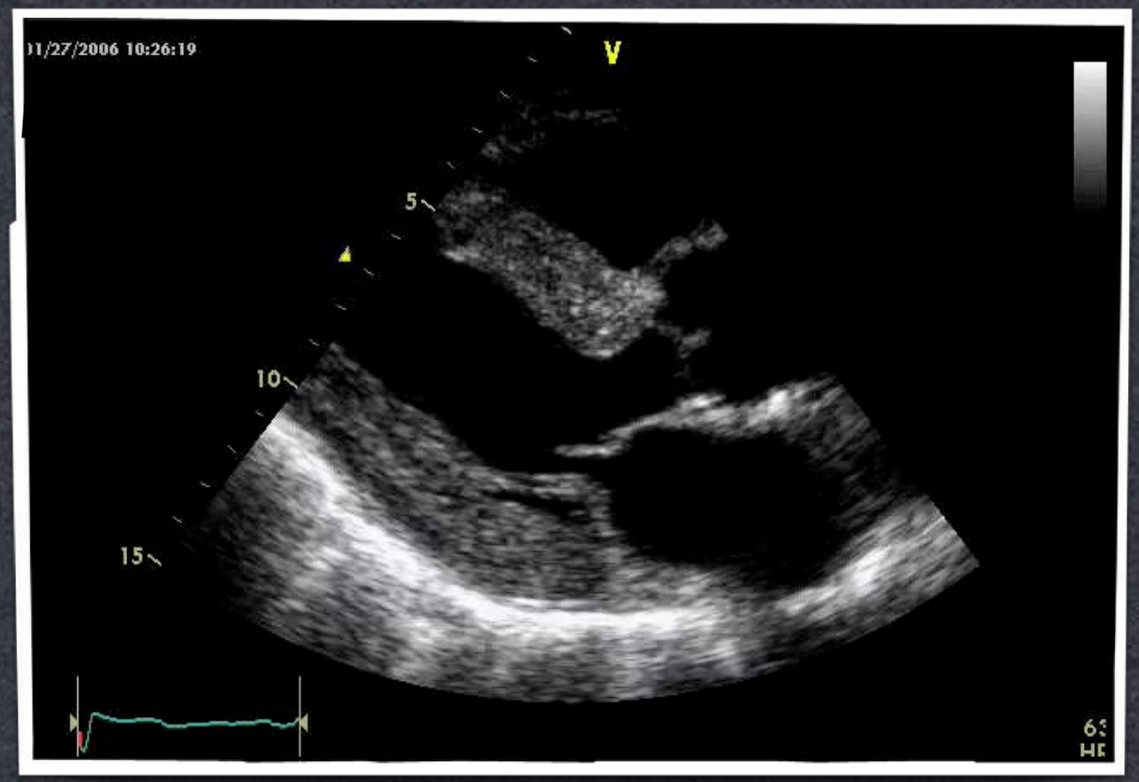


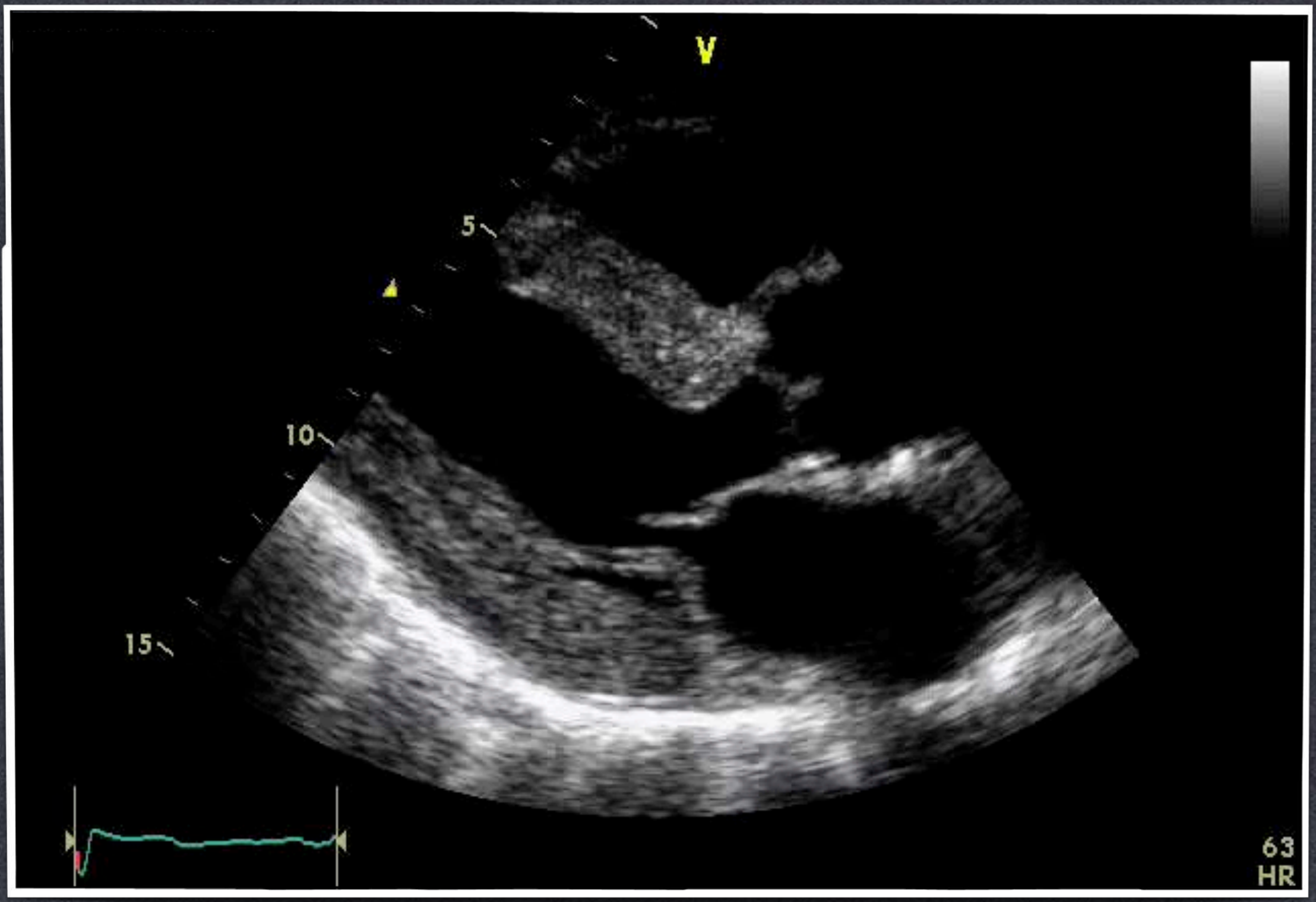
Diastology - Tips and Tricks

Christopher J Kramer RDCS FASE ACS
Aurora Cardiovascular Services
Aurora Medical Group
Milwaukee, Wisconsin

No Disclosures


AFL


HYUNDAI
9
youi
HYUNDAI
15
youi


V
5
10
15
63
HR

GUIDELINES AND STANDARDS

Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography

Sherif F. Nagueh, MD, Chair,† Christopher P. Appleton, MD,† Thierry C. Gillebert, MD,*
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GUIDELINES AND STANDARDS

Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography

cardiovascular anesthesiologists, and cardiology fellows.

Objectives:

Upon completing this activity, participants will be able to: 1. Describe the hemodynamic determinants and clinical application of mitral inflow velocities. 2. Recognize the hemodynamic determinants and clinical application of pulmonary venous flow velocities. 3. Identify the clinical application and limitations of early diastolic flow propagation velocity. 4. Assess the hemodynamic determinants and clinical application of mitral annulus tissue Doppler velocities. 5. Use echocardiographic methods to estimate left ventricular filling pressures in patients with normal and depressed EF, and to grade the severity of diastolic dysfunction.

Author Disclosures:

Thierry C. Gillebert: Research Grant – Participant in comprehensive research agreement between GE Ultrasound, Horten, Norway and Ghent University; Advisory Board – Astra-Zeneca, Merck, Sandoz.

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Conflict of interest: The authors have no conflicts of interest to disclose except as noted above.

Estimated time to complete this activity: 1 hour

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D. Inflow Patterns and Hemodynamics 111
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A. Performance and Acquisition 113
B. Clinical Application 113
C. Limitations 113
V. Pulmonary Venous Flow 113
A. Acquisition and Feasibility 113
B. Measurements 113
C. Hemodynamic Determinants 114
D. Normal Values 114
E. Clinical Application to Patients With Depressed and Normal EFs 114

From the Methodist DeBakey Heart and Vascular Center, Houston, TX (S.F.N.); Mayo Clinic Arizona, Phoenix, AZ (C.P.A.); the University of Ghent, Ghent, Belgium (T.C.G.); Eastern Piedmont University, Novara, Italy (P.N.M.); Mayo

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Volume 22, Issue 2, Pages 107-133 (February 2009)

Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of

ASE/EACVI GUIDELINES AND STANDARDS

Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging

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D. Heart Transplantation 292
E. Atrial Fibrillation 295

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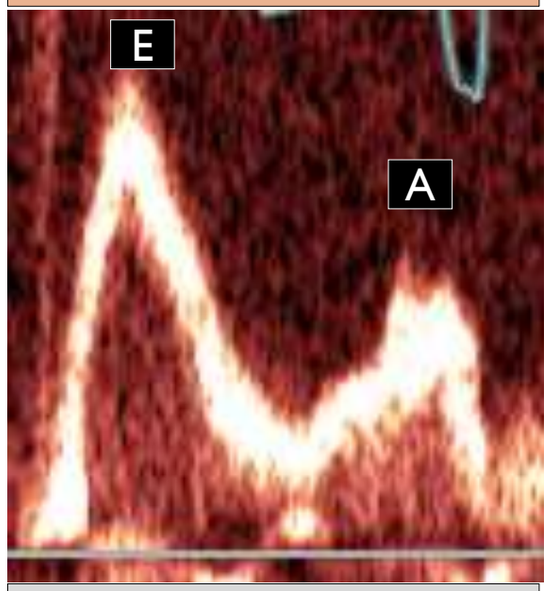
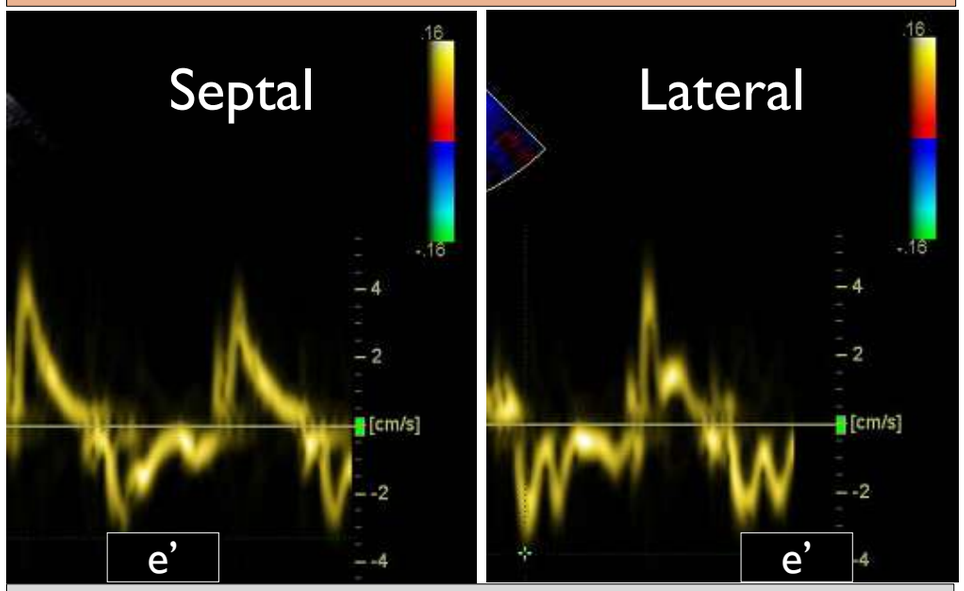
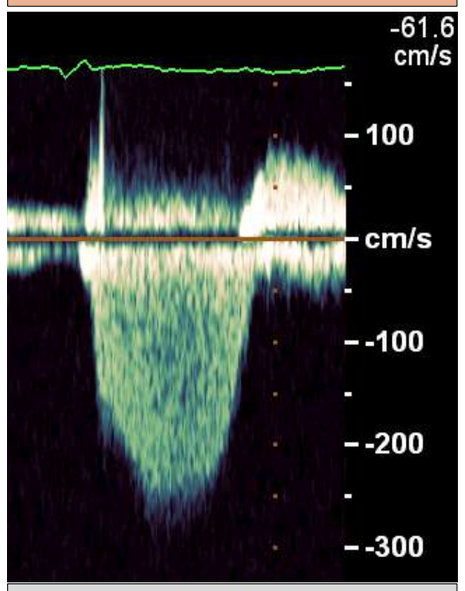
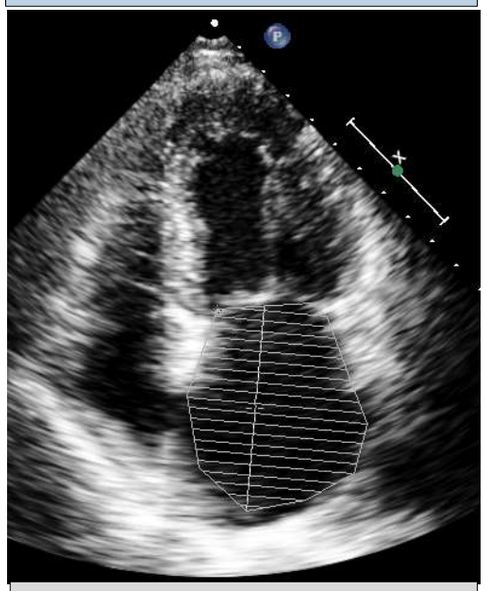
Volume 29, Issue 4, Pages 277-314. (April 2016)

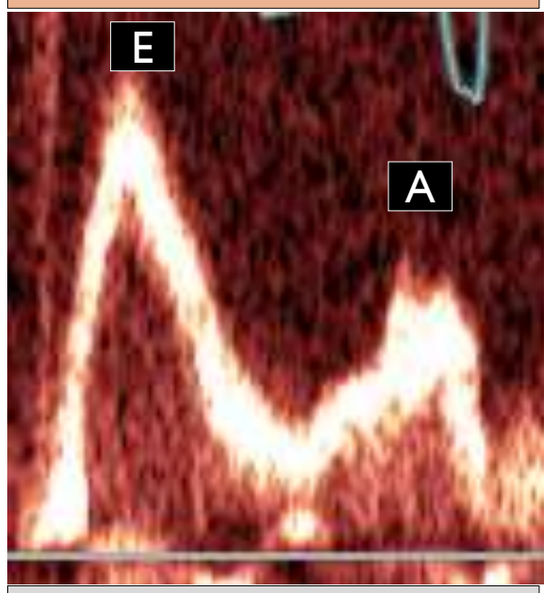
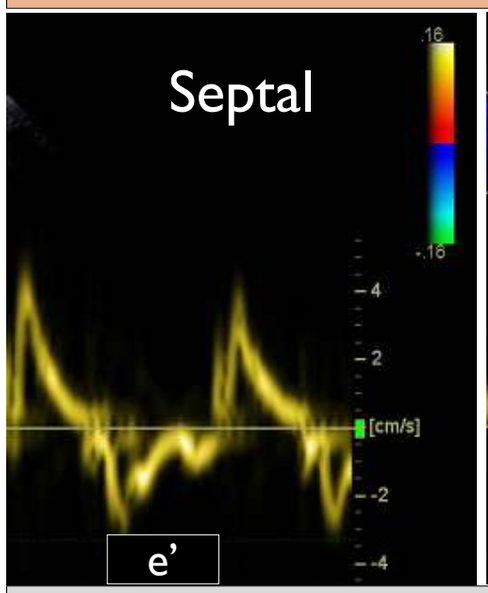
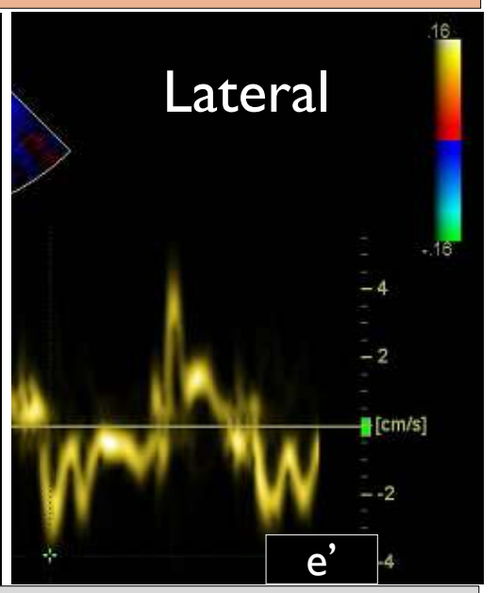
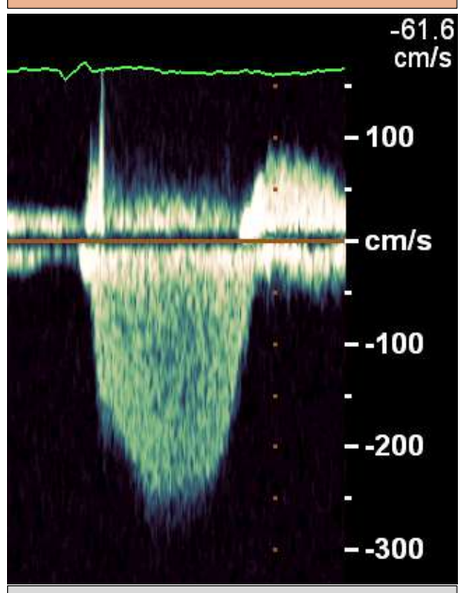
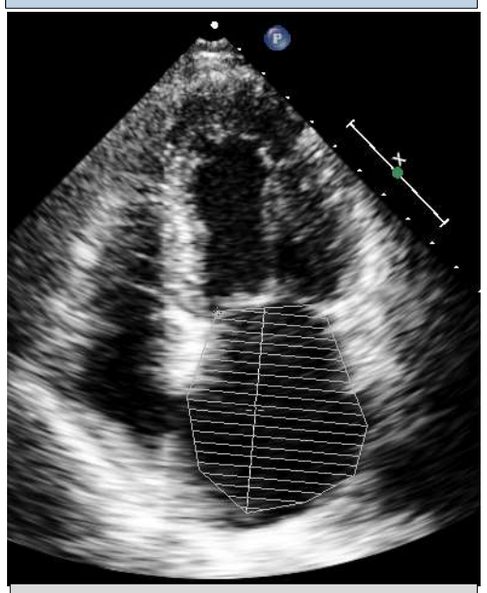
4 Key Echo Parameters for Grading Diastolic Dysfunction

