



# INTRODUCTION TO RIGHT VENTRICLE ASSESSMENT IN THE ICU



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# Focused Echo: What to look for?

## 4 E'S

**Effusion**

**EF**

**Entrance**

**Equality**



# Case 1

- Rapid response called
- Arrive to find 65F sitting upright in bed with increased work of breathing
- HR 120, BP 90/50, O2 89% RA, T 100.8

# Case 1

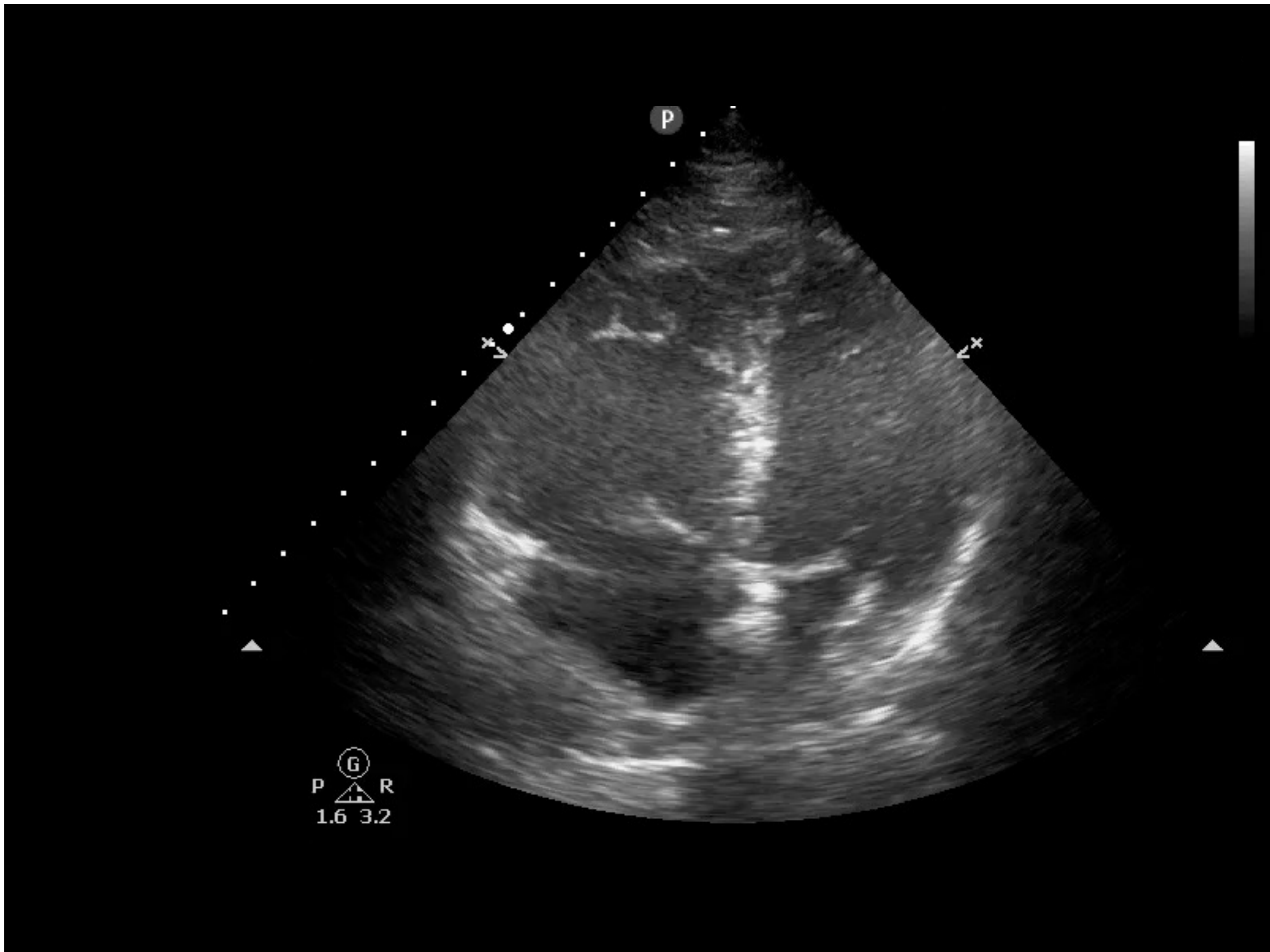
- PMH: HTN, COPD, CHF
- Post-op day 2 from laparoscopic CCY
- PE: Alert, CV: tachycardia no murmurs, Pulm: tachypneic, no wheezing, crackles at bases. Abd: soft, NT, Ext: palpable distal pulses

