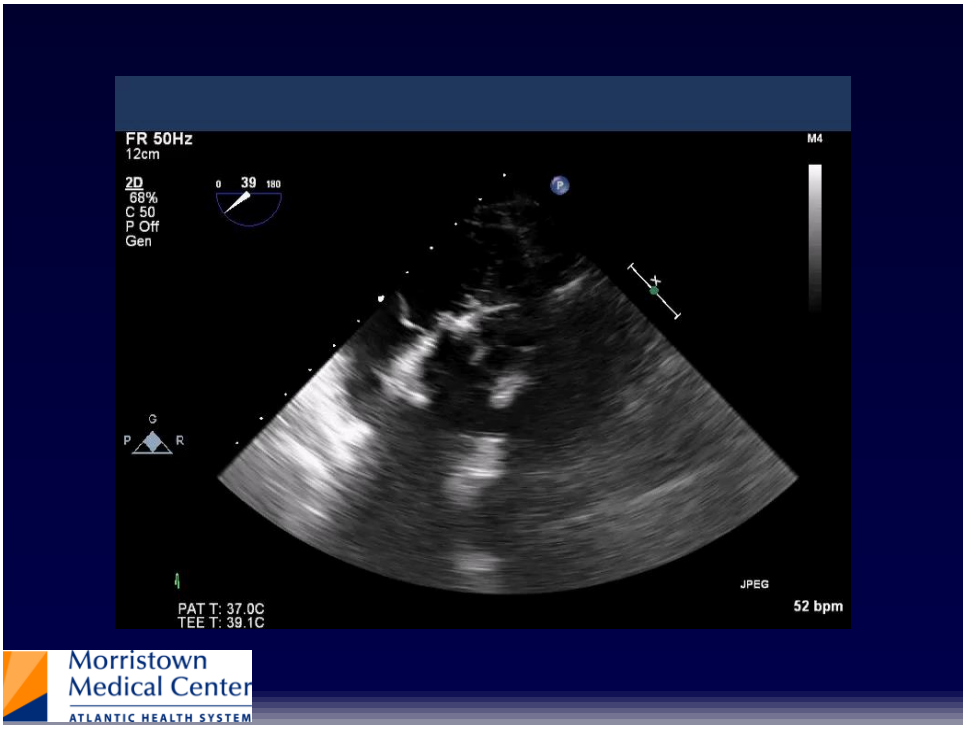
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P R
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52 bpm
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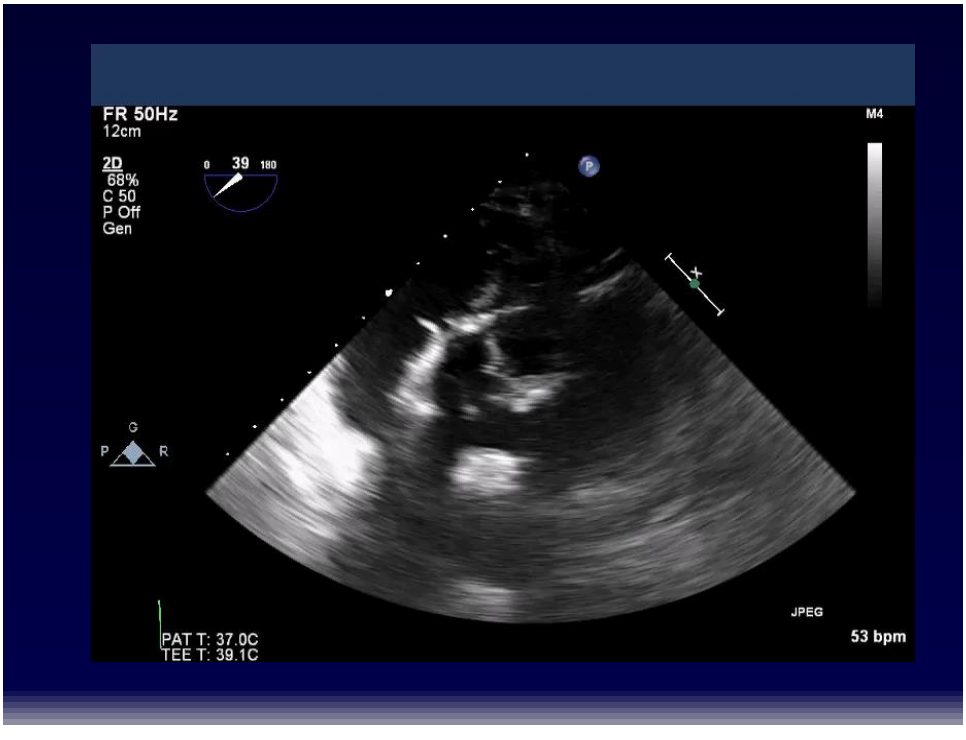
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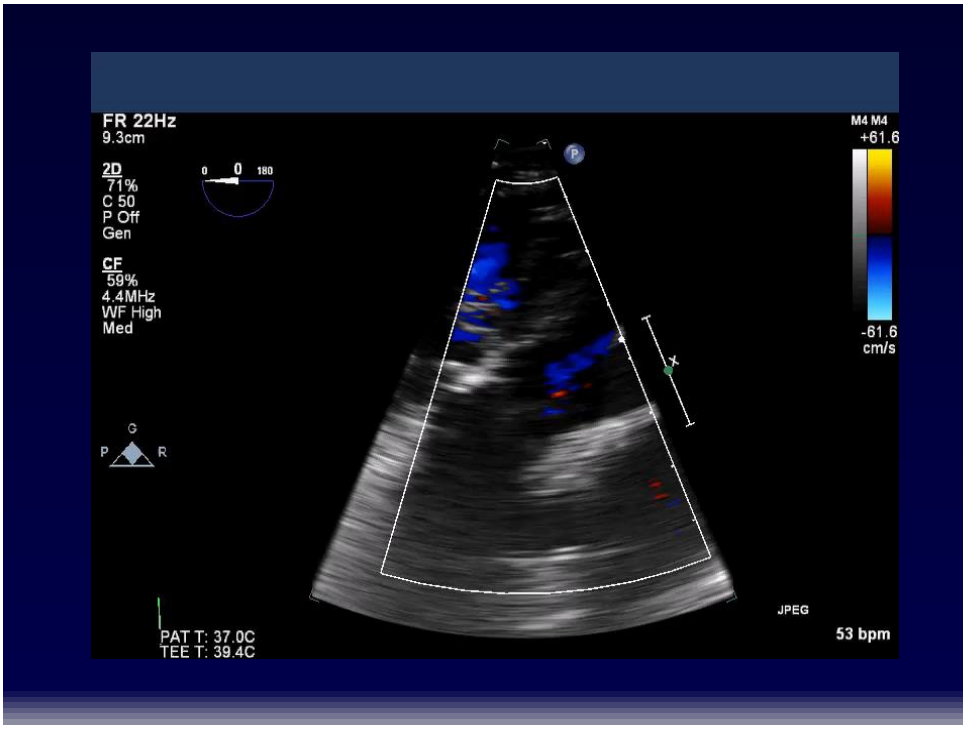
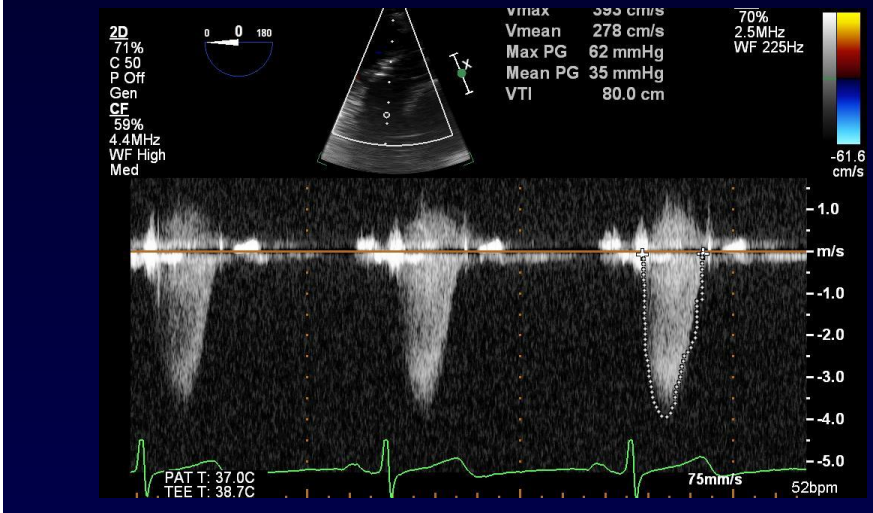
TEE T: 39.1C
53 bpm





