
# Ultrasound in the Crashing Patient

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High Risk EM Hawaii

# Outline

- Ultrasound Protocol
- Ultrasound Technique
- Clinical Cases

# Ultrasound Protocols

Multiple protocols exist to evaluate volume status via ULS. The main components interrogate the Heart, Lungs and IVC.

RUSH= Rapid ULS for SHock in HoTN
RADiUS= Rapid Assessment of Dyspnea with ULS (Heart, Pleural Line, Pleural eff, IVC)
Triple Scan= Heart + Lungs + IVC
ACES= **Abdominal and Cardiac Evaluation with Sonography in Shock**
**FALLS= Fluid Administration Limited by Lung ULS**

# Ultrasound Protocols

- RUSH

# Ultrasound Protocols

- RUSH
- RADiUS

# Ultrasound Protocols

- RUSH
- RADiUS
- Triple Scan

# Ultrasound Protocols

- RUSH
- RADiUS
- Triple Scan
- ACES

# Ultrasound Protocols

# Ultrasound Protocols

1. Cardiac Ultrasound
2. Lung Ultrasound
3. IVC Ultrasound

# Goals of the Exam

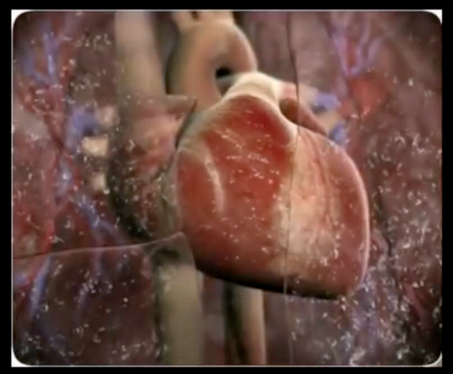
Pump function: Confirm Sys dysfunction (? acute vs chronic). Guide resuscitation
Lung exam: Pulmonary edema ( Helps distinguish b/w acute vs chronic heart failure)
IVC eval: Helps to assess between acute vs chronic heart failure as primary process. Helps in volume assessment.

# Goals of the Exam

Evaluate Pump Function

# Goals of the Exam

Evaluate Pump Function



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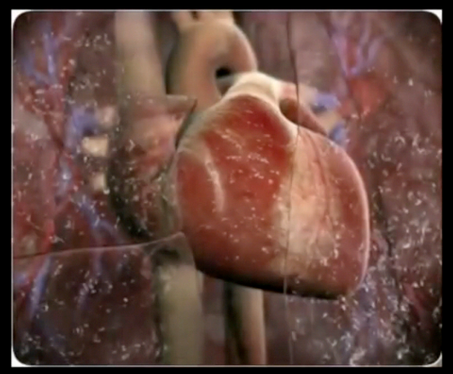
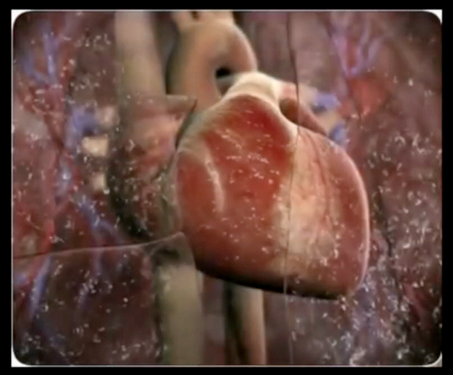
Evaluate Pump Function



Assess for Pulmonary Edema

# Goals of the Exam

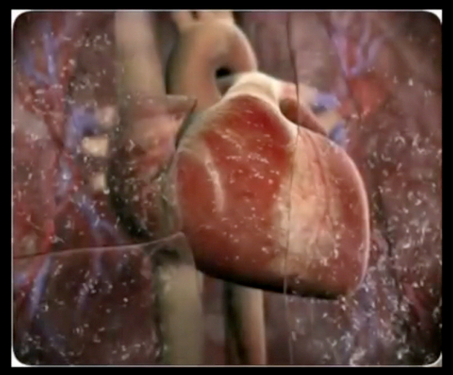
Evaluate Pump Function



Assess for Pulmonary Edema

# Goals of the Exam

Evaluate Pump Function



Assess for Pulmonary Edema

Interrogate IVC

# Cardiac Views

# Cardiac Views

- Parasternal Long Axis

# Cardiac Views

- Parasternal Long Axis
- Parasternal Short Axis

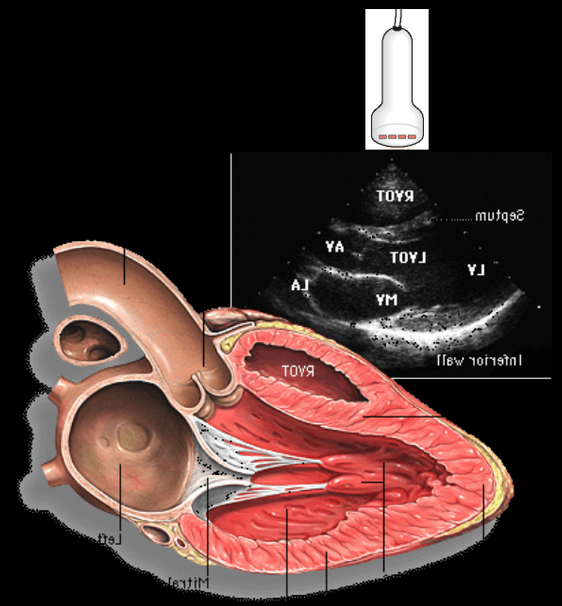
# Cardiac Views

- Parasternal Long Axis
- Parasternal Short Axis
- Subxiphoid

# Cardiac Views

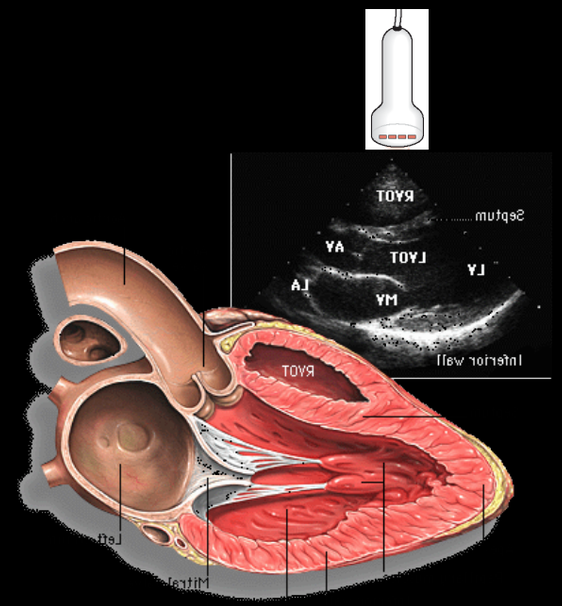
- Parasternal Long Axis
- Parasternal Short Axis
- Subxiphoid
- Apical / 4 Chamber View

# Parasternal Long




nipple level
marker to right shoulder

# Parasternal Long

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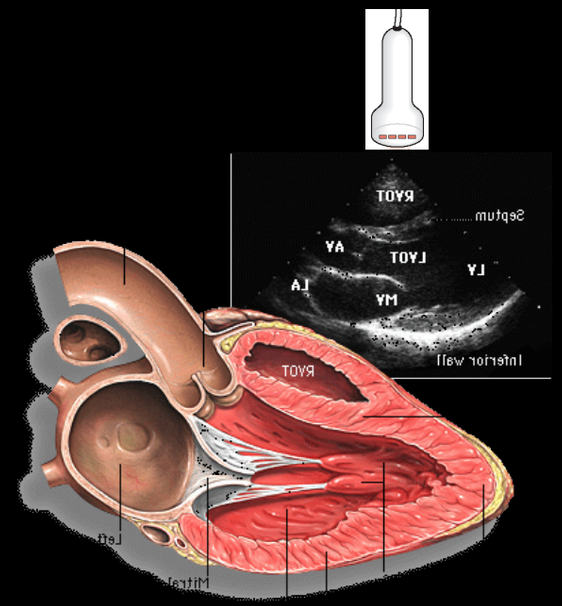


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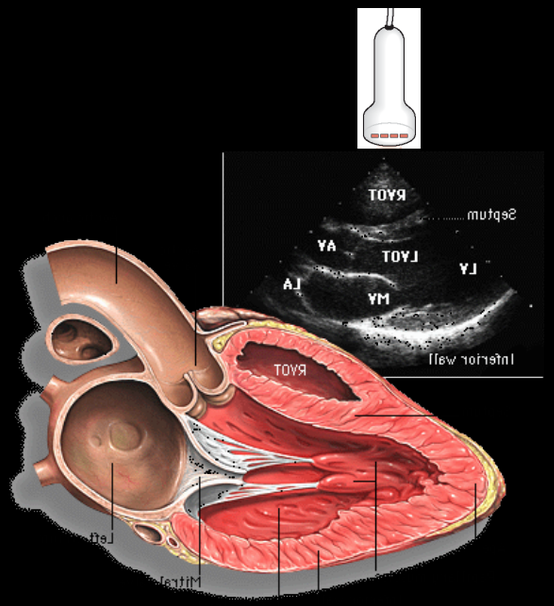
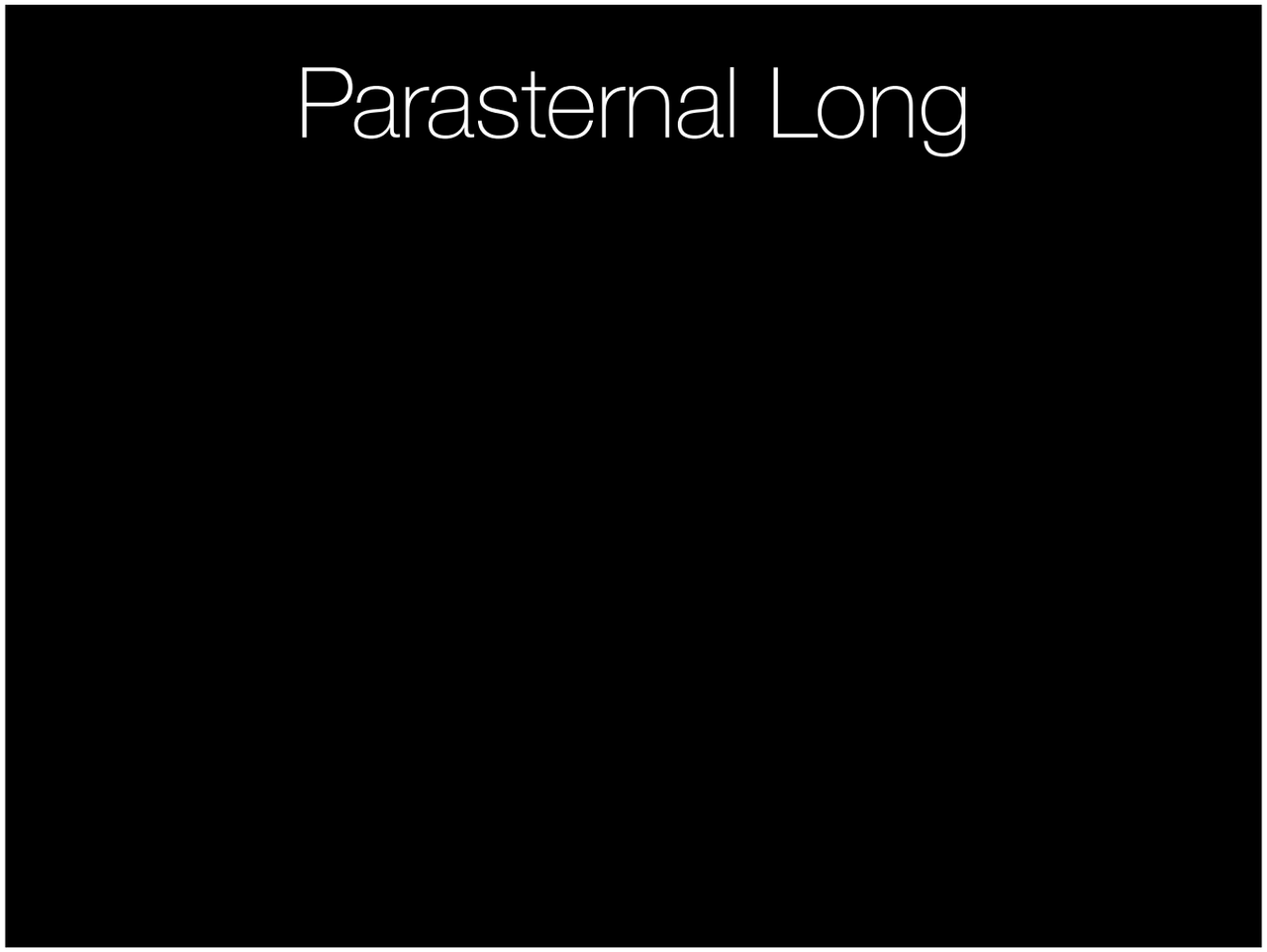