# Right Zones



# Left Zones





P

G  
P R  
1.6 3.2

x

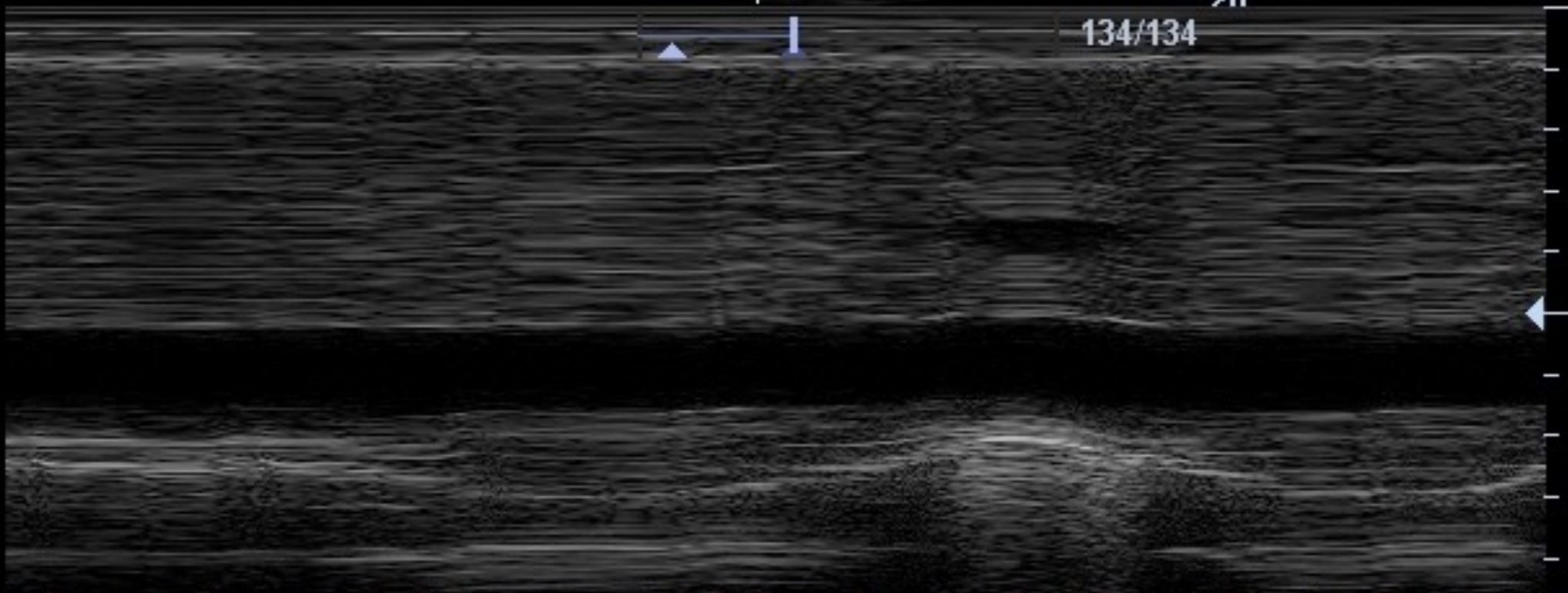
x



M



0  
10  
20



134/134

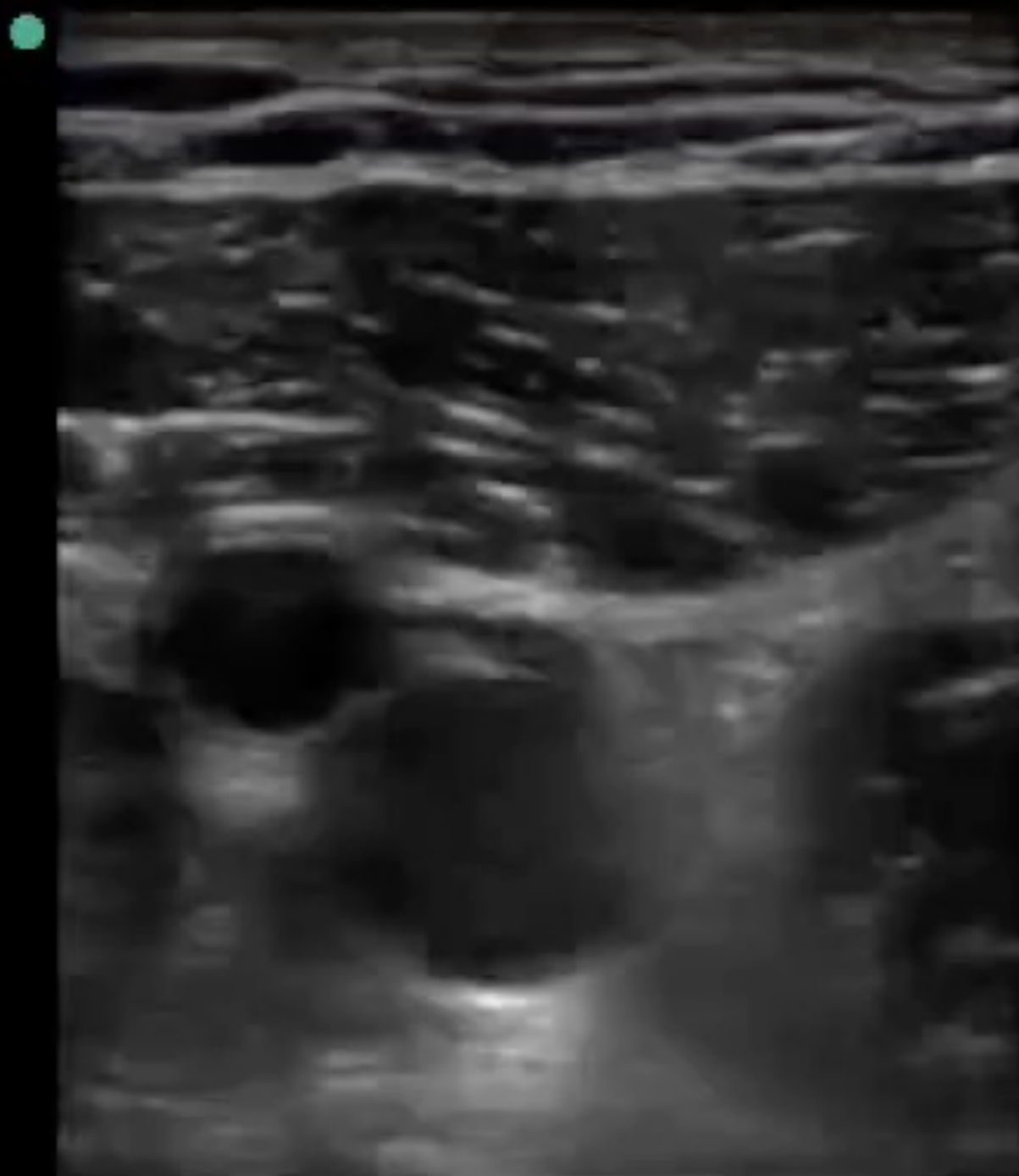
10  
20



5.2/5.2

Res  
S

MB



Sup  
SLA



30%

MI

0.7

TIS

0.2



3.1



Res



0



MB On



Dual

Page 1/2

# RV Assessment

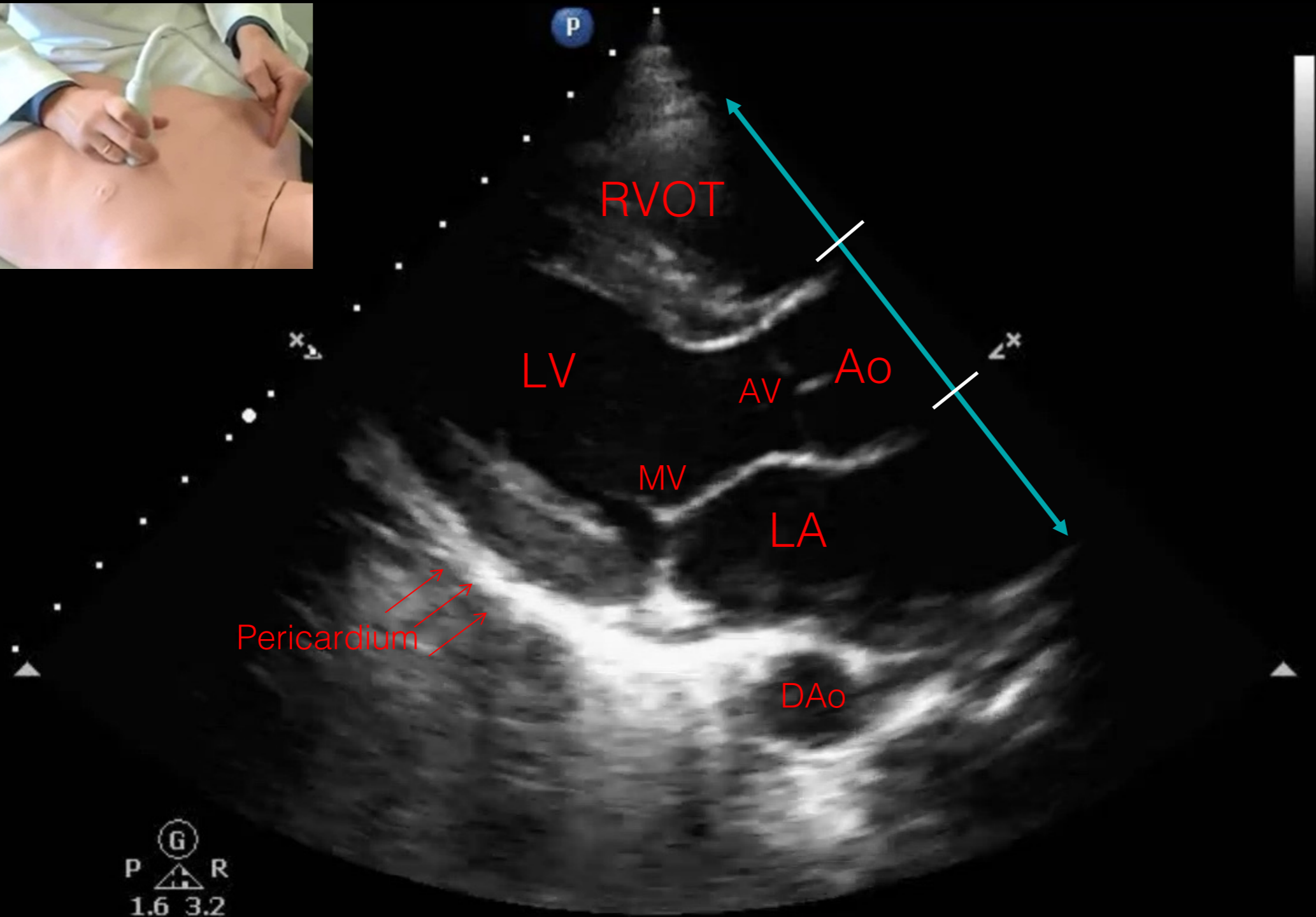
- Size
- Function



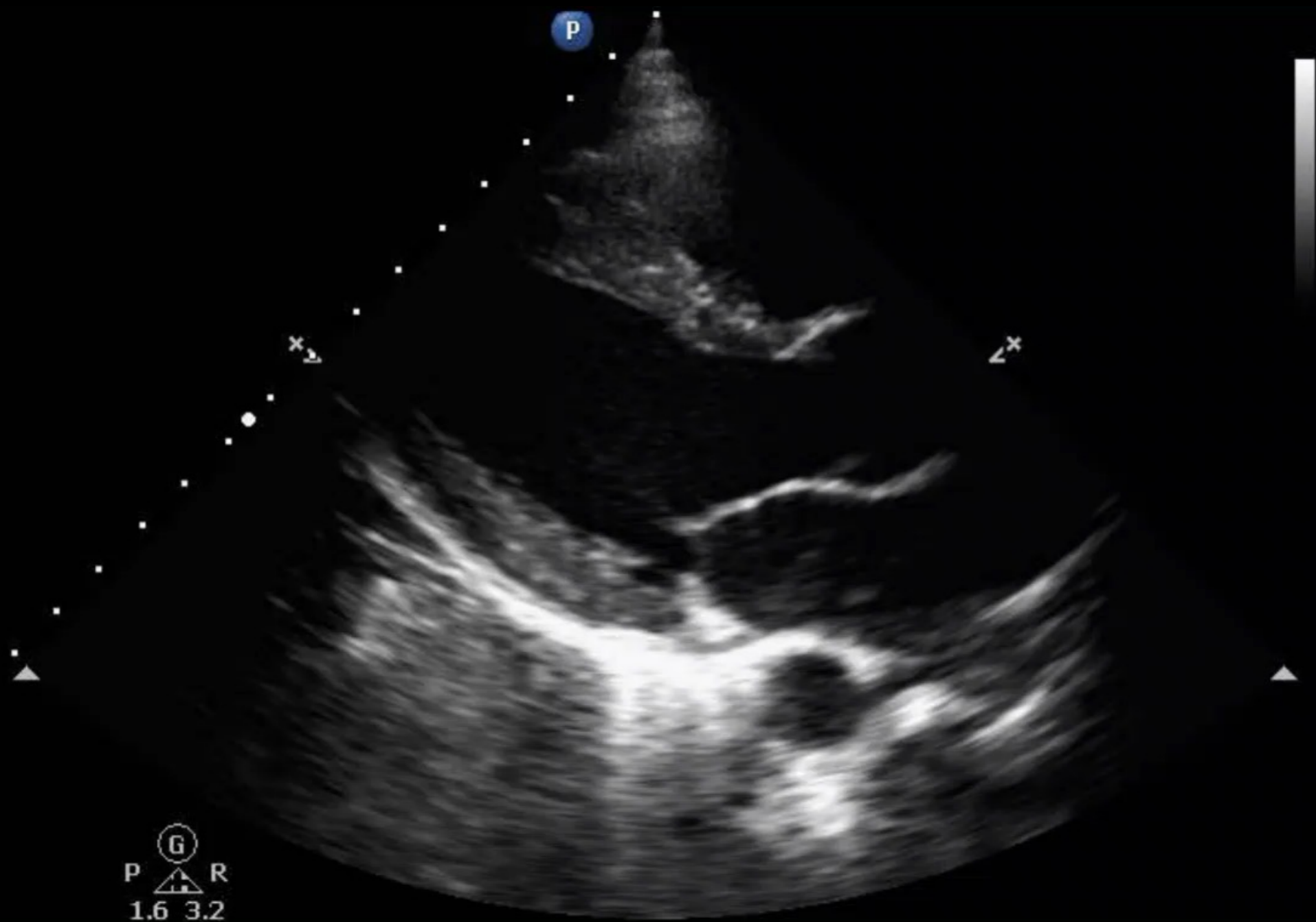
# Standard Echo Views

- Parasternal long-axis
- Parasternal short-axis
- Subcostal 4 chamber
- Apical 4 Chamber