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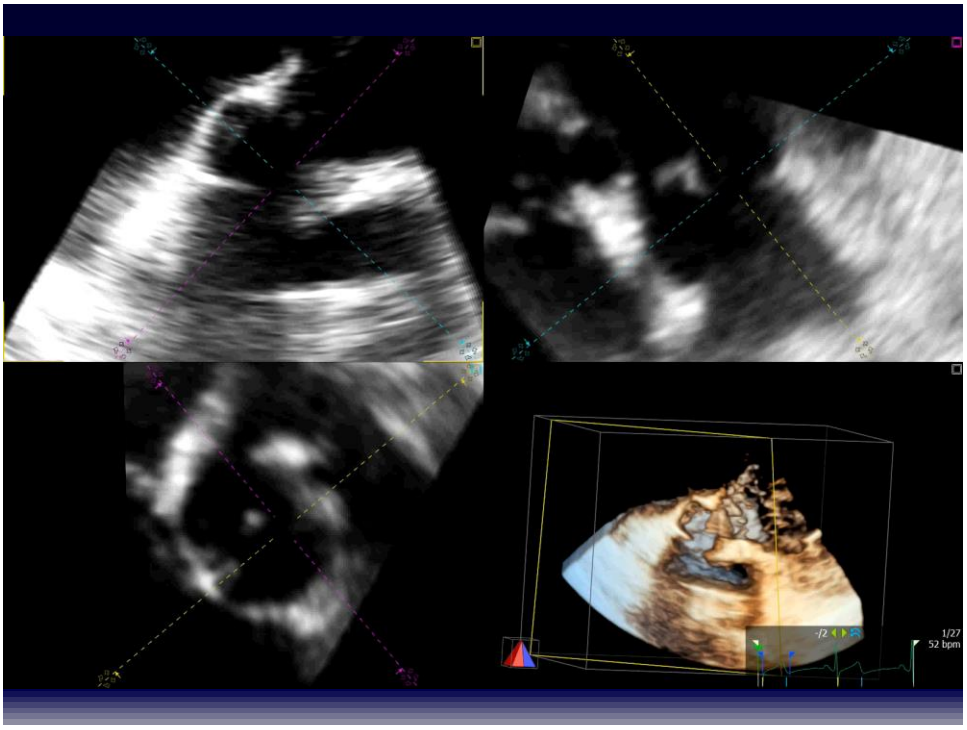

CT

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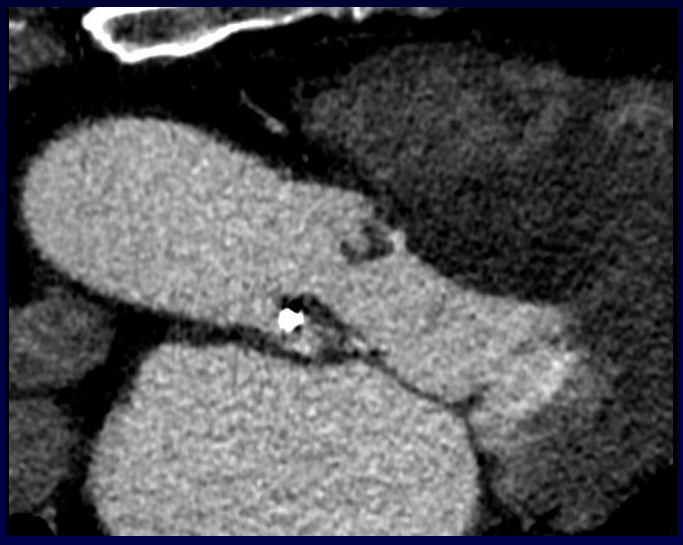

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Diagnosis

Prosthetic Valve Degeneration

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Diagnosis

Prosthetic Valve Degeneration

Some degree of underlying PPM

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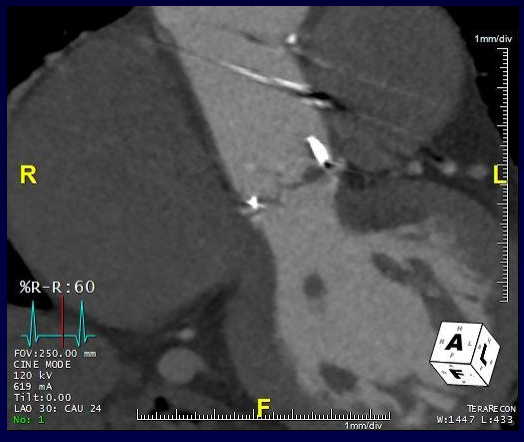
Example of Chart Used to Avoid PPM at Time of Operation

		EOAi by Prosthesis size (mm)				
Prosthesis size (mm)	**19**	**21**	**23**	**25**	**27**	**29**
Average EOA (cm^2)	1.1	1.3	1.5	1.8	2.3	2.7
BSA (m^2)						
0.6	1.83	2.17	2.50	3.00	3.83	4.50
0.7	1.57	1.86	2.14	2.57	3.29	3.86
0.8	1.38	1.63	1.88	2.25	2.88	3.38
0.9	1.22	1.44	1.67	2.00	2.56	3.00
1	1.10	1.30	1.50	1.80	2.30	2.70
1.1	1.00	1.18	1.36	1.64	2.09	2.45
1.2	0.92	1.08	1.25	1.50	1.92	2.25
1.3	0.85	1.00	1.15	1.38	1.77	2.08
1.4	0.79	0.93	1.07	1.29	1.64	1.93
1.5	0.73	0.87	1.00	1.20	1.53	1.80
1.6	0.49	0.88	0.88	0.88	0.88	1.69
1.7	0.65	0.76	0.88	1.06	1.35	1.59
1.8	0.61	0.72	0.83	1.00	1.28	1.50
1.9	0.58	0.68	0.79	0.95	1.21	1.42
2	0.55	0.65	0.75	0.90	1.15	1.35
2.1	0.52	0.62	0.71	0.86	1.10	1.29
2.2	0.50	0.59	0.68	0.82	1.05	1.23
2.3	0.48	0.57	0.65	0.78	1.00	1.17
2.4	0.46	0.54	0.63	0.75	0.96	1.13
2.5	0.44	0.52	0.60	0.72	0.92	1.08

Similar story, different patient



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JACC: CARDIOVASCULAR IMAGING
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IMAGING VIGNETTE

Color Paucity as a Marker of Transcatheter Valve Thrombosis

Leo Marcoff, MD,[a] Konstantinos P. Koulogiannis, MD,[a] Lillian Aldaia, MD,[a] David P. Fuschetto, MD,[b] Robert M. Kipperman, MD,[a] Saaron Laighold, MD,[b] Linda D. Gillam, MD[a]

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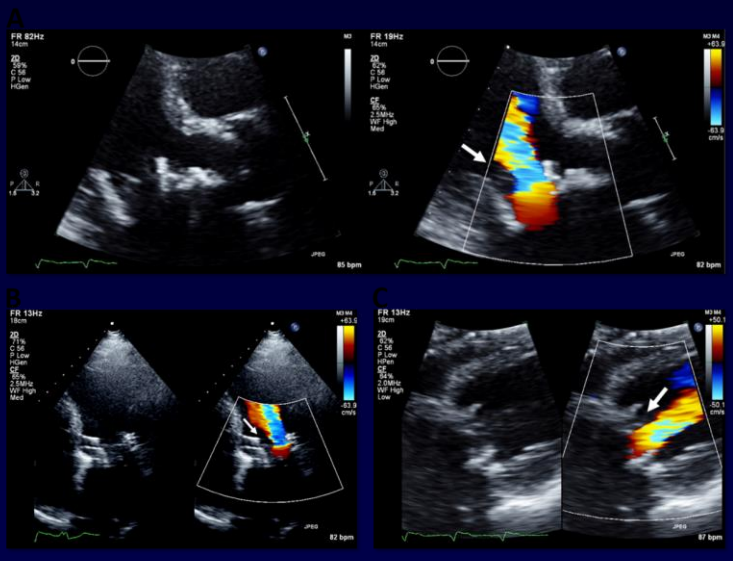

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Case 2

Mismatch between symptoms and echo findings

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- 72 yo male who underwent “elective” mitral valve repair for severe mitral regurgitation due to myxomatous mitral valve disease
- Repair done at high volume center of excellence with “excellent” result
- Post-operatively new dyspnea on exertion
- PE unremarkable (HR 72 NSR)