***Indicator towards the right shoulder***

# Parasternal Long



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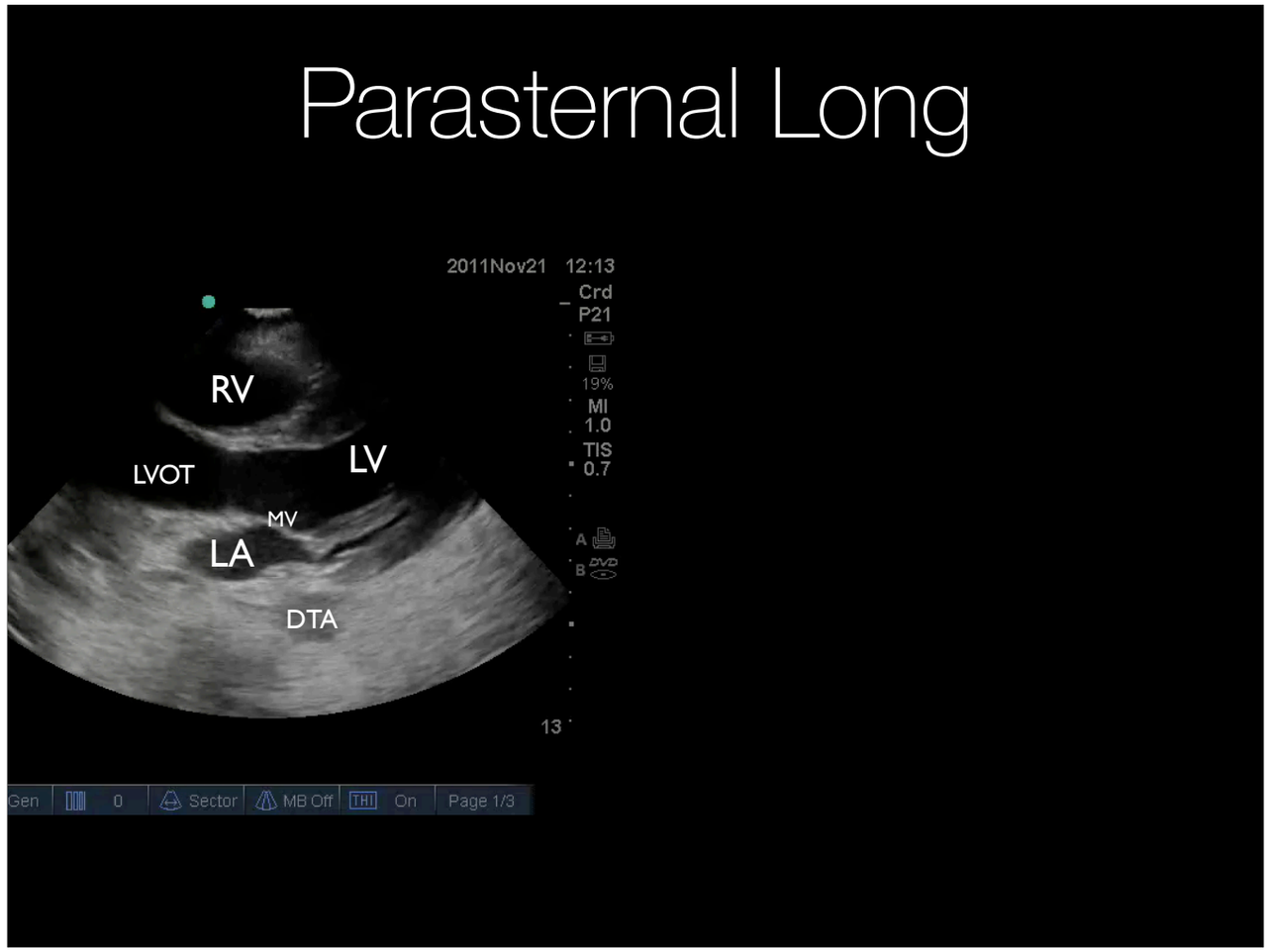

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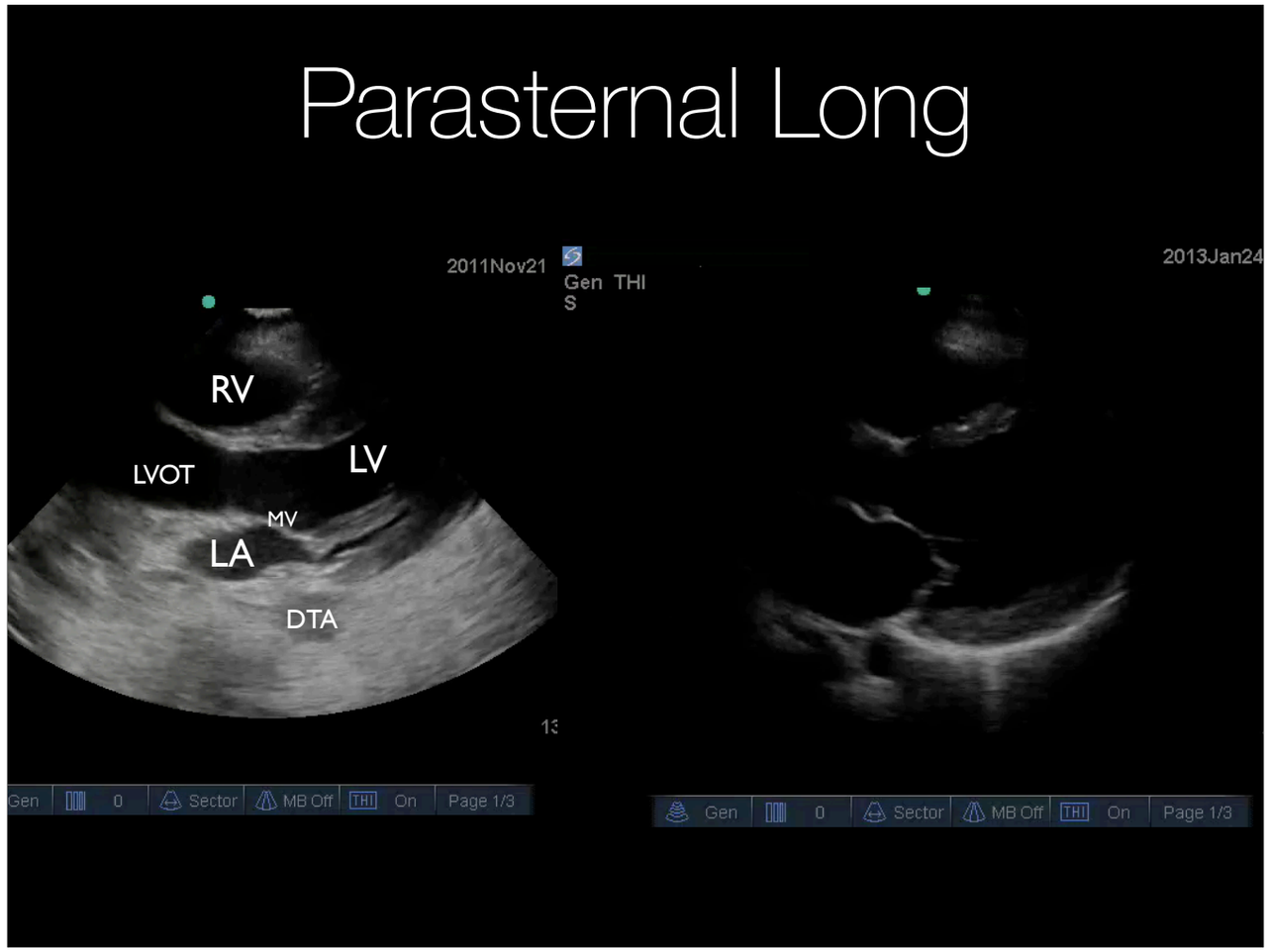

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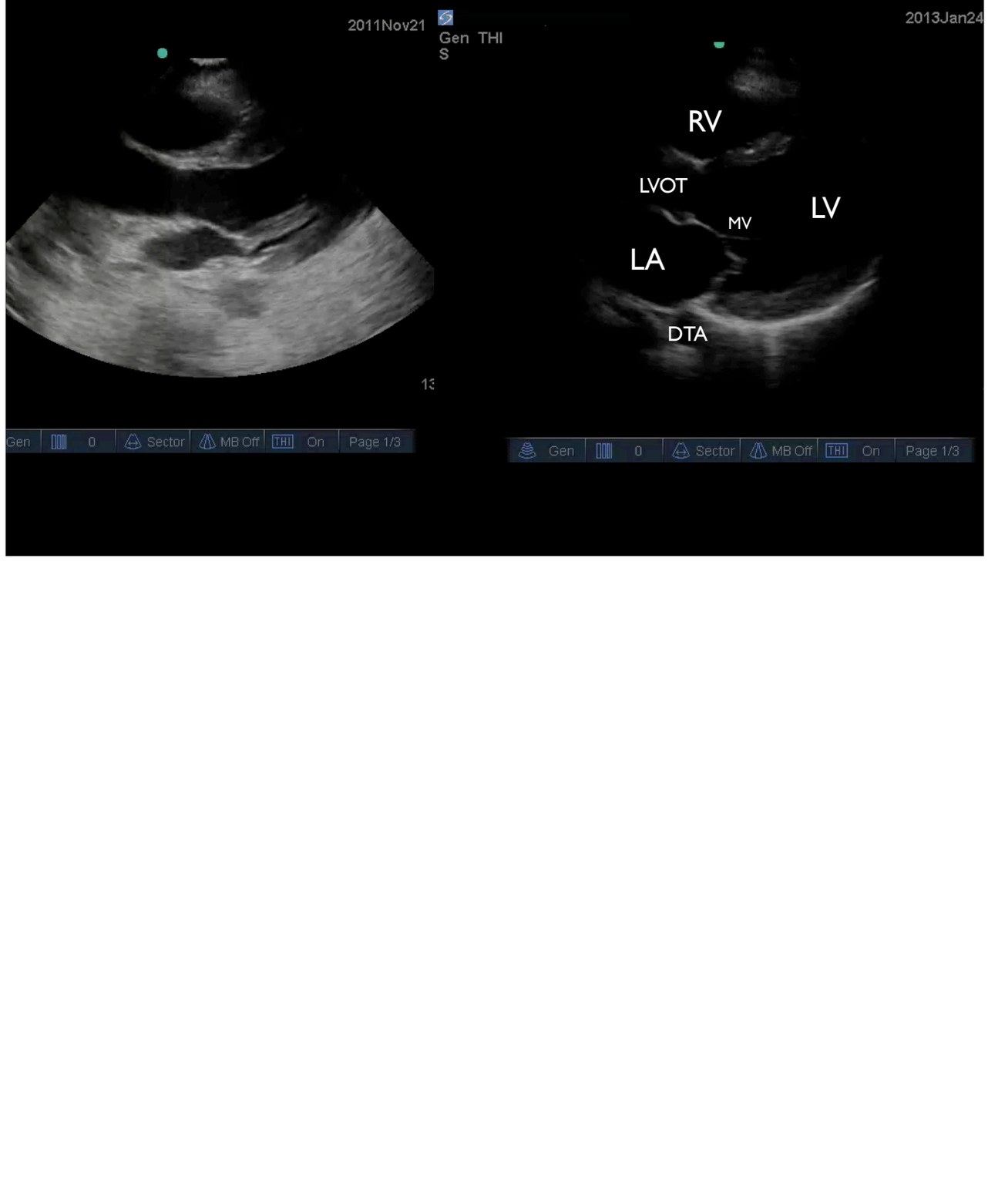

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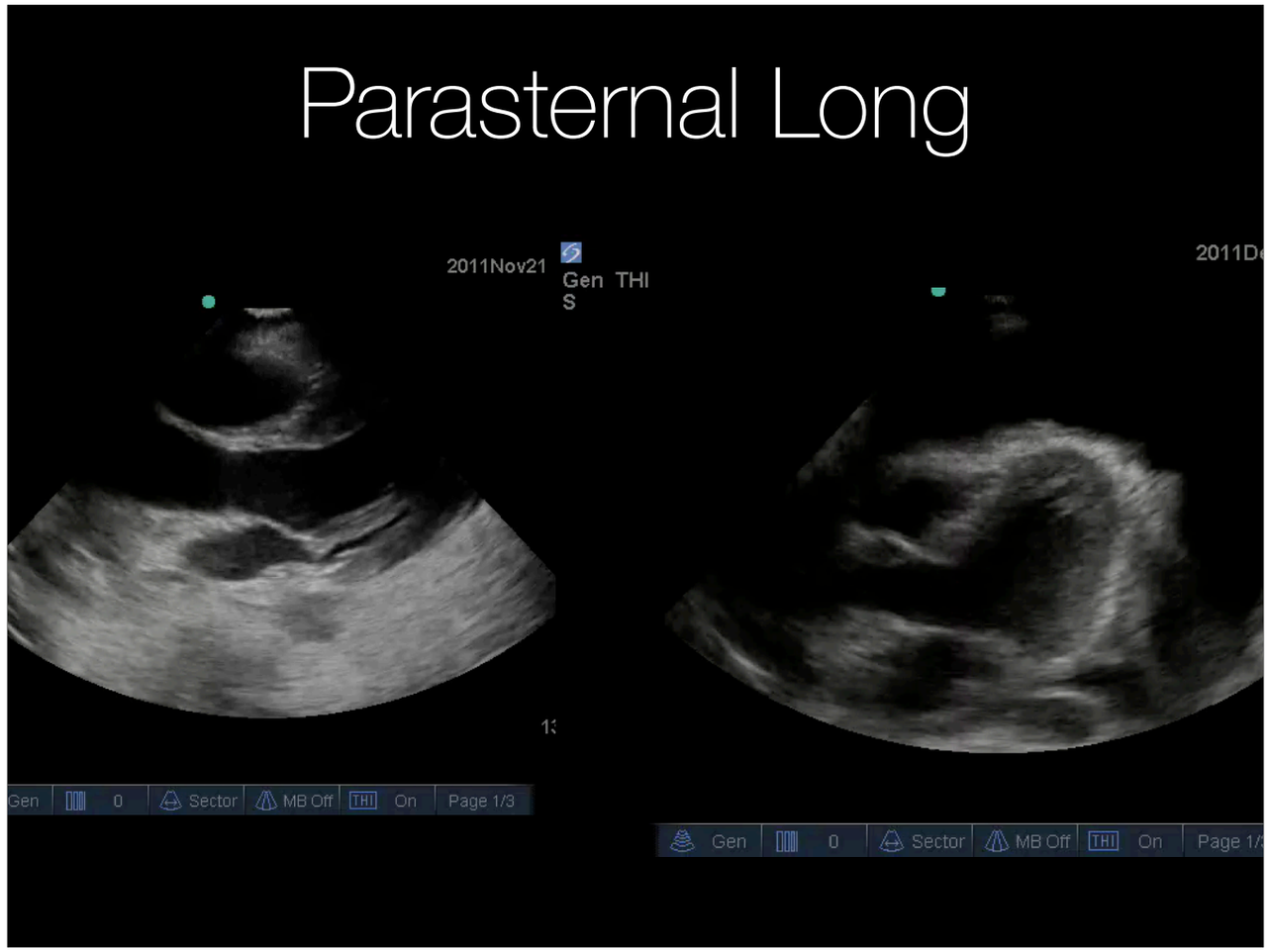

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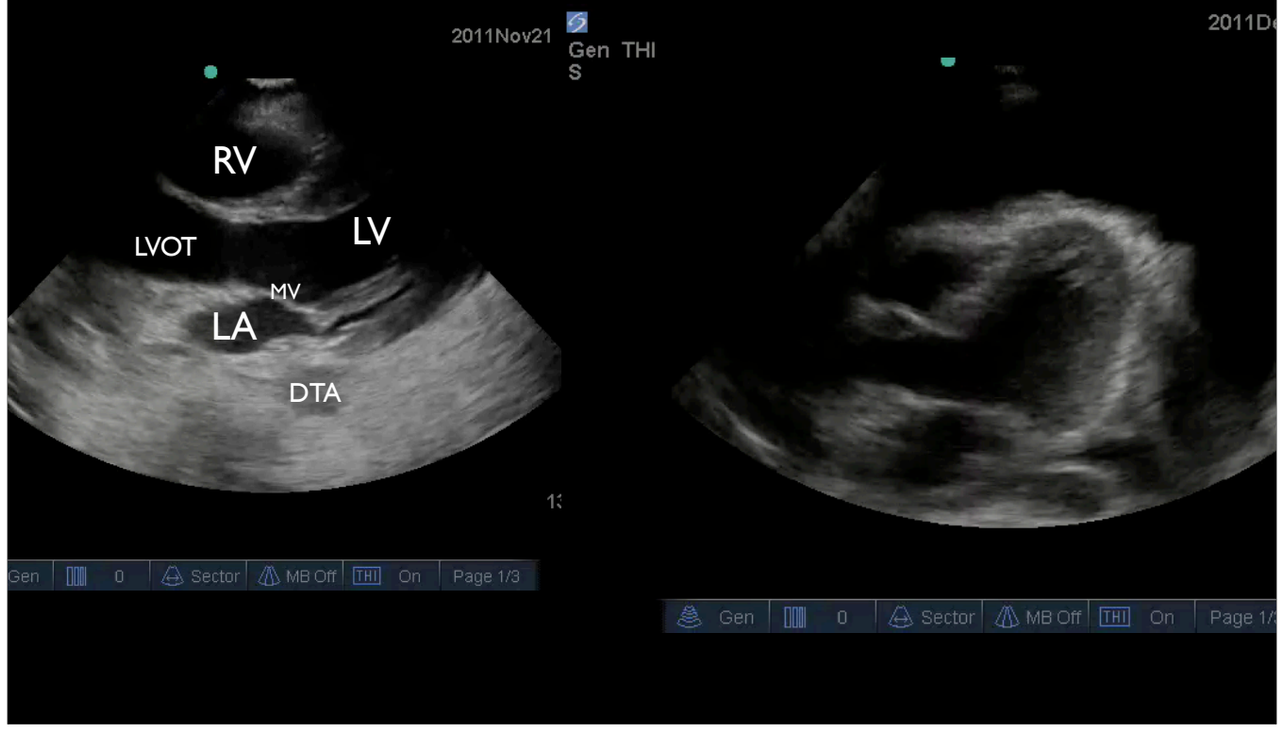

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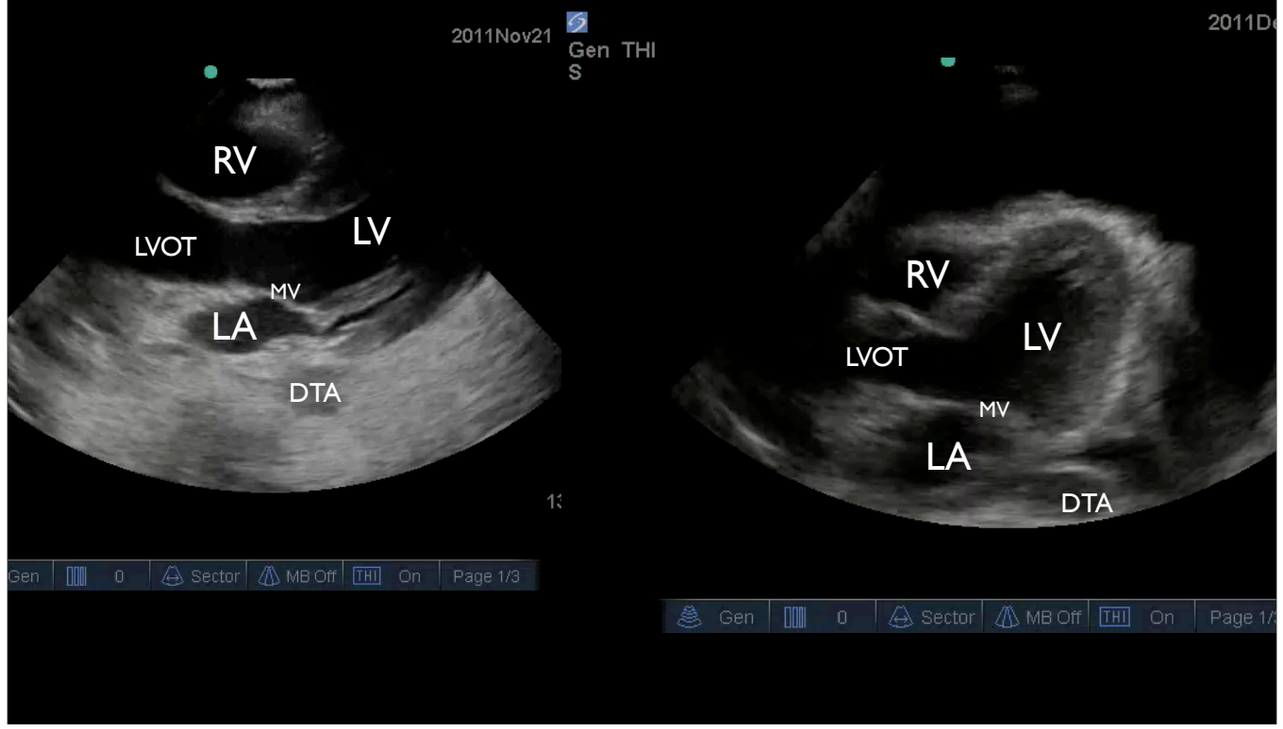
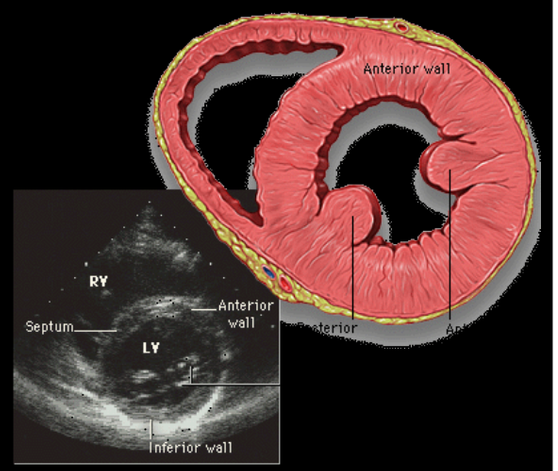


# Parasternal Short



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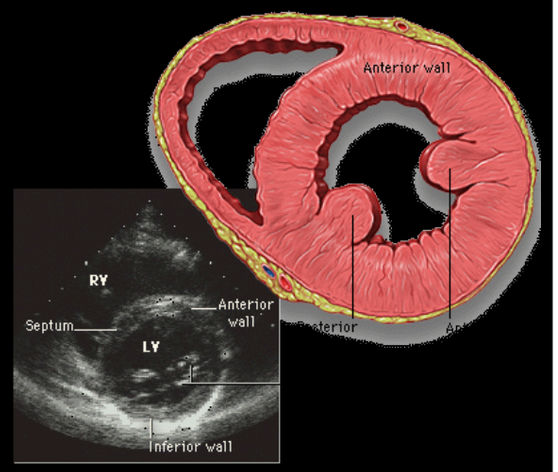
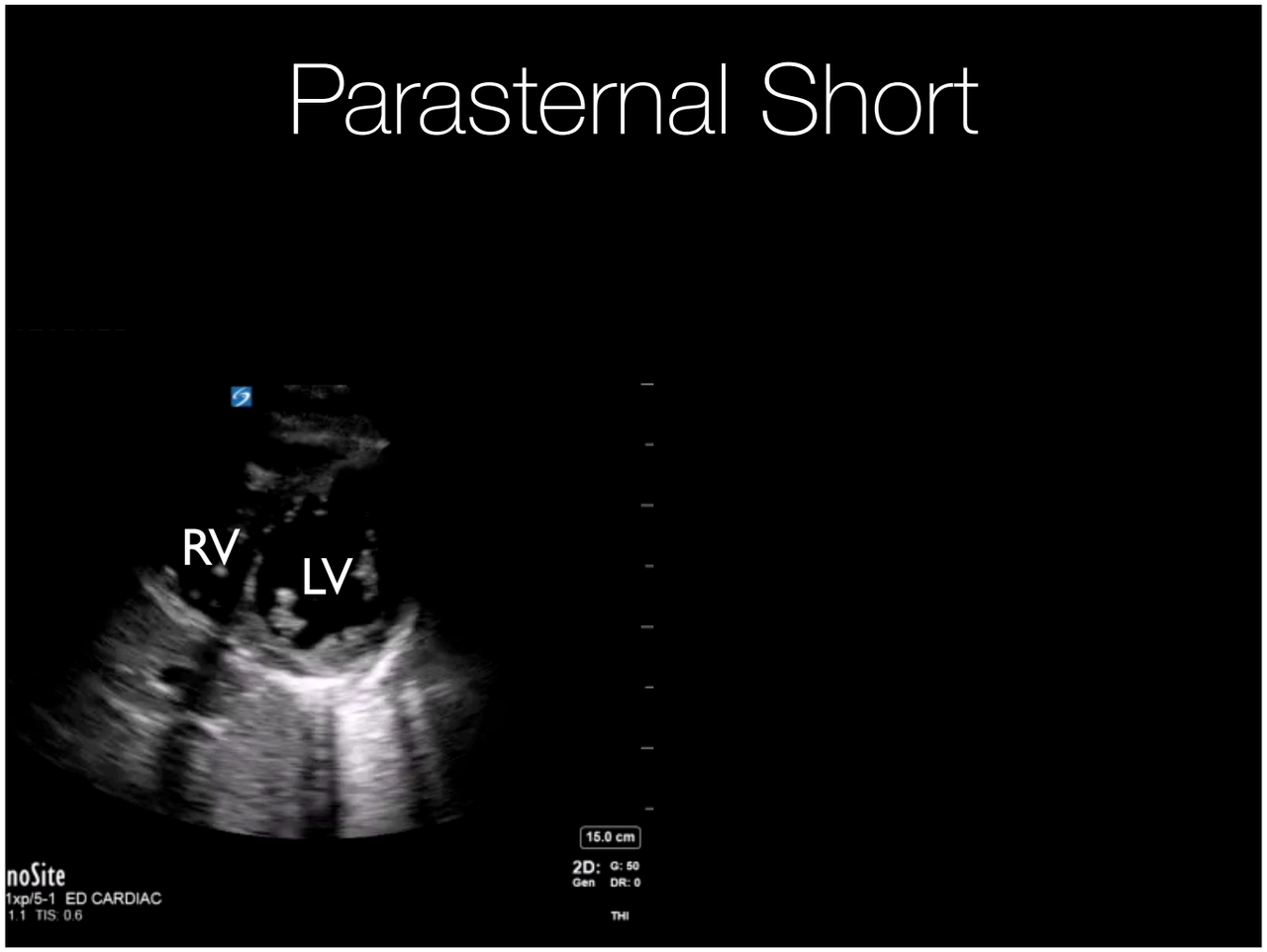



***Indicator towards the right hip***

# Parasternal Short

UPDATE images

# Parasternal Short



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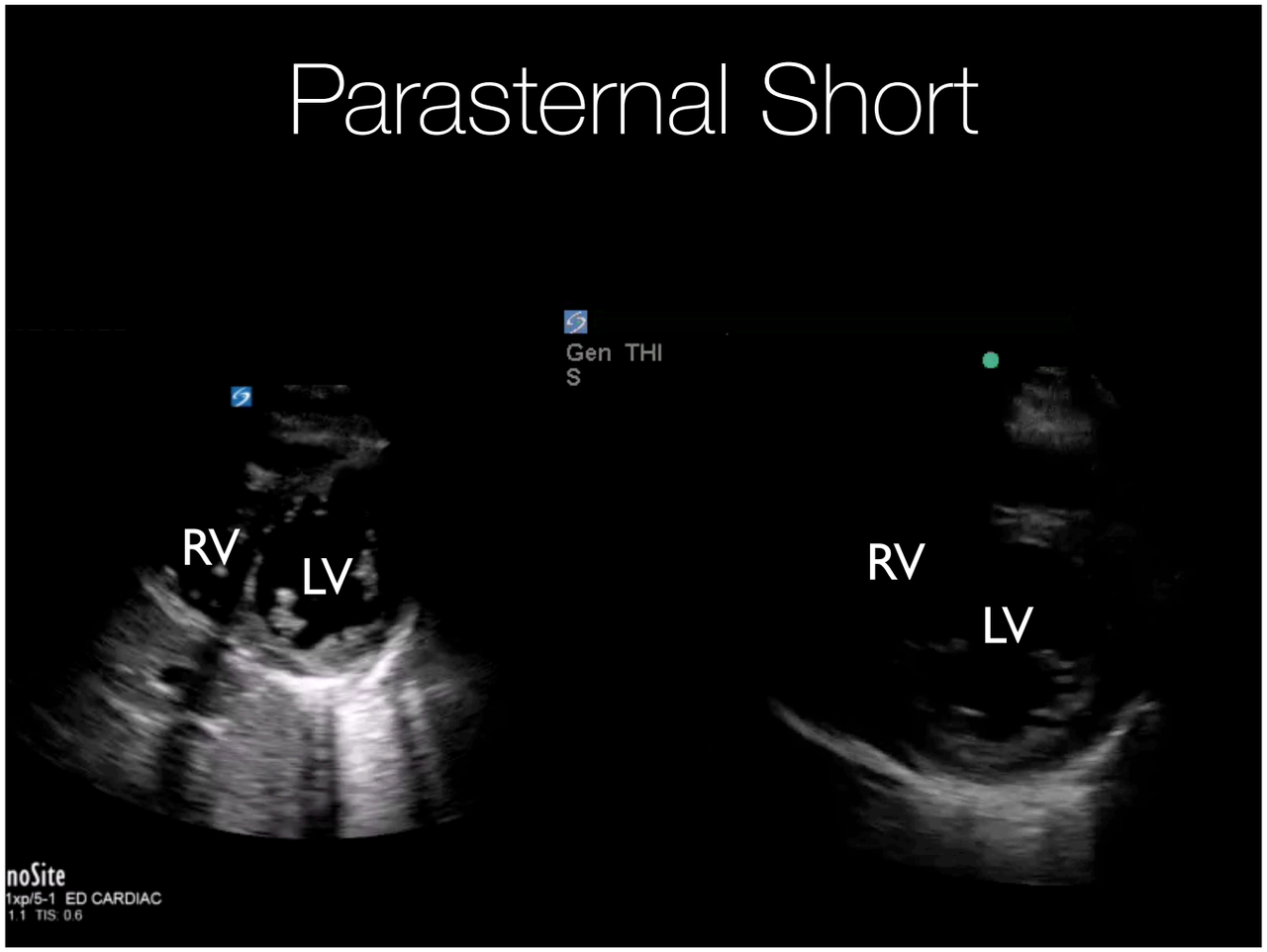
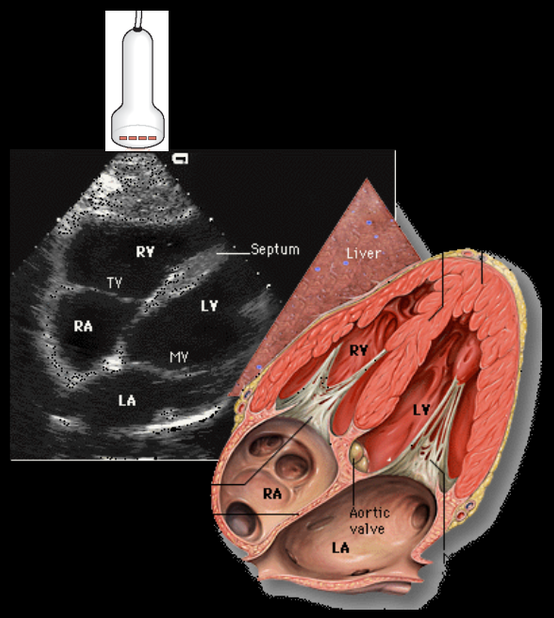
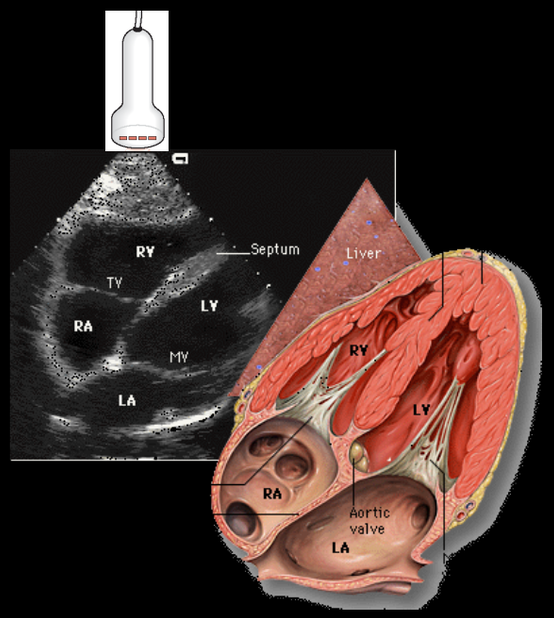


# Subxiphoid / Subcostal




marker to the right (opposite of cardiology)
liver as an acoustic window
can be uncomfortable

# Subxiphoid / Subcostal

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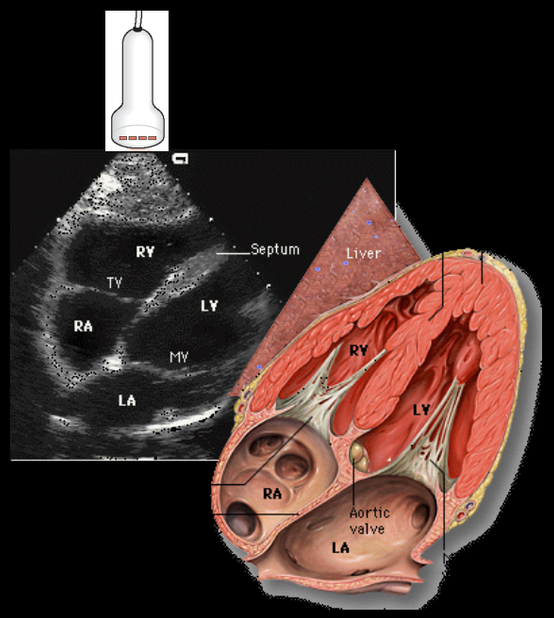
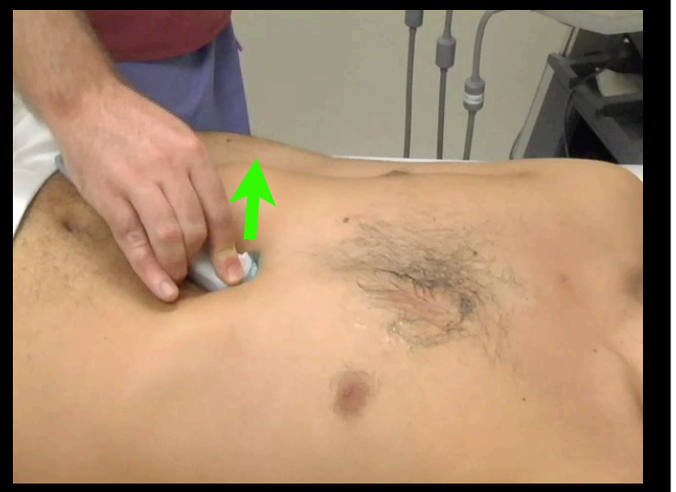
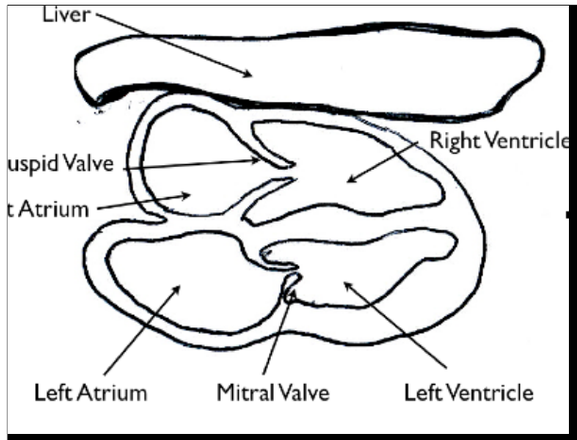


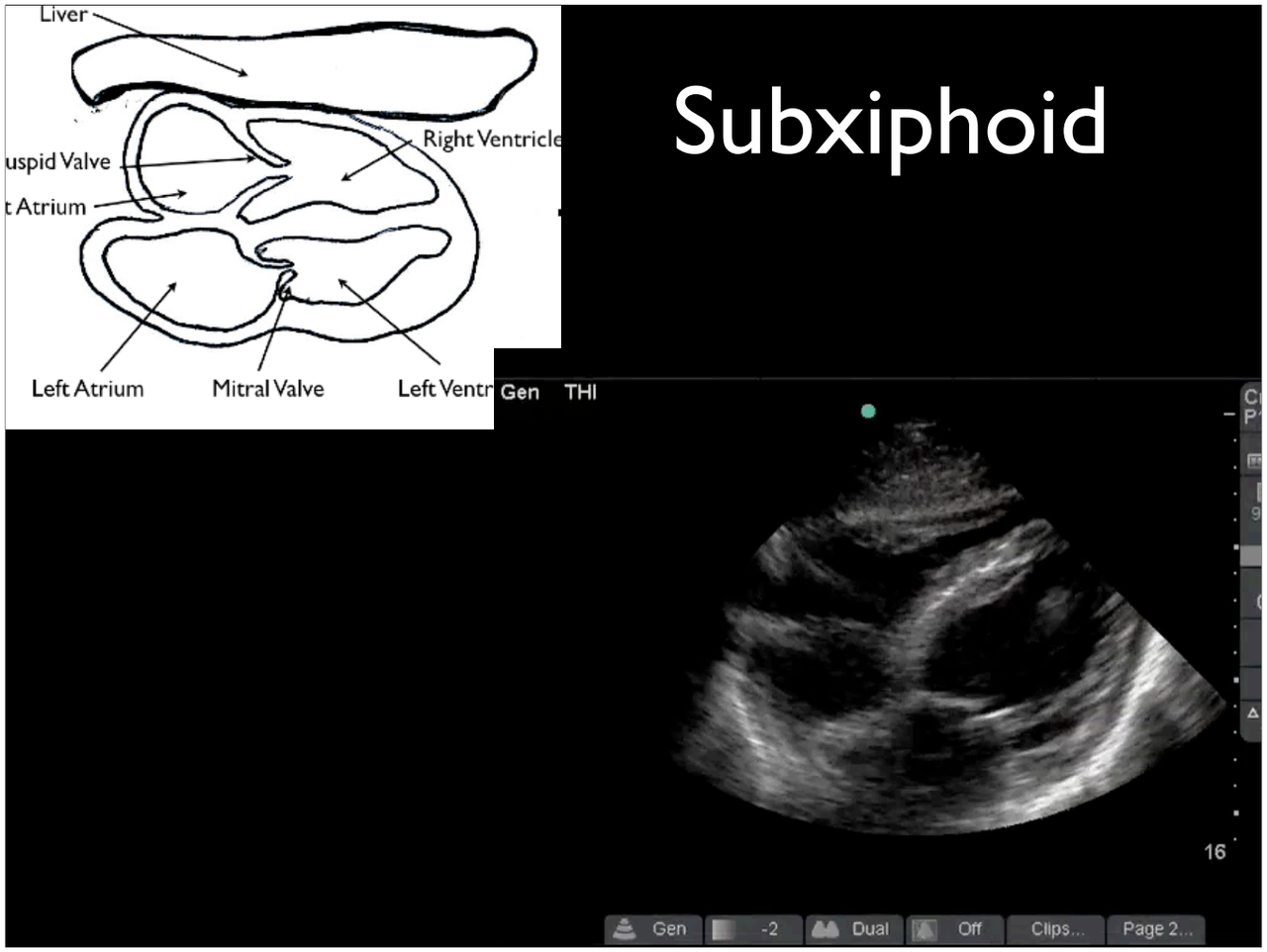
***Indicator towards the patient's right***



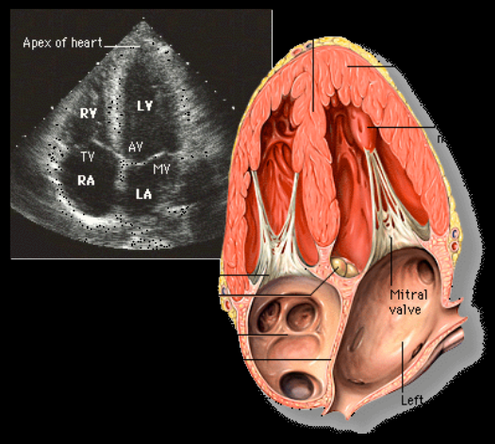

# Subxiphoid

Right Ventricle, Pericardium, Interventricular Septum

# Subxiphoid


Liver
Right Ventricle
uspid Valve
t Atrium
Left Atrium
Mitral Valve
Left Ventr
Gen THI
16
Gen
-2
Dual
Off
Clips...
Page 2...

# 4 Chamber/Apical

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liver as an acoustic window
can be uncomfortable

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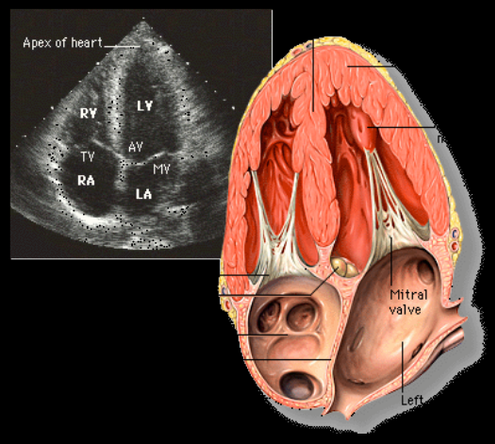


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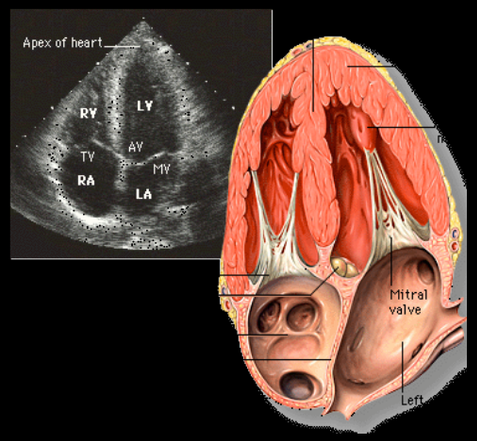


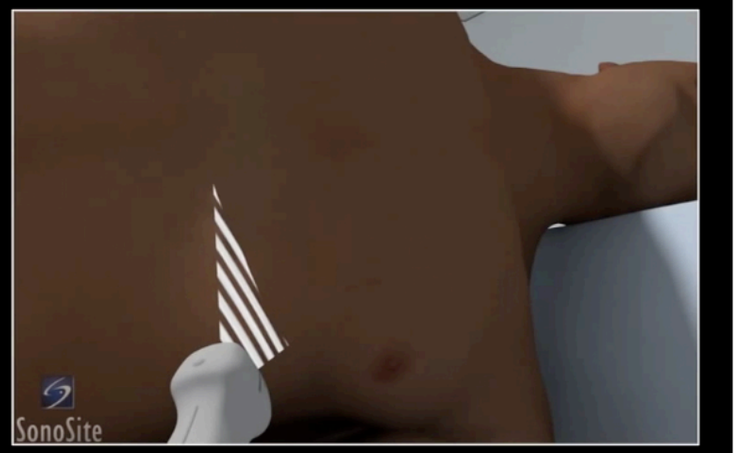

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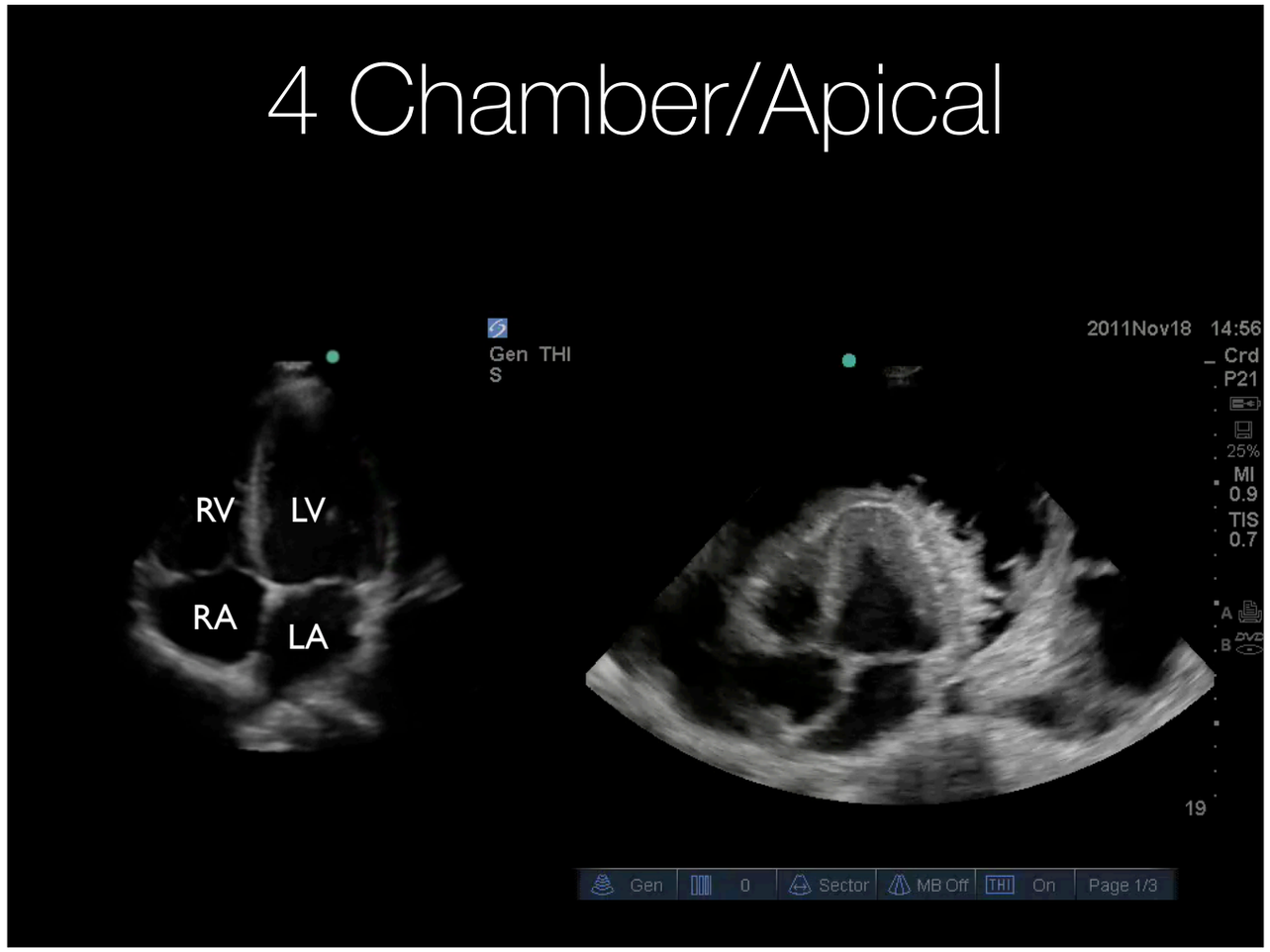

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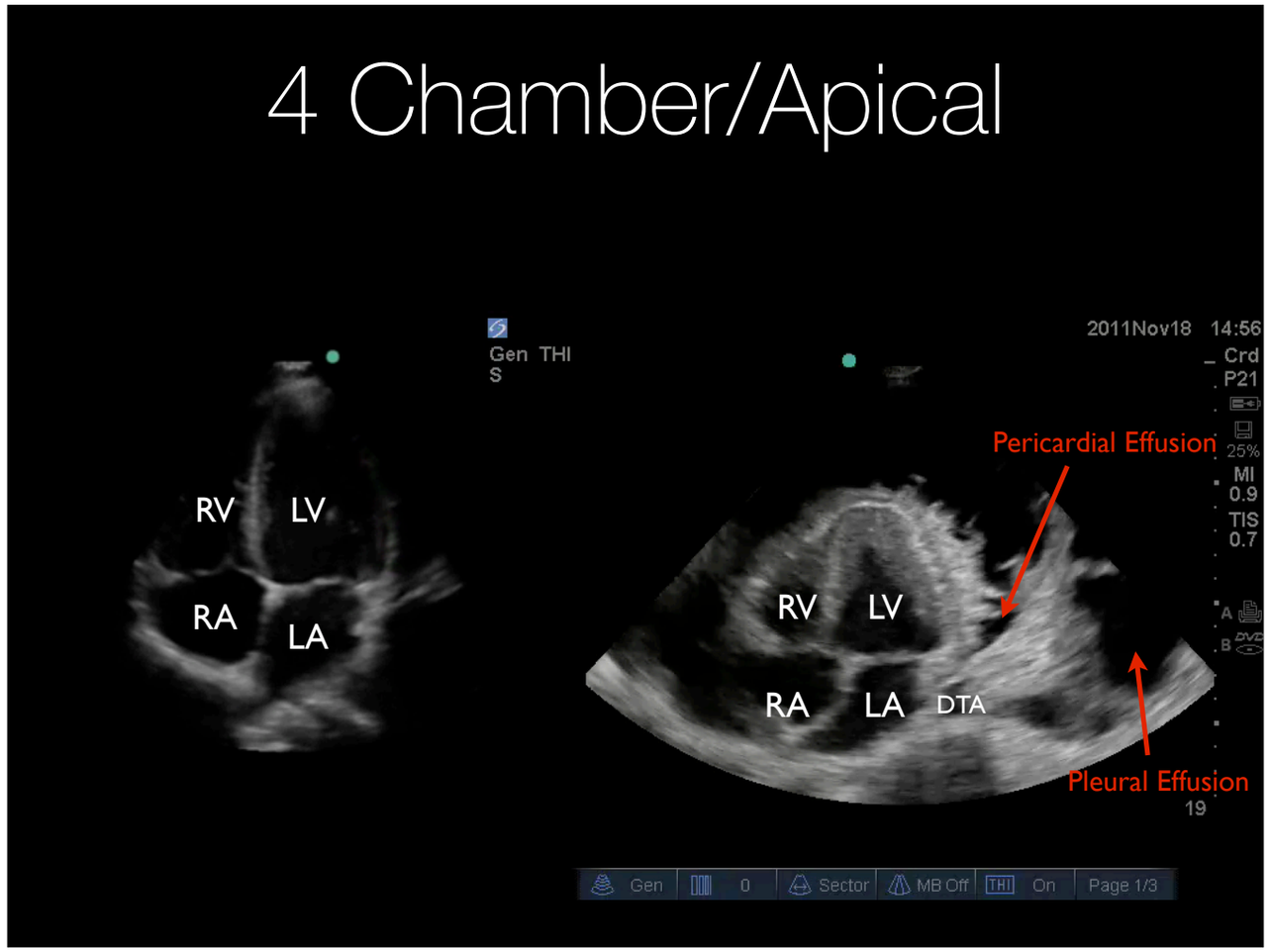


# Protocol

# Protocol

1. Cardiac Ultrasound

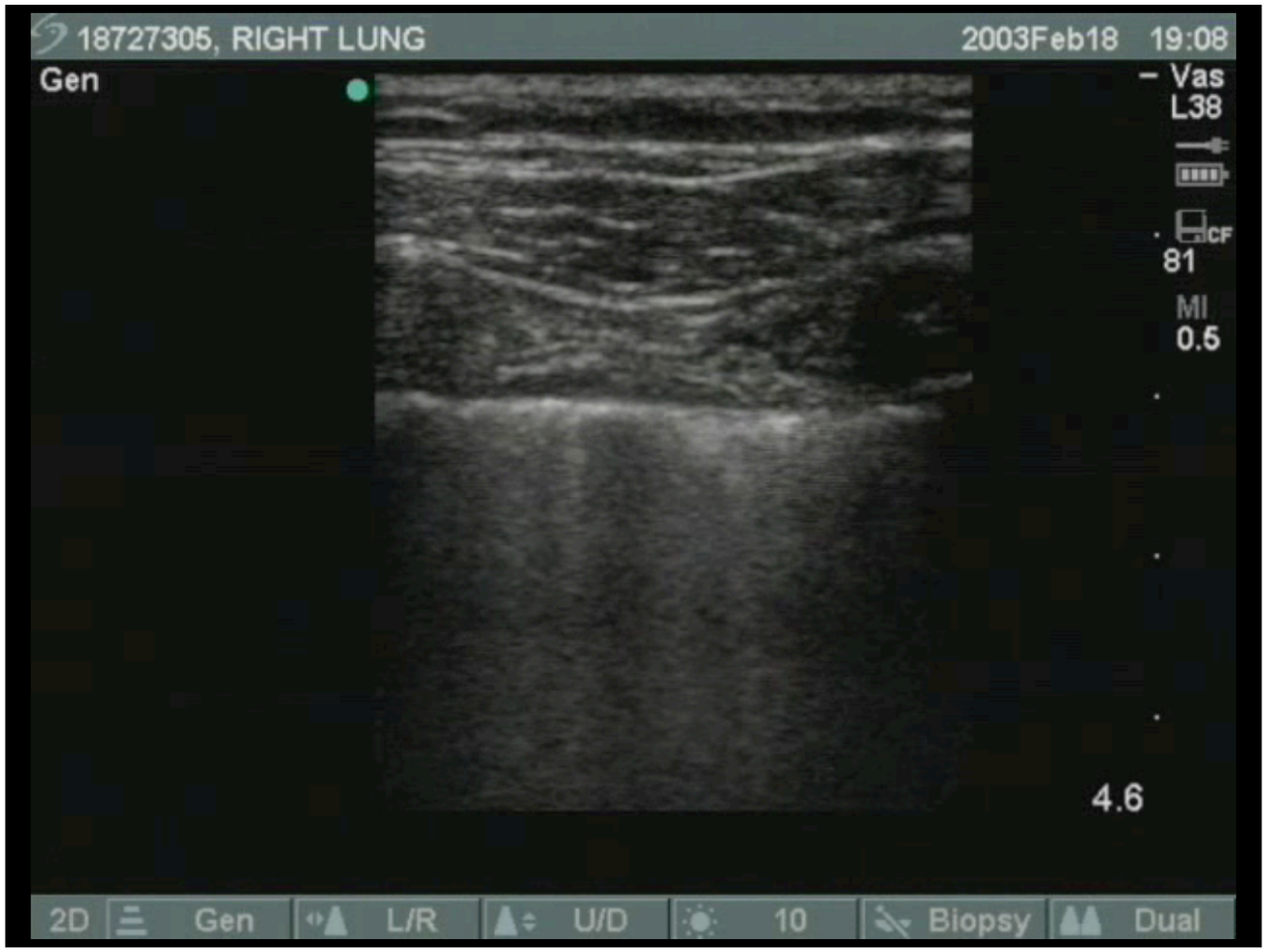
# Protocol

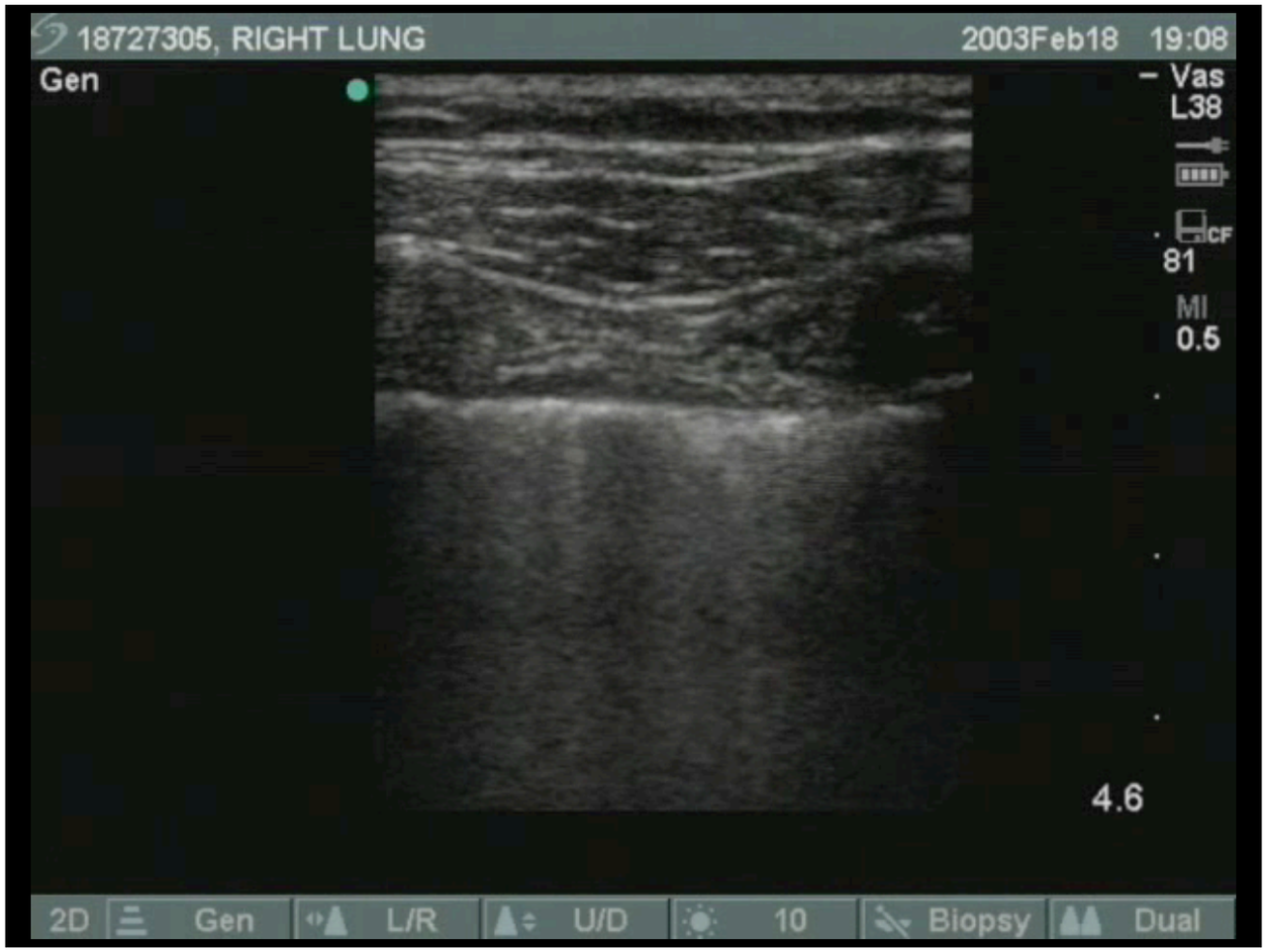
1. Cardiac Ultrasound
2. Lung Ultrasound

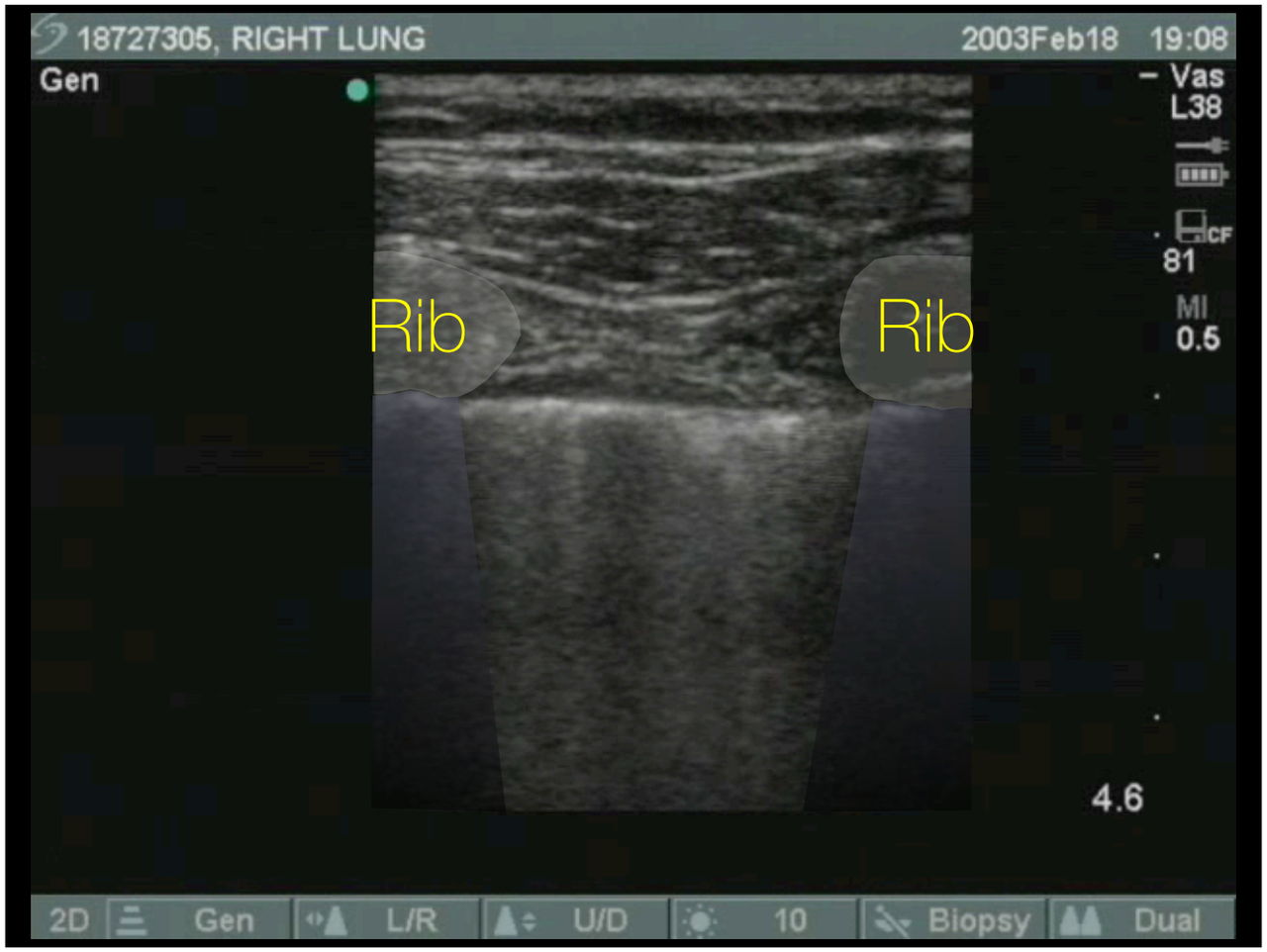
# Protocol

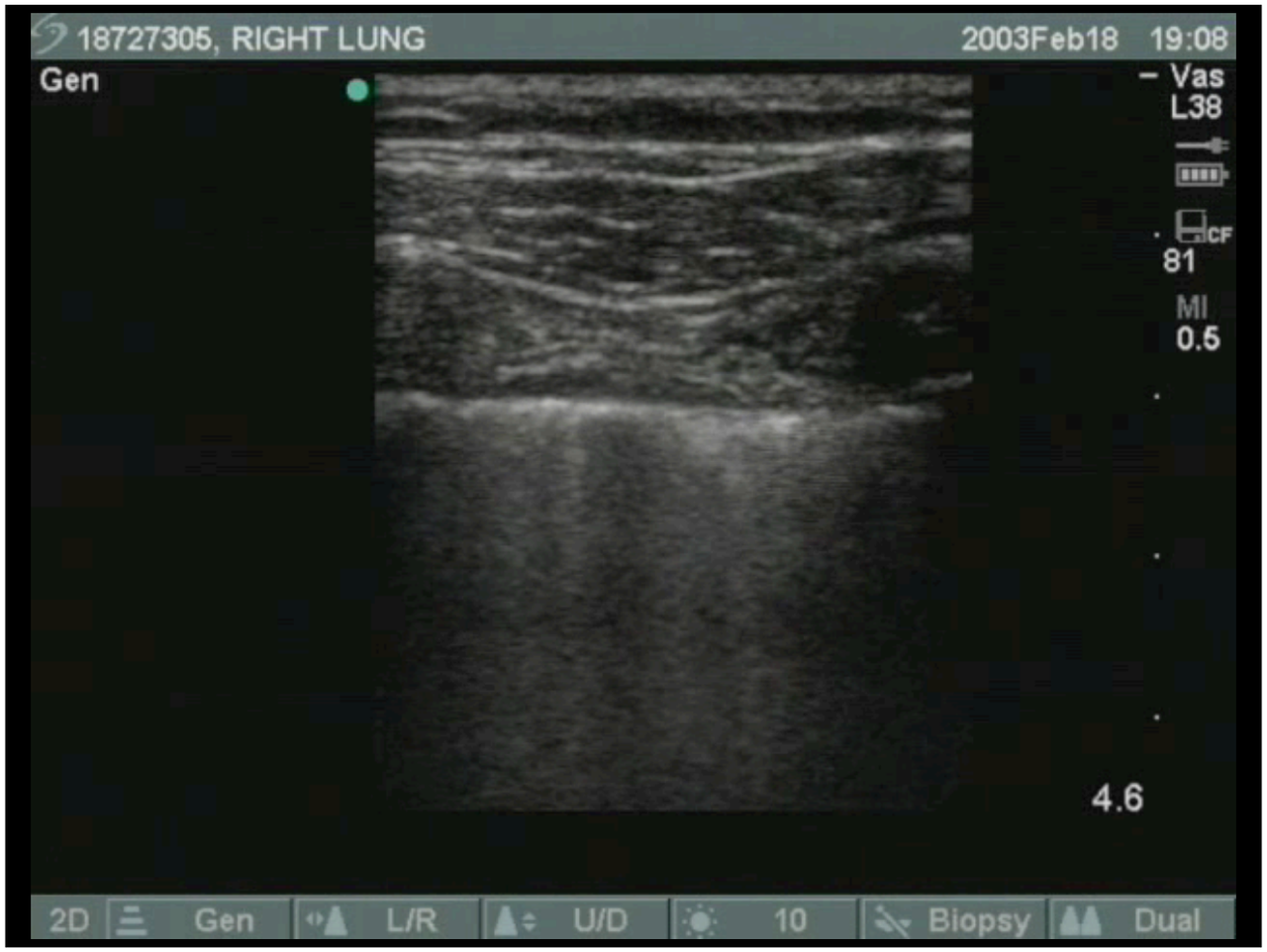
1. Cardiac Ultrasound
2. Lung Ultrasound
3. IVC Ultrasound

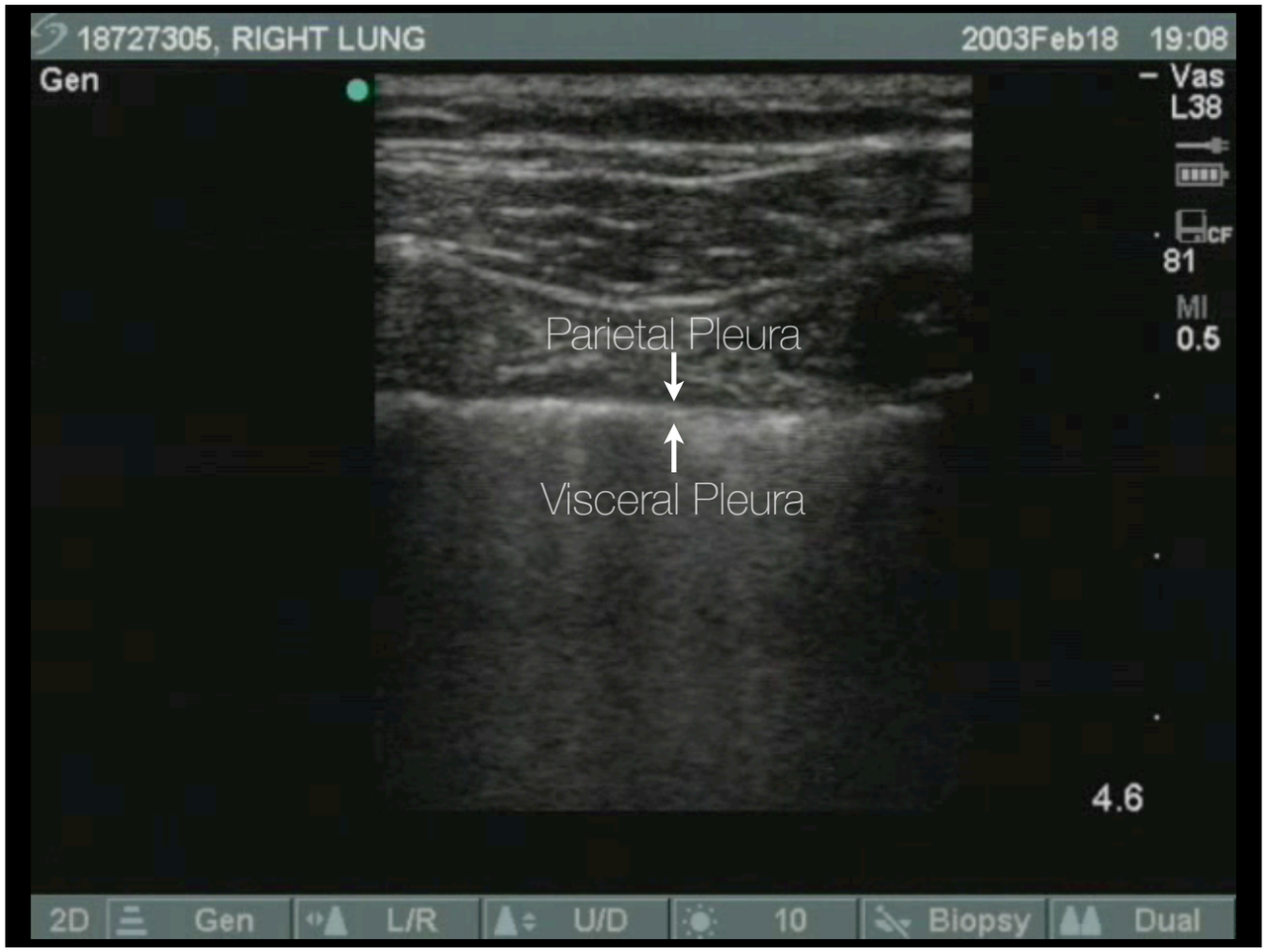
2-3 rib spaces, compare both sides

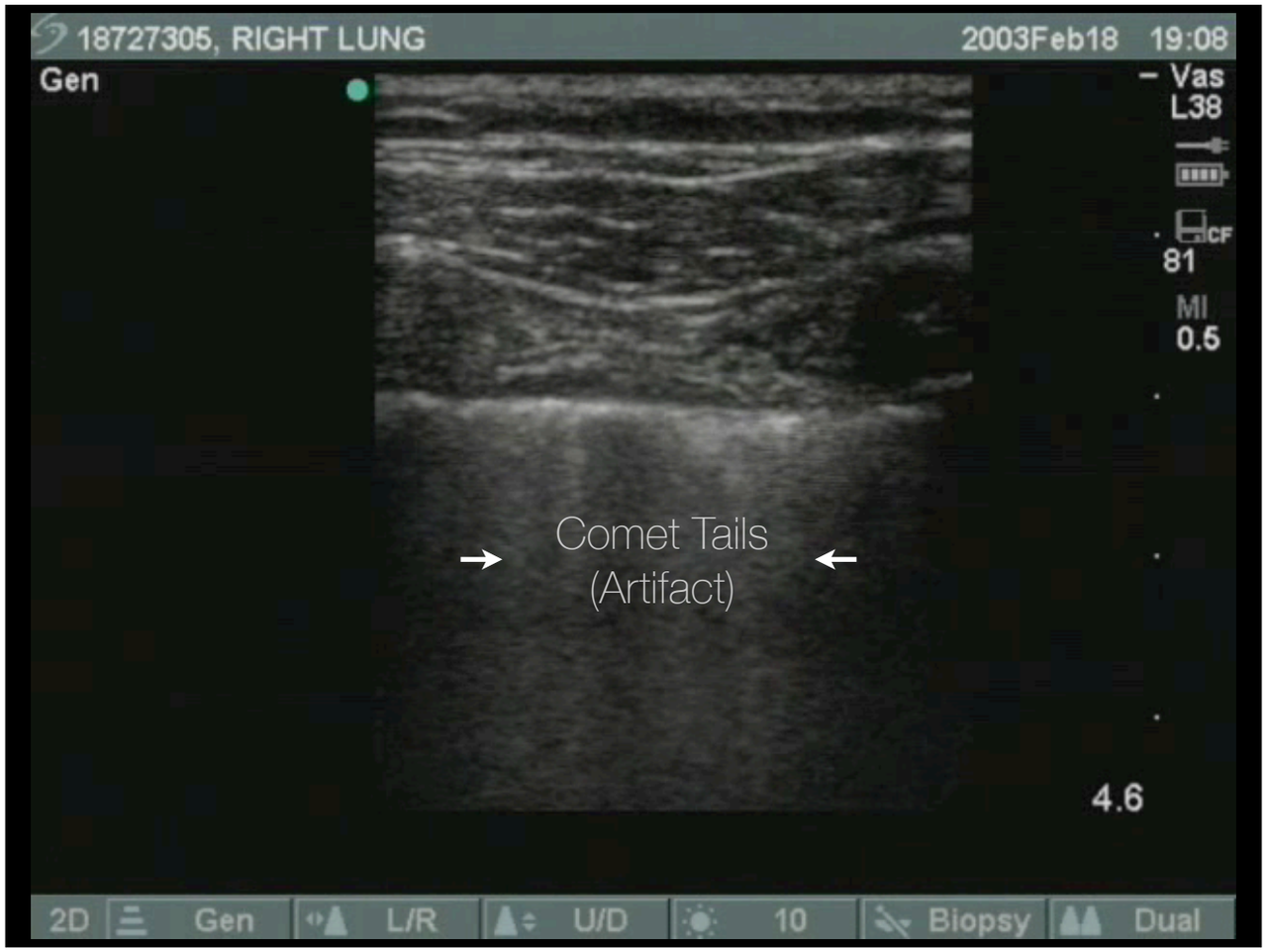

18727305, RIGHT LUNG
2003Feb18 19:08
Gen
– Vas
L38
CF
81
MI
0.5
4.6
2D
Gen
L/R
U/D
10
Biopsy
Dual

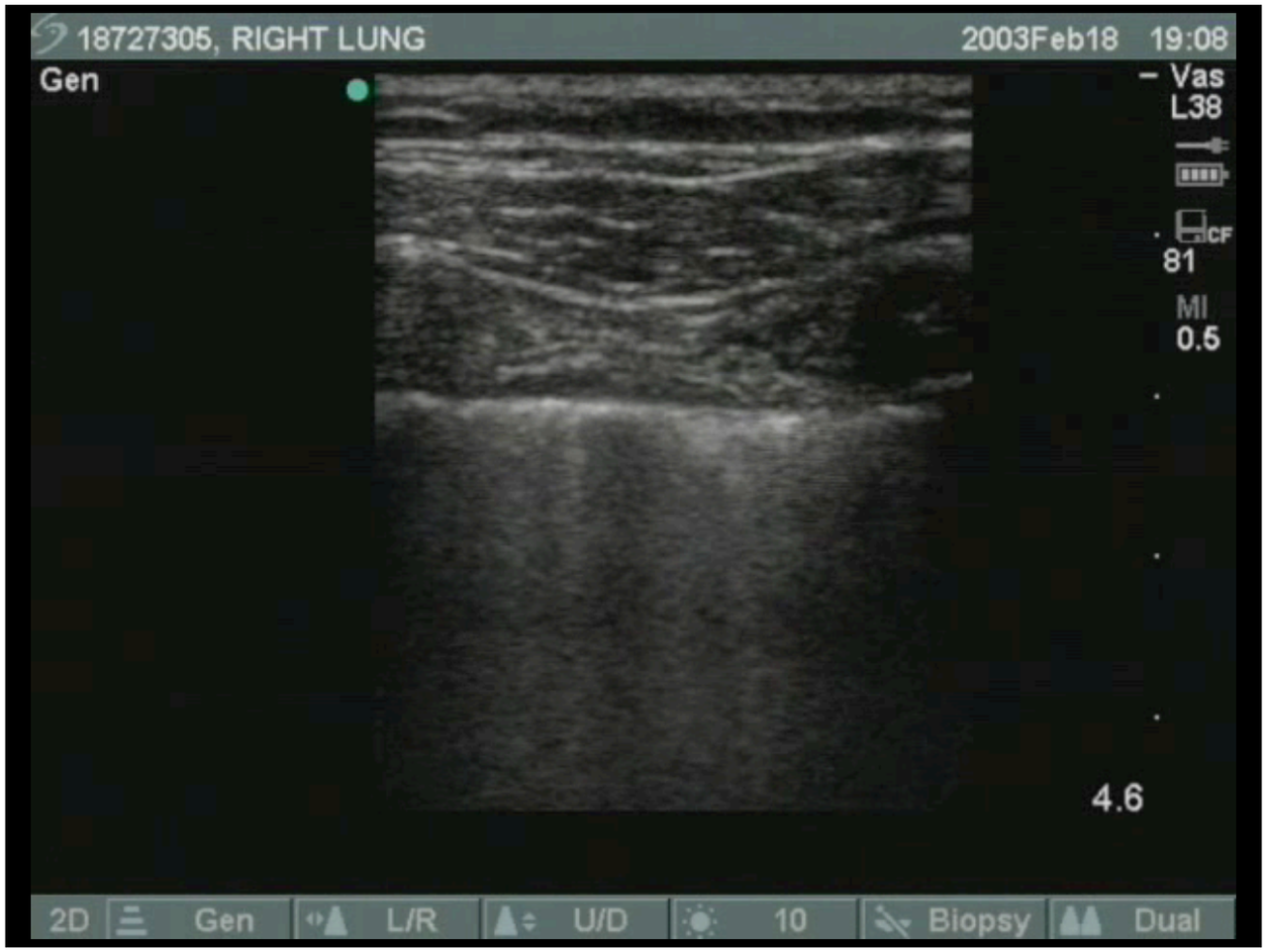

18727305, RIGHT LUNG
2003Feb18 19:08
Gen
– Vas
L38
CF
81
MI
0.5
4.6
2D
Gen
L/R
U/D
10
Biopsy
Dual