1	2	3	4
			
Mitral Inflow	Mitral Tissue Doppler	TR Jet	LA Volume Index

Reflect Acute Pressure Changes ⟷ Chronic Changes

Courtesy of Dr. Muhamed Saric

4 Key Echo Parameters for Grading Diastolic Dysfunction

1	2		3	4
				
Mitral Inflow	Mitral Tissue Doppler		TR Jet	LA Volume Index
E/A ≥ 0.8	Septal e' ≥ 7 cm/s	Lateral e' ≥ 10 cm/s	Vmax < 2.8 m/s RV-RA ΔP < 32 mm Hg	LAVI < 34 mL/m^2
Normal Values				

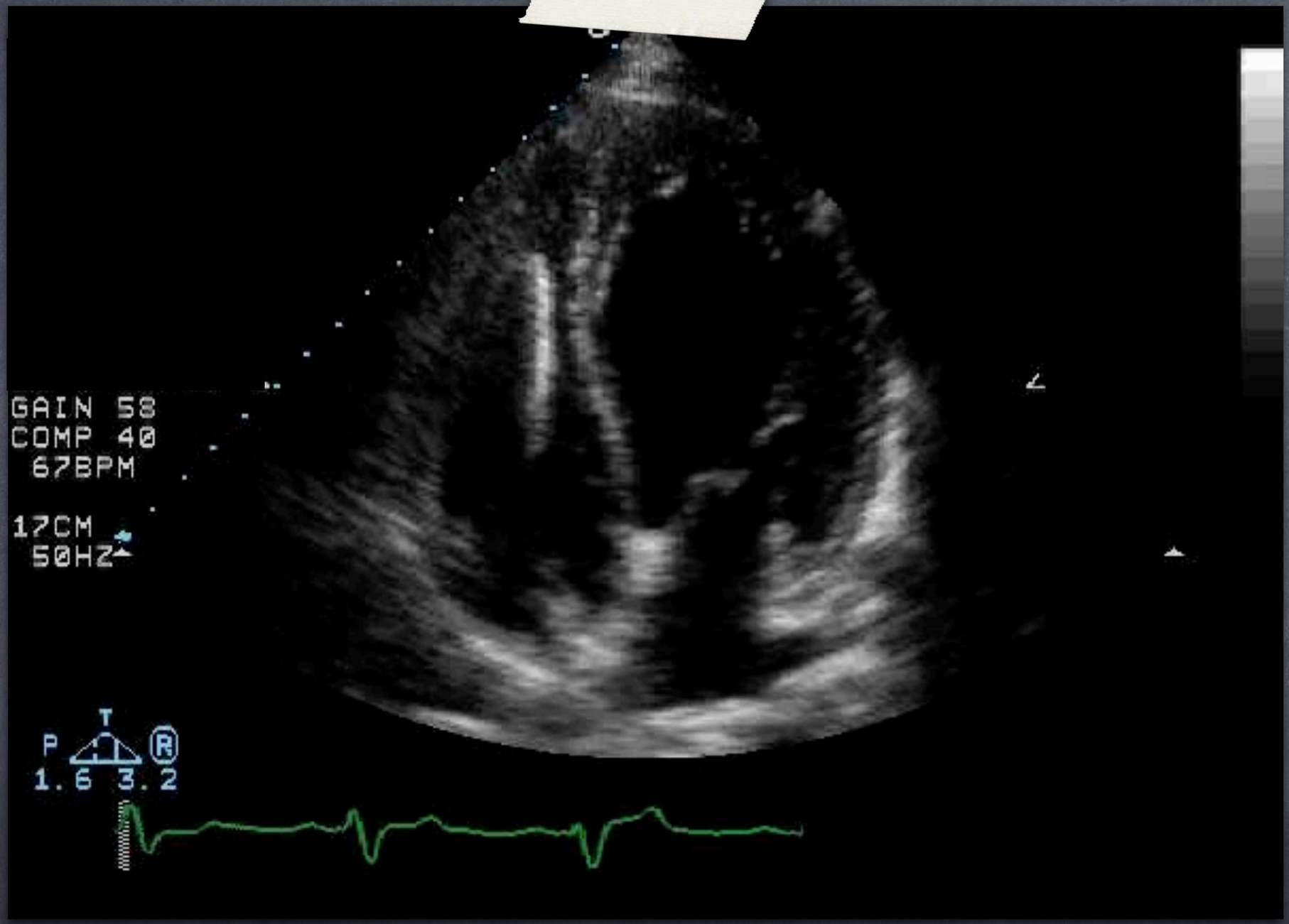
Courtesy of Dr. Muhamed Saric

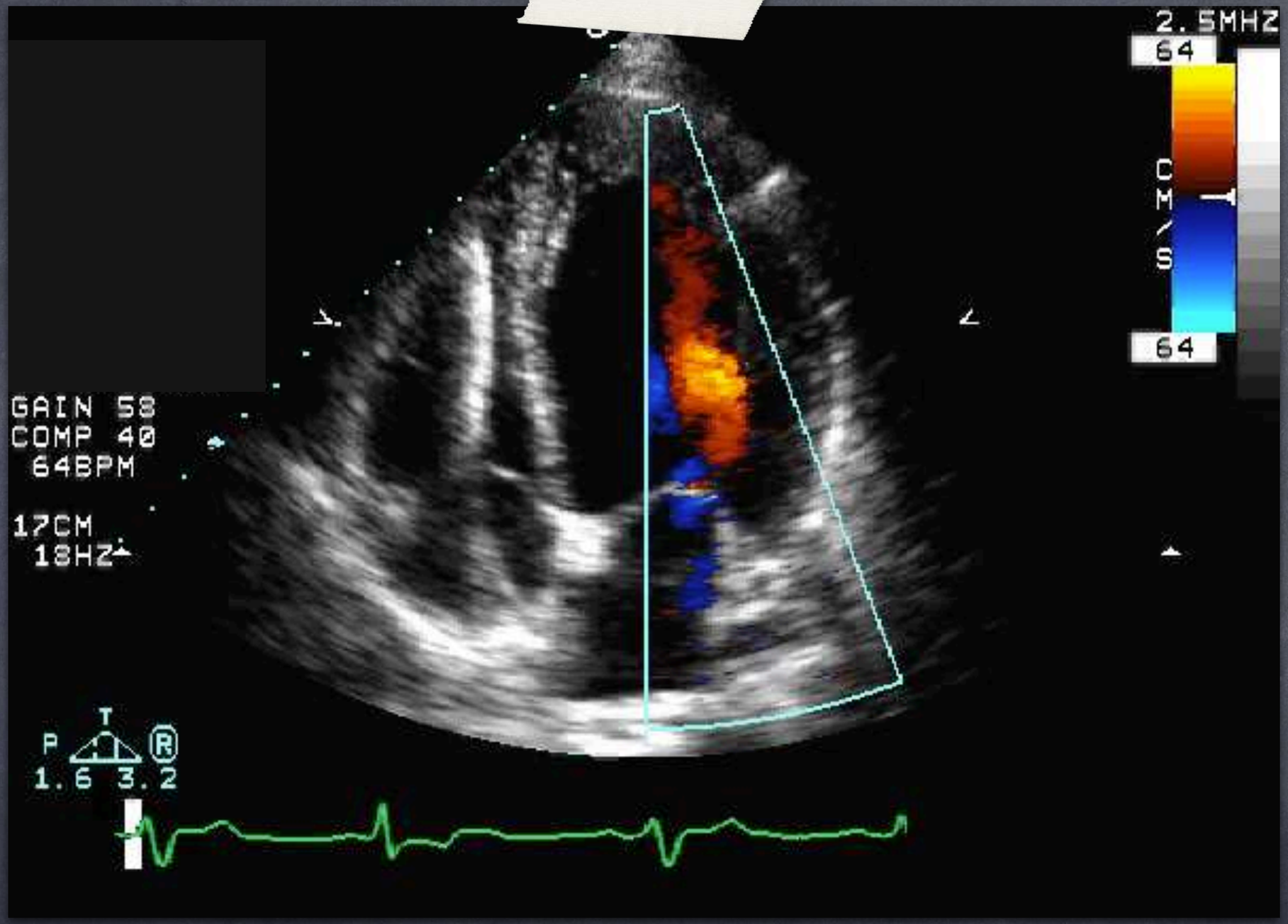
Objectives

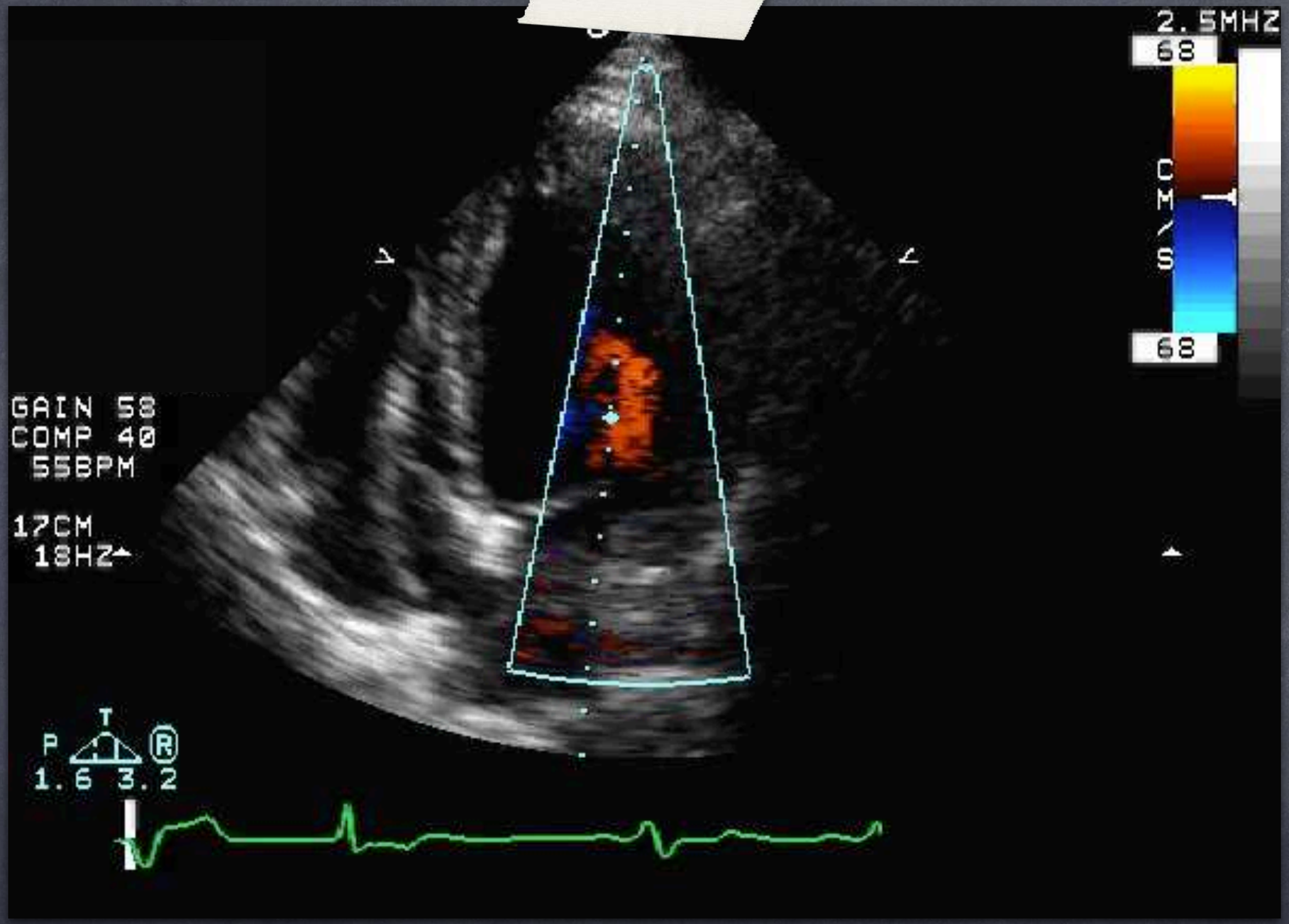
- Correct E/A ratio measurement
- Correct e’ measurement, E/e’ ratio
- Correct calculation of LA volume index
- Correct TR velocity

Mitral Valve Inflow

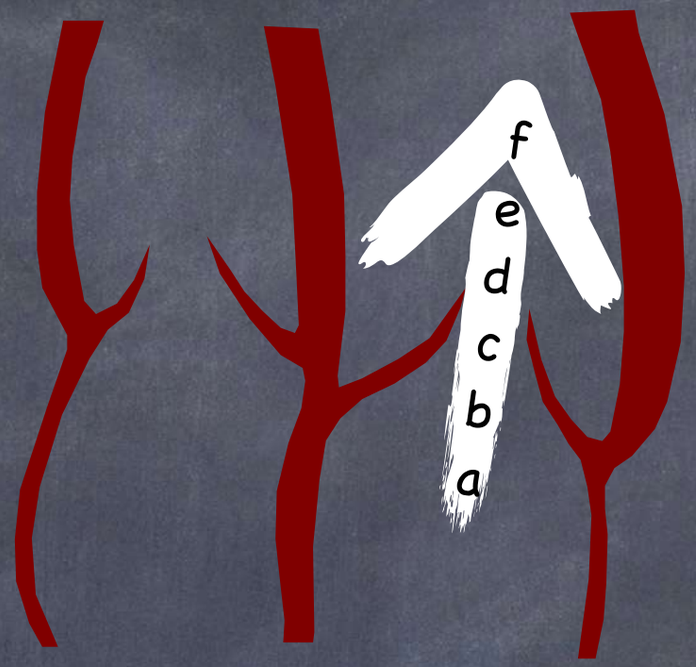
- Apical 4-chamber view
- Cursor parallel to blood flow
- Pulsed wave Doppler
- Sample size 0.5-1.5 mm (machine dependent)
- Place sample volume (SV) at mitral leaflet tips
- Optimize scale & baseline
- Minimize filter & gain