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TTE

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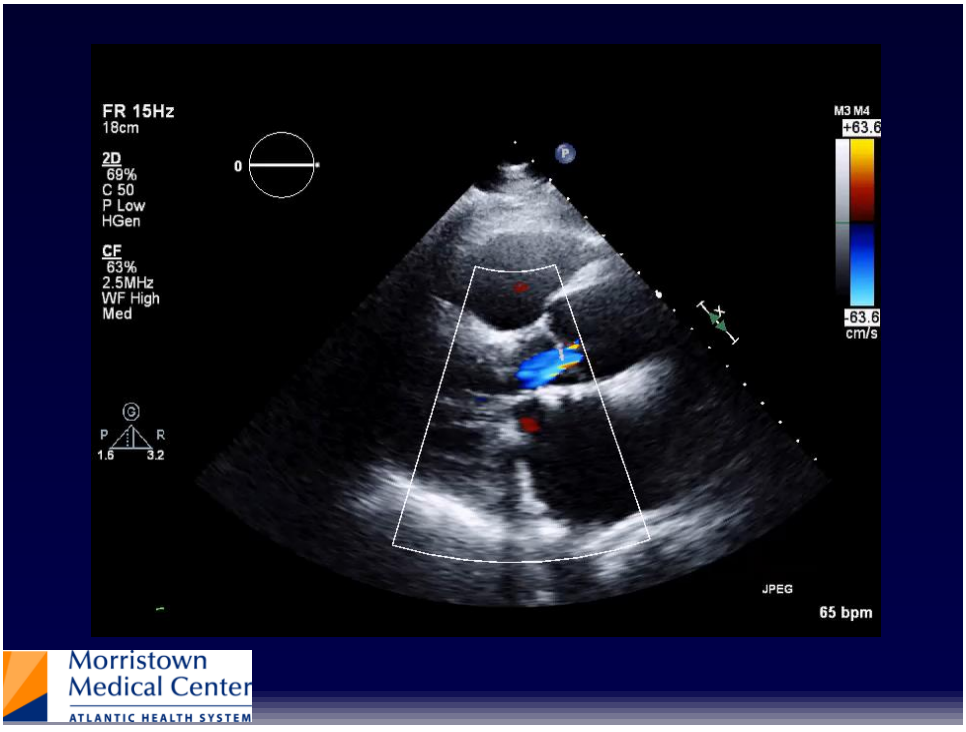
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69%
C 50
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HGen
CF
63%
2.5MHz
WF High
Med
M3 M4
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-63.6
cm/s
JPEG
65 bpm
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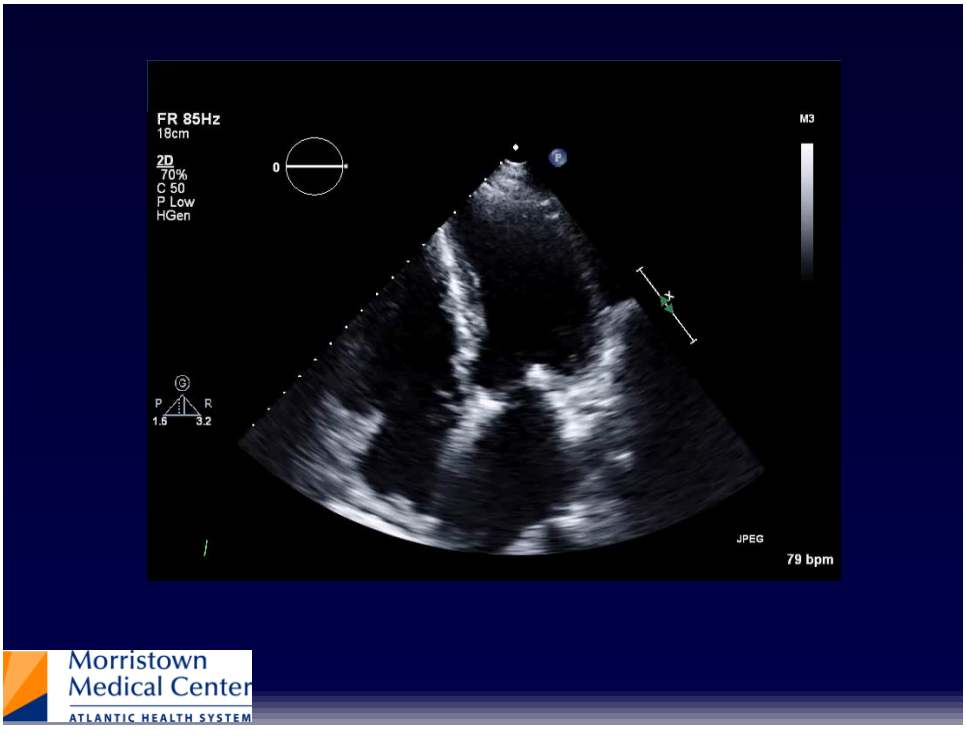
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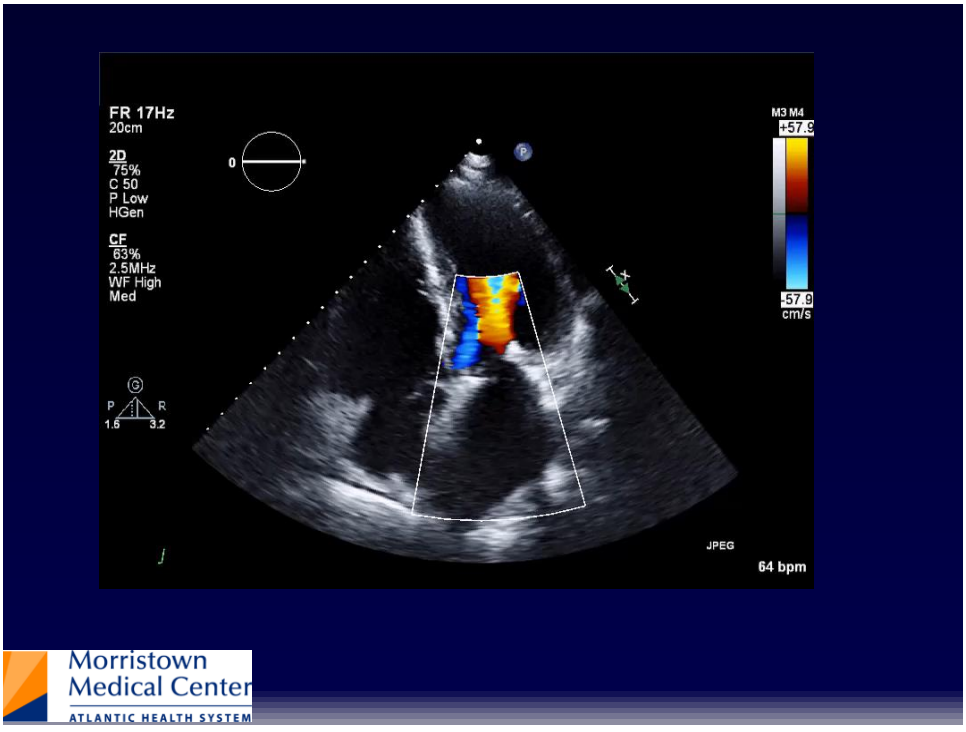
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WF High
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-57.9
cm/s
JPEG
64 bpm
Morristown
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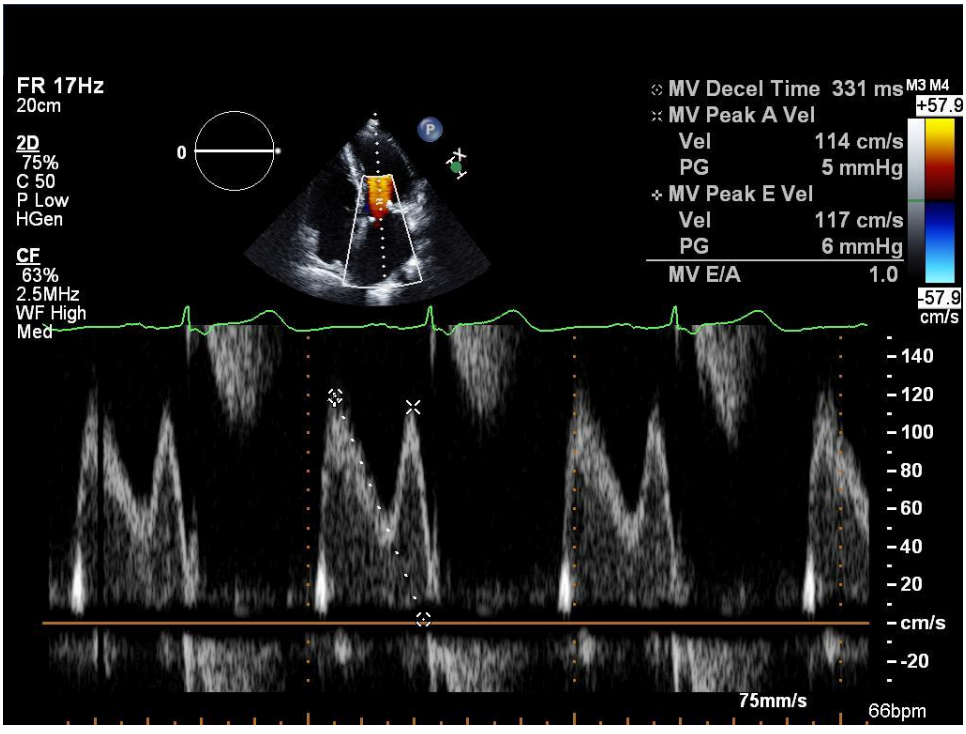
ATLANTIC HEALTH SYSTEM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C 50
P Low
HGen
CF
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WF High
Med
MV Decel Time 331 ms
MV Peak A Vel
Vel 114 cm/s
PG 5 mmHg
MV Peak E Vel
Vel 117 cm/s
PG 6 mmHg
MV E/A 1.0
M3 M4
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-57.9
cm/s
140
120
100
80
60
40
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cm/s
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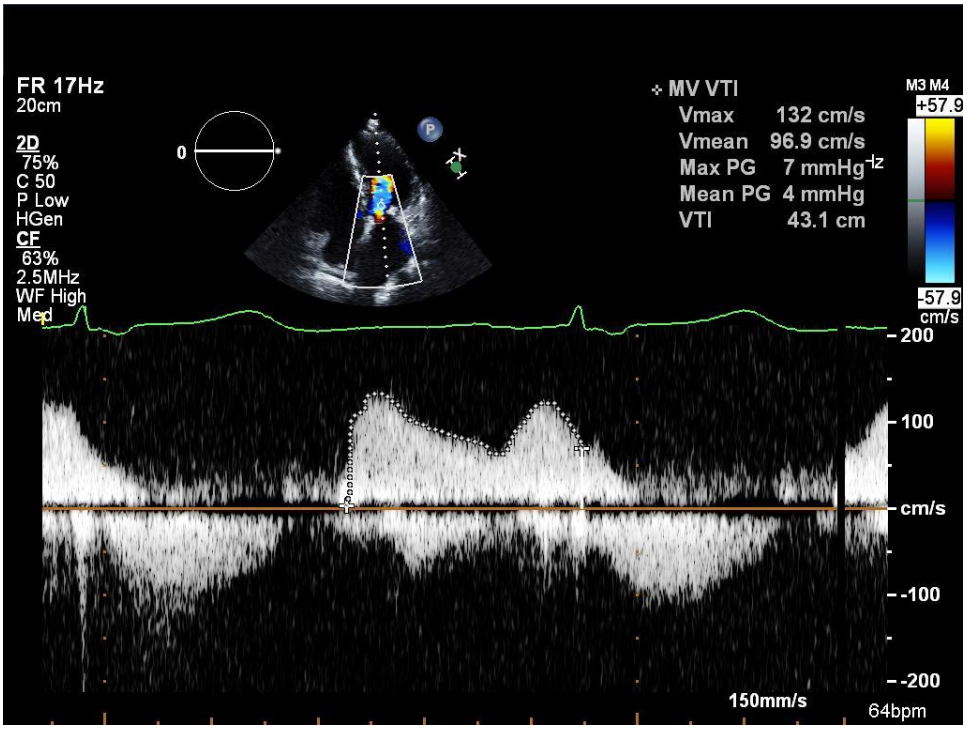
75mm/s
66bpm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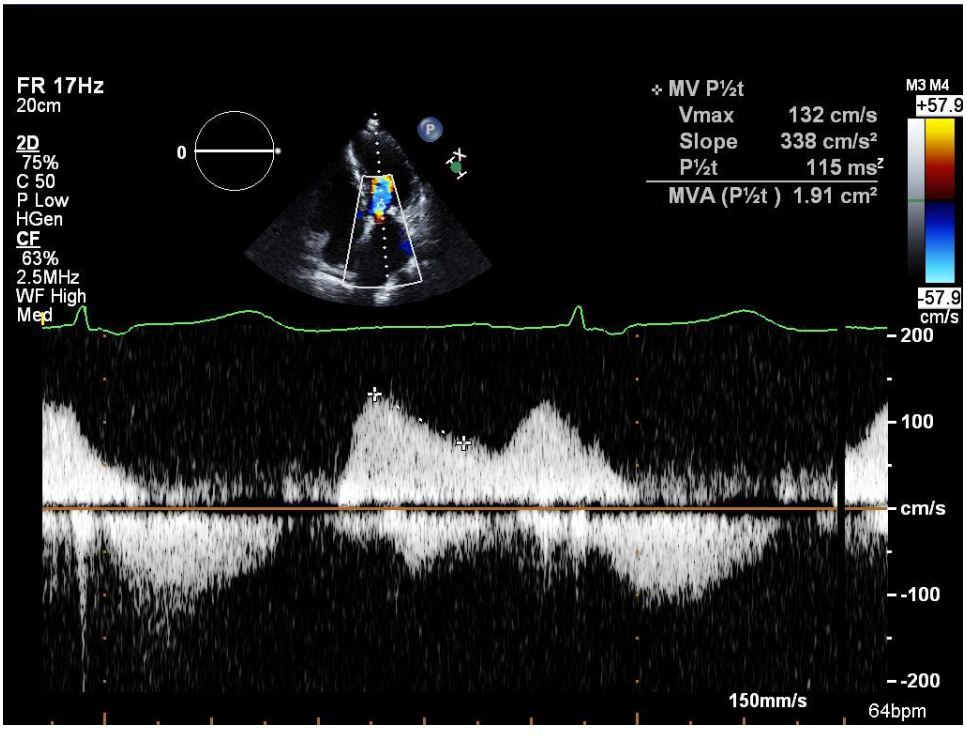
WF High
Med
MV VTI
Vmax 132 cm/s
Vmean 96.9 cm/s
Max PG 7 mmHg
Mean PG 4 mmHg
VTI 43.1 cm
M3 M4
+57.9
-57.9
cm/s
200
100
cm/s
-100
-200
150mm/s
64bpm