# Parasternal long-axis

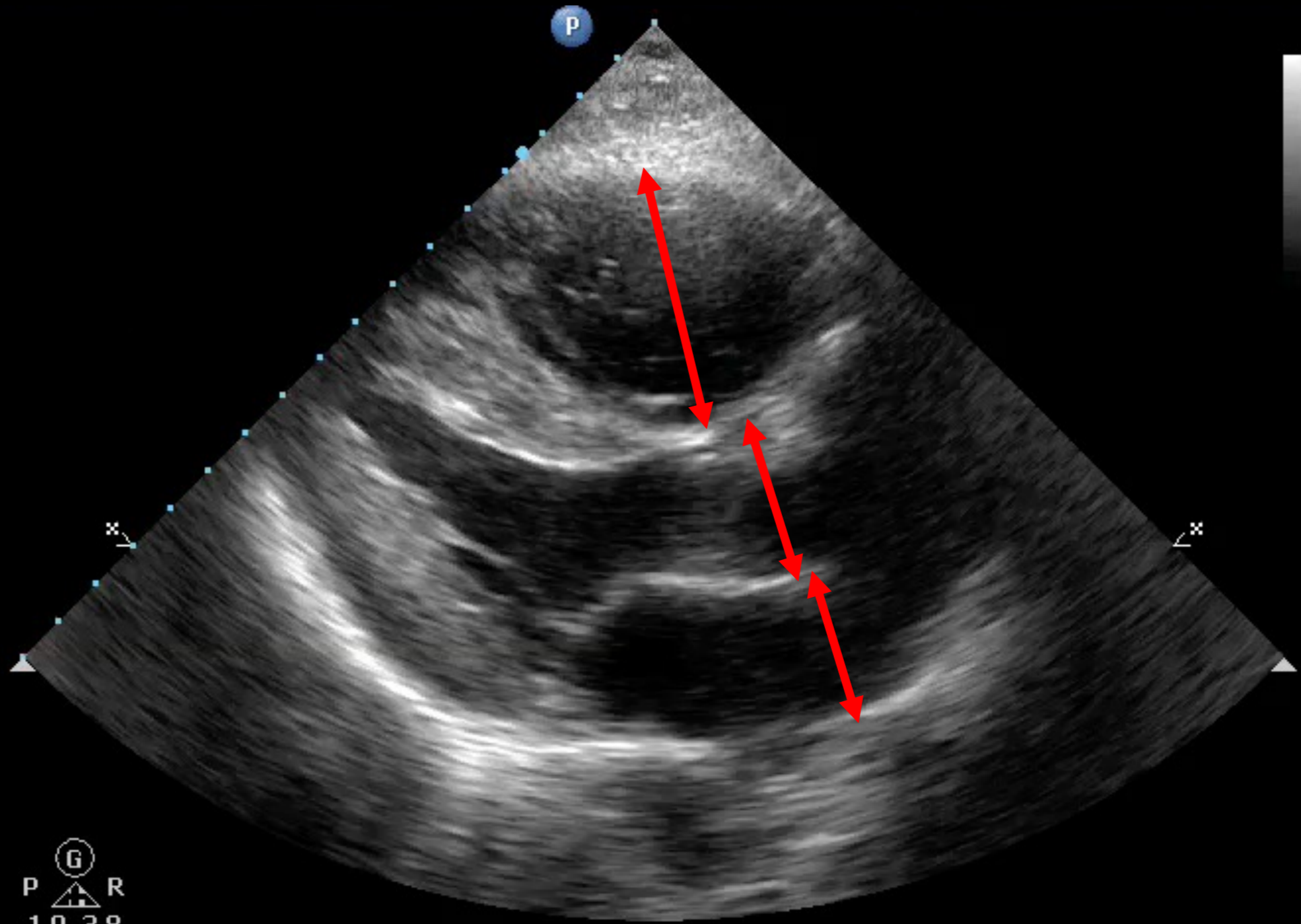


# Parasternal long-axis



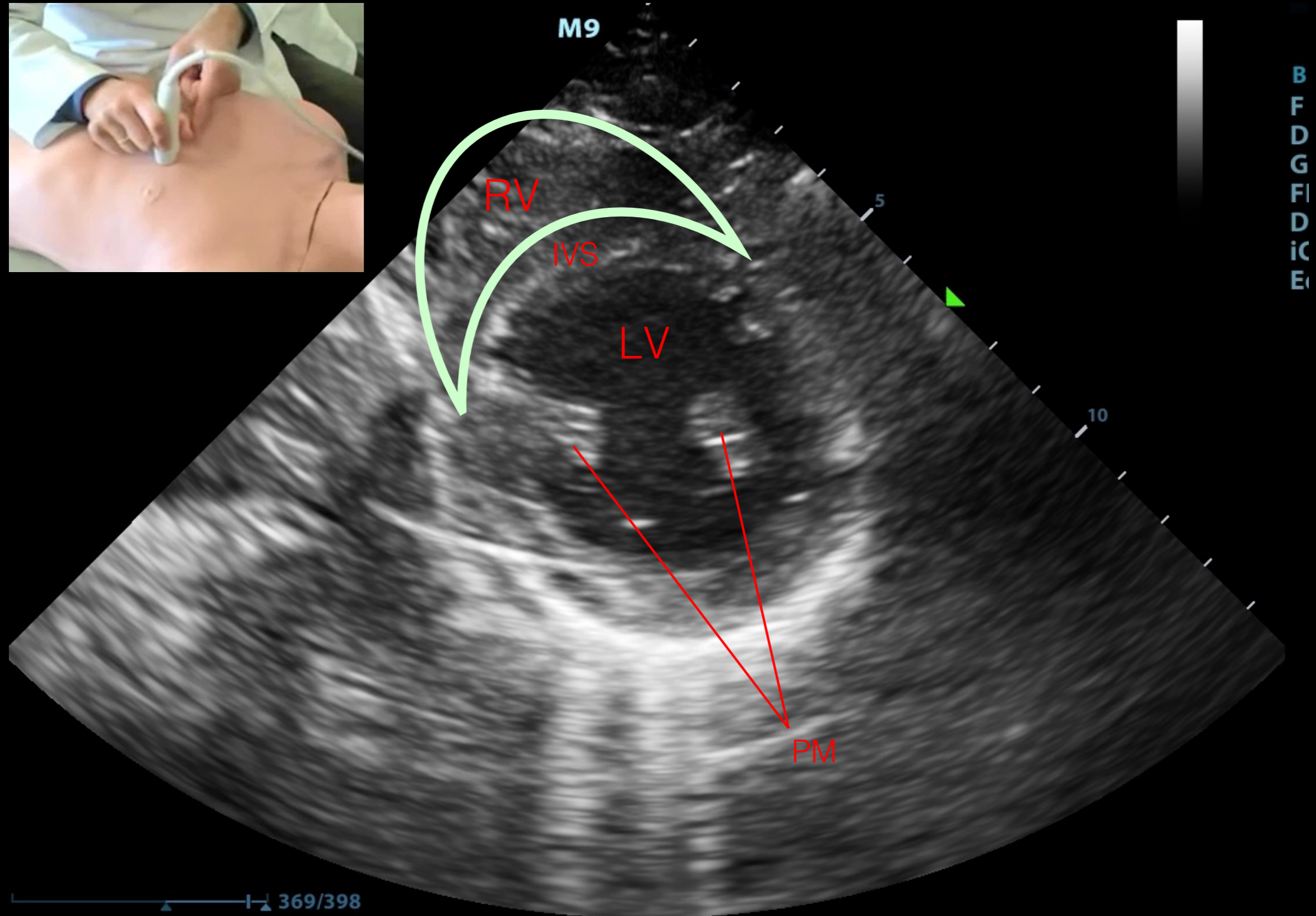
ED ECHO  
S4-2  
31Hz  
17cm

2D  
H3  
Gn 55  
232dB/C5  
D/2/0

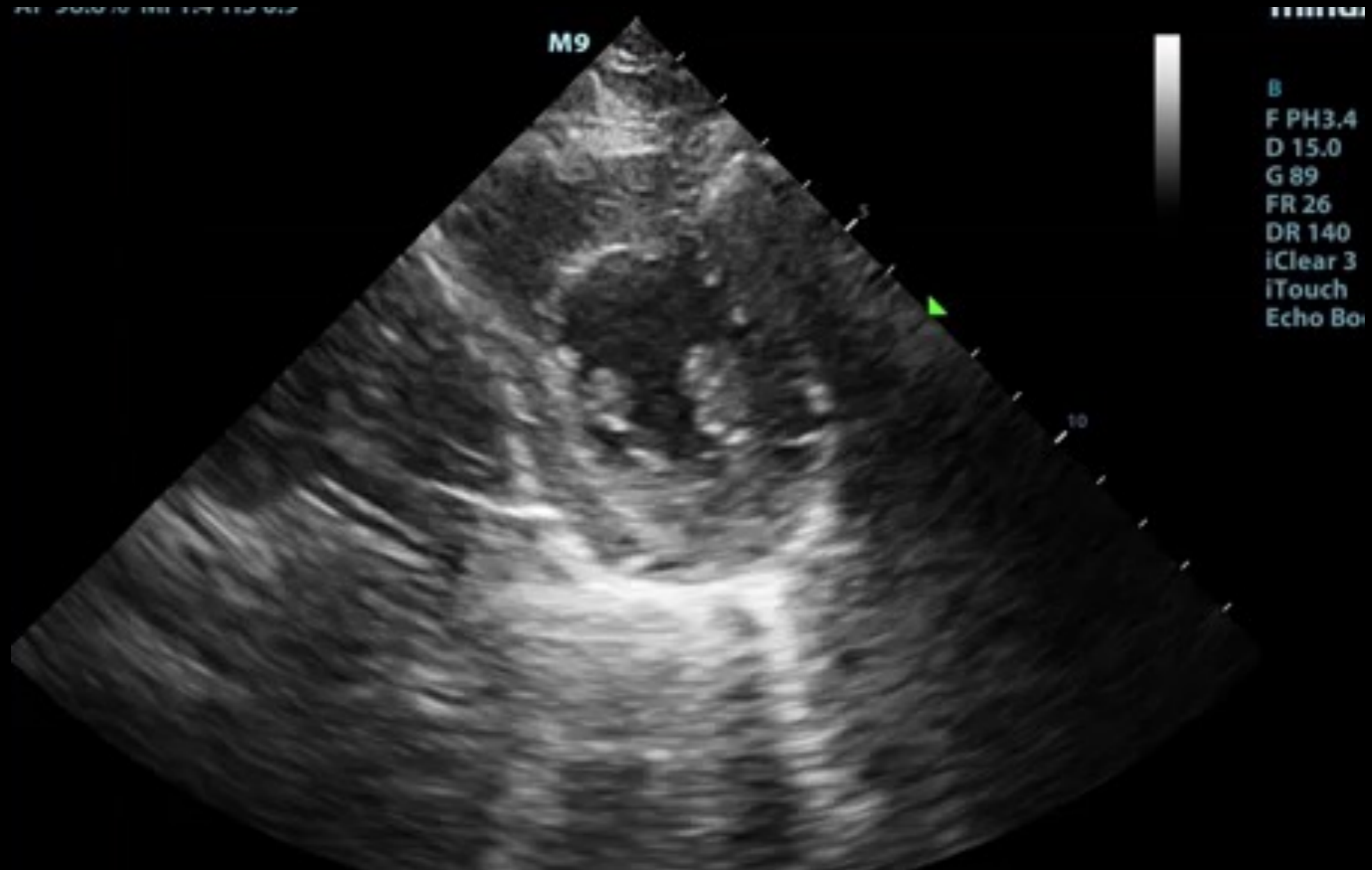


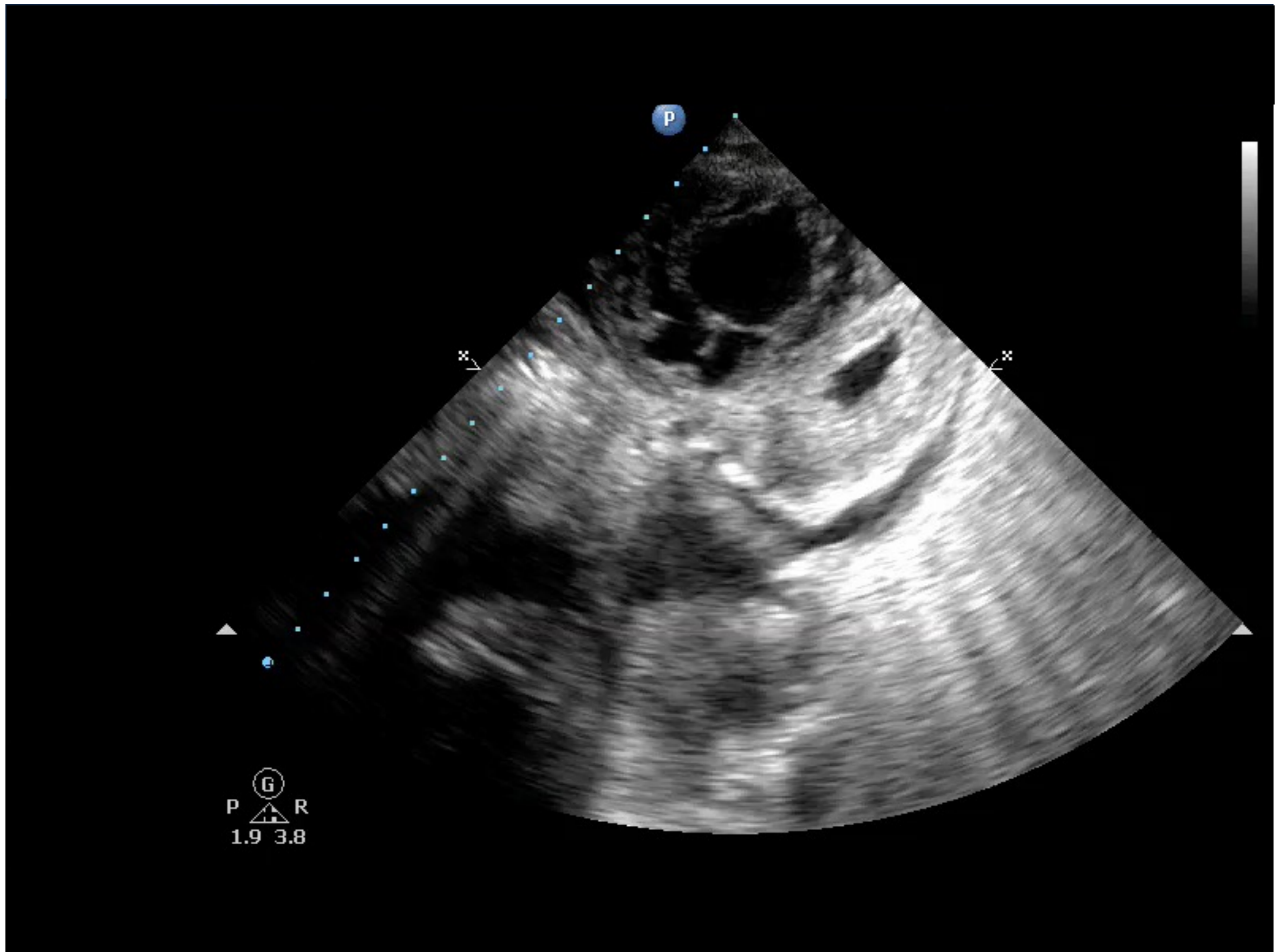
⊙  
P R  
1.9 3.8

# Parasternal short-axis

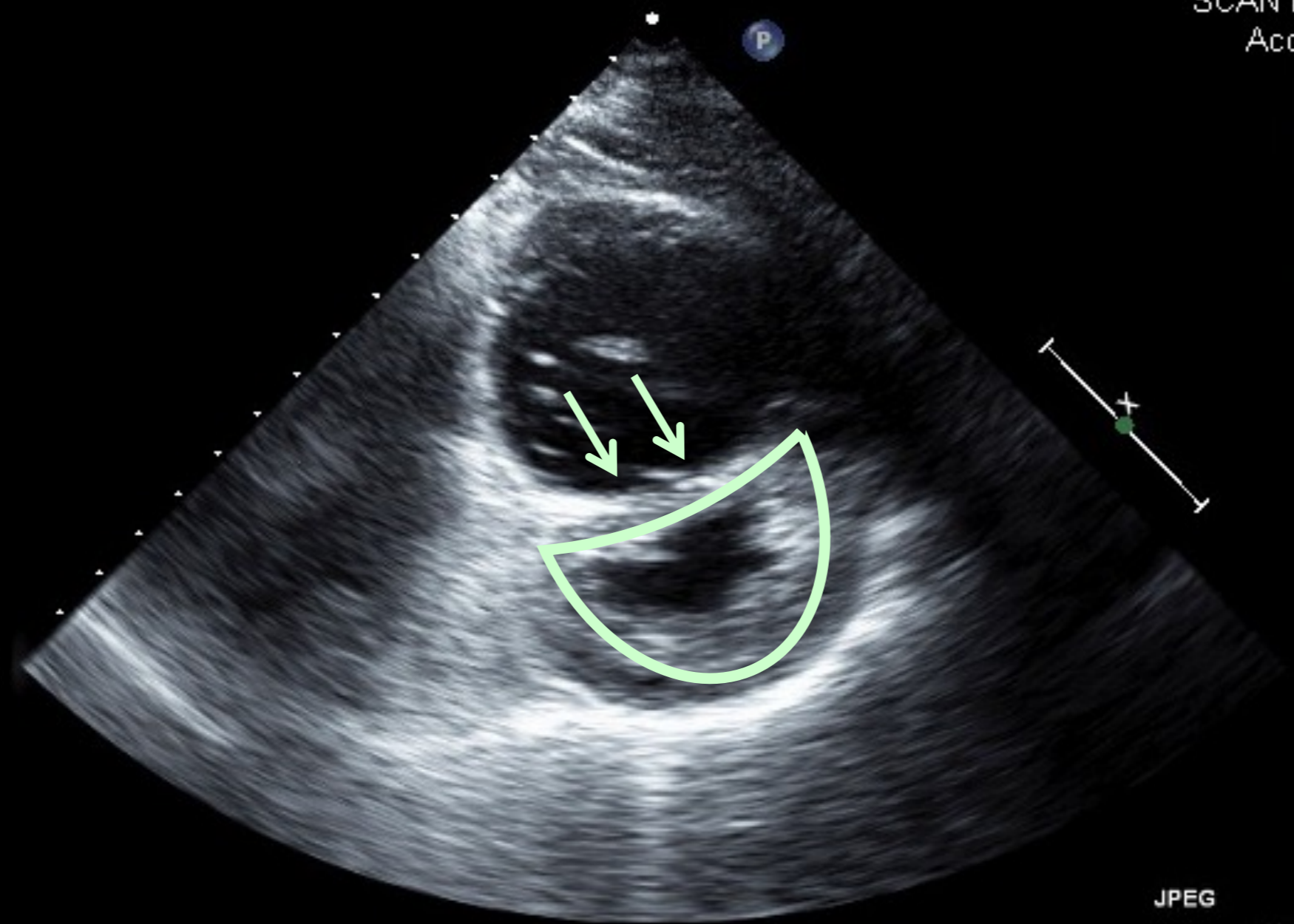