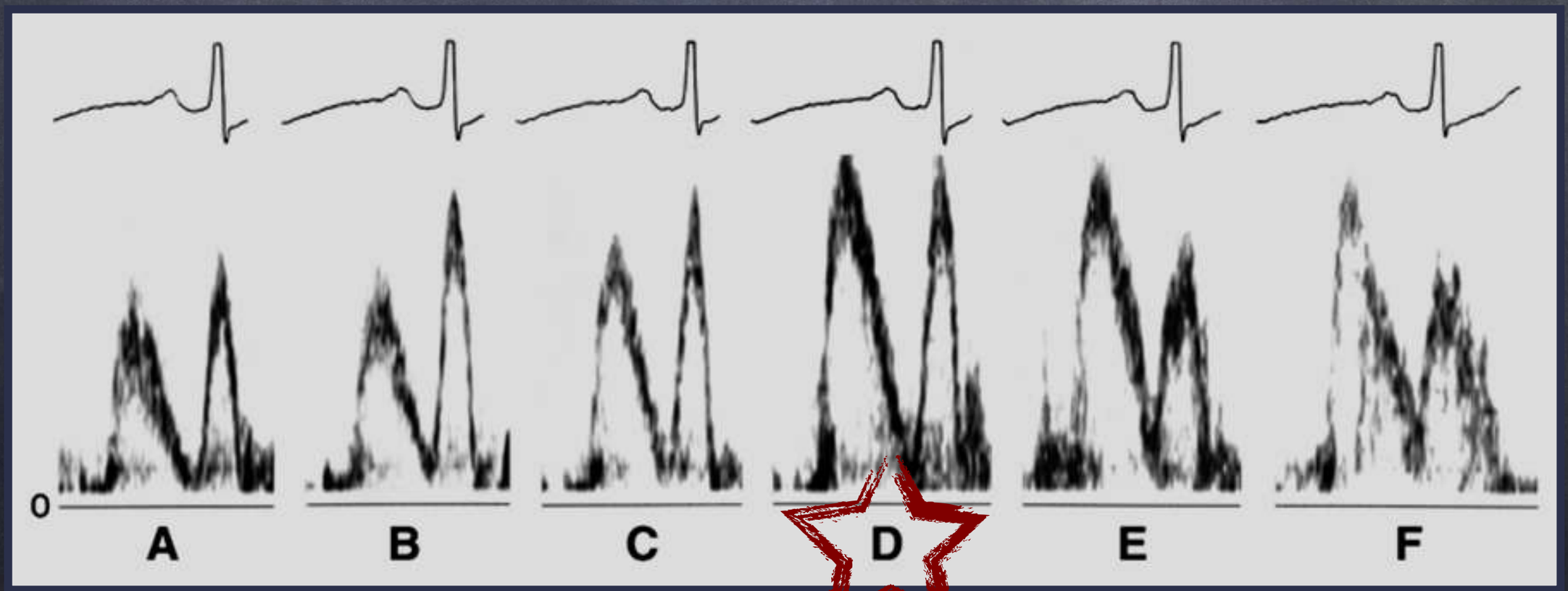

GAIN 58
COMP 40
67BPM
17CM
50HZ
T
P
R
1.6 3.2


2.5MHZ
64
CM/S
64
GAIN 58
COMP 40
64BPM
17CM
18HZ
T
P
R
1.6 3.2

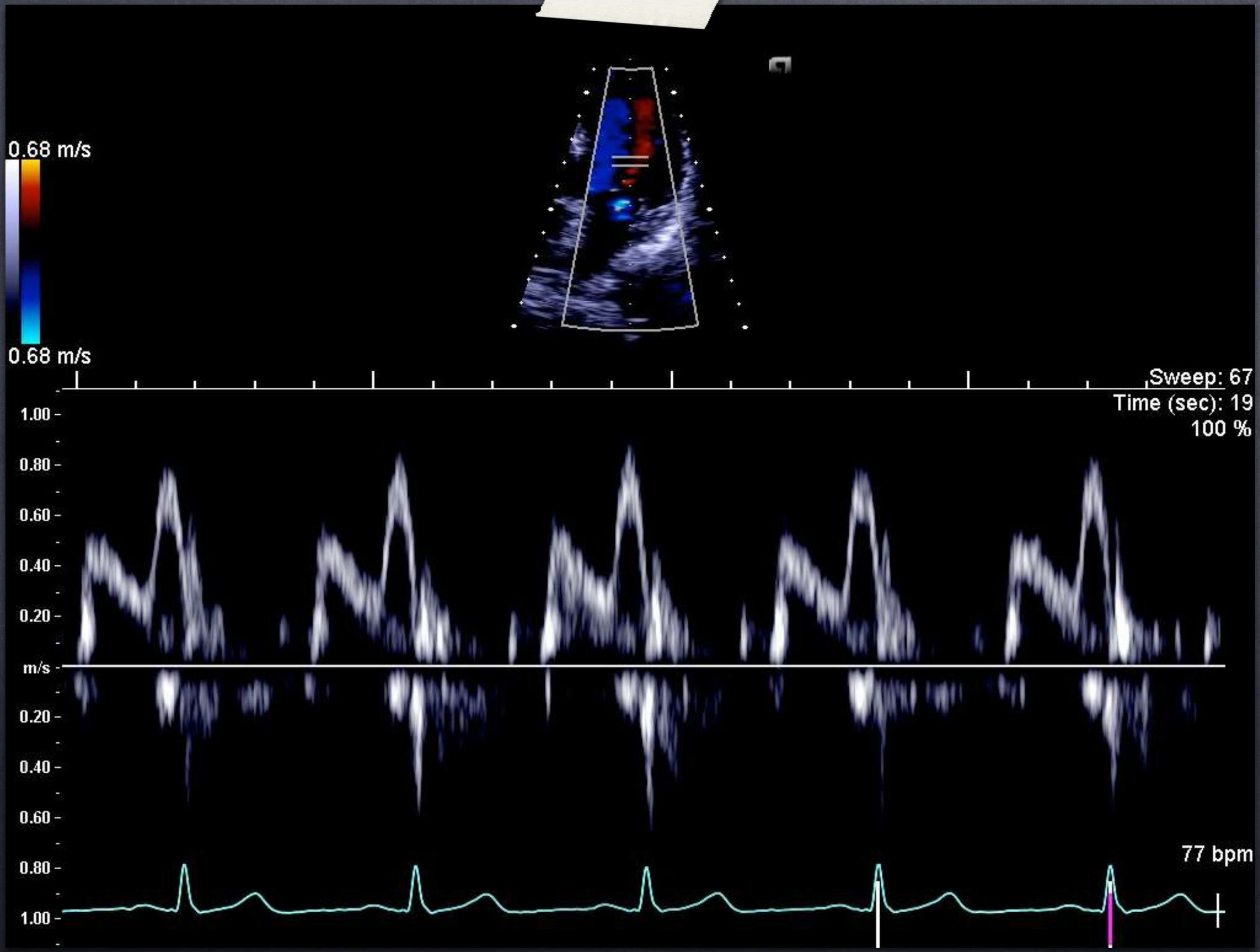

2.5MHZ
68
CM/S
68
GAIN 58
COMP 40
55BPM
17CM
18HZ
T
P
R
1.6
3.2

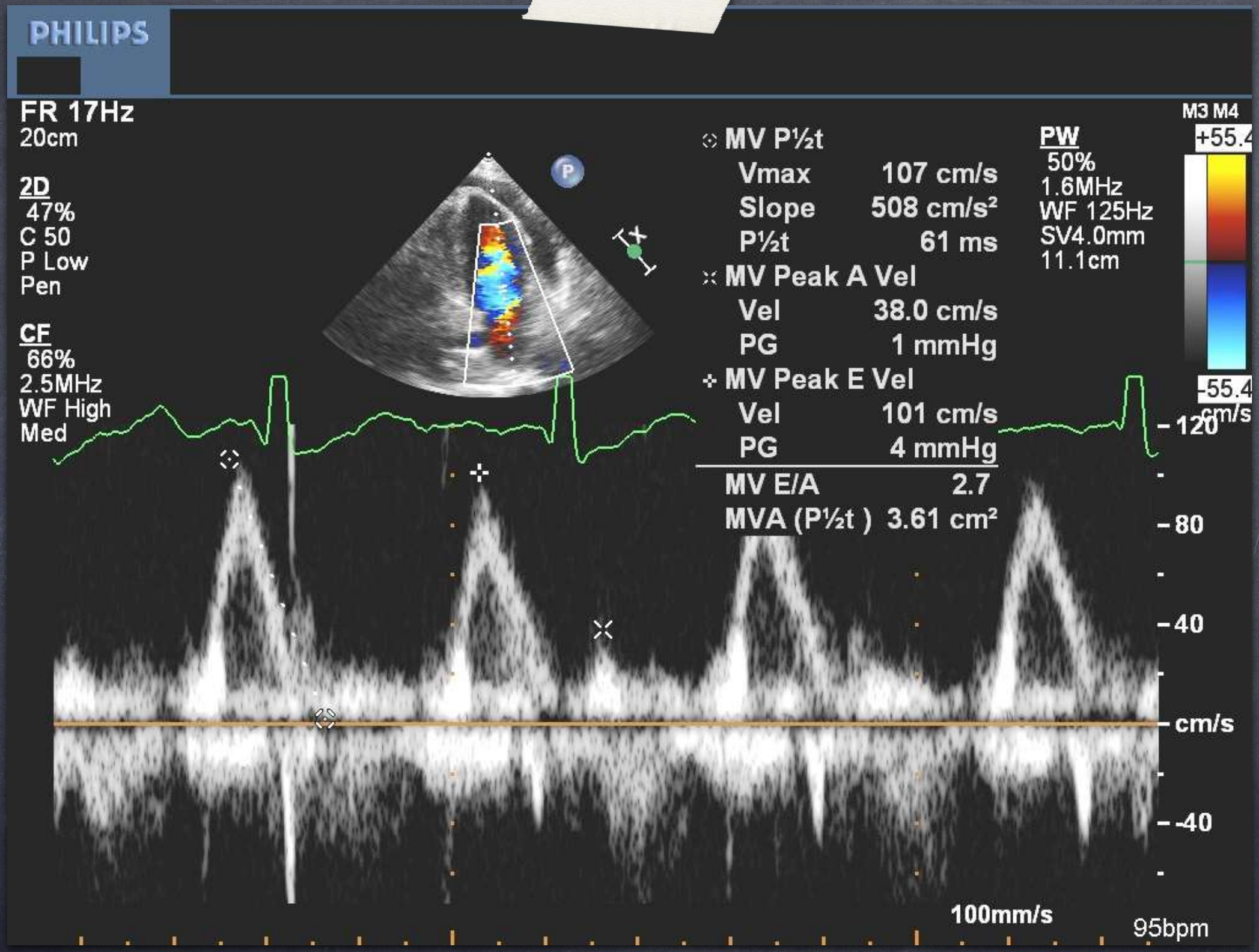
Mitral Valve Inflow





Adapted from: Appleton et al. JASE 1997; 10 (3): 280

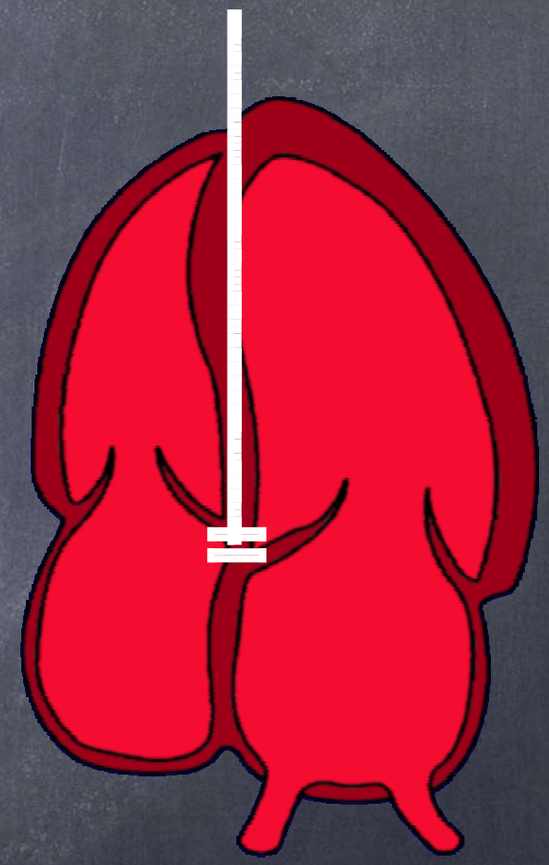

0.68 m/s
0.68 m/s
Sweep: 67
Time (sec): 19
100 %
1.00
0.80
0.60
0.40
0.20
m/s
0.20
0.40
0.60
0.80
1.00
77 bpm


PHILIPS
FR 17Hz
20cm
2D
47%
C 50
P Low
Pen
CF
66%
2.5MHz
WF High
Med
MV P½t
Vmax 107 cm/s
Slope 508 cm/s²
P½t 61 ms
MV Peak A Vel
Vel 38.0 cm/s
PG 1 mmHg
MV Peak E Vel
Vel 101 cm/s
PG 4 mmHg
MV E/A 2.7
MVA (P½t) 3.61 cm²
PW
50%
1.6MHz
WF 125Hz
SV4.0mm
11.1cm
M3 M4
+55.4
-55.4
cm/s
120
80
40
cm/s
-40
100mm/s
95bpm

MV inflow...

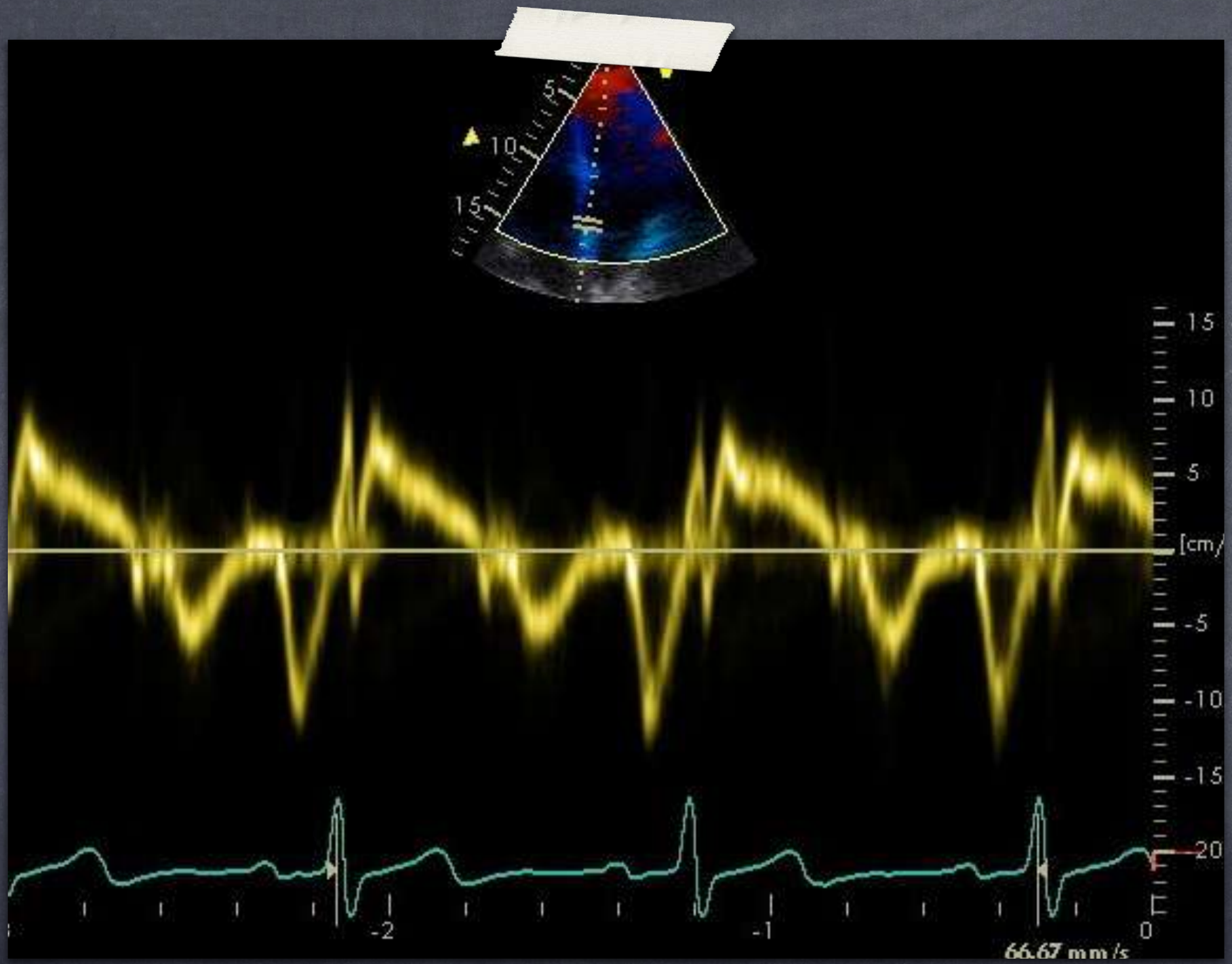
Tissue Doppler

- Apical 4-chamber view
- Cursor parallel to mitral annular motion
- Place SV at mitral annulus

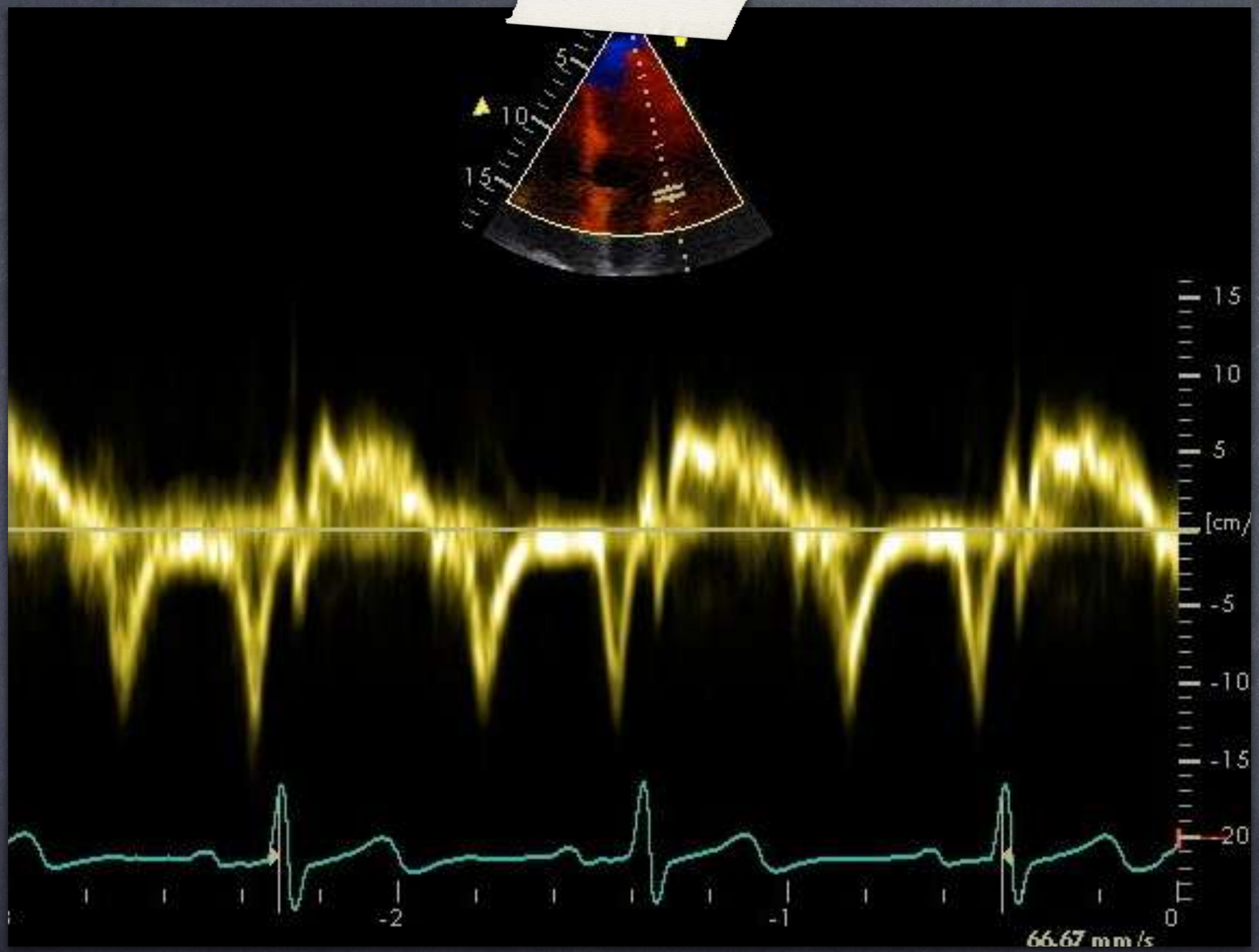


Tissue Doppler Imaging

- Pulsed wave Doppler
- Decrease Doppler scale
- Decrease power, filter & gain
- Increase reject & compress