FR 17Hz
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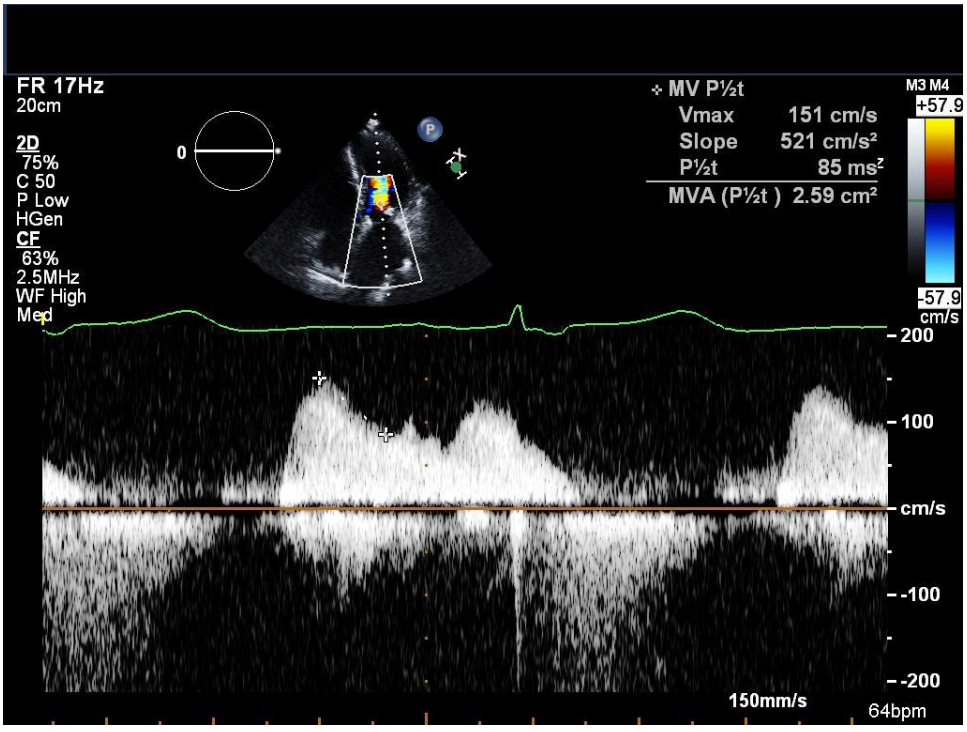
75%
C 50
P Low
HGen
CF
63%
2.5MHz
WF High
Med
MV P½t
Vmax 132 cm/s
Slope 338 cm/s²
P½t 115 ms²
MVA (P½t) 1.91 cm²
M3 M4
+57.9
-57.9
cm/s
200
100
cm/s
-100
-200
150mm/s
64bpm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C 50
P Low
HGen
CF
63%
2.5MHz
WF High
Med
MV P½t
Vmax 151 cm/s
Slope 521 cm/s²
P½t 85 ms²
MVA (P½t) 2.59 cm²
M3 M4
+57.9
-57.9
cm/s
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cm/s
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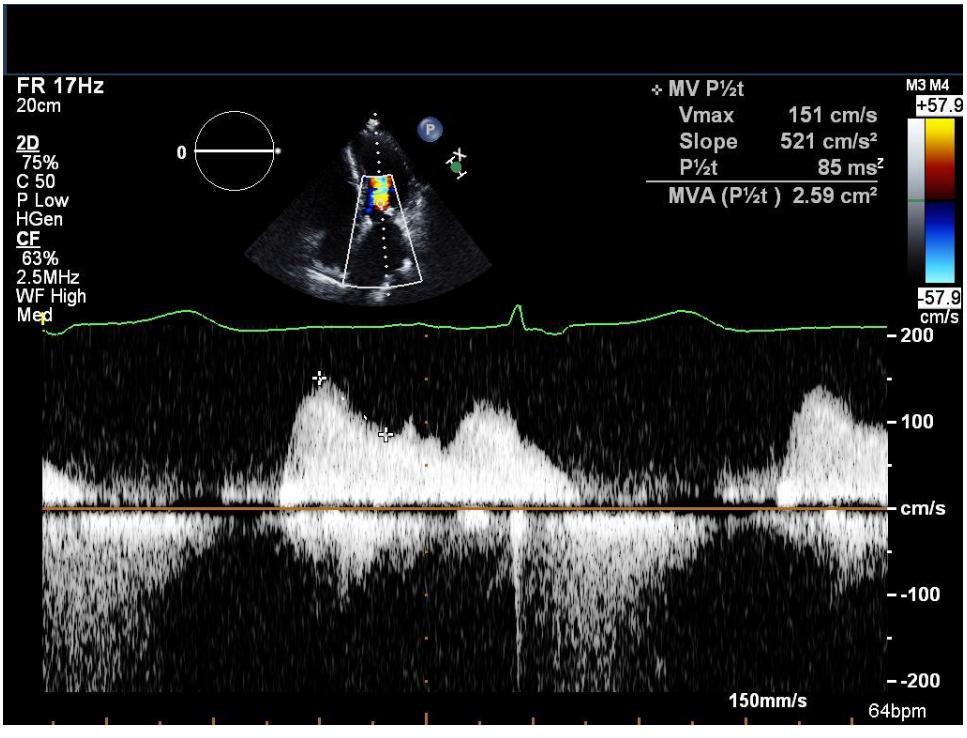
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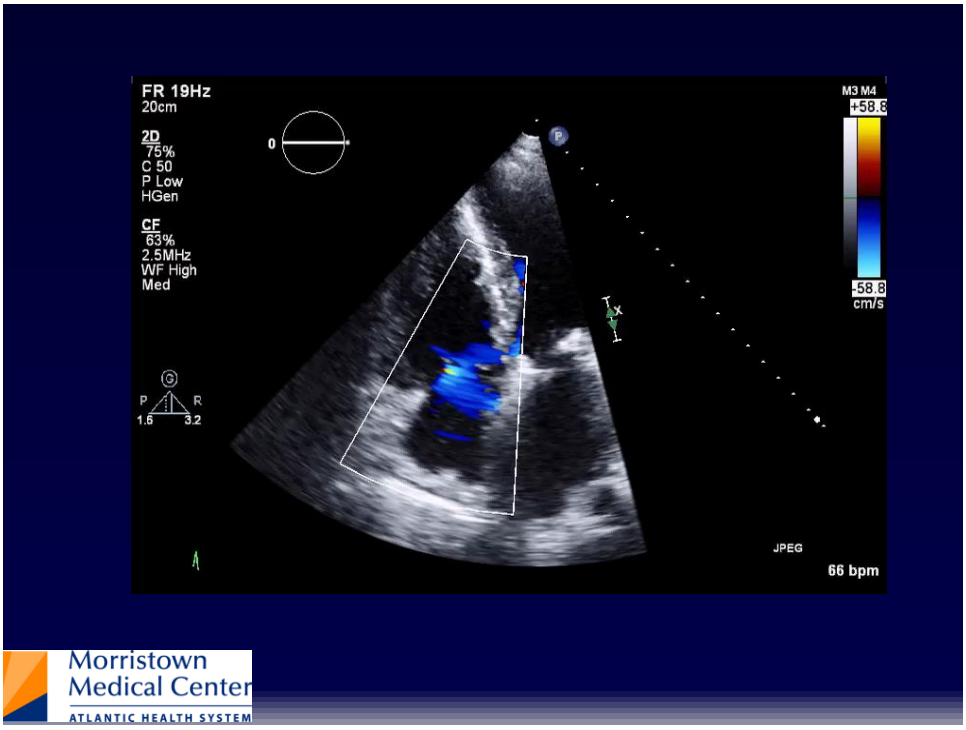
63%
2.5MHz
WF High
Med
MV P½t
Vmax 151 cm/s
Slope 521 cm/s²
P½t 85 ms²
MVA (P½t) 2.59 cm²
M3 M4
+57.9
-57.9
cm/s
200
100
cm/s
-100
-200
150mm/s
64bpm