# Parasternal short-axis





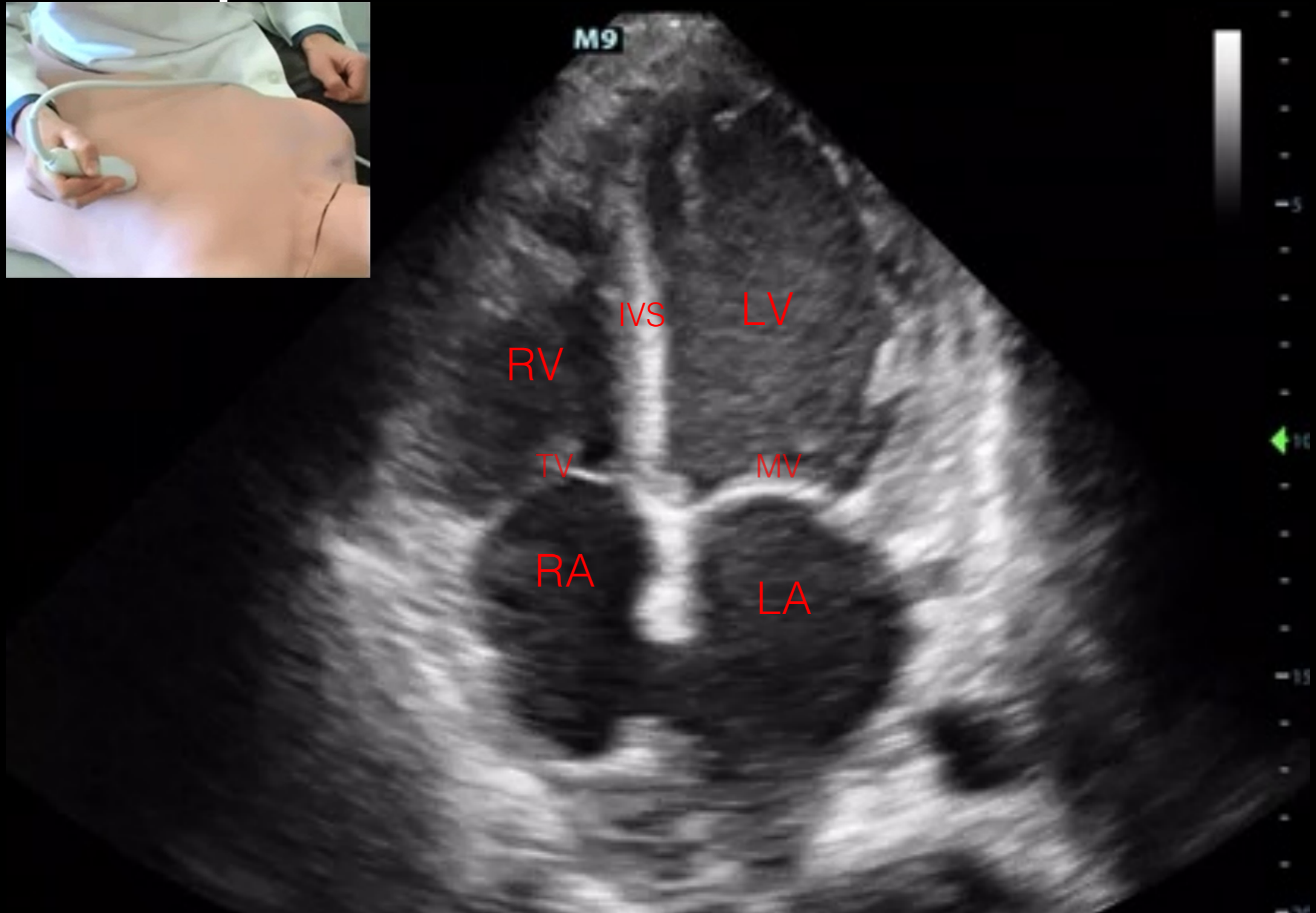
Study Time: 10:42:4  
SCAN I  
Acc



JPEG

\*\*

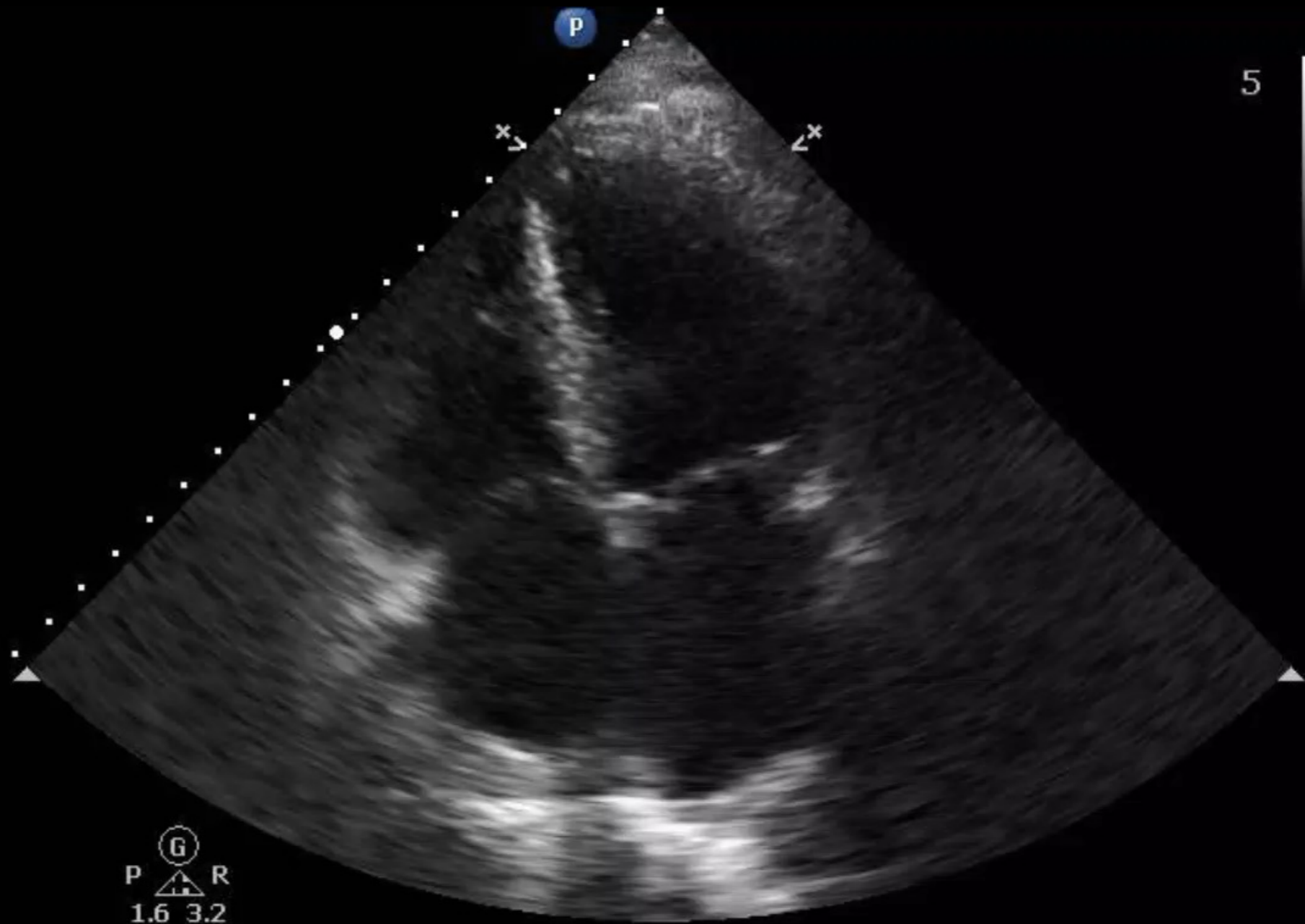
# Apical 4-chamber

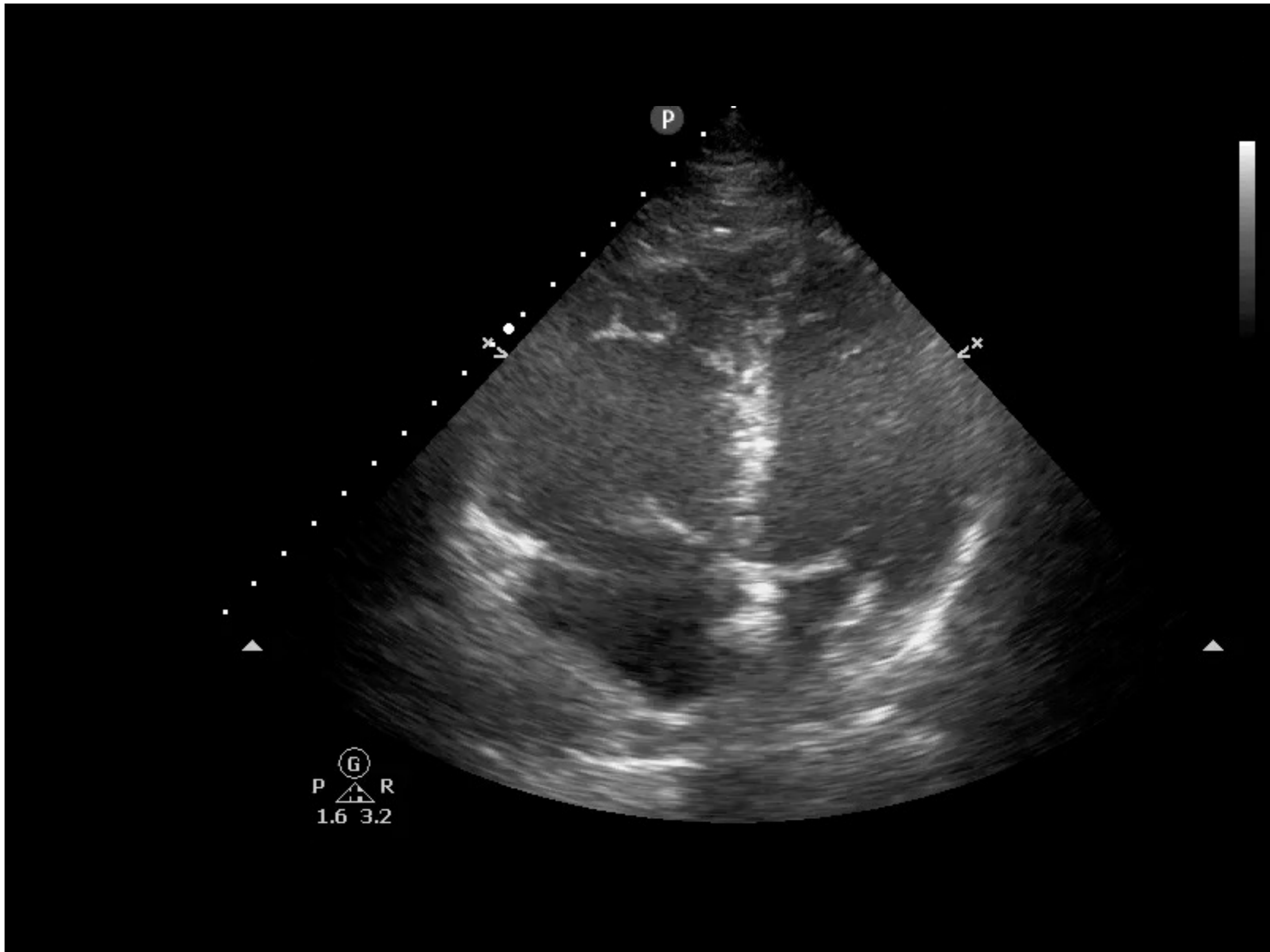


# Apical 4-chamber

ED ECHO  
S4-2  
36 Hz  
19.0cm

2D  
HGen  
Gn 98  
C 51  
1/2/0