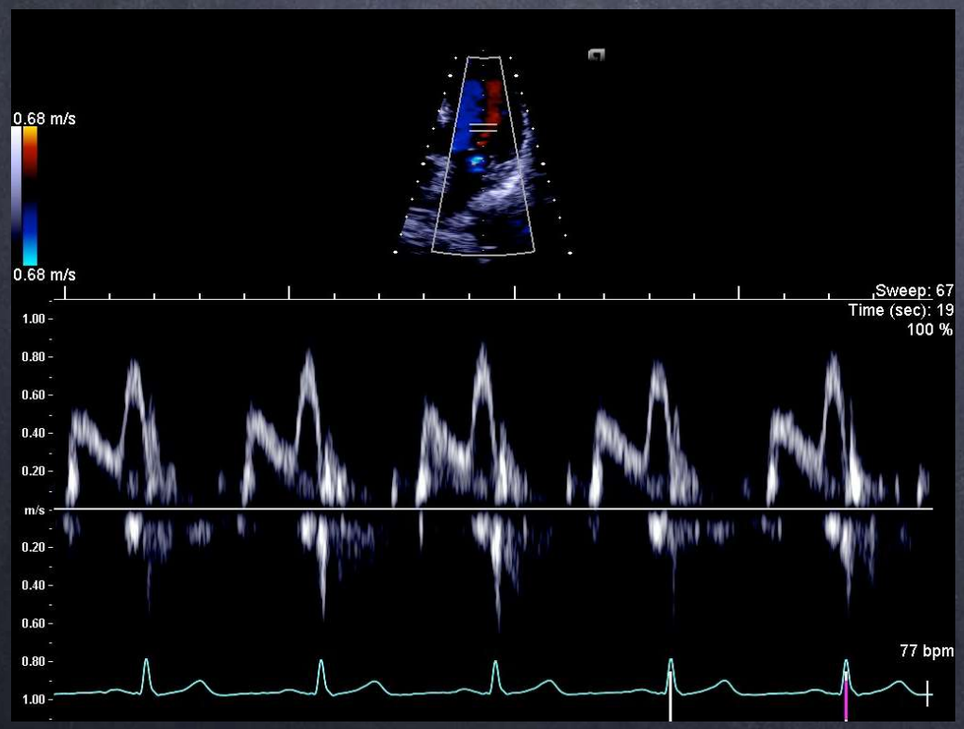
Medial e′

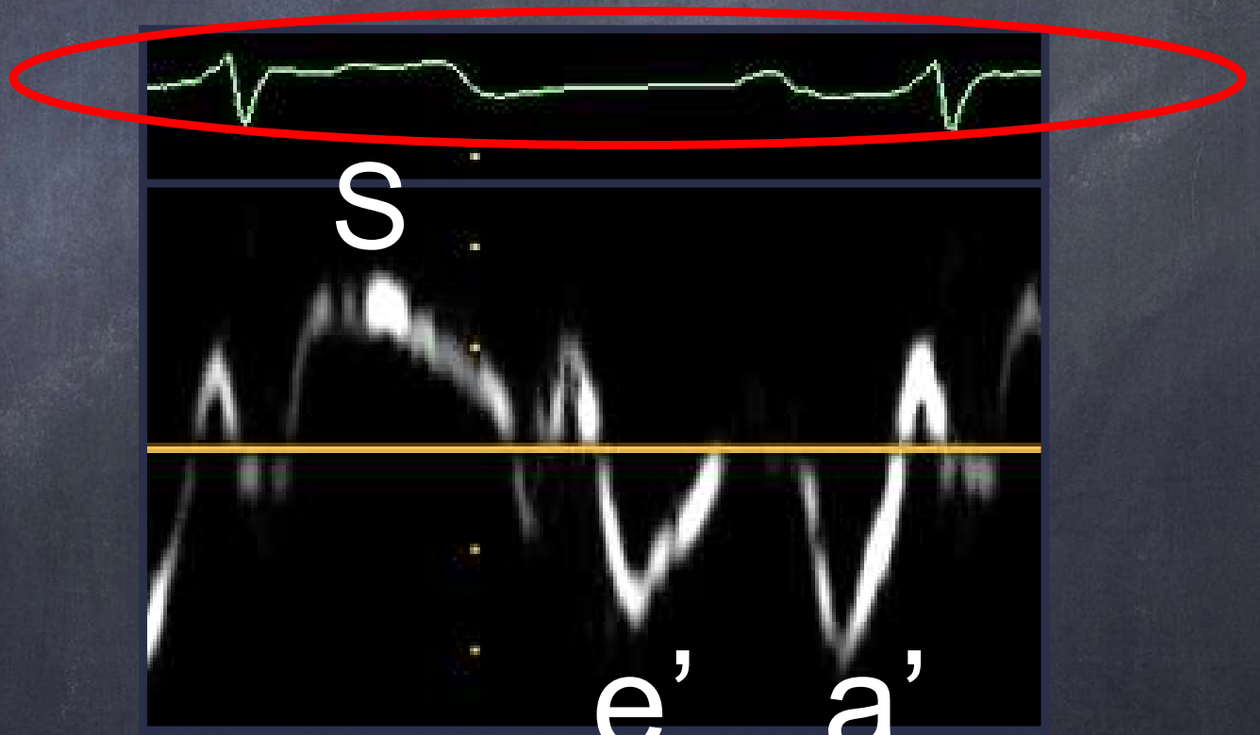


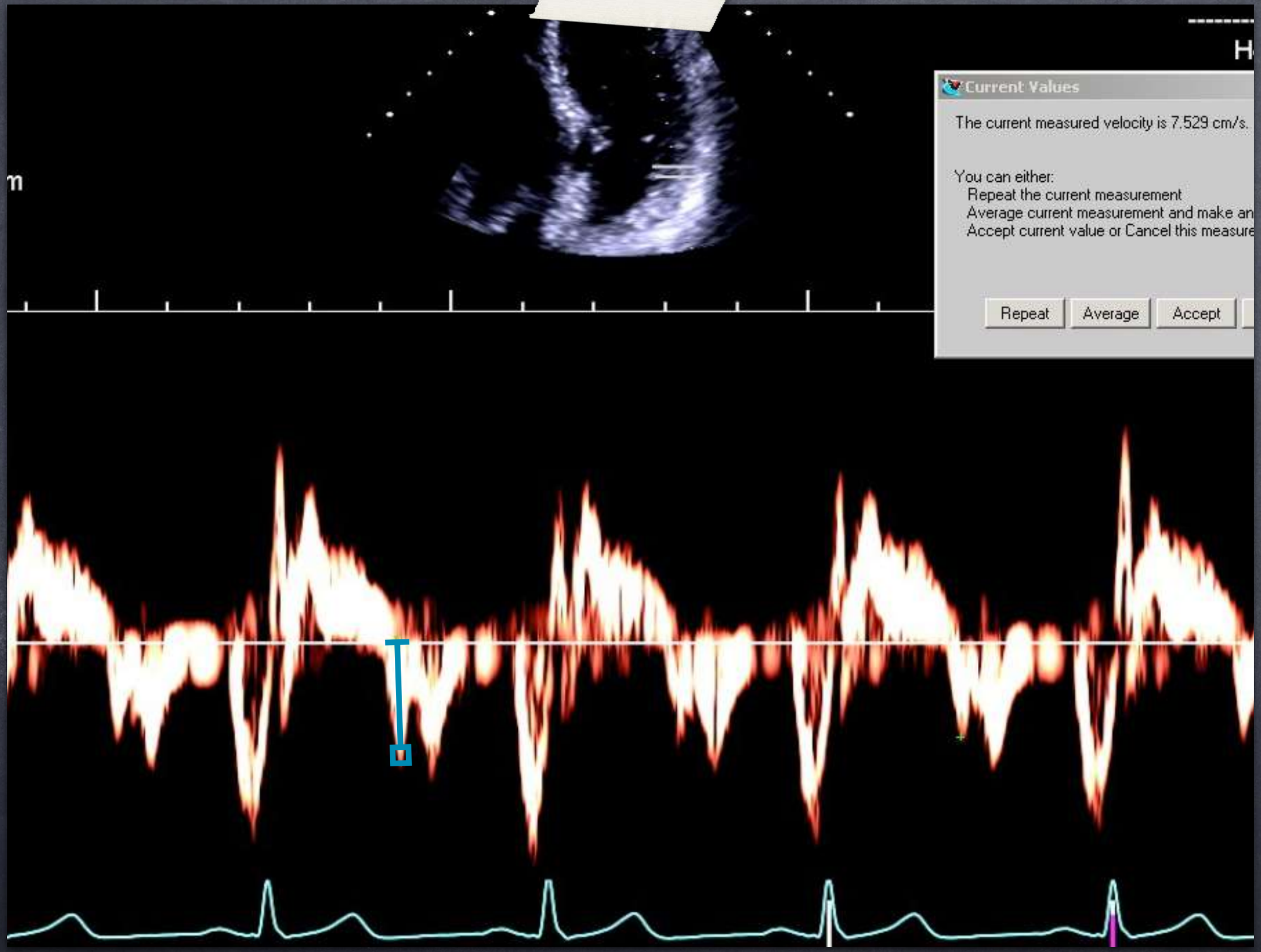
Lateral e’

Tissue Doppler Imaging

- Mitral annular e' velocity (m/sec)
- Mitral annular a' velocity (m/sec)

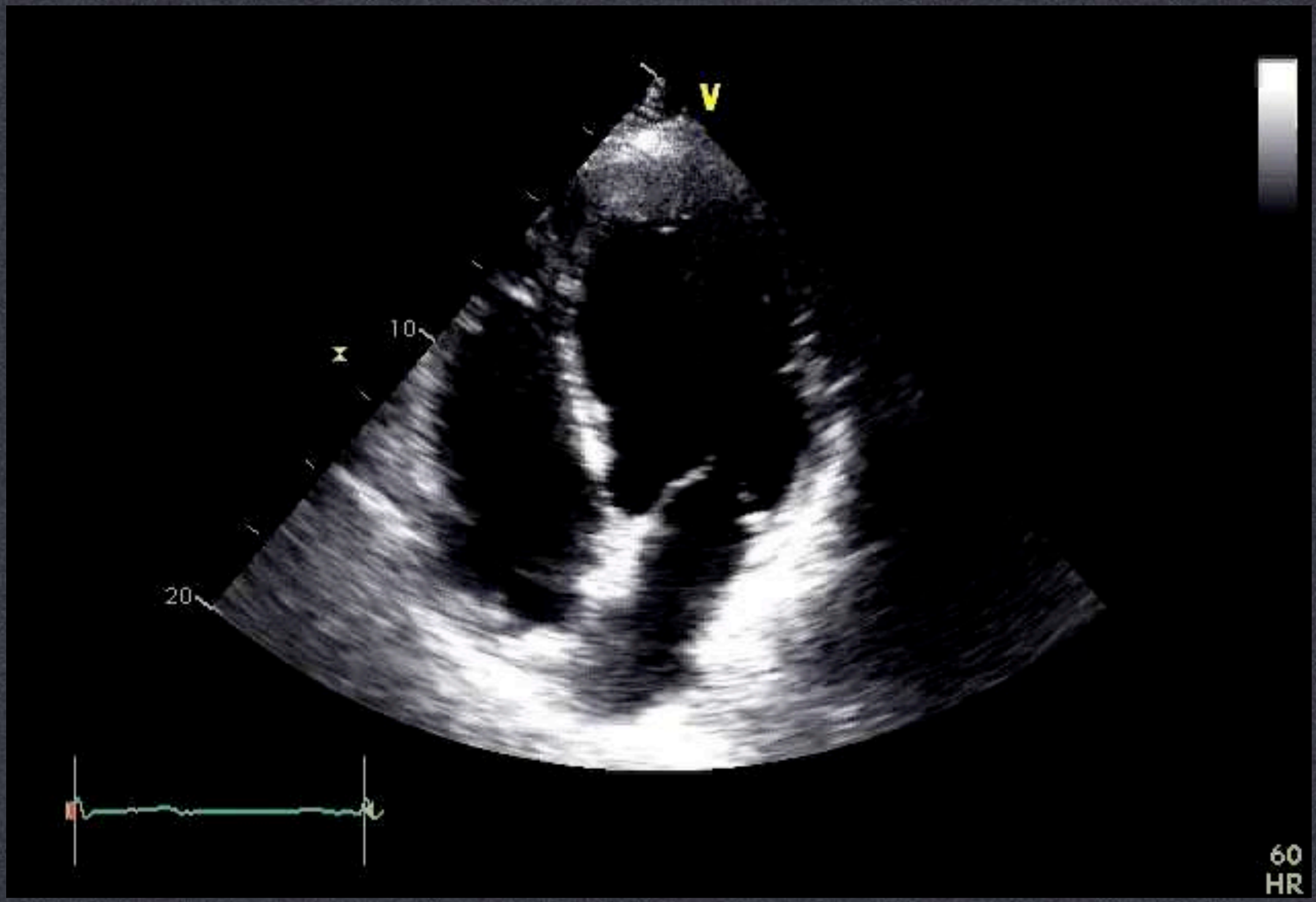




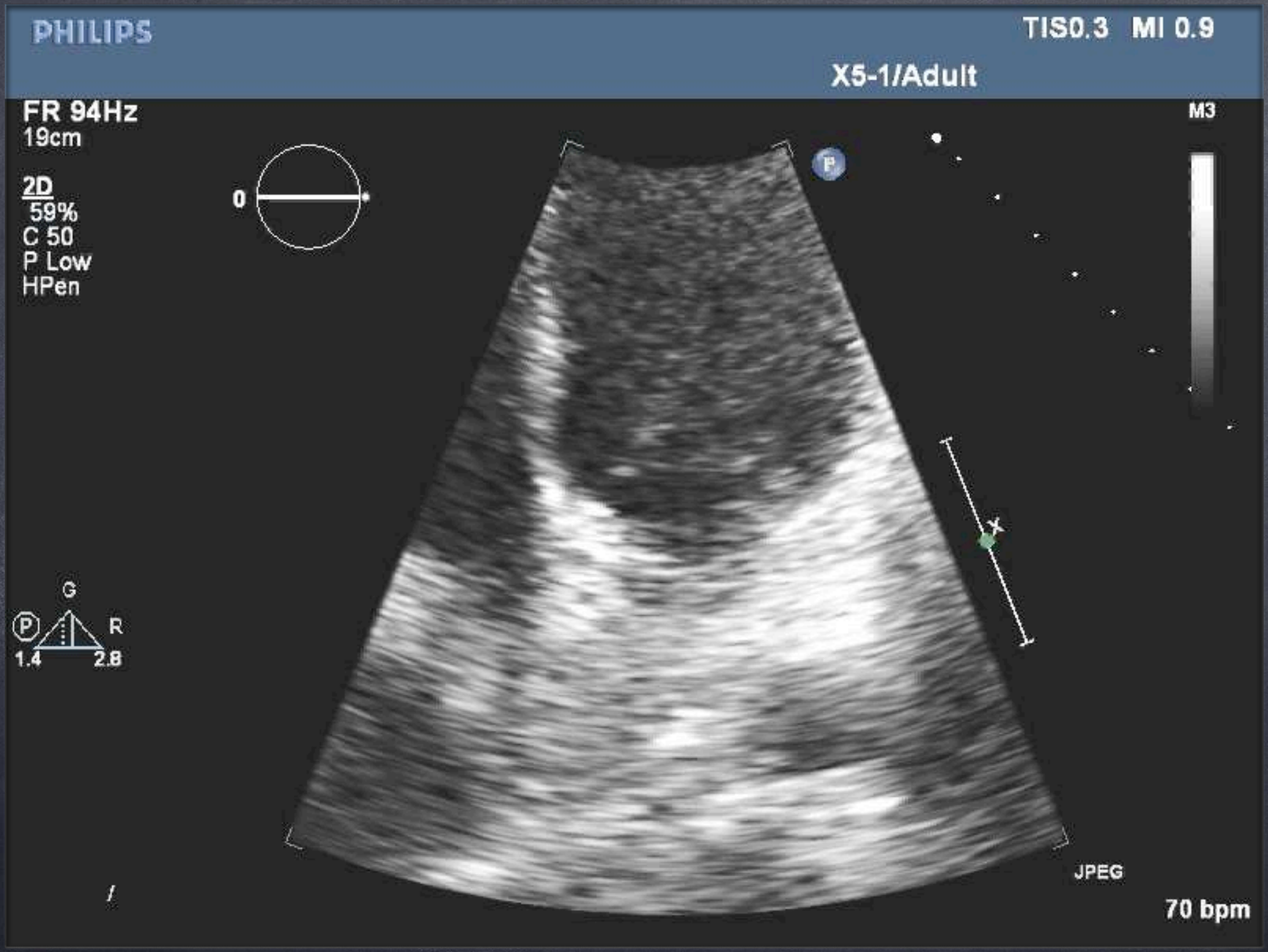

Current Values
The current measured velocity is 7.529 cm/s.
You can either:
Repeat the current measurement
Average current measurement and make an
Accept current value or Cancel this measure
Repeat
Average
Accept