FR 19Hz
20cm
2D
75%
C 50
P Low
HGen
CF
63%
2.5MHz
WF High
Med
M3 M4
+58.8
-58.8
cm/s
JPEG
66 bpm
Morristown
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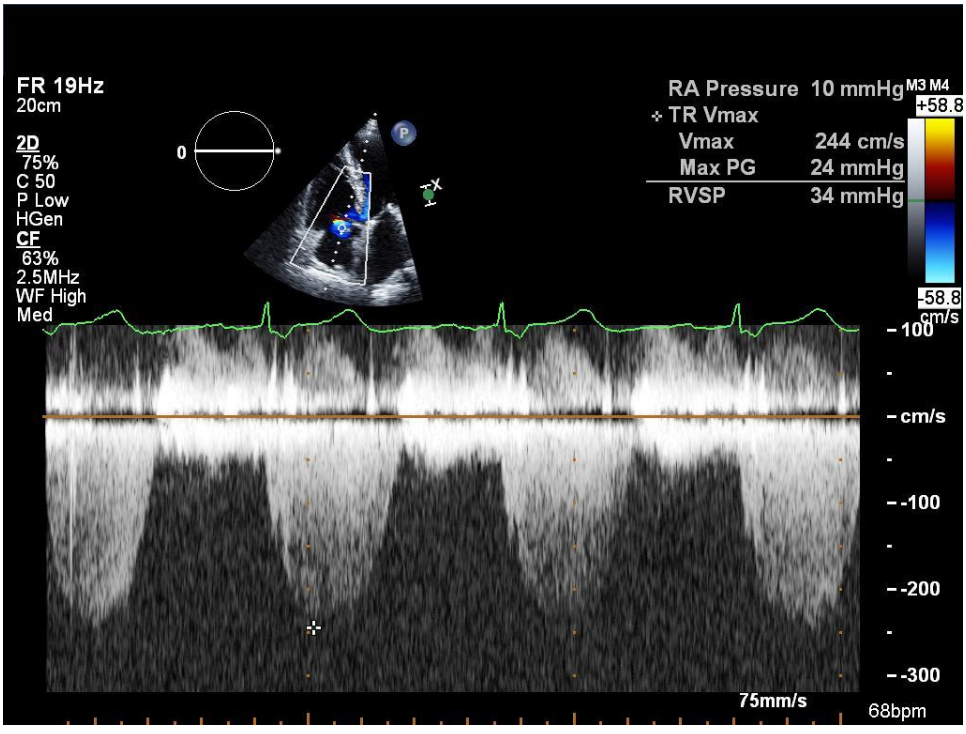
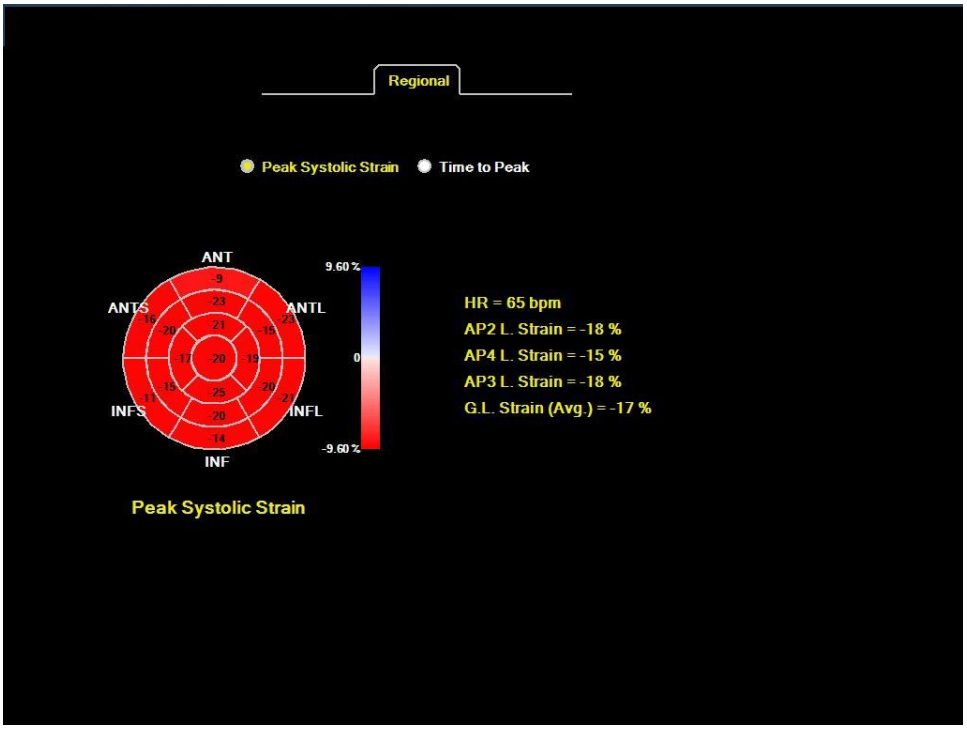

FR 19Hz
20cm
2D
75%
C 50
P Low
HGen
CF
63%
2.5MHz
WF High
Med
RA Pressure 10 mmHg
TR Vmax
Vmax 244 cm/s
Max PG 24 mmHg
RVSP 34 mmHg
M3 M4
+58.8
-58.8
cm/s
100
cm/s
-100
-200
-300
75mm/s
68bpm



What would you do next?