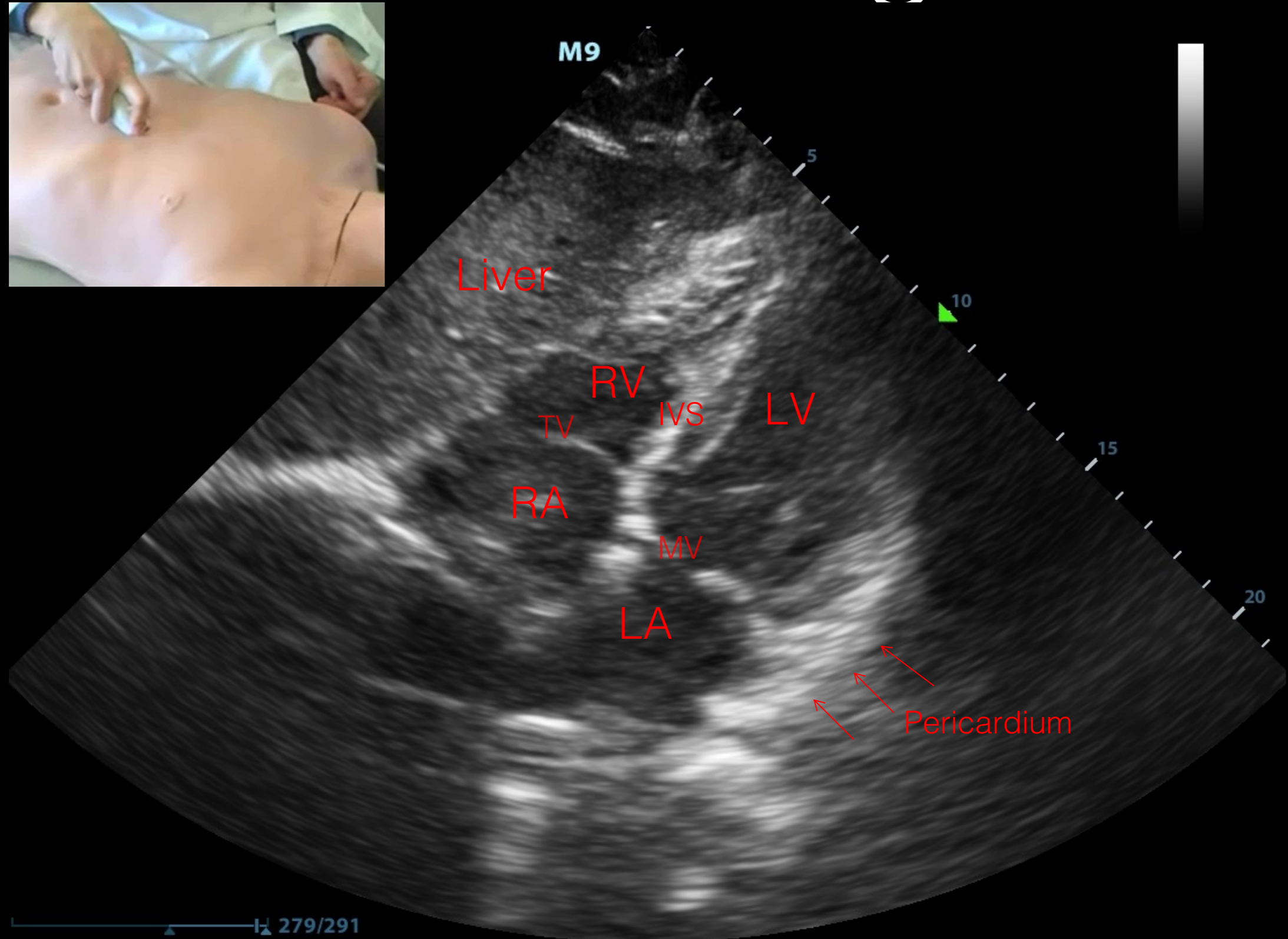
P

x

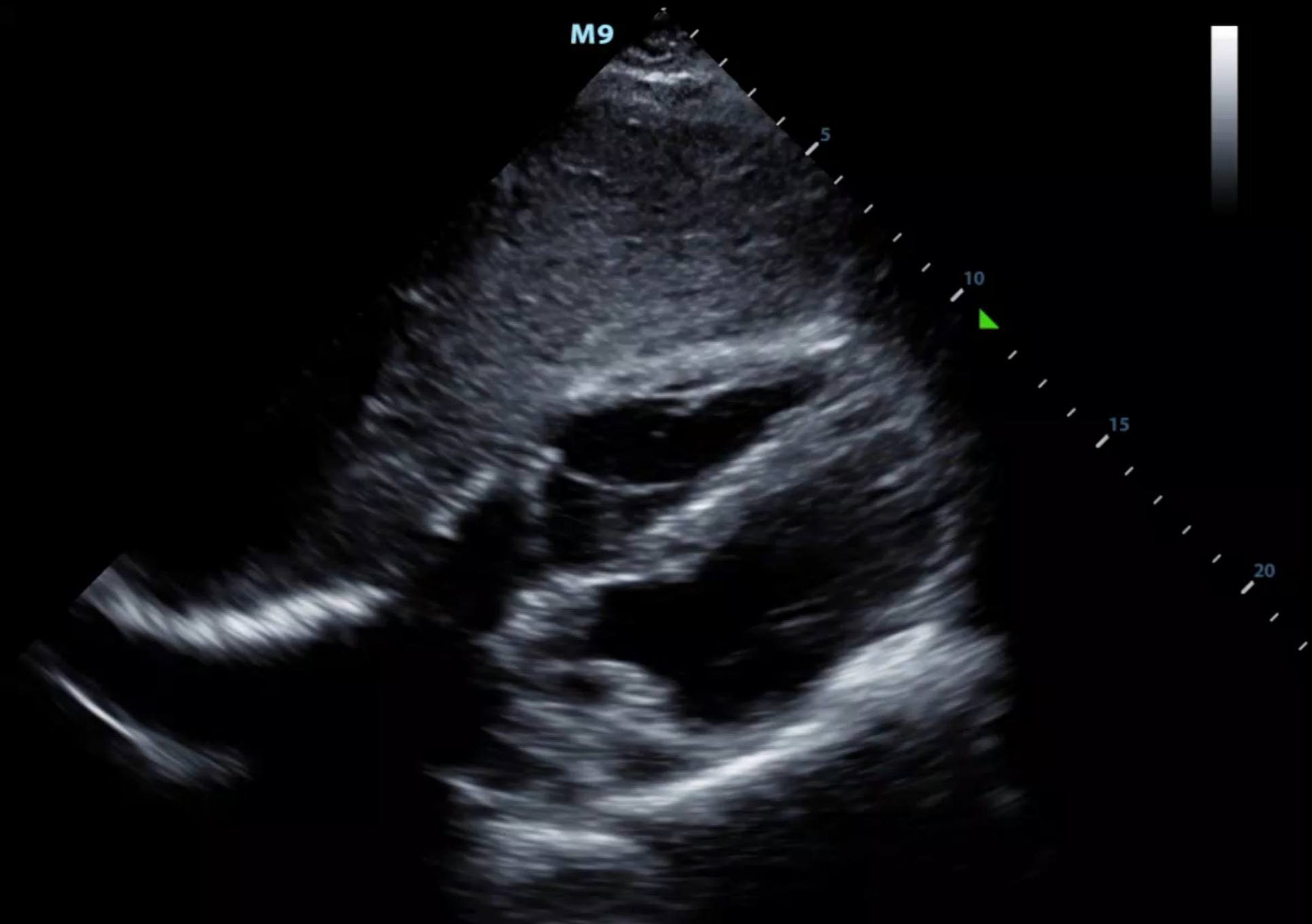
x

G  
P R  
1.6 3.2

# Subcostal long-axis



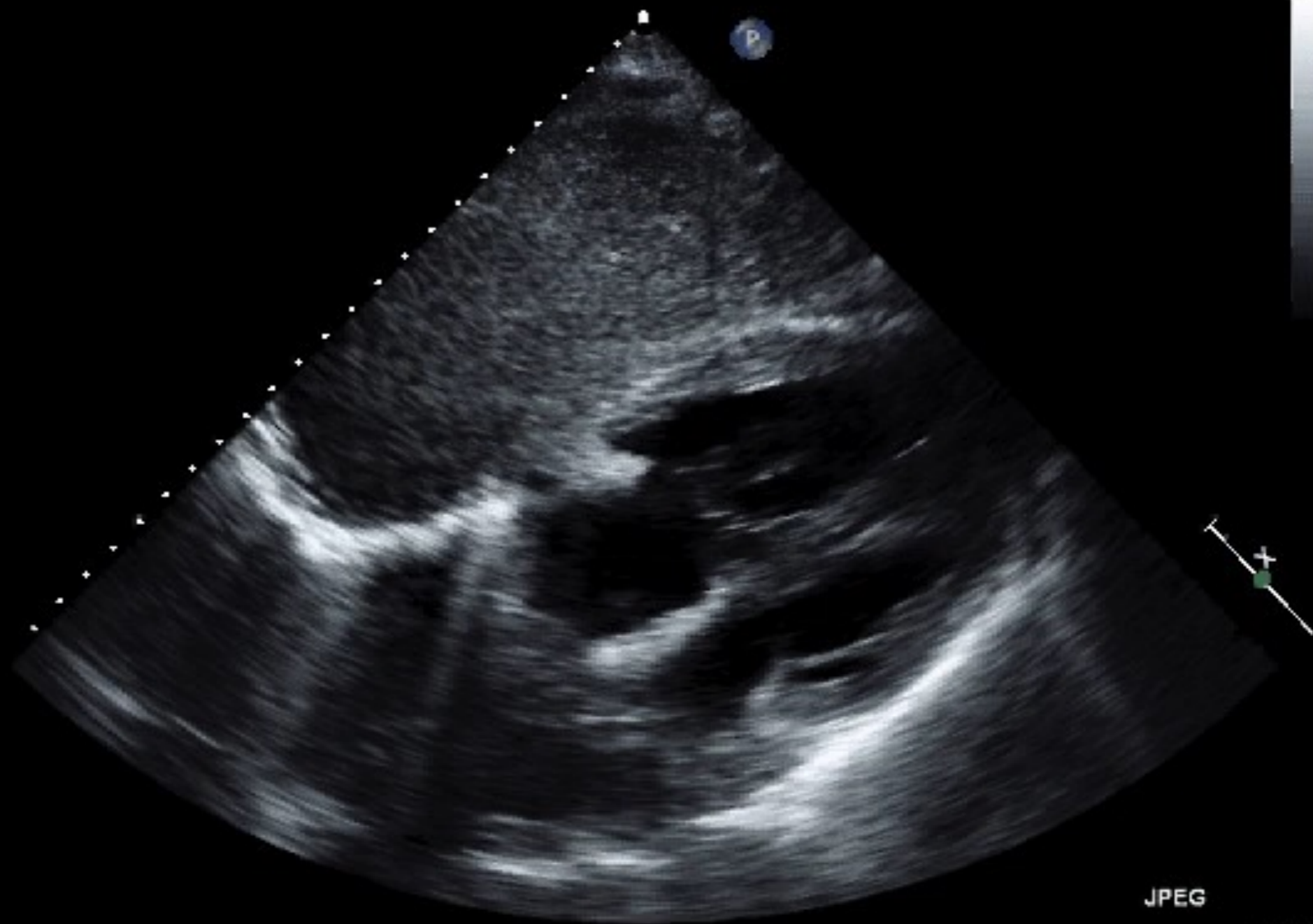
# Subcostal long-axis



# Subcostal long-axis

24cm

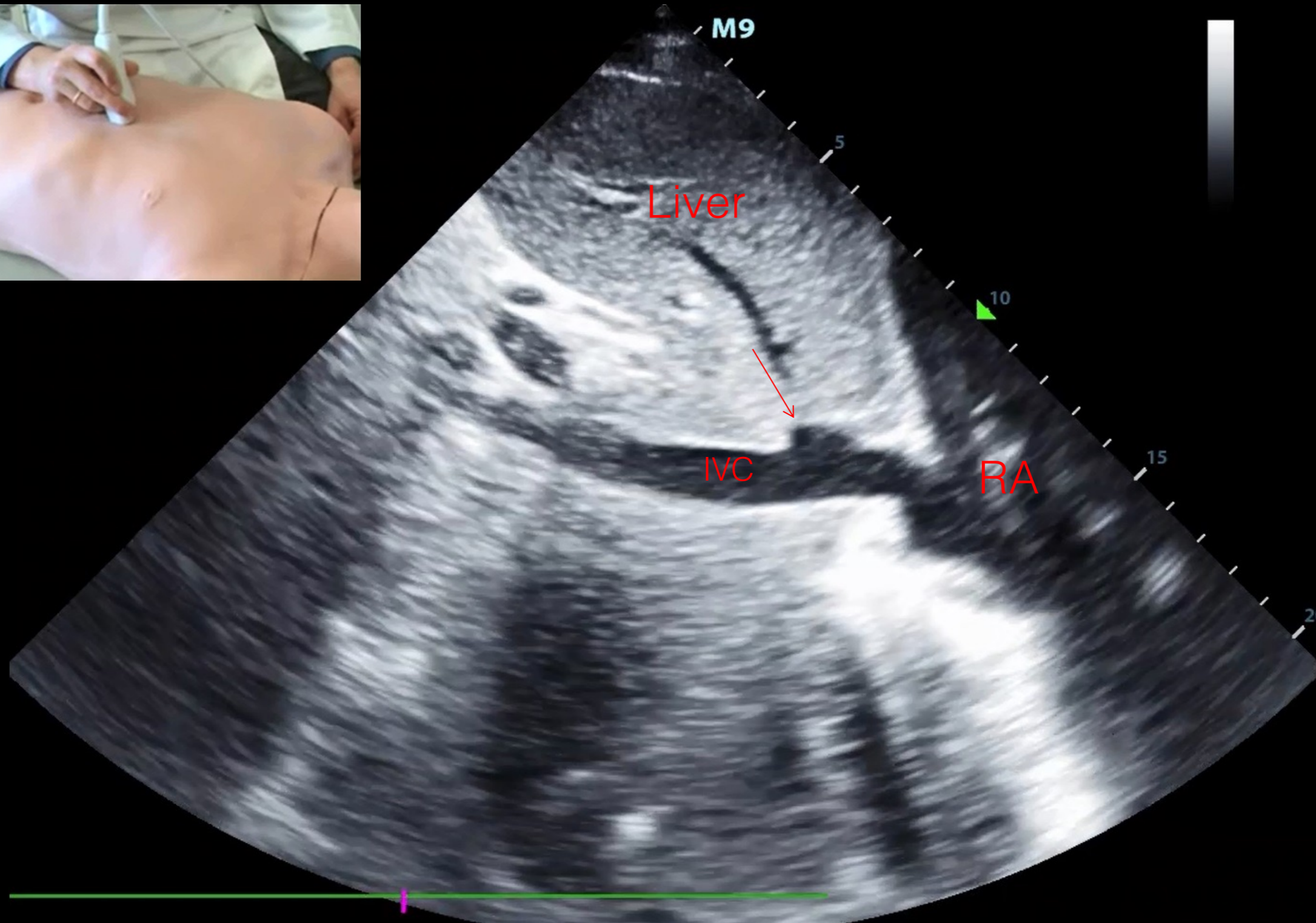
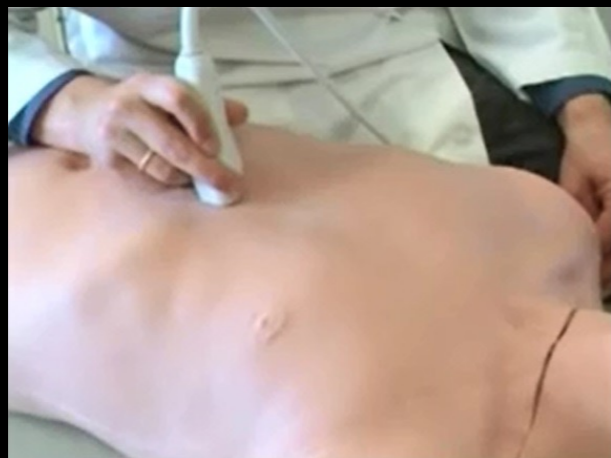
**2D**  
66%  
C 50  
P Med  
HPen