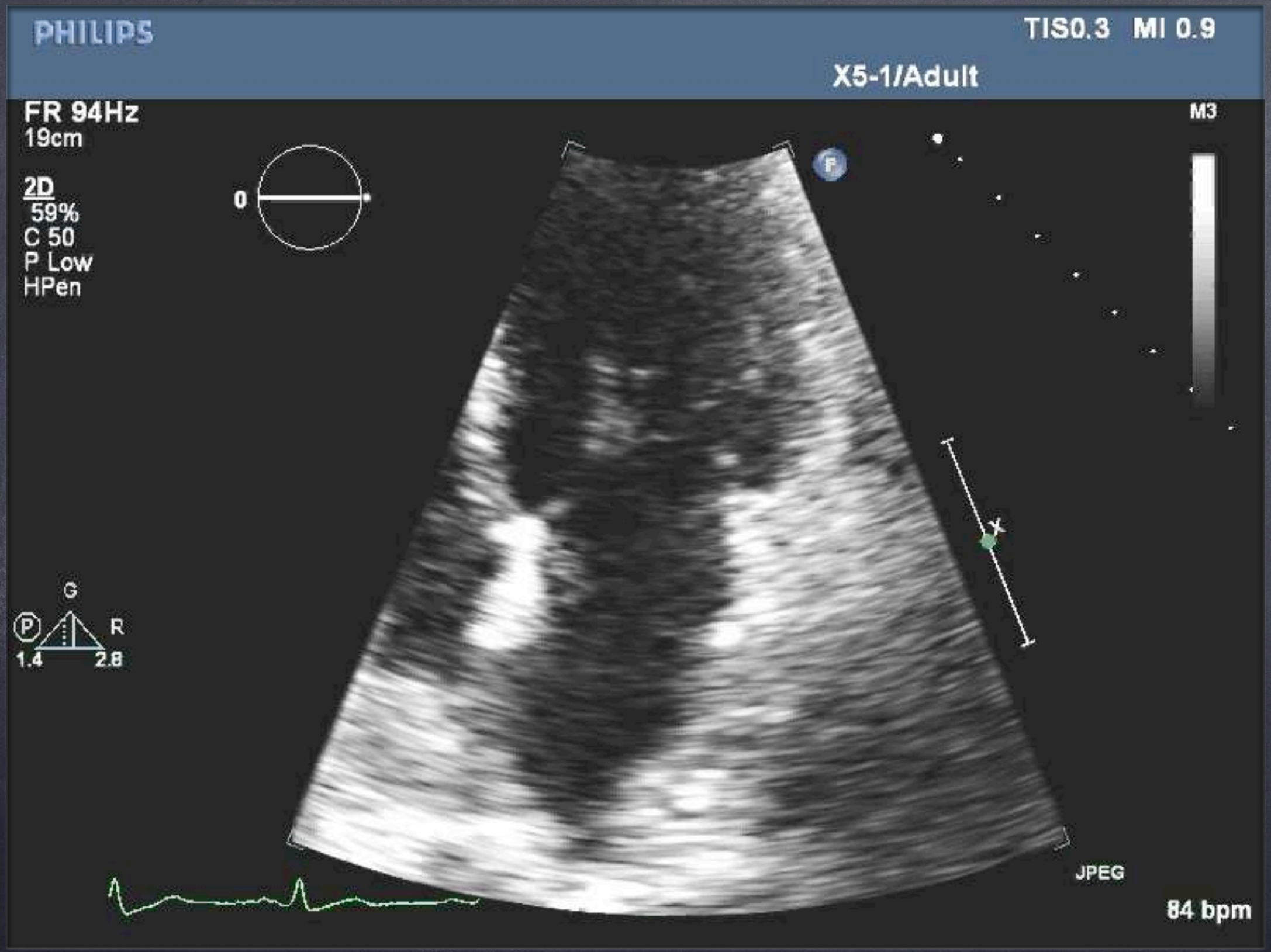
LA Measurement

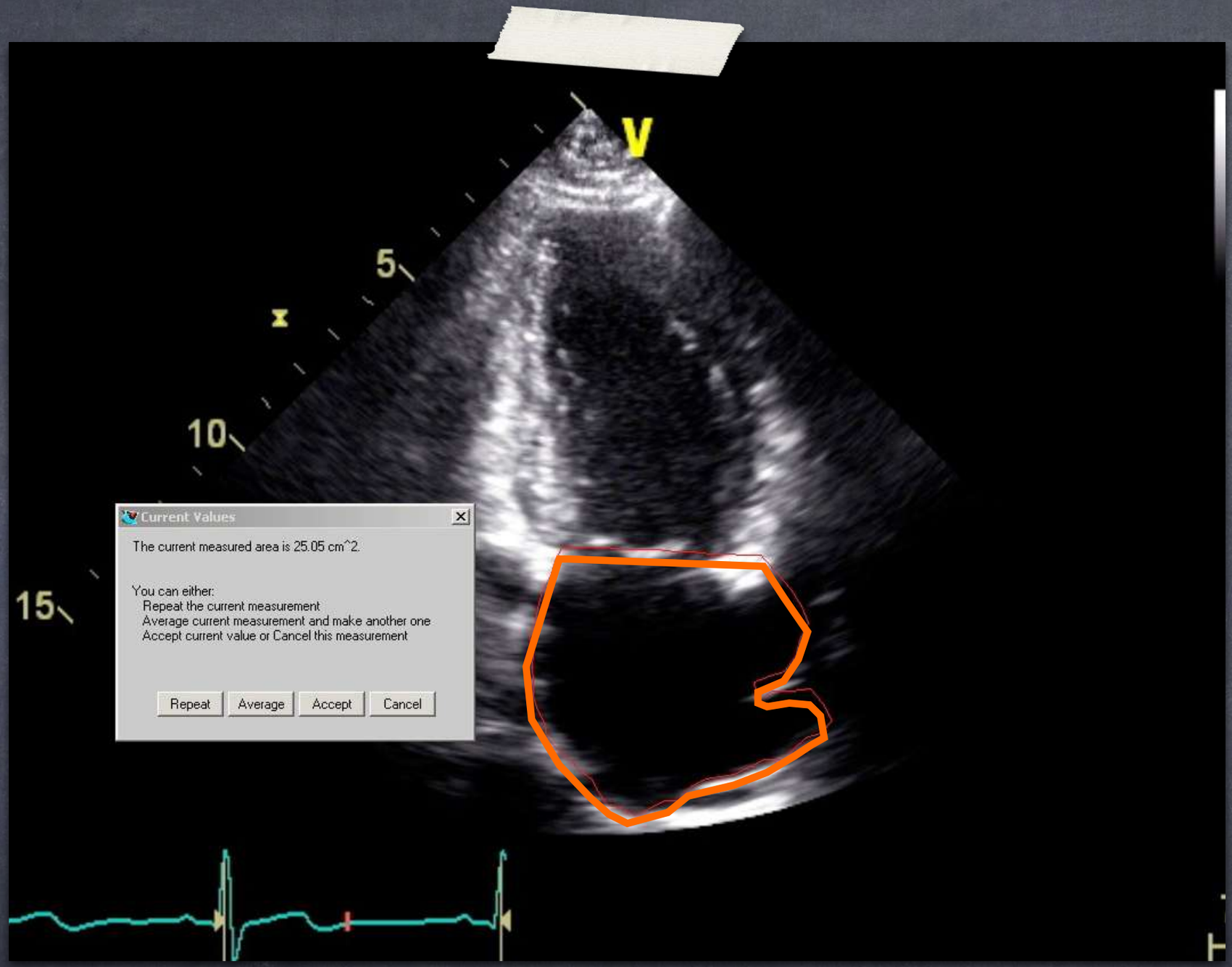
- Apical 4-chamber & 2- chamber
- Apical long axis
- Ensure atrial elongation
- Locate frame prior to MV opening (end systole)
- Measure left atrial area
- Measure left atrial length
- Index the LA volume to the body surface area



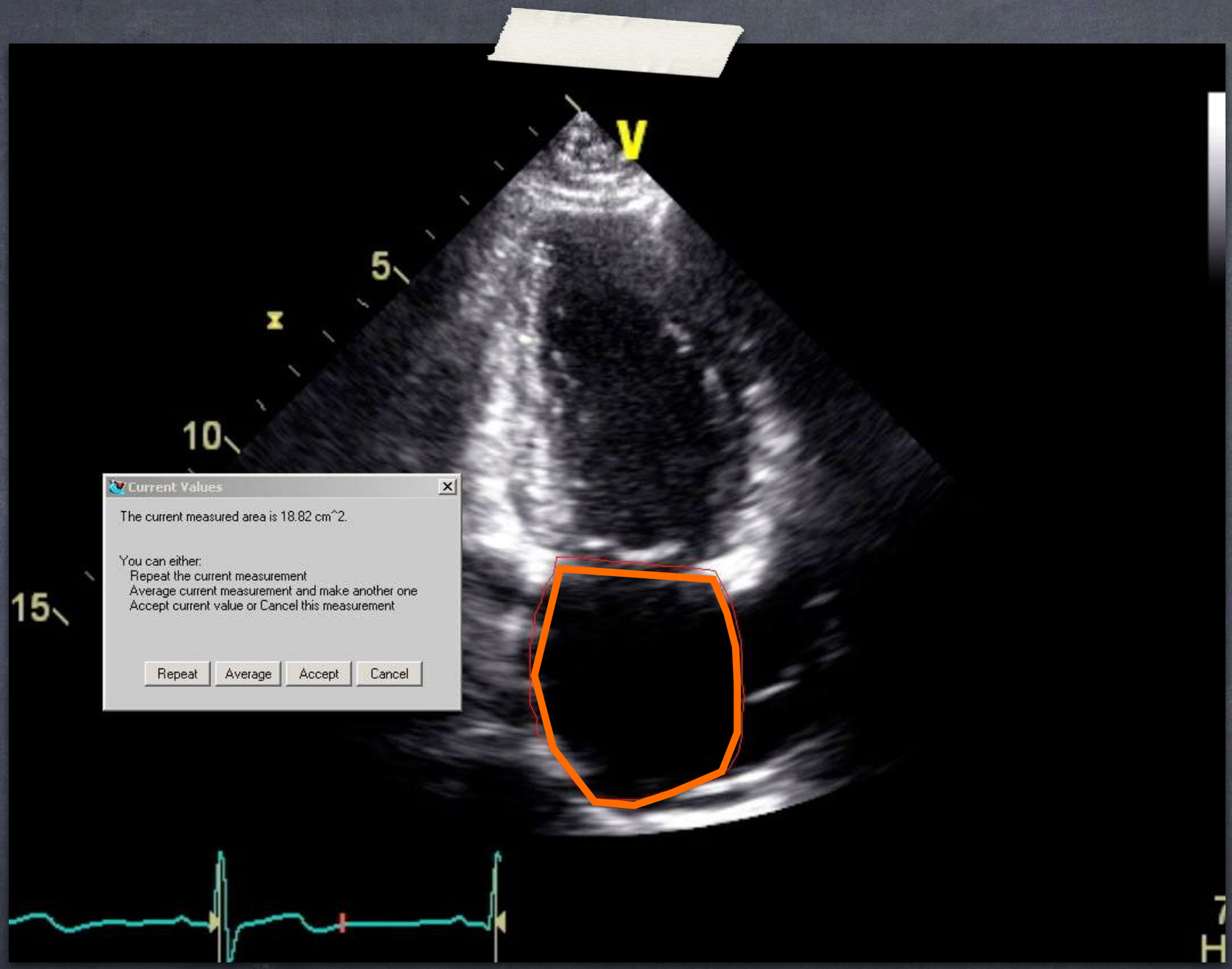
NOTE: DO NOT FORESHORTEN!!


PHILIPS
TIS0.3 MI 0.9
X5-1/Adult
FR 94Hz
19cm
2D
59%
C 50
P Low
HPen
0
M3
P
X
G
R
1.4
2.8
JPEG
70 bpm


PHILIPS
TIS0.3 MI 0.9
X5-1/Adult
FR 94Hz
19cm
2D
59%
C 50
P Low
HPen
0
M3
F
X
G
P
R
1.4
2.8
JPEG
84 bpm

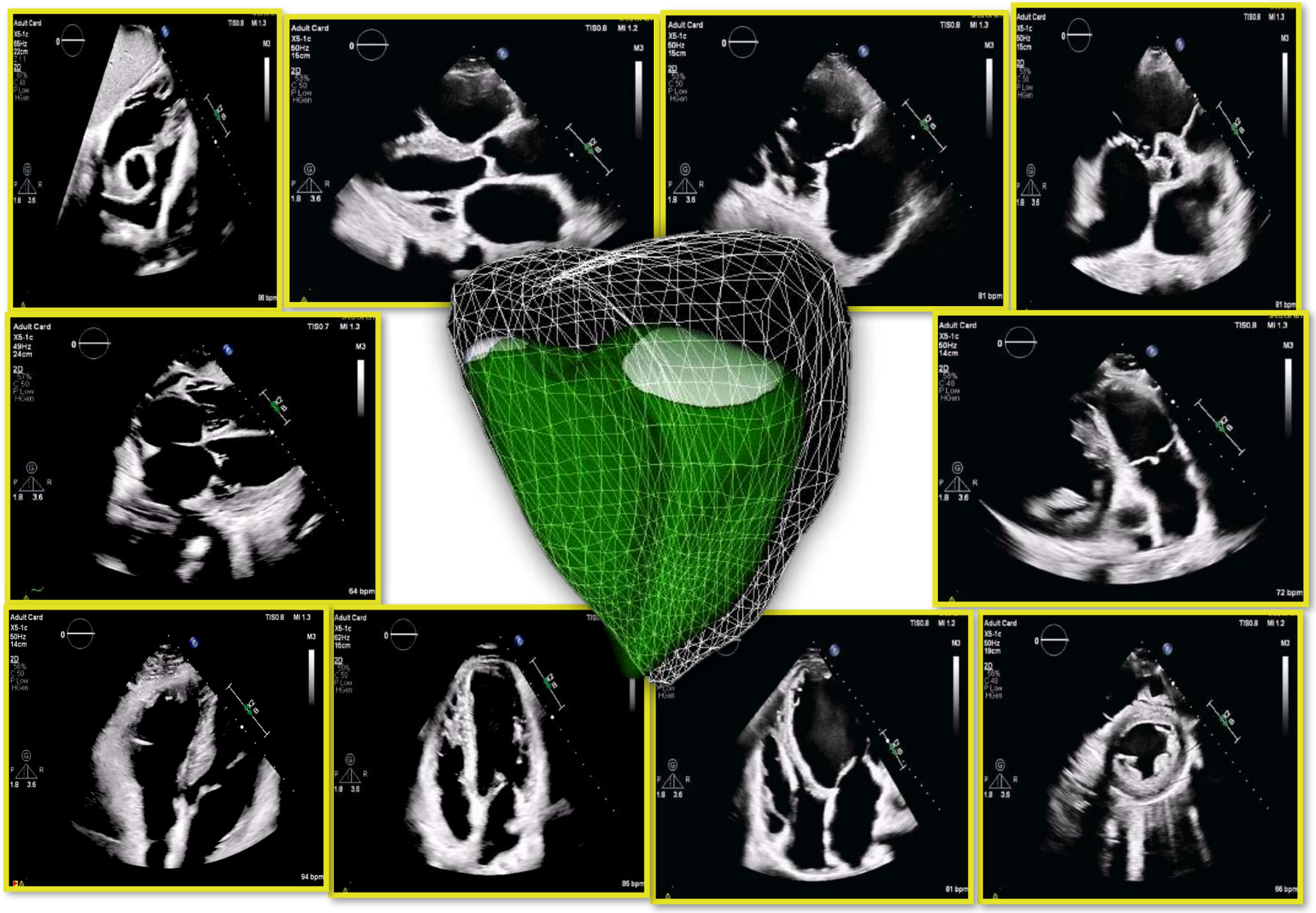

5
10
15
Current Values
The current measured area is 25.05 cm^2.
You can either:
Repeat the current measurement
Average current measurement and make another one
Accept current value or Cancel this measurement
Repeat
Average
Accept
Cancel