A) Offer reassurance
B) TEE
C) Pulmonary function tests
D) Chest CT
E) Stress echo

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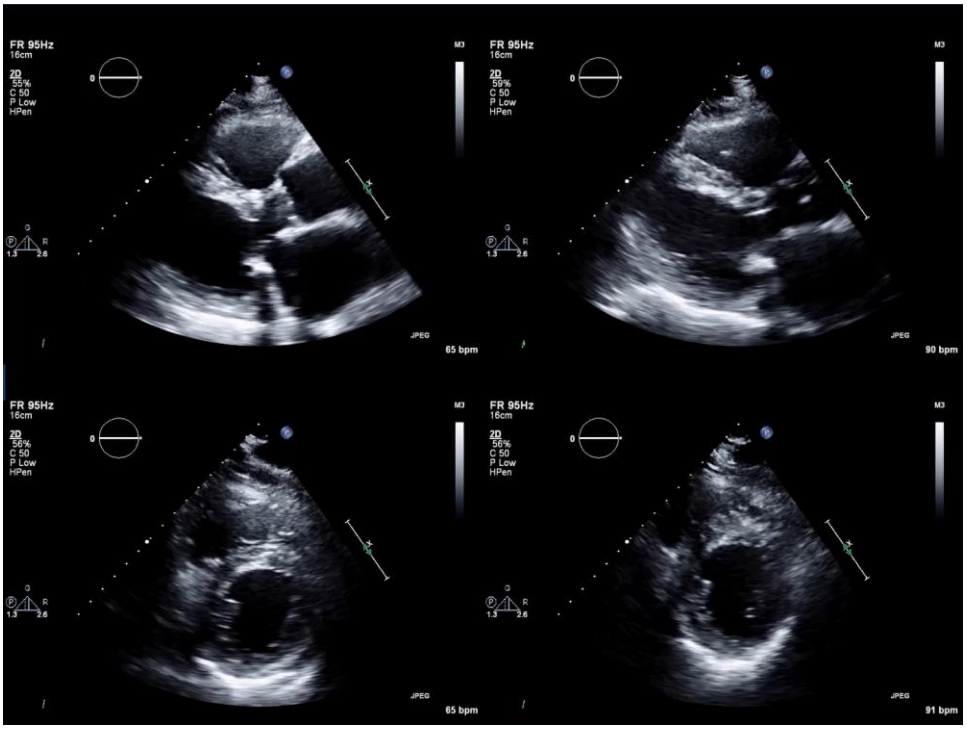
ATLANTIC HEALTH SYSTEM

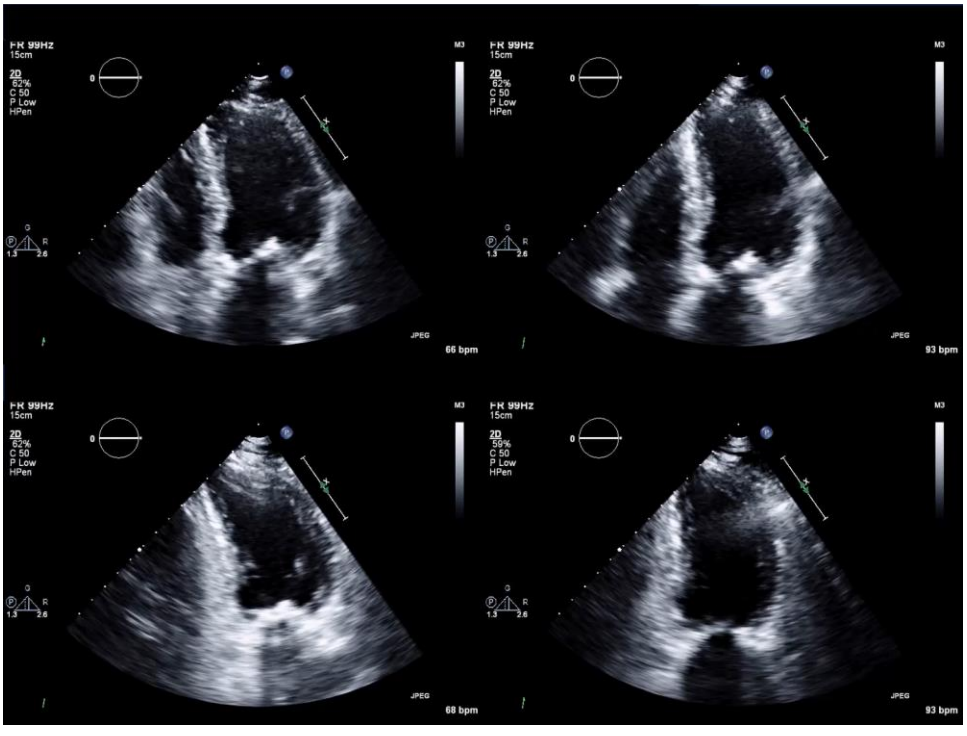
What would you do next?

A) Offer reassurance
B) TEE
C) Pulmonary function tests
D) Chest CT
E) Stress echo

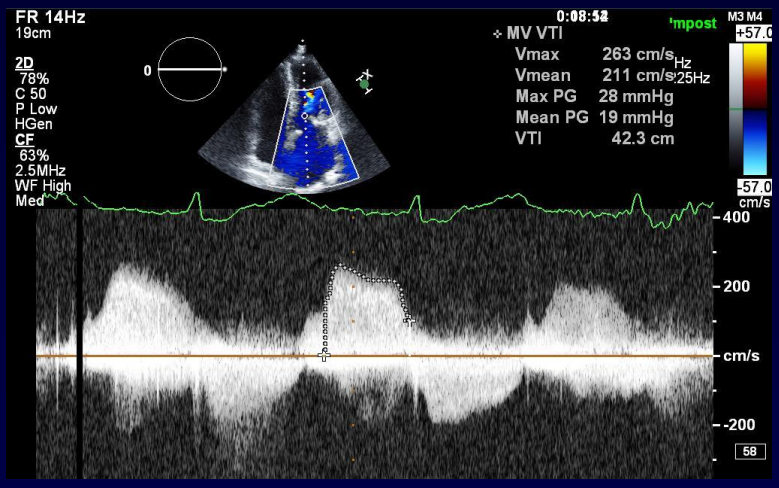
Stress response

- Bicycle stress attempted, could not bicycle (knee pain)
- Switched to Bruce –completed 4 mins
- Stopped due to dyspnea
- Peak HR 121
- Peak BP 150/80
- Post BNP 400 pg/ml


FR 95Hz
16cm
2D
55%
C 50
P Low
HPen
65 bpm
FR 95Hz
16cm
2D
59%
C 50
P Low
HPen
90 bpm
FR 95Hz
16cm
2D
56%
C 50
P Low
HPen
65 bpm
FR 95Hz
16cm
2D
56%
C 50
P Low
HPen
91 bpm


FR 99Hz
15cm
2D
62%
C 50
P Low
HPen
66 bpm
FR 99Hz
15cm
2D
62%
C 50
P Low
HPen
93 bpm
FR 99Hz
15cm
2D
62%
C 50
P Low
HPen
68 bpm
FR 99Hz
15cm
2D
59%
C 50
P Low
HPen
93 bpm

HR 117



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Conclusion

Iatrogenic mitral stenosis

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Indications for Stress Echo in MS

- Discordance between resting assessment of severity (gradient, valve area, PAP) and symptoms
- Assess adequacy of rate control
- May be helpful in predicting ability to cope with pregnancy

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Case

Is this severe AS?

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AS Severity

	Mild	Moderate	Severe
Mean Gradient mmHg	<20	20-39	≥40
AVA cm^2	1.5 – 2.0	1-1.5	≤1.0
Peak gradient mmHg	<36	36-63	≥64

Normal aortic valve area = 3-4 cm^2

Case

75 yo female with longstanding hypertension presents with progressive dyspnea on exertion (now unable to walk >20 ft)