JPEG

97 bpm

# IVC



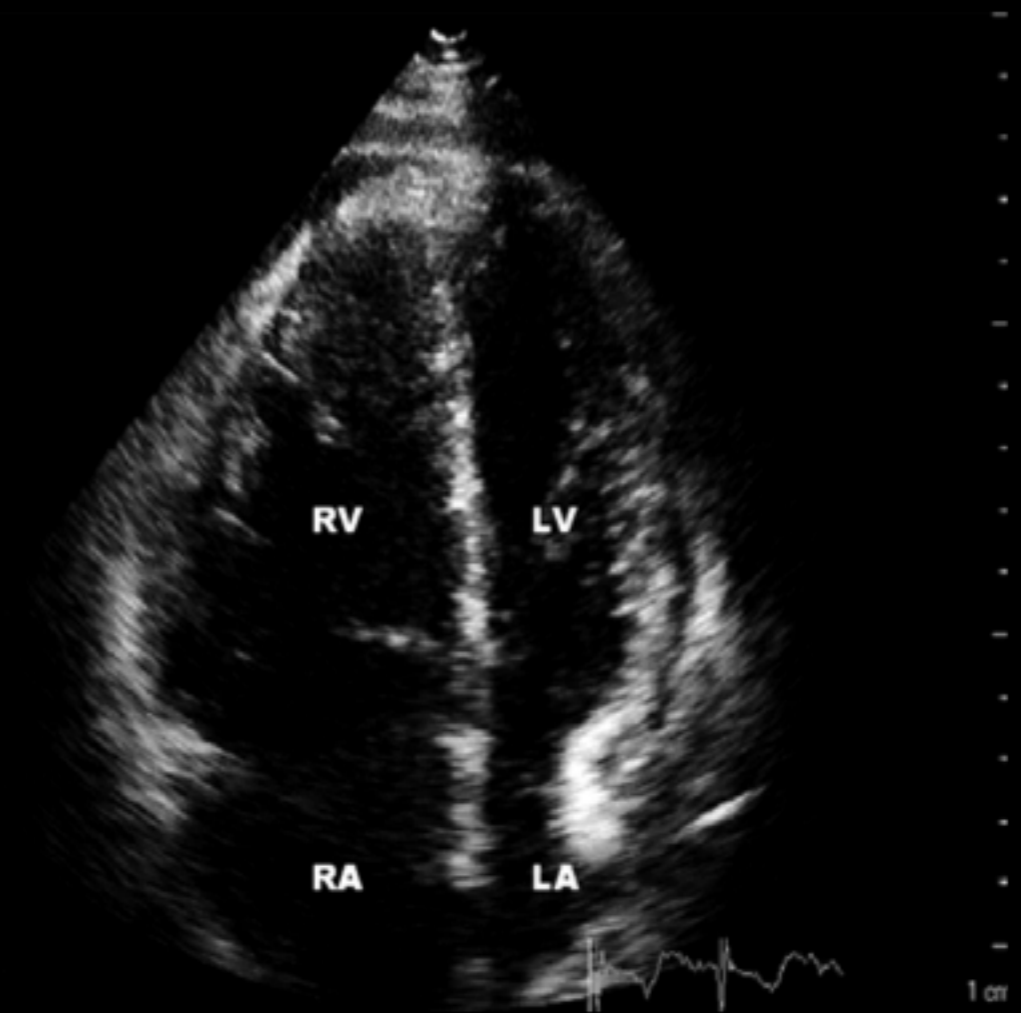
# IVC





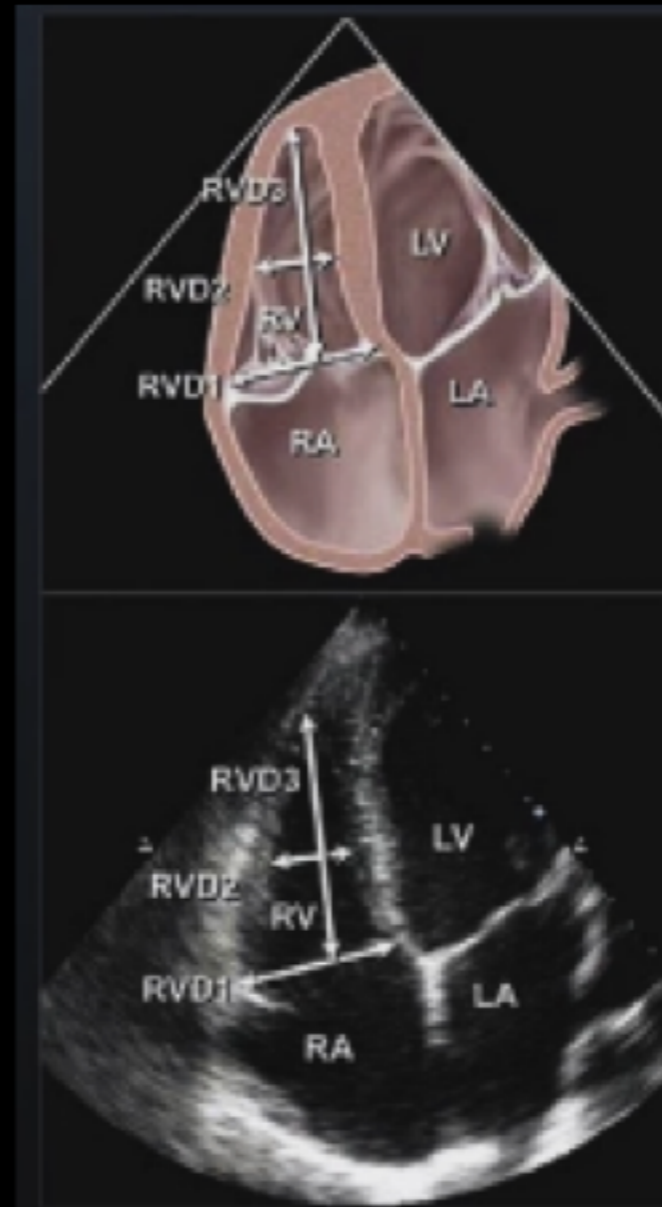
# RV Dysfunction – 2D Echo

- RV Dilation
- Dilated IVC
- Septal Flattening
- Visualized clot
- McConnell's Sign



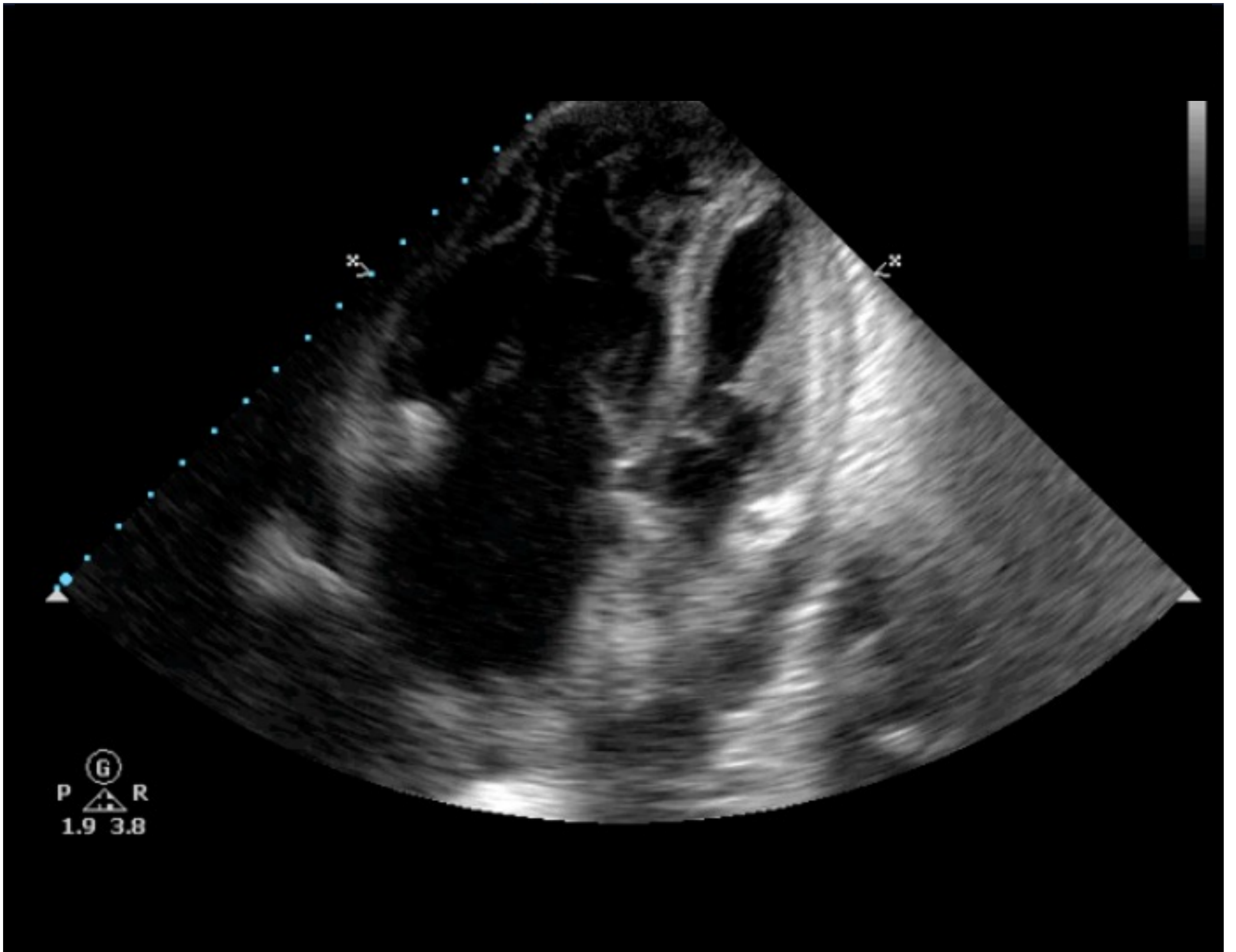
# RV dilation

- Measurements
  - RV diameter and length
  - Diastole
- Size
  - Base < 4.2cm (RVD1)
  - Mid < 3.5cm (RVD2)
  - Length < 8.6cm (RVD3)



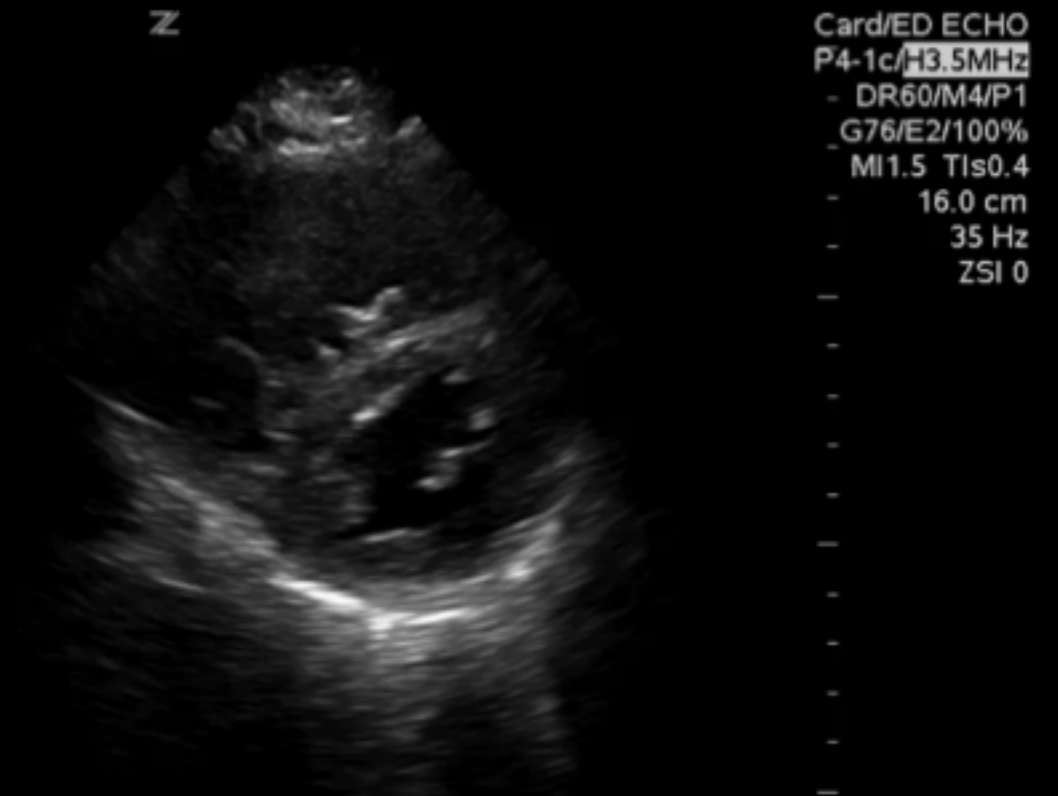
# RV dilation > 1:1





# Septal Flattening

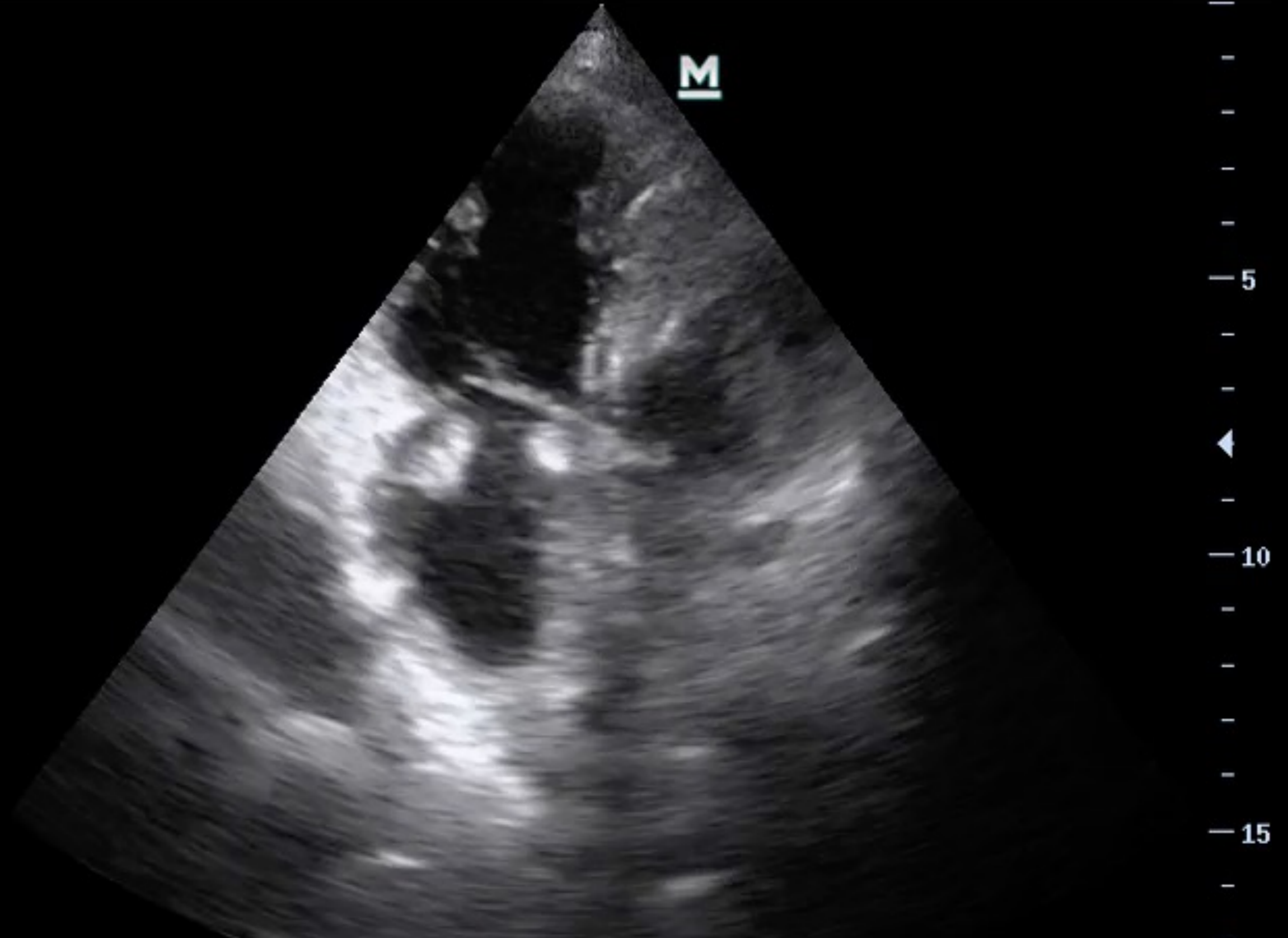
- Interventricular septum
  - Normal: LV bowing
  - Abnormal: septal flattening, RV septal bowing
- D-sign