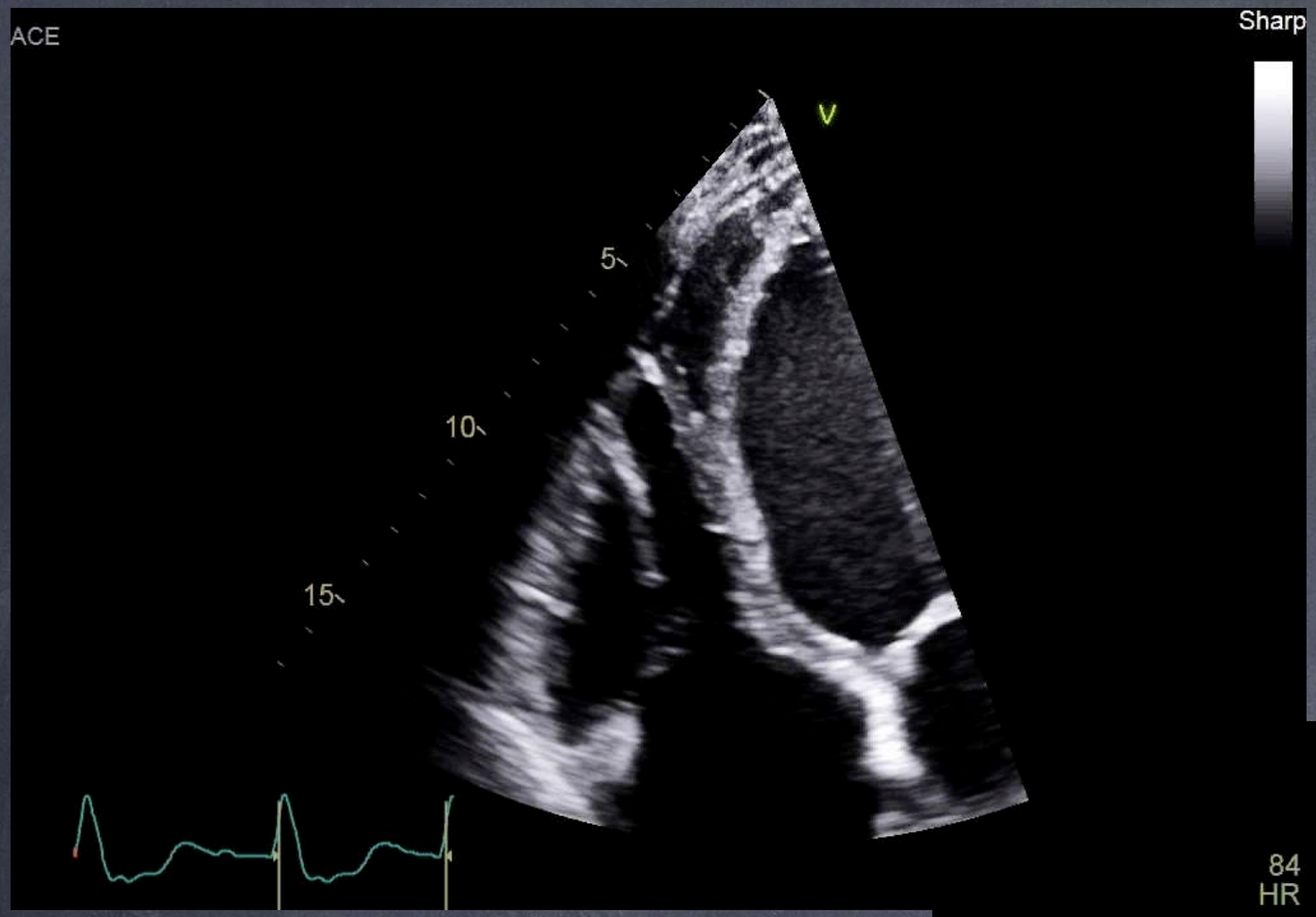
Right/Wrong

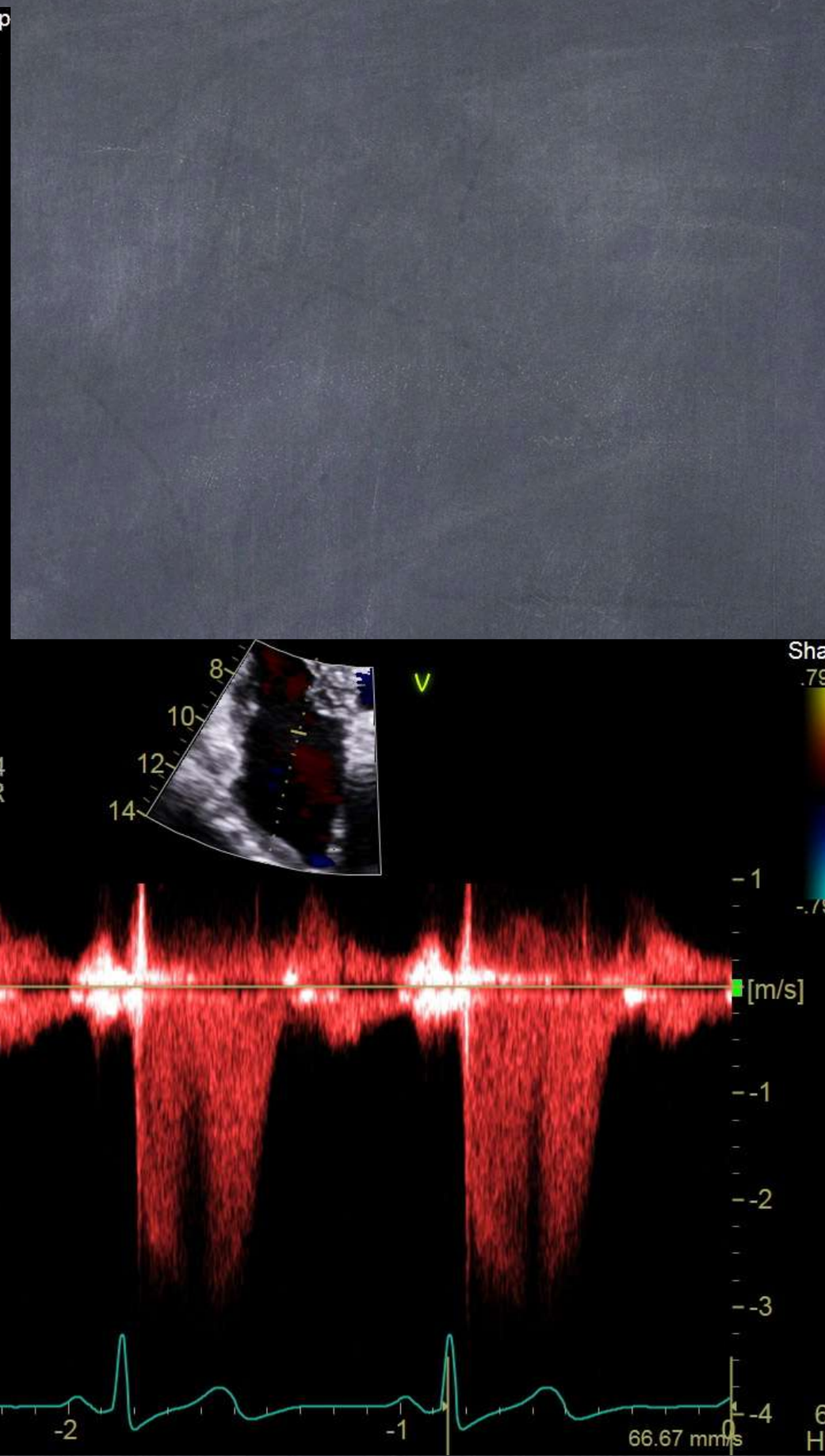

V
5
10
15
Current Values
The current measured area is 18.82 cm^2.
You can either:
Repeat the current measurement
Average current measurement and make another one
Accept current value or Cancel this measurement
Repeat
Average
Accept
Cancel

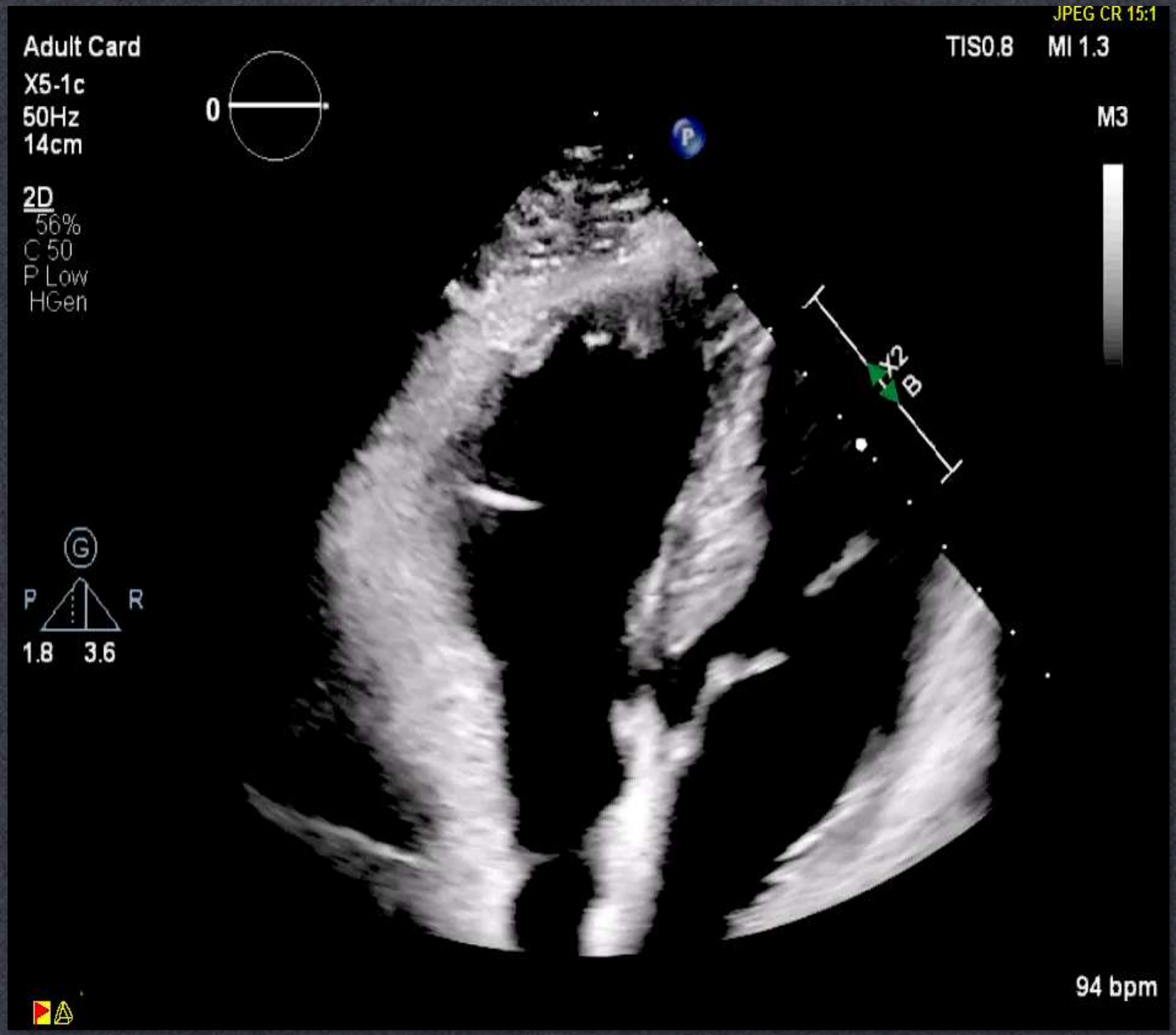
Right/Wrong

Comprehensive RV Assessment




ACE
Sharp
V
5
10
15


Sharp
.79
-.79
V
8
10
12
14
84
HR
1
[m/s]
-1
-2
-3
-4
-3
-2
-1
0
66.67 mm/s
61
HR

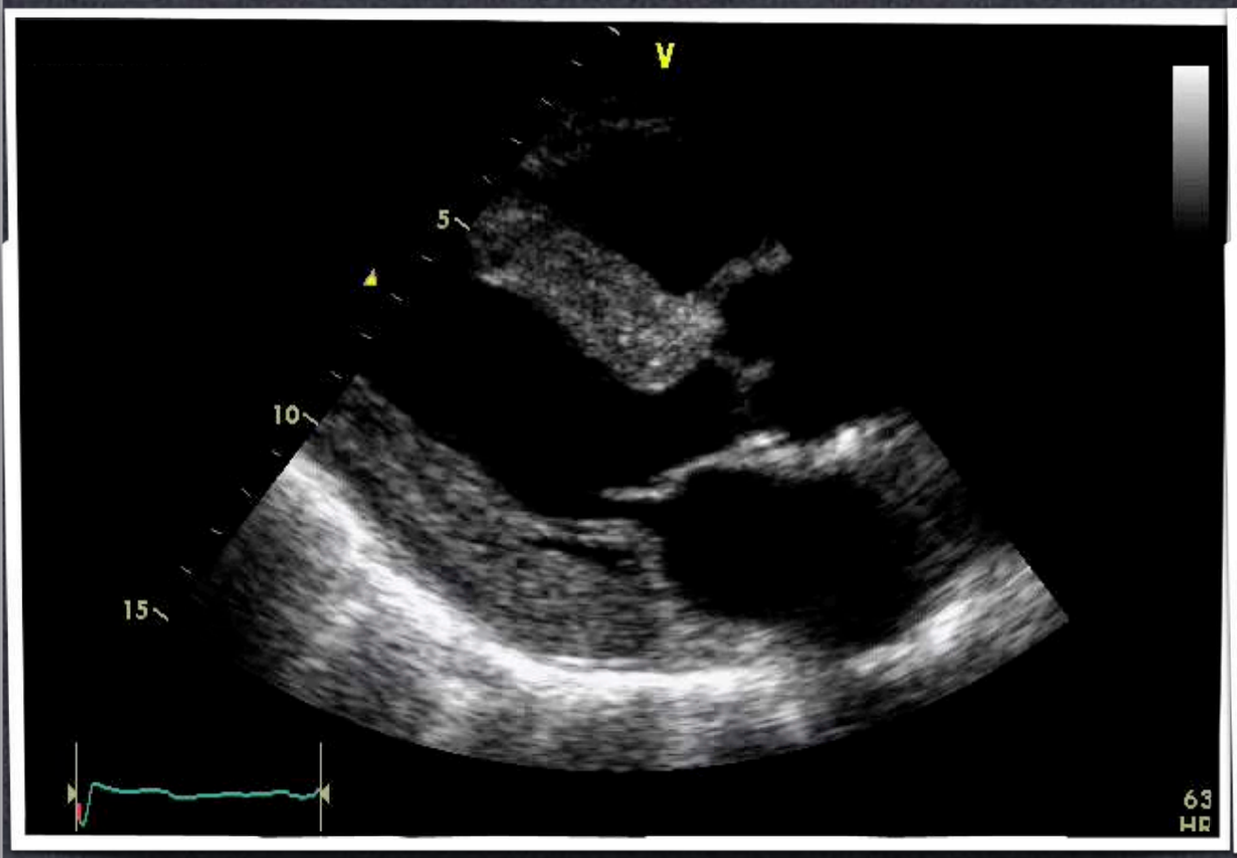

JPEG CR 15:1
Adult Card
X5-1c
50Hz
14cm
2D
56%
C 50
P Low
HGen
TIS0.8
MI 1.3
M3
0
X2
B
G
P
R
1.8
3.6
94 bpm

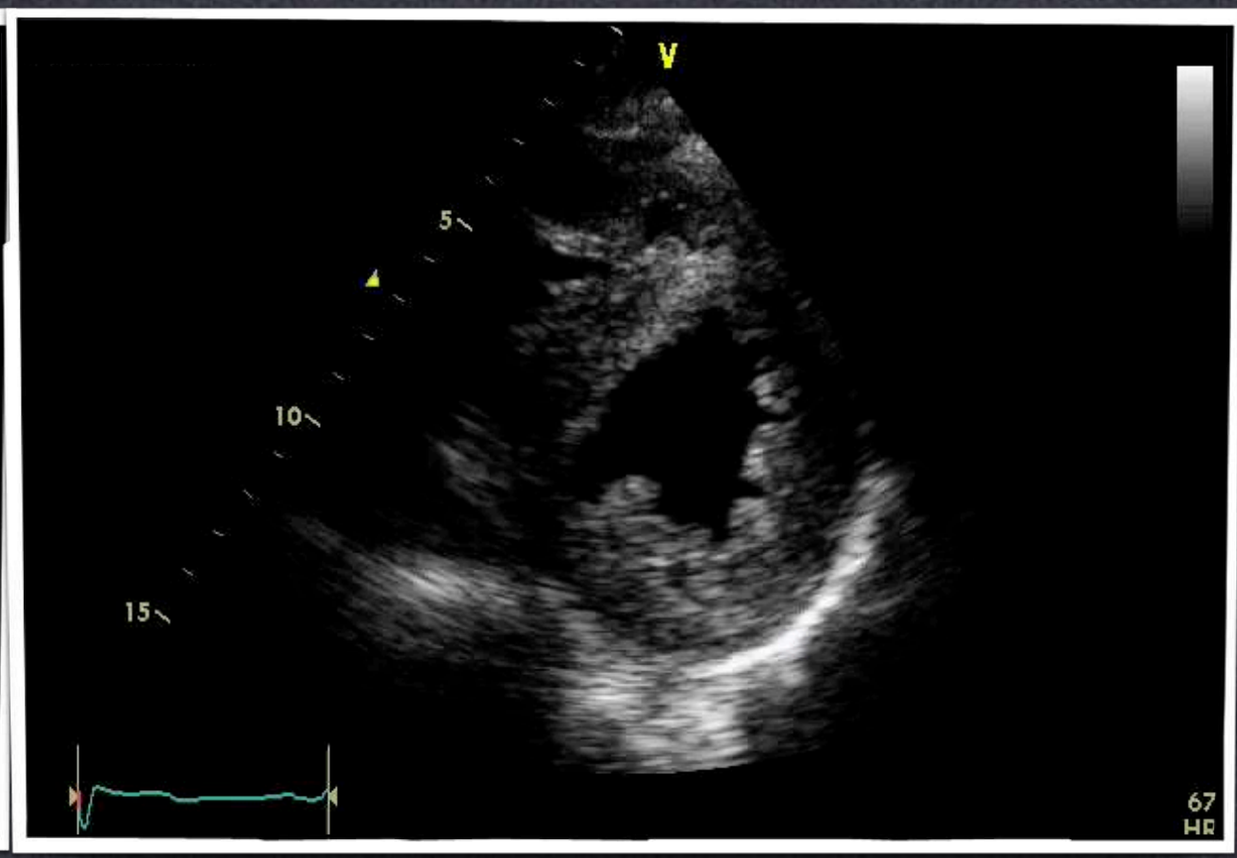
Diastolic Worksheet

Measurements	Values
LA size	
E wave	
A wave	
E/A ratio	
Decel Time	
e’	
E/e’ ratio	
TR Velocity	
Pulmonary Veins	
Valsalva	

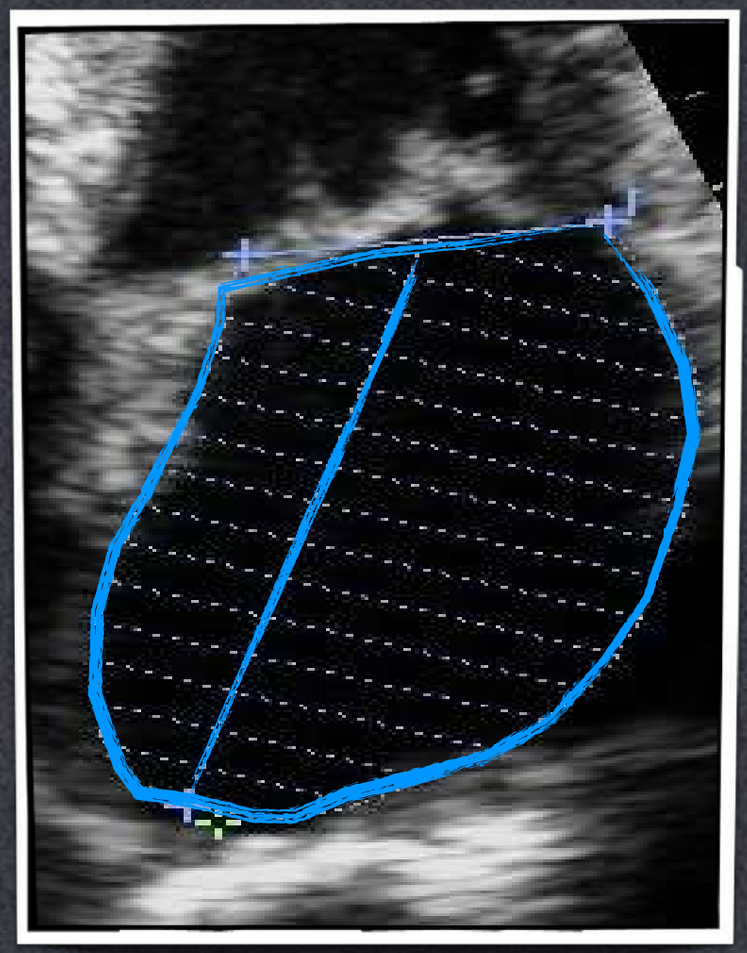
Case #1

- 64 year old male
- Family history of Amyloidosis
- Positive Fat Aspirate
- Amyloidosis of liver
- Concern: Cardiac involvement of Amyloidosis