BSA = 1.5 m^2

PE: BP 160/70

S1, S2 single, S4

3/6 ESM at base radiating to carotids, 1/6 holodiastolic murmur at LSB

Basal rales

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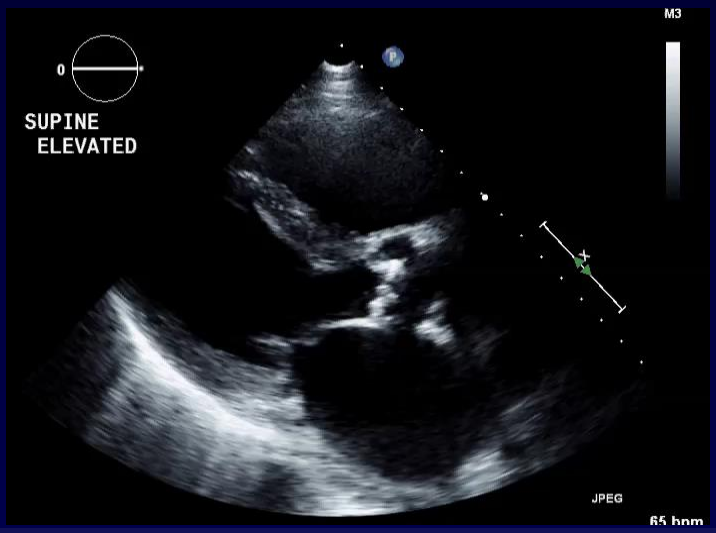
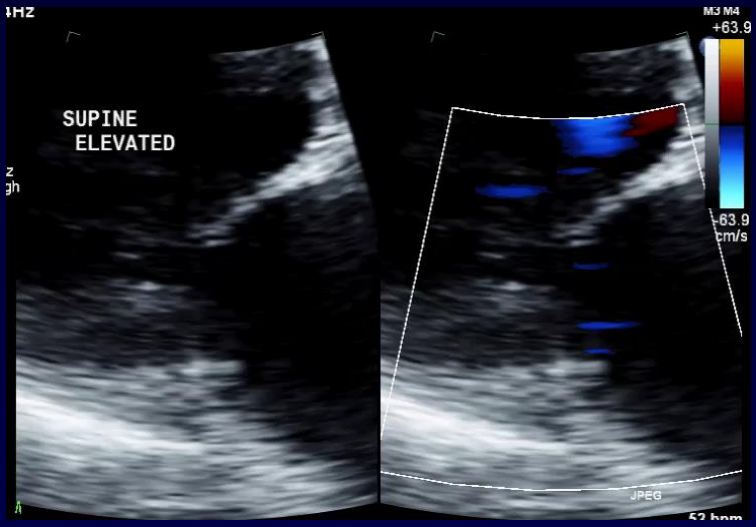
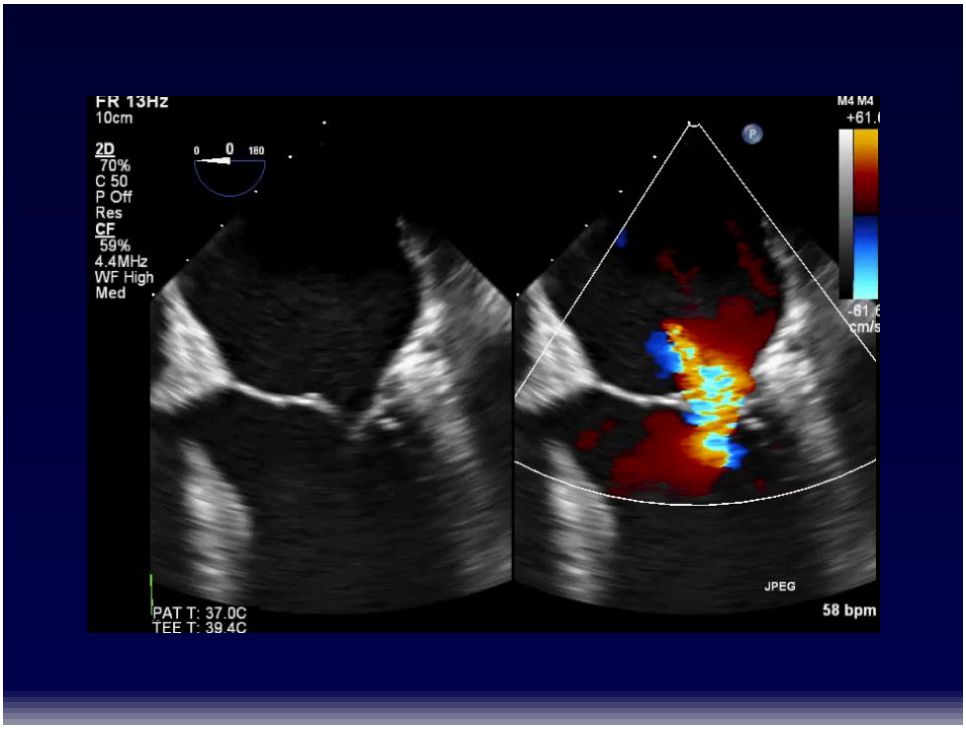
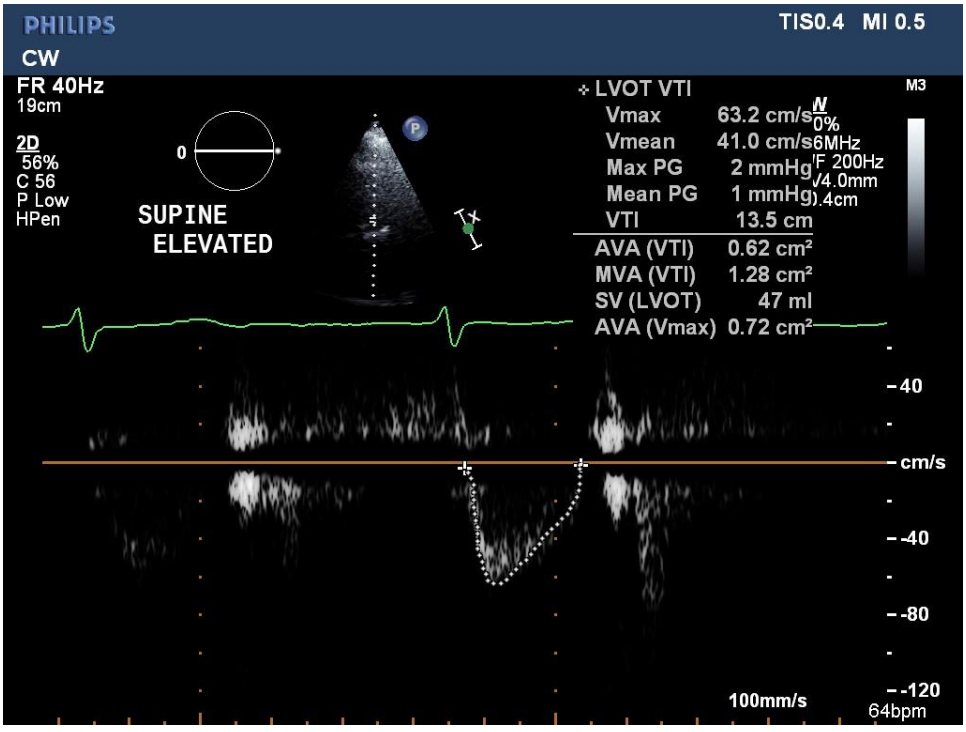
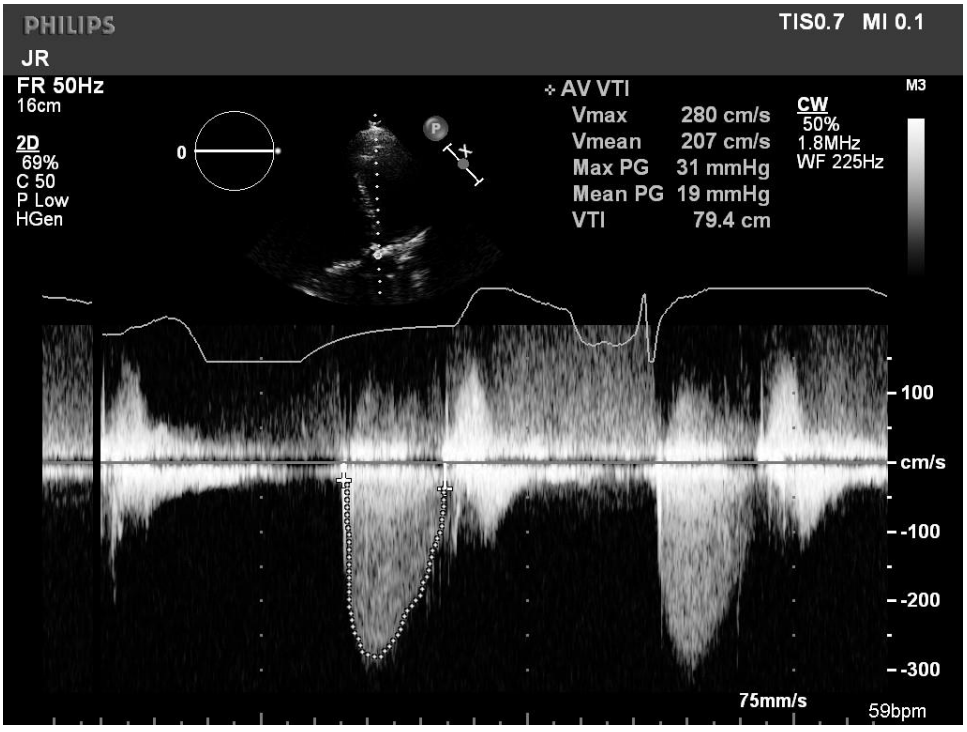
LVOT = 2.3
LVEDD 4.6
Wall thickness = 1.2 cm