# Clot in Transit

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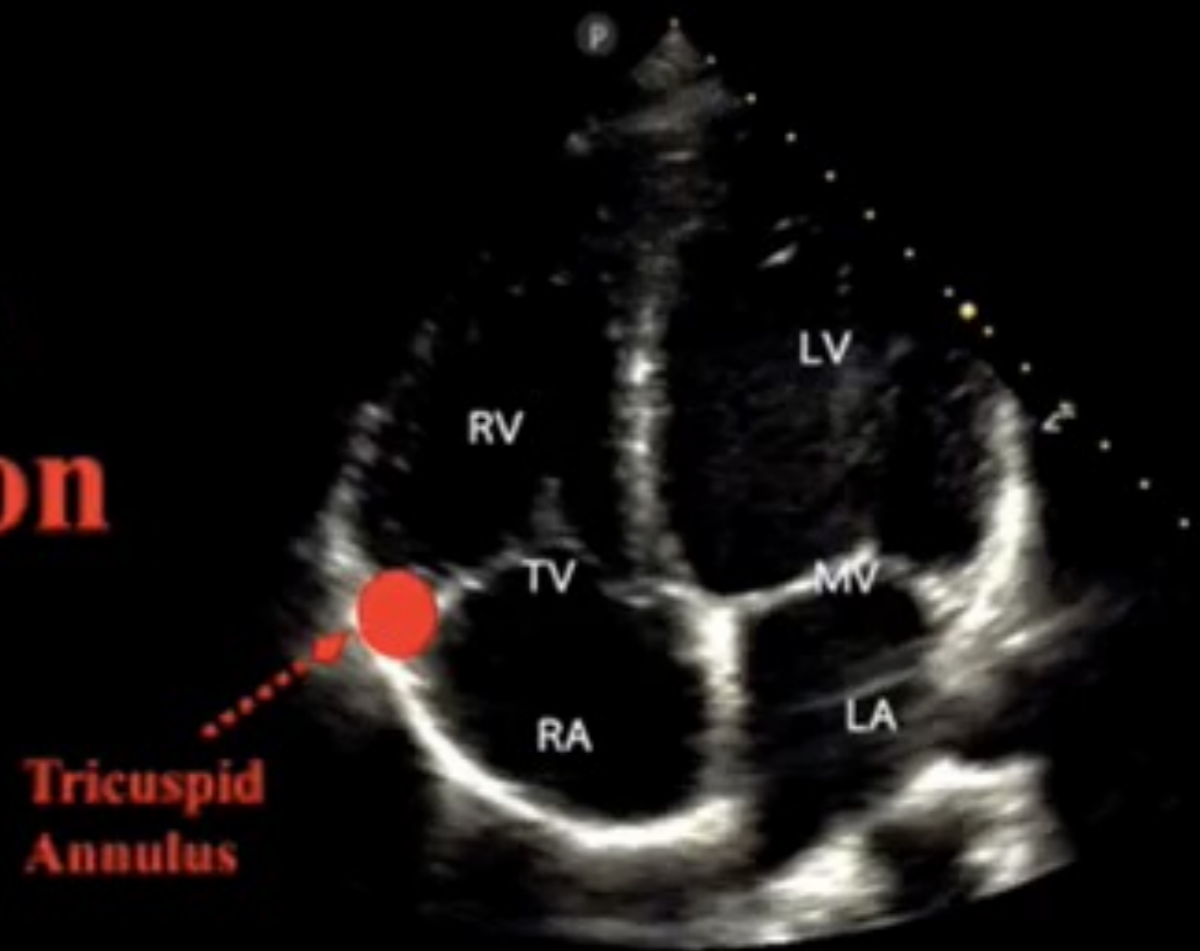


# RV Function

- Qualitative, “eyeball”
- TAPSE
- Fractional Area Change (FAC)

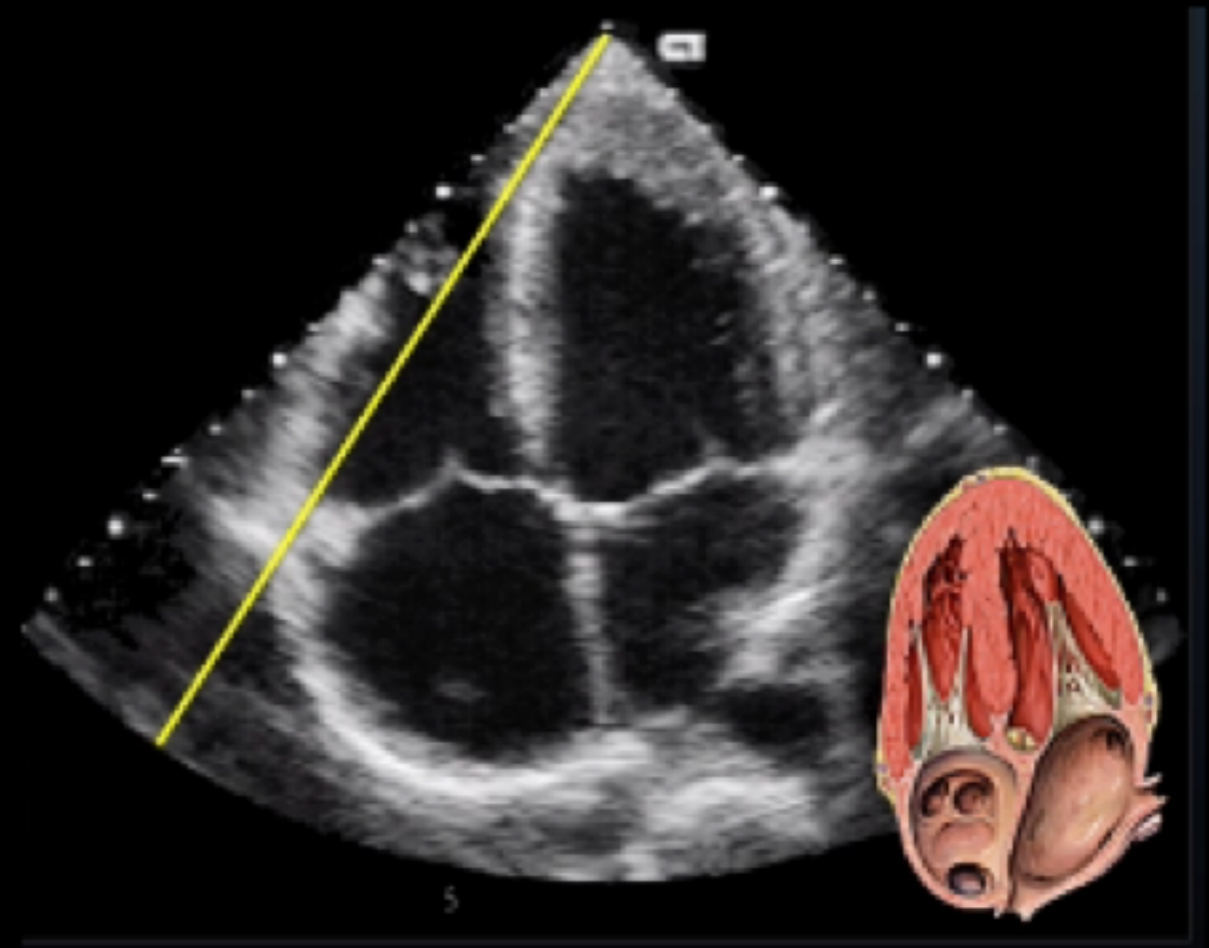
# TAPSE

**Tricuspid  
Annular Plane  
Systolic Excursion**



# RV FUNCTION: TAPSE

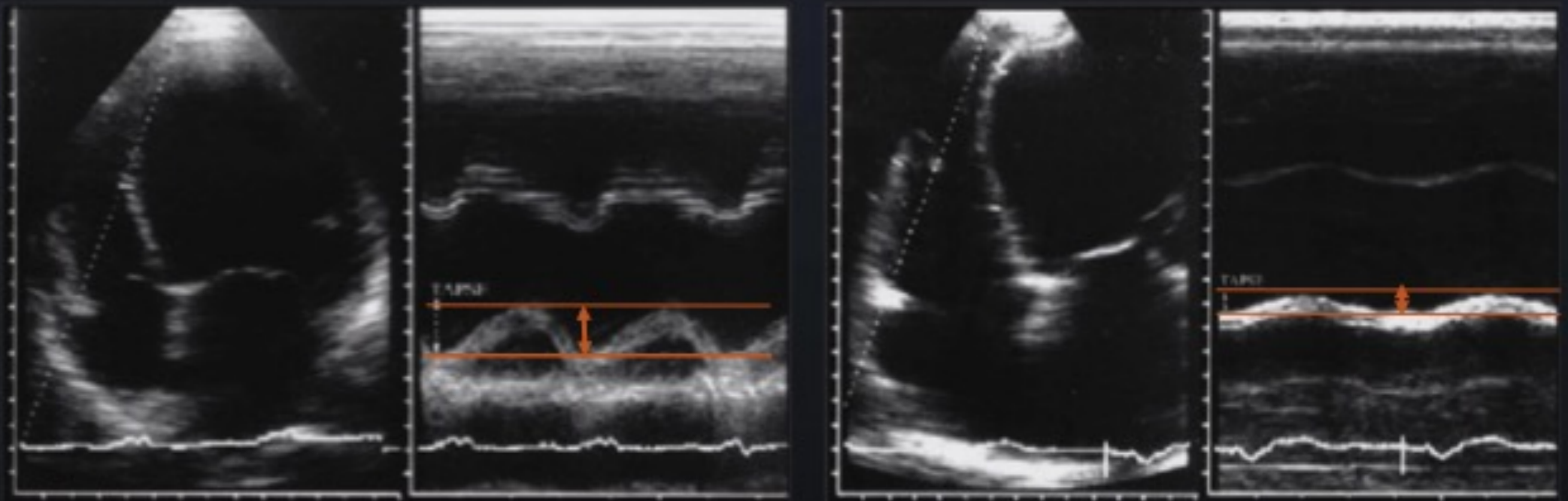
- Tricuspid Annular Plane Systolic Excursion
- A4C
- M-Mode
  - M-mode over lateral tricuspid annulus
  - Record M-mode waveform
  - Measure height of tricuspid annulus wave
- Normal > 1.7cm