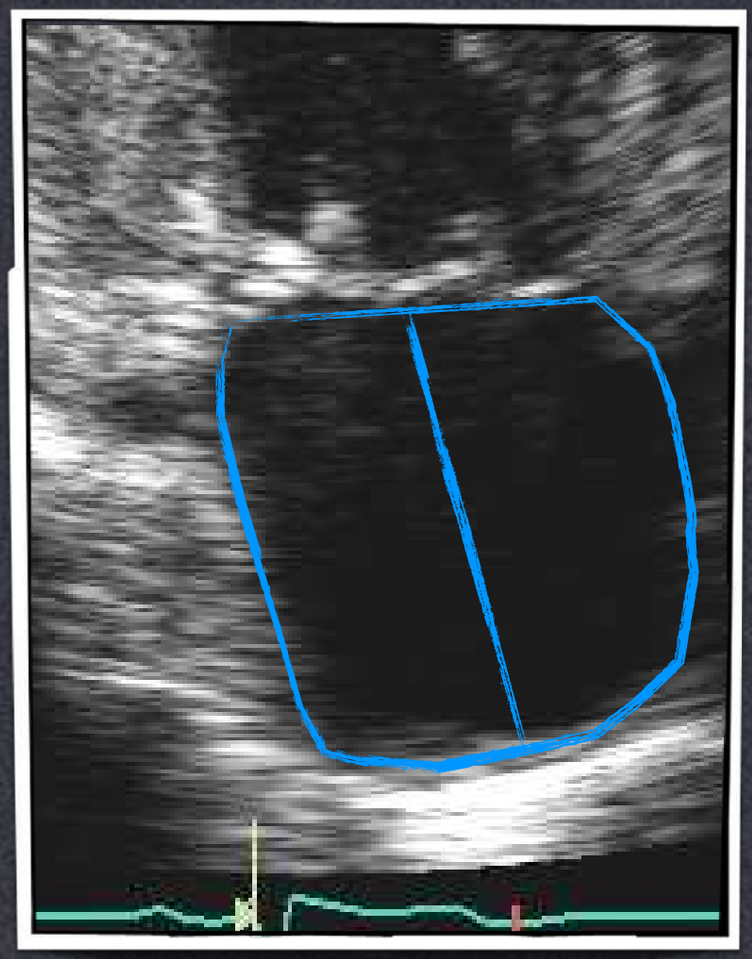
CASE #1



LA 4 CHAMBER

AREA = 24.4

LENGTH = 5.7 CM



LA 2 CHAMBER

AREA = 23.4

LENGTH = 5.9 CM

CASE #1

CALCULATING LA VOLUME

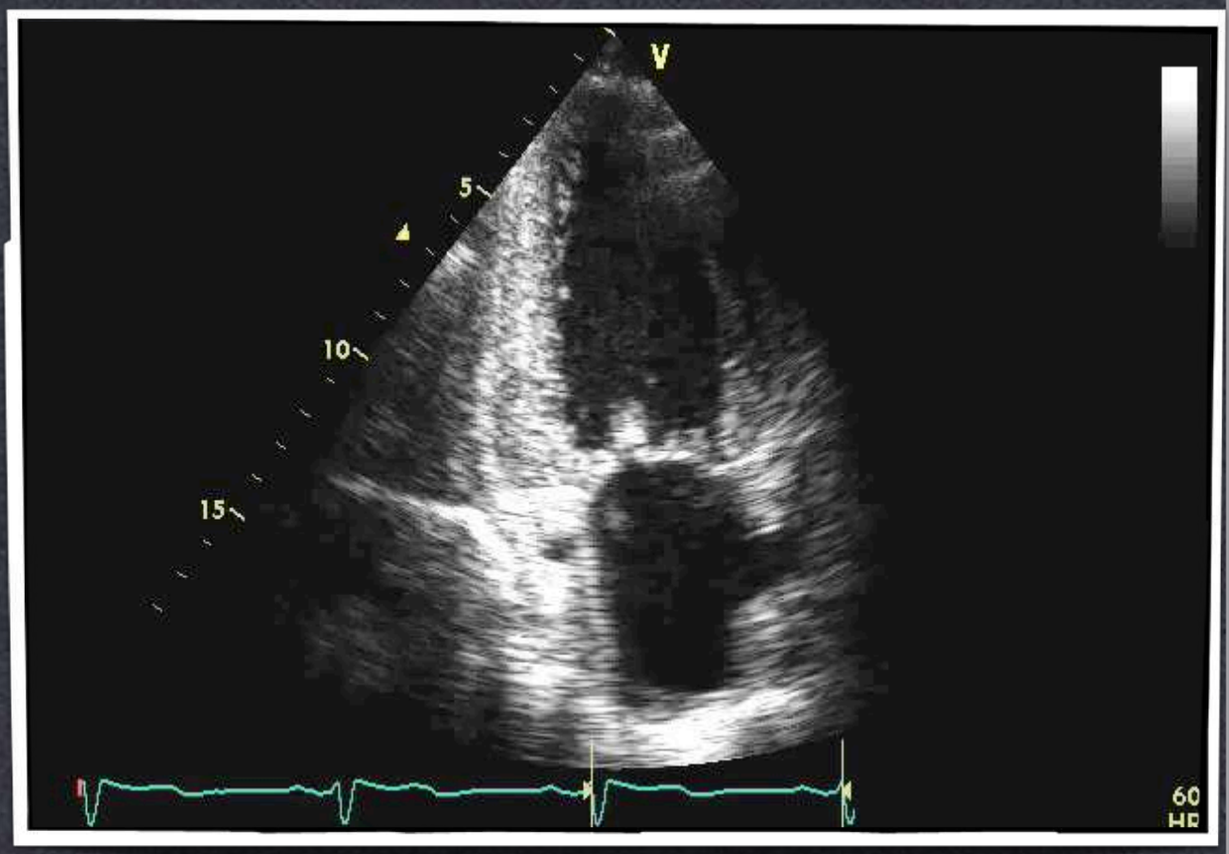
$$\text{LA Volume} = \frac{0.85 * (A1) * (A2)}{\text{Length}_{(\text{shortest})}}$$

$$\text{LA Volume} = \frac{0.85 * (24.4) * (23.4)}{5.7}$$

LA Volume = 85 cc

LA Volume Index = 85 cc / 2.0 m^2

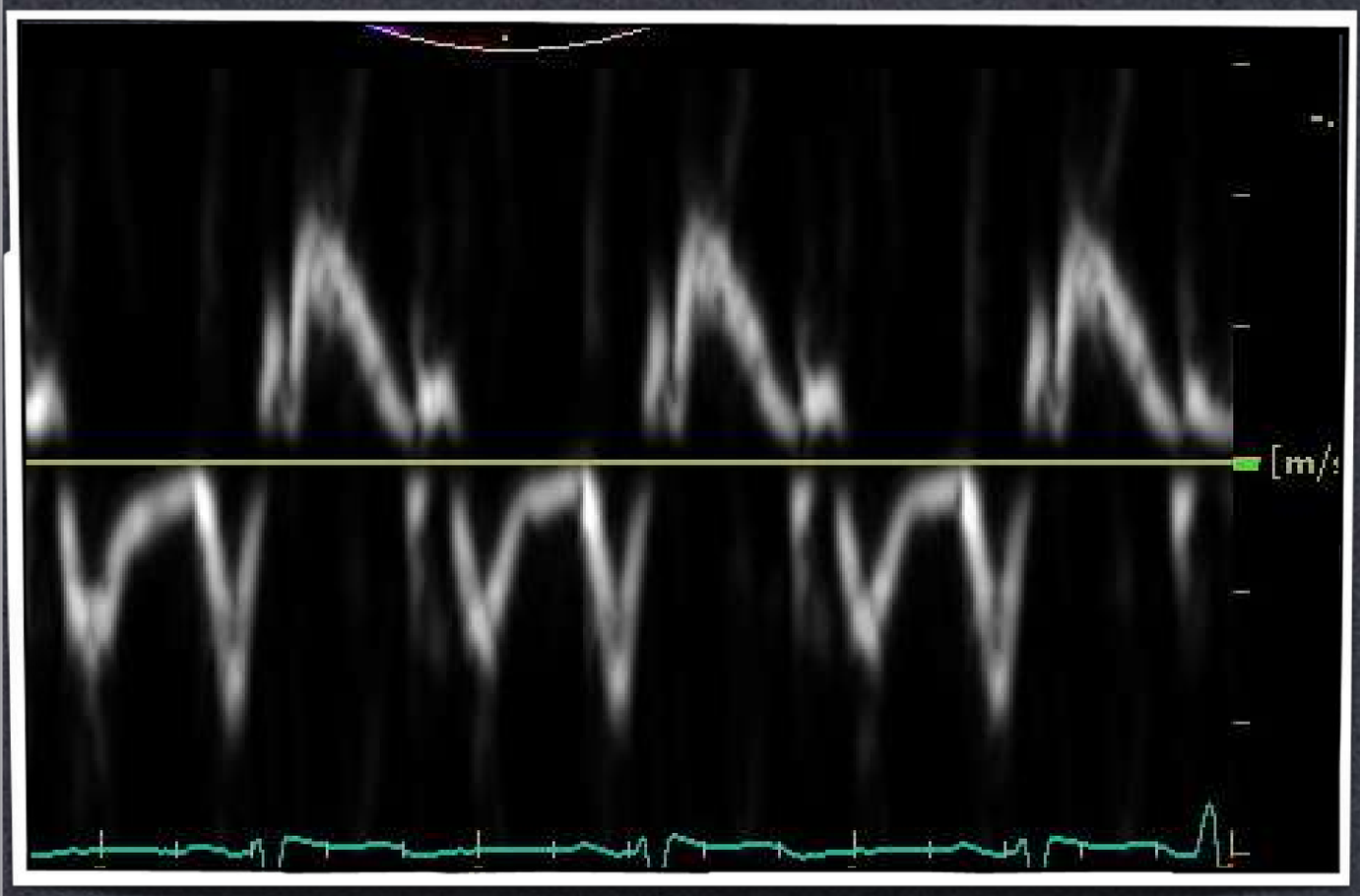
= 43 cc/m^2



	New Guidelines
LA Volume Index	
Normal	16-34 cc/m^2
Mild	35-41 cc/m^2
Moderate	42-48 cc/m^2
Severe	49 and >

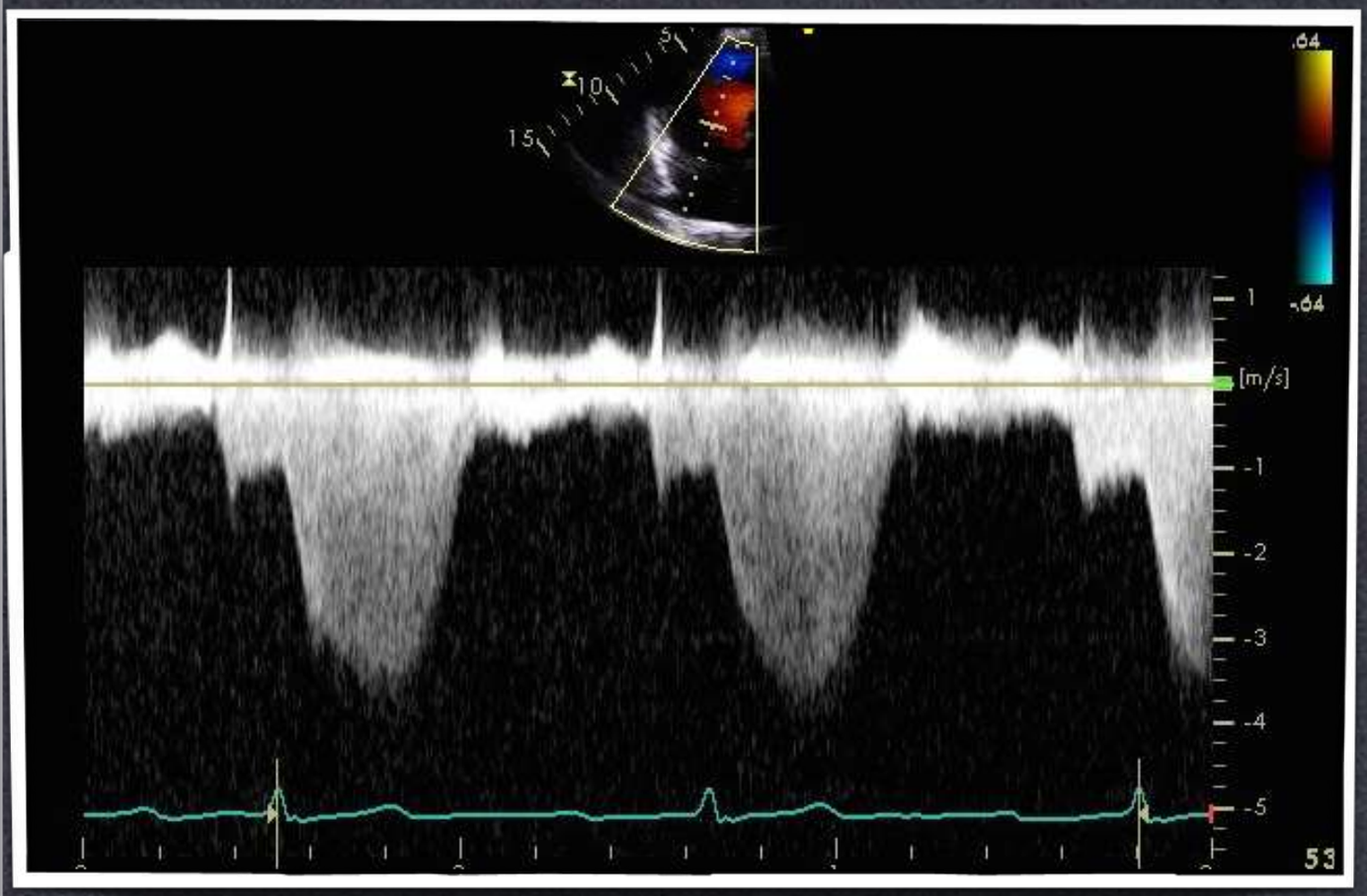
Measurements	Values
LA size	43 cc/m²
E wave	0.9 m/s
A wave	0.4 m/s
E/A ratio	2.25
Decel Time	135 ms
e’	
E/e’ ratio	
TR Velocity	
Pulmonary	
Valsalva	

CASE #1



Measurements	Values
LA size	43 cc/m^2
E wave	0.9 m/s
A wave	0.4 m/s
E/A ratio	2.25
Decel Time	135 ms
e’	0.04 m/s
E/e’ ratio	22.5
TR Velocity	
Pulmonary Veins	
Valsalva	

CASE #1



Measurements	Values
LA size	43 cc/m^2
E wave	0.9 m/s
A wave	0.4 m/s
E/A ratio	2.25
Decel Time	135 ms
e’	0.04 m/s
E/e’ ratio	22.5
TR Velocity	3.4 m/s
Pulmonary Veins	
Valsalva	