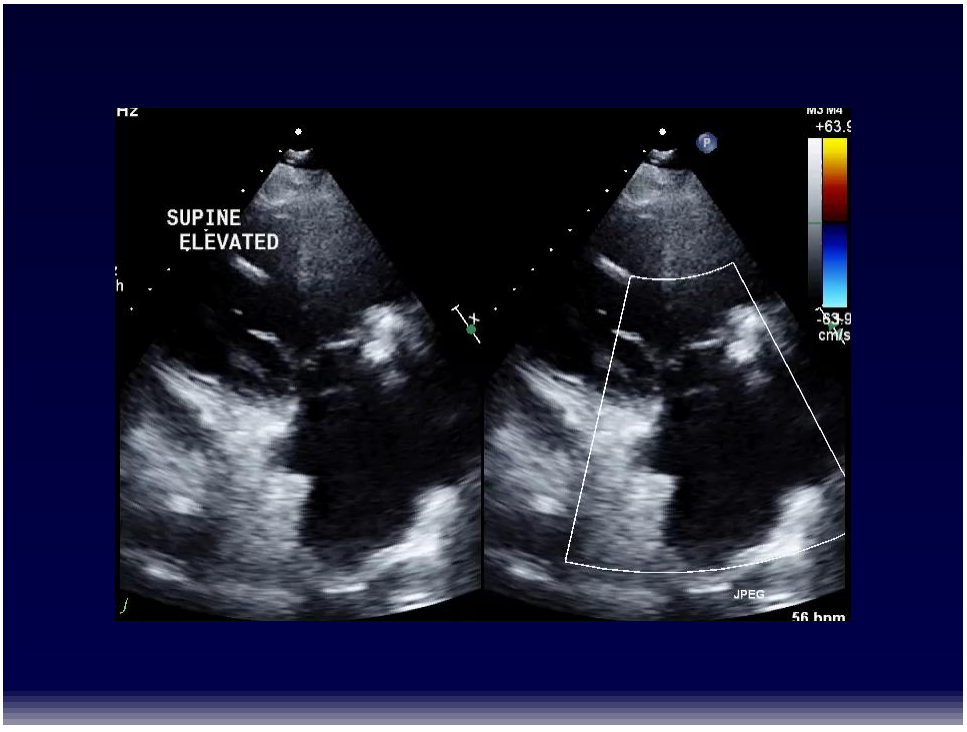


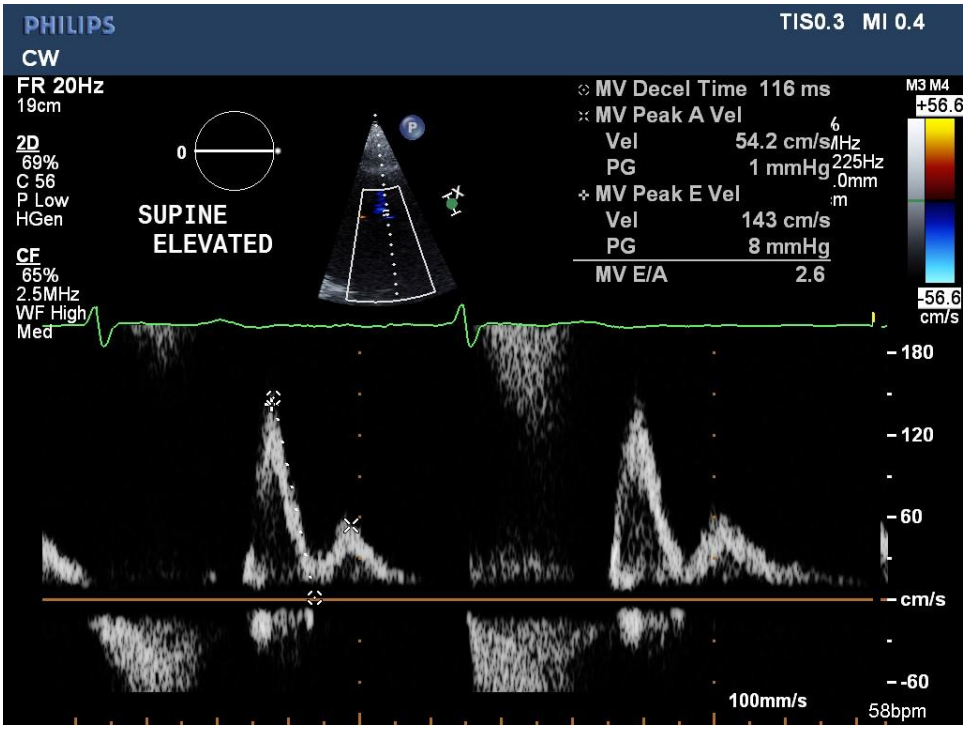



FR 13Hz
10cm
2D
70%
C 50
P Off
Res
CF
59%
4.4MHz
WF High
Med
M4 M4
JPEG
PAT T: 37.0C
TEE T: 39.4C
58 bpm


PHILIPS
TIS0.4 MI 0.5
CW
FR 40Hz
19cm
2D
56%
C 56
P Low
HPen
SUPINE
ELEVATED
LVOT VTI
Vmax 63.2 cm/s
Vmean 41.0 cm/s
Max PG 2 mmHg
Mean PG 1 mmHg
VTI 13.5 cm
AVA (VTI) 0.62 cm²
MVA (VTI) 1.28 cm²
SV (LVOT) 47 ml
AVA (Vmax) 0.72 cm²
M3
-40
cm/s
-40
-80
-120
100mm/s
64bpm


PHILIPS
TIS0.7 MI 0.1
JR
FR 50Hz
16cm
2D
69%
C 50
P Low
HGen
AV VTI
Vmax 280 cm/s
Vmean 207 cm/s
Max PG 31 mmHg
Mean PG 19 mmHg
VTI 79.4 cm
CW
50%
1.8MHz
WF 225Hz
M3
100
cm/s
-100
-200
-300
75mm/s
59bpm


SUPINE
ELEVATED
cm/s
JPEG



Derived Hemodynamics

- Peak gradient = 31 mmHg
- Mean gradient = 19 mmHg
- AV VTI = 79.4 cm
- LVOT VTI 13.5 cm (peak 0.62)
- SV = 56 cc (31 cc/m^2)
- Calculated AVA = 0.7 cm^2

Impedance

$$Z_{ao} = \frac{SAP + MG}{SVI},$$

$$\frac{130 + 19}{31}$$

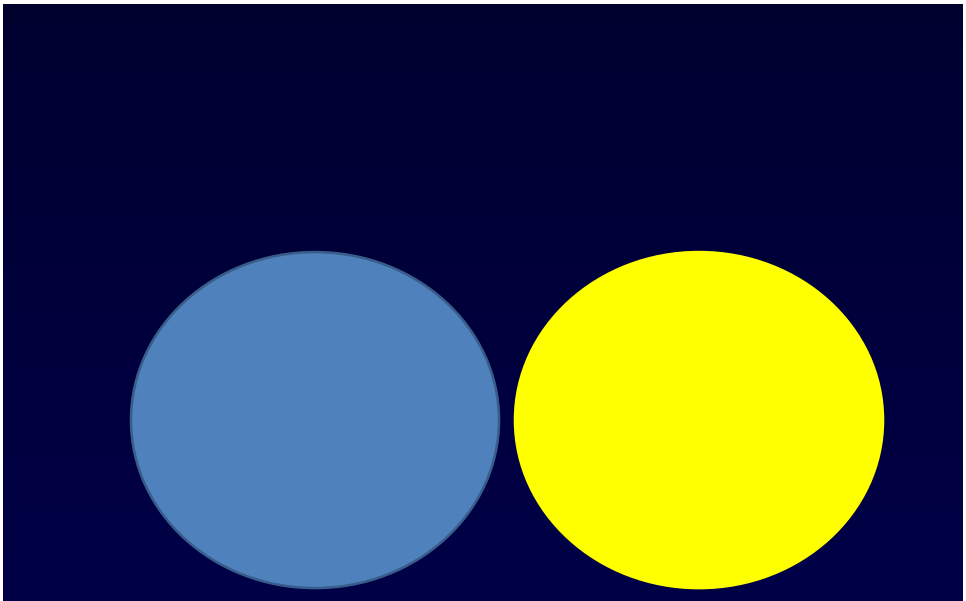
= 4.8 mmHg/ml/m^2

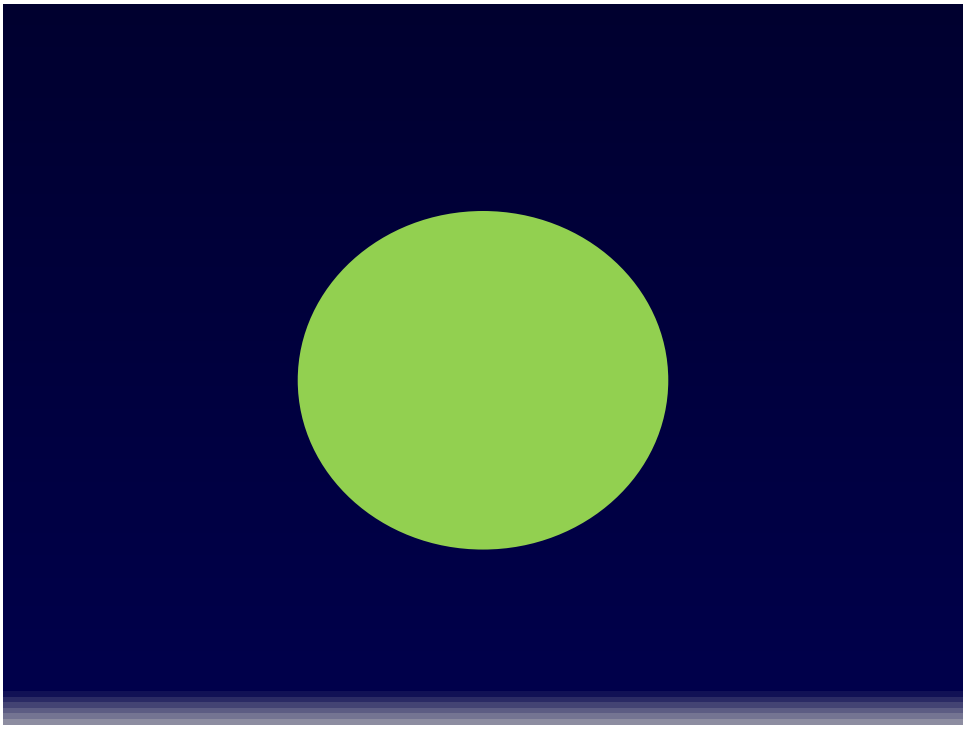
Diagnosis

Low gradient, low stroke volume, preserved LVEF severe aortic stenosis with low SV due to MR

Summary

- It is important to reconcile discordant estimates of the severity of valve stenosis





If the numbers /images don't fit you must not quit

Thank you!