# TAPSE

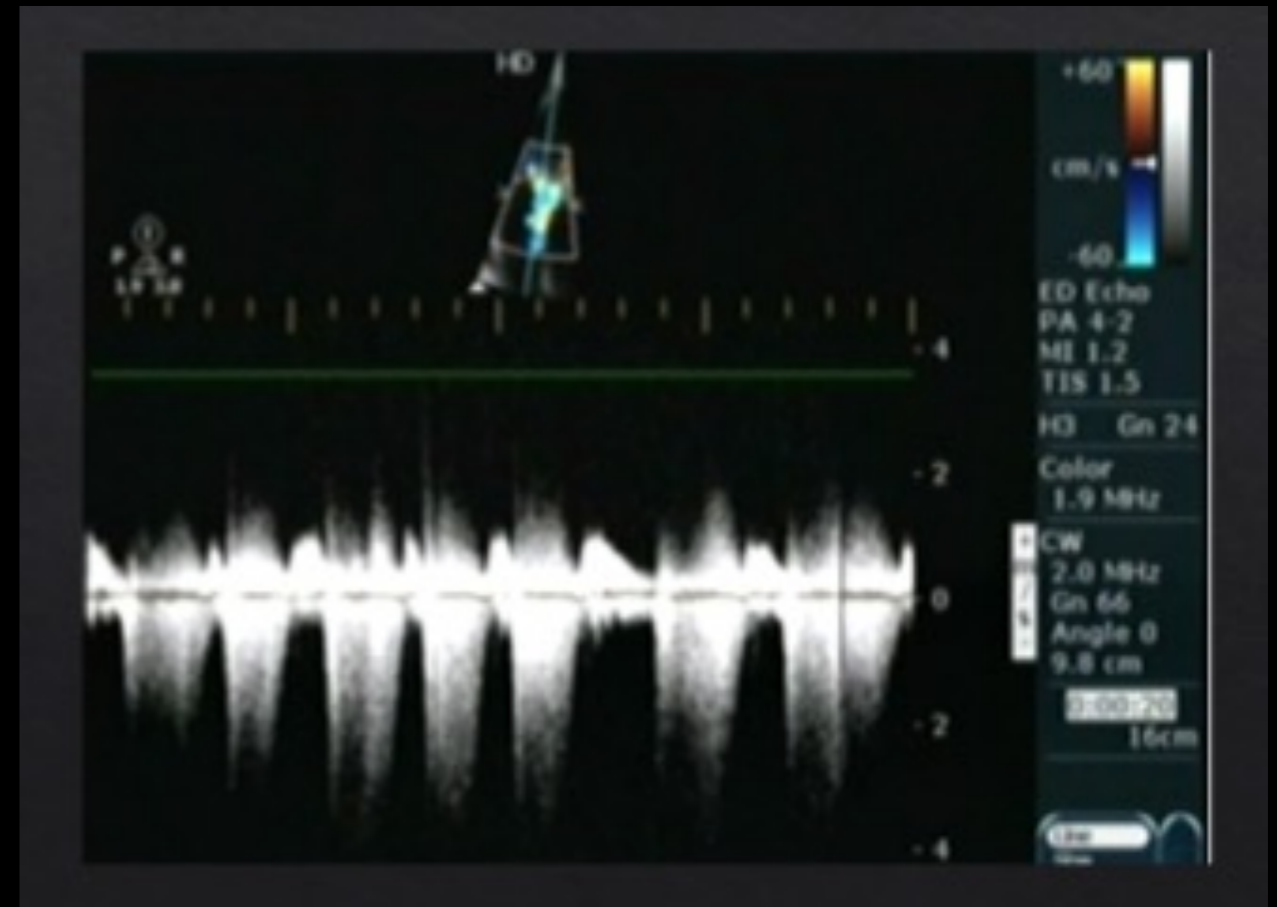
Normal

Abnormal



# RV Systolic Pressure

- Views
  - A4C, PS Short, RV inflow
  - TR jet
- $RVSP = \Delta P + RAP$ 
  - $\Delta P = 4V_{max}^2$
  - $RAP =$  estimated from IVC
- Continuous Wave Doppler
  - Measuring gate placed into regurgitation jet
  - Calculates  $V_{max}$



# Right Atrial Pressure

- ◆ Inferior Vena Cava Diameter
  - ◆ Distal to Hepatic Vein
  - ◆ Max Inspiration and Expiration
  - ◆ Perpendicular to Long Axis

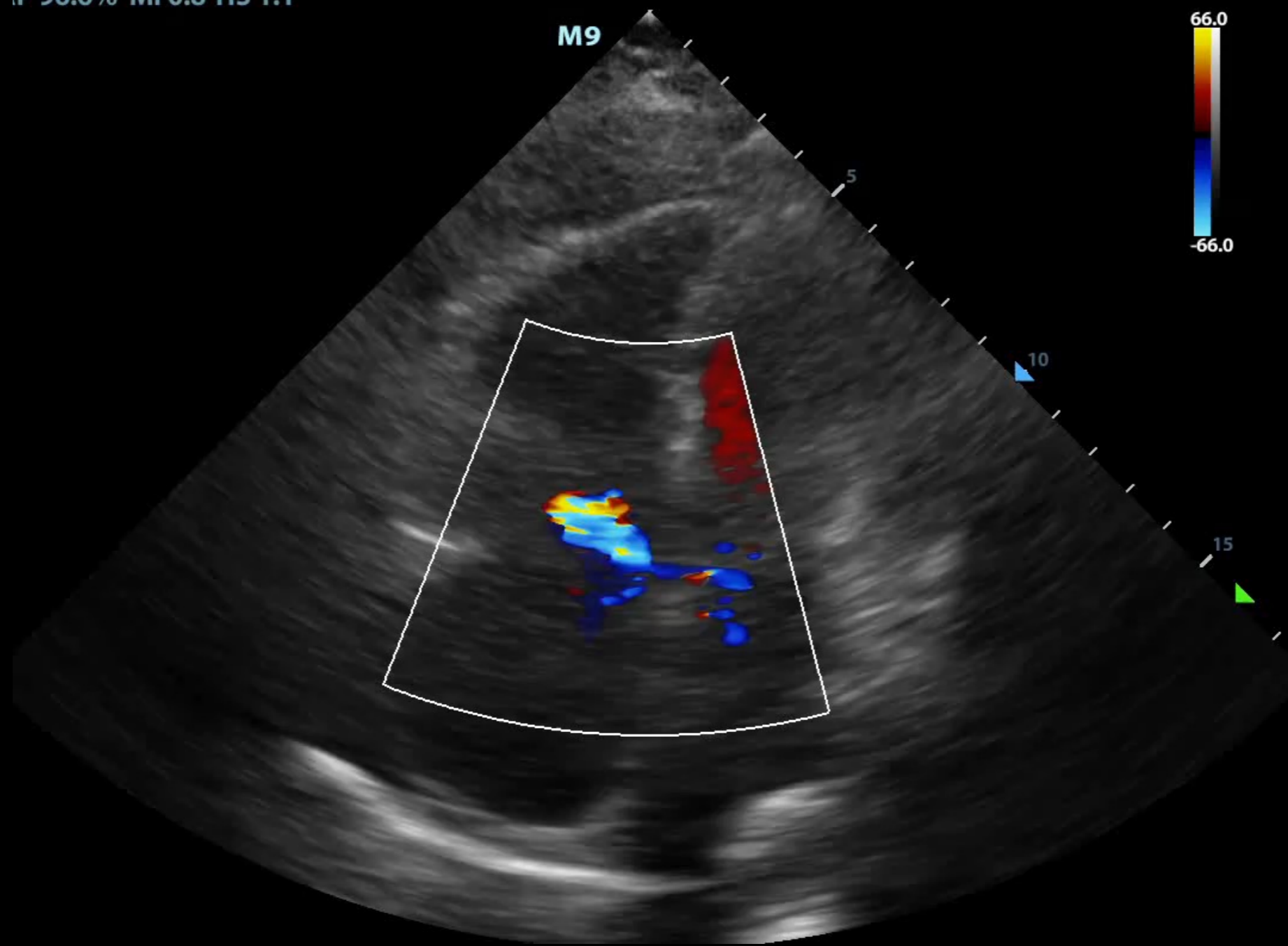
Variable	Normal	Intermediate		High
IVC Diameter	<2.1cm	>2.1cm	<2.1cm	>2.1cm
Collapse with Respirations	>50%	<50%	>50%	<50%
Right Atrial Pressure	3	8		15

# Tricuspid Regurgitation

- ◆ Continuous Wave Doppler
  - ◆ Cursor at max TR Jet
- ◆ Normal Regurgitant Jet
  - ◆  $<2\text{m/s}$
- ◆ Abnormal Regurgitant Jet
  - ◆  $>3\text{m/s}$



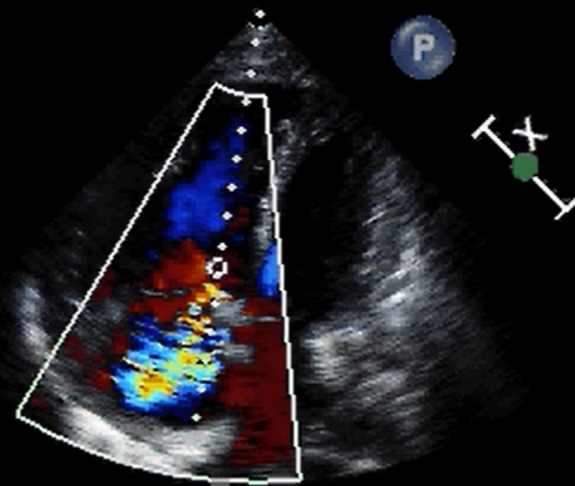
IP 96.6% MI 0.8 TIS 1.1



GO

FR 15Hz  
16cm

2D  
55%  
C 50  
P Med  
HPen  
CF  
66%  
2.5MHz  
WF High  
Med



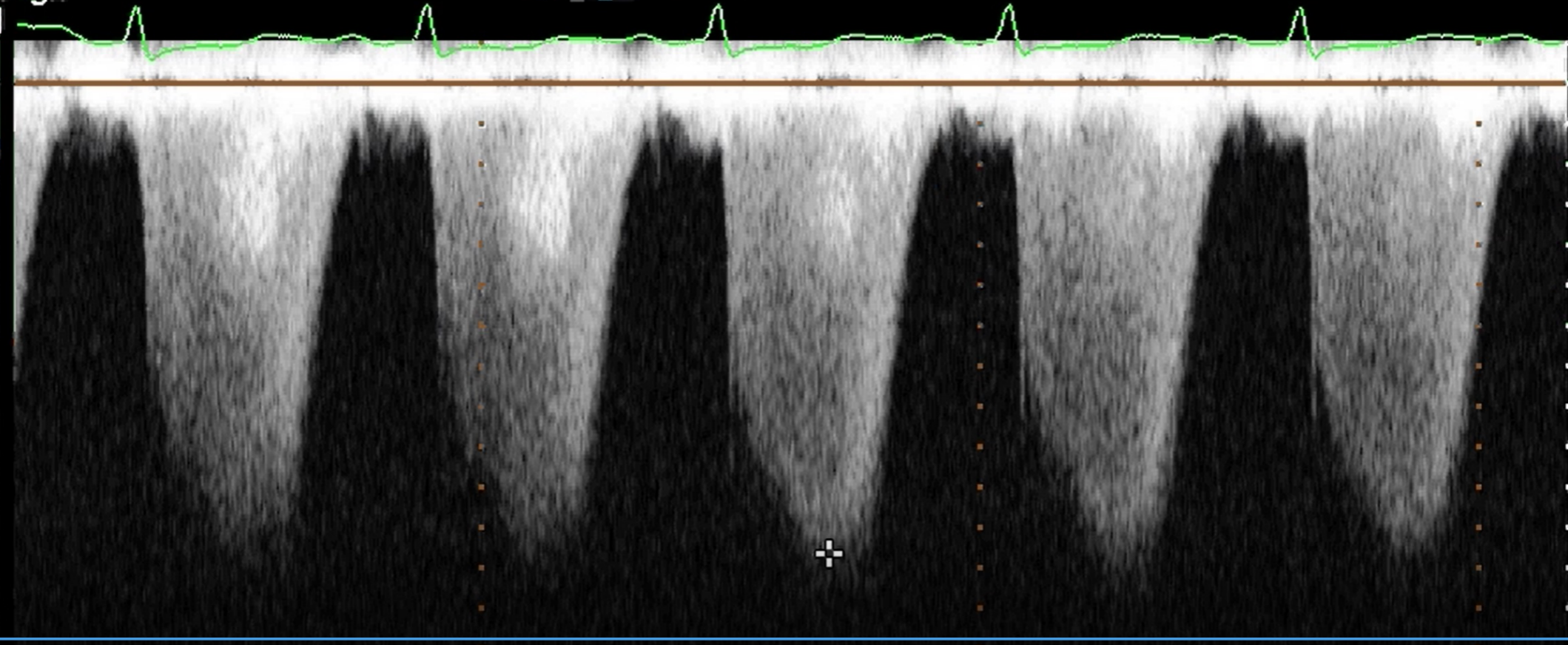
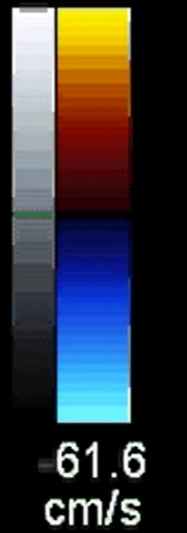
+ TR Vmax

Vmax 582 cm/s  
Max PG 136 mmHg

CW

60%  
1.8MHz  
WF 225Hz

M3 M4  
+61.6



m/s  
-1.0  
-2.0  
-3.0  
-4.0  
-5.0  
-6.0  
-7.0

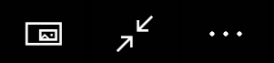
0:00:00

0:00:00



75mm/s

103bpm



# Take home points

- Echocardiographic signs of RV dysfunction
  - Large RV (RV > LV)
  - Dilated IVC
  - Septal flattening (D-shaped LV)
  - McConnell's Sign
  - TAPSE < 17 mm
  - Elevated RVSP

# Question

- 65 yo M with hx: htn, COPD, CHF. Acutely short of breath on POD 2 after laparoscopic CCY. HR 120, BP 90/50, O2 89% RA, T 100.8. PE: Alert, CV: tachycardia no murmurs, Pulm: tachypneic, no wheezing, crackles at bases. Abd: soft, NT, Ext: palpable distal pulse. Point of care ultrasound: A line predominant lung US. Heart: Hyperdynamic LV function. RV>LV. McConnell's sign. Plethoric IVC. Incompressible common femoral vein. In this situation McConnell's sign is:
  - A) Specific for pulmonary embolus
  - B) Suggestive of acute right heart dysfunction
  - C) Present if the right ventricle is larger than the left ventricle
  - D) Present if the function of the base of the right hear is preserved relative to the apex

# Questions??

- <http://www.chestnet.org/Education/Advanced-Clinical-Training/Certificate-of-Completion-Program/Critical-Care-Ultrasonography>
- <http://www.sccm.org/Education-Center/Critical-Care-Ultrasound>