CASE #1

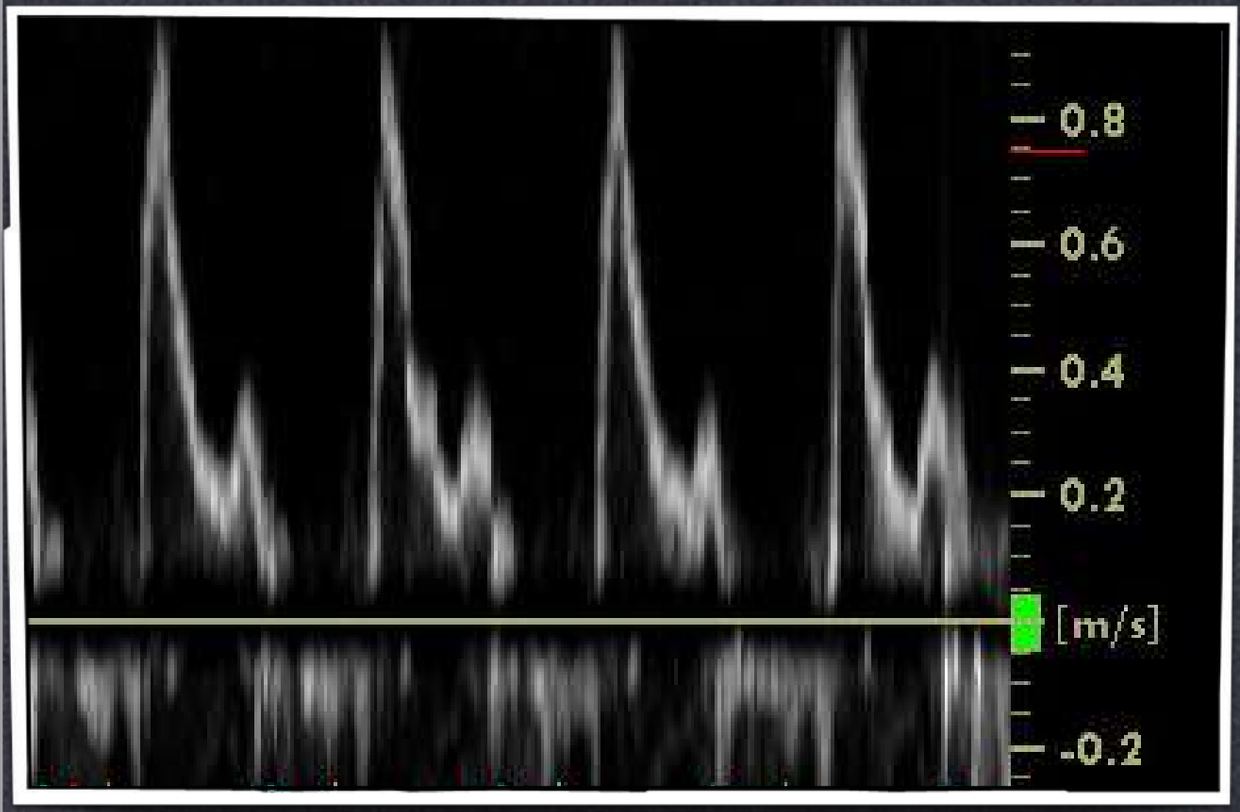
Diastolic Function Grading

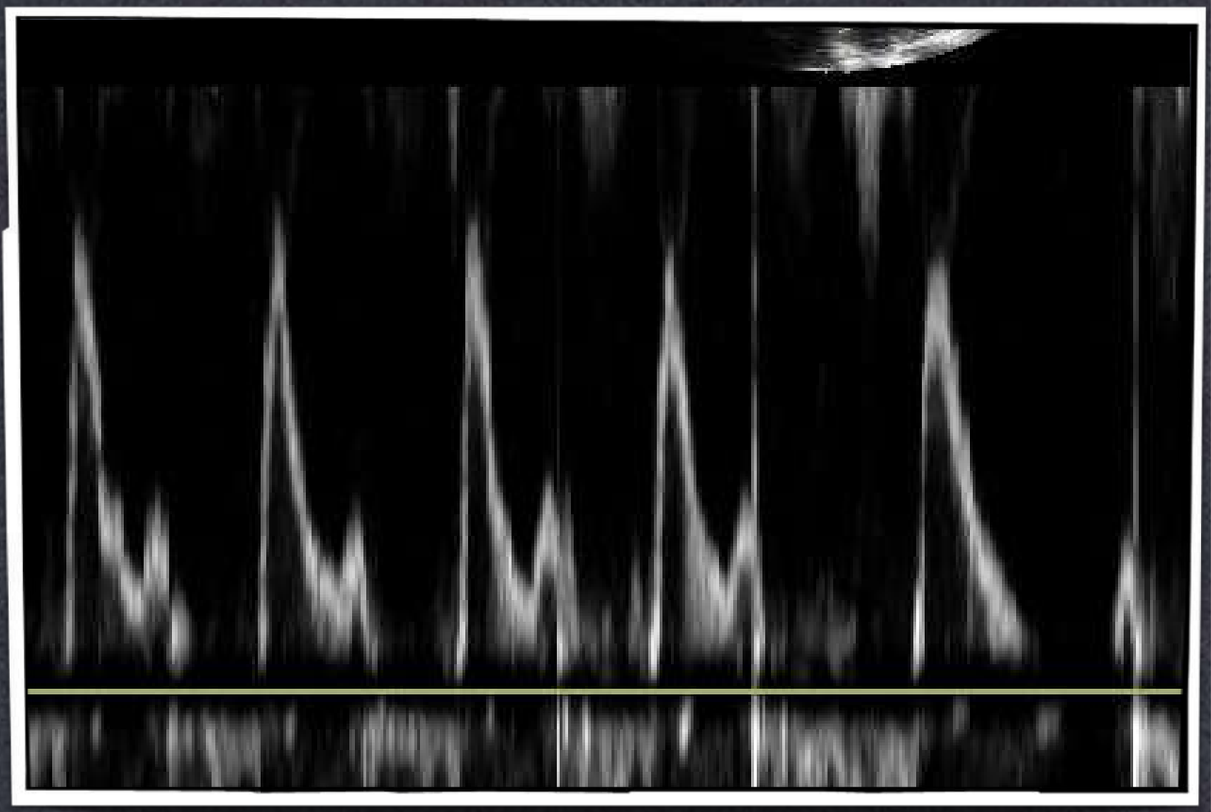
- Normal
- Grade I (Mildly increased filling pressure)
- Grade II (Moderately increased filling pressure)
- Grade III (Severely increased filling pressure: Reversible)
- Grade IV (Severely increased filling pressure: Irreversible)

Diastolic Function Grading

- Normal filling
- Grade I (Mildly increased filling pressure)
- Grade II (Moderately increased filling pressure)
- Grade III (Severely increased filling pressure)

VALSALVA





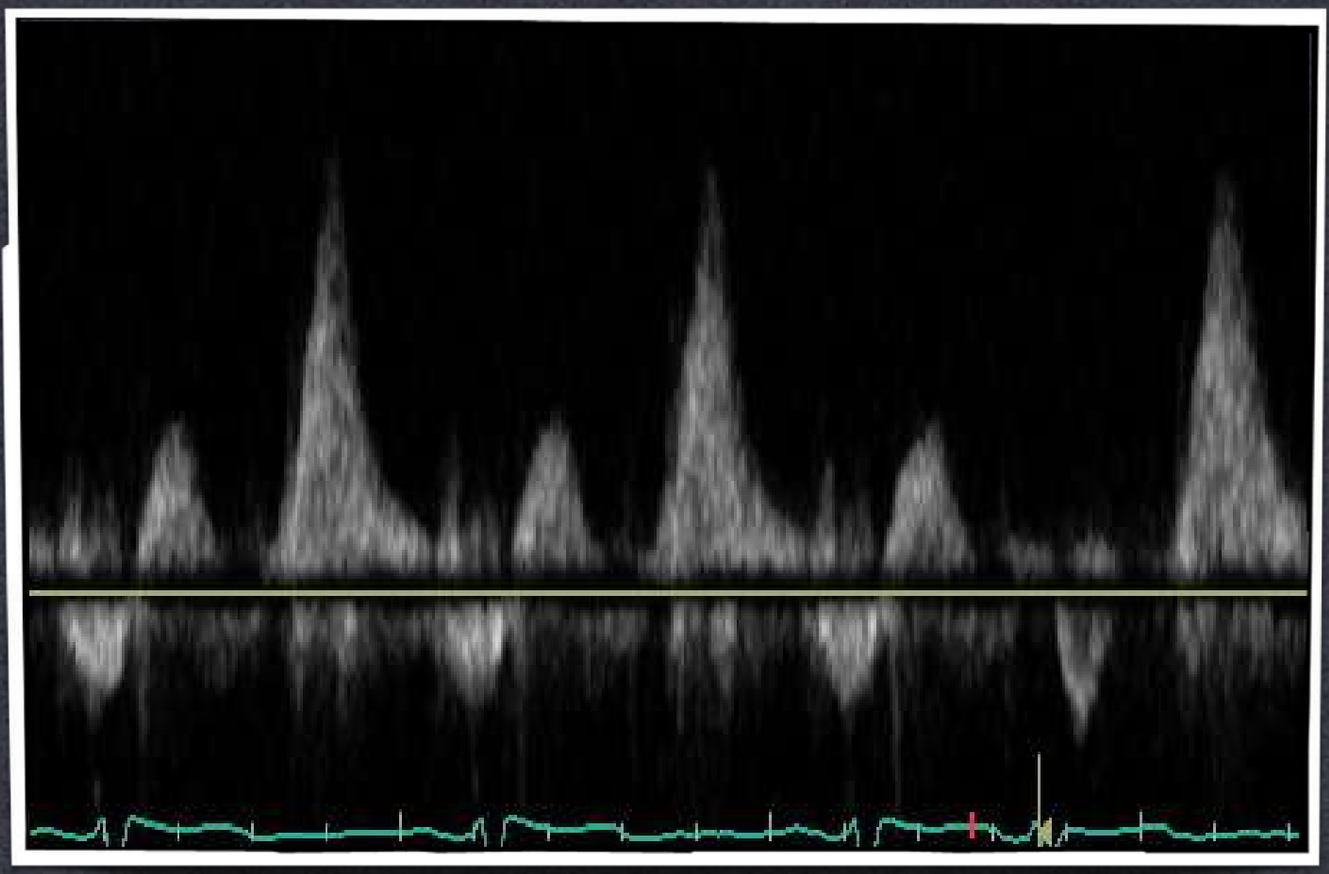
E/A RATIO = 2.3

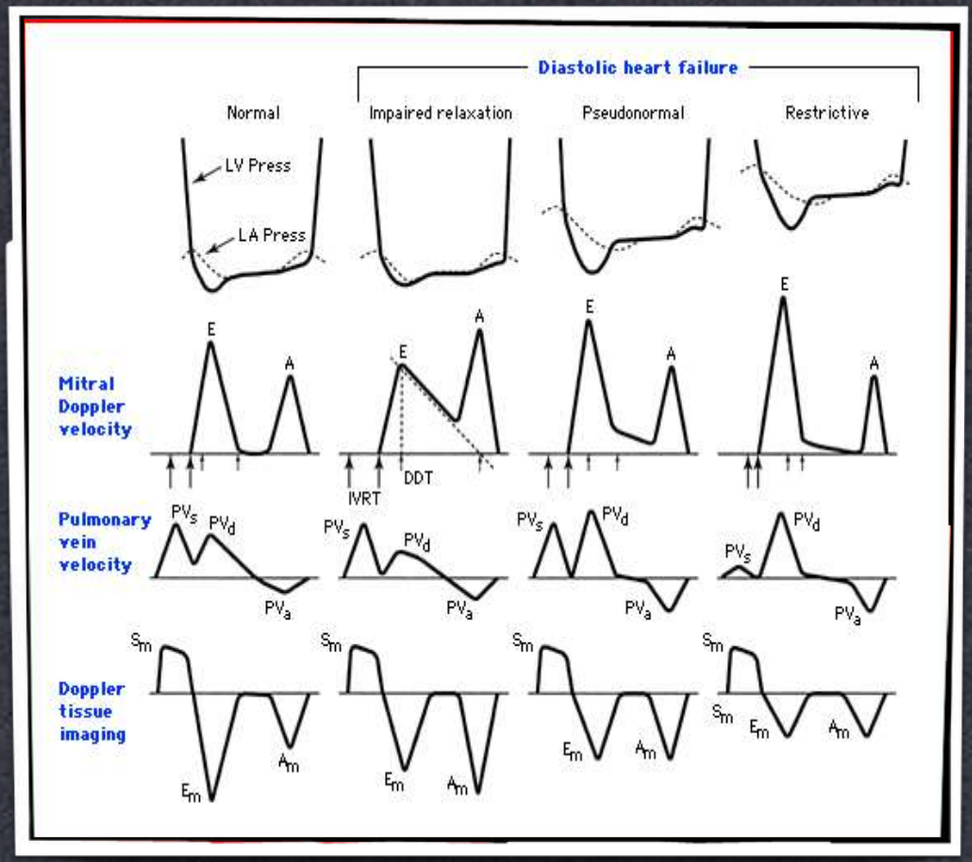
E/A RATIO = 2. 0

CHANGE E/A RATIO = 2.3 - 2.0 = 0.3

VALSALVA ->DEC CO ->INC HR

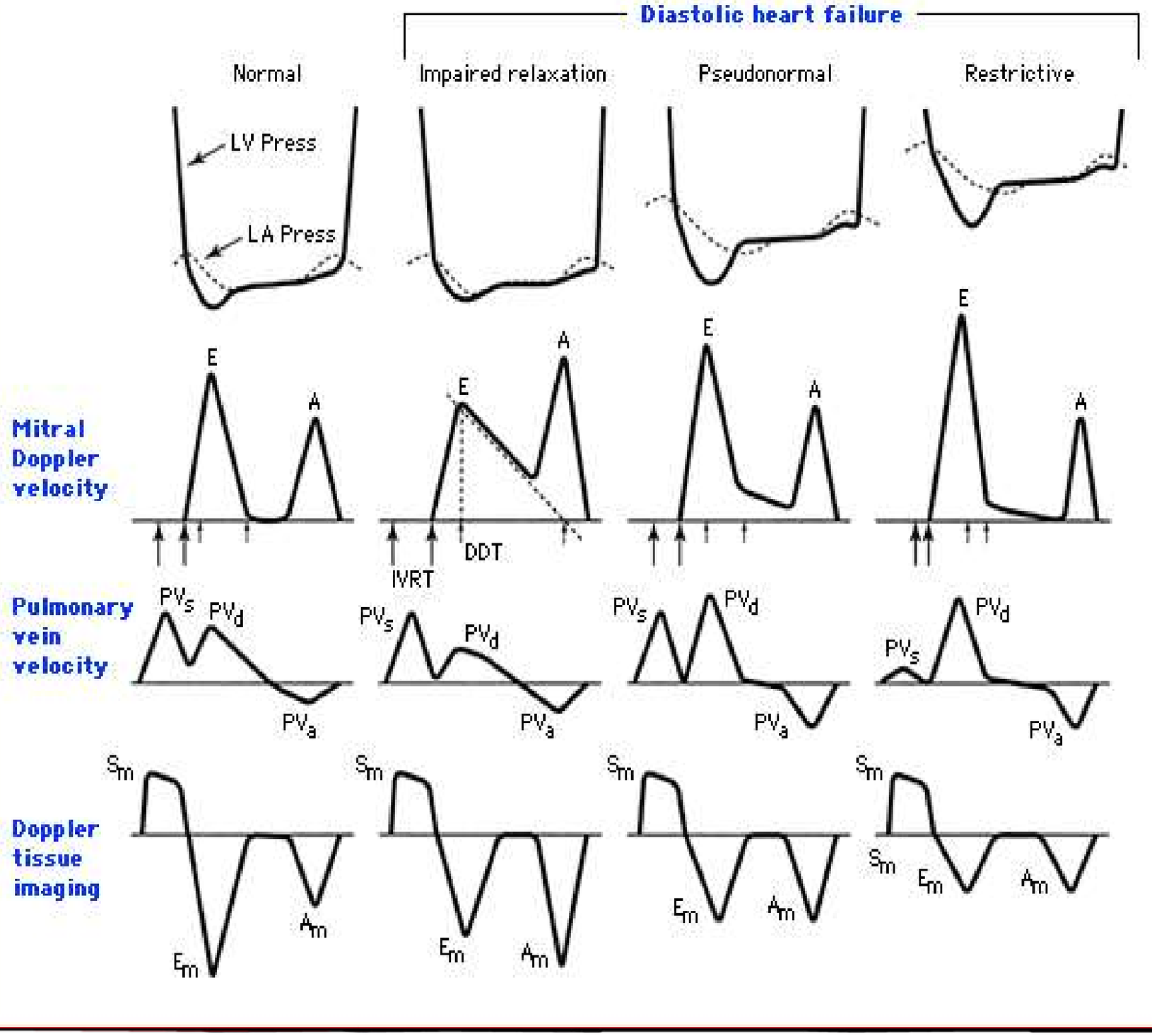
CASE #1

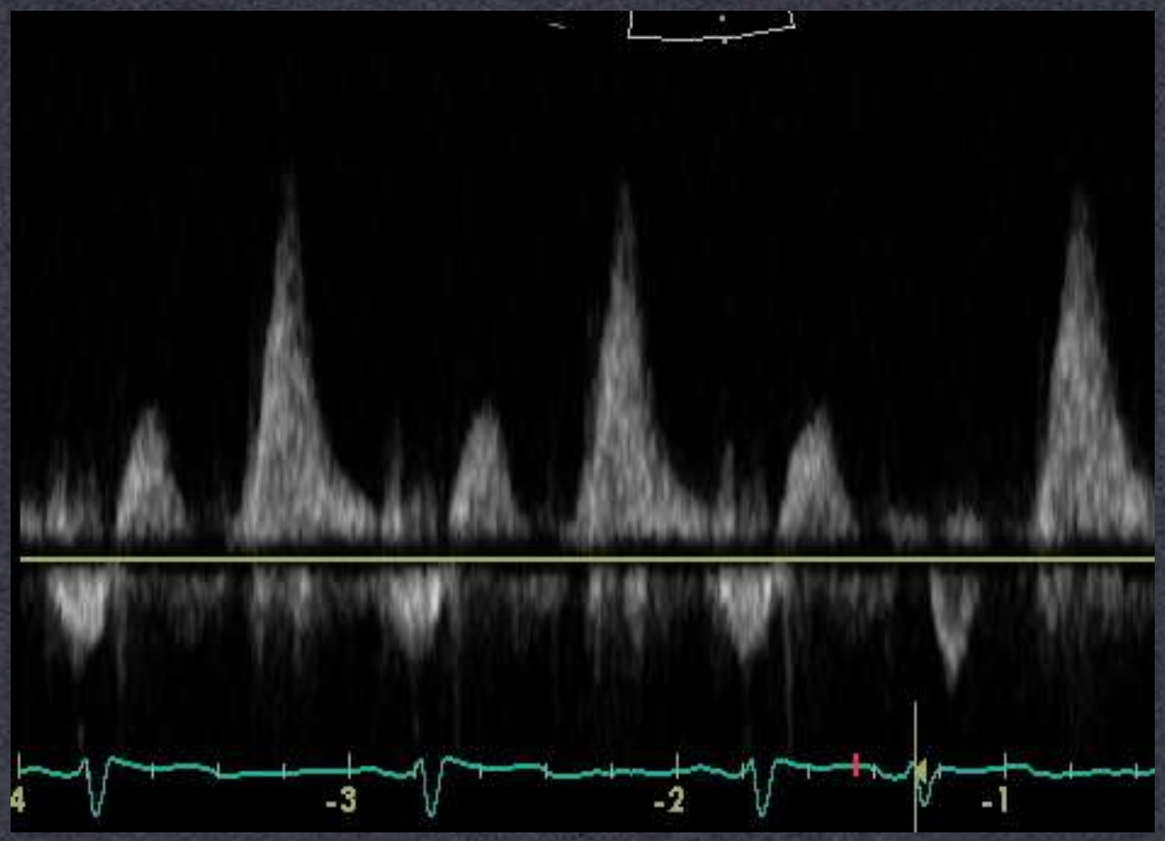




SYSTOLIC WAVE < DIASTOLIC WAVE

CASE #1


Diastolic heart failure
Normal
Impaired relaxation
Pseudonormal
Restrictive
LV Press
LA Press
Mitral Doppler velocity
E
A
IVRT
DDT
Pulmonary vein velocity
PVs
PVd
PVa
Doppler tissue imaging
Sm
Em
Am



Measurements	Values
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E/A ratio	2.25
Decel Time	135 ms
e’	0.04 m/s
E/e’ ratio	22.5
TR Velocity	3.4 m/s
Pulmonary Veins	S < D
Valsalva	Delta 0.3

CASE #1 SUMMARY

Conclusion

- Question your signals, pay attention to your measurements
- Recognizing patterns and variations
- Use all your tools in your arsenal
- Put all the clues together...

Aurora St. Luke's Hospital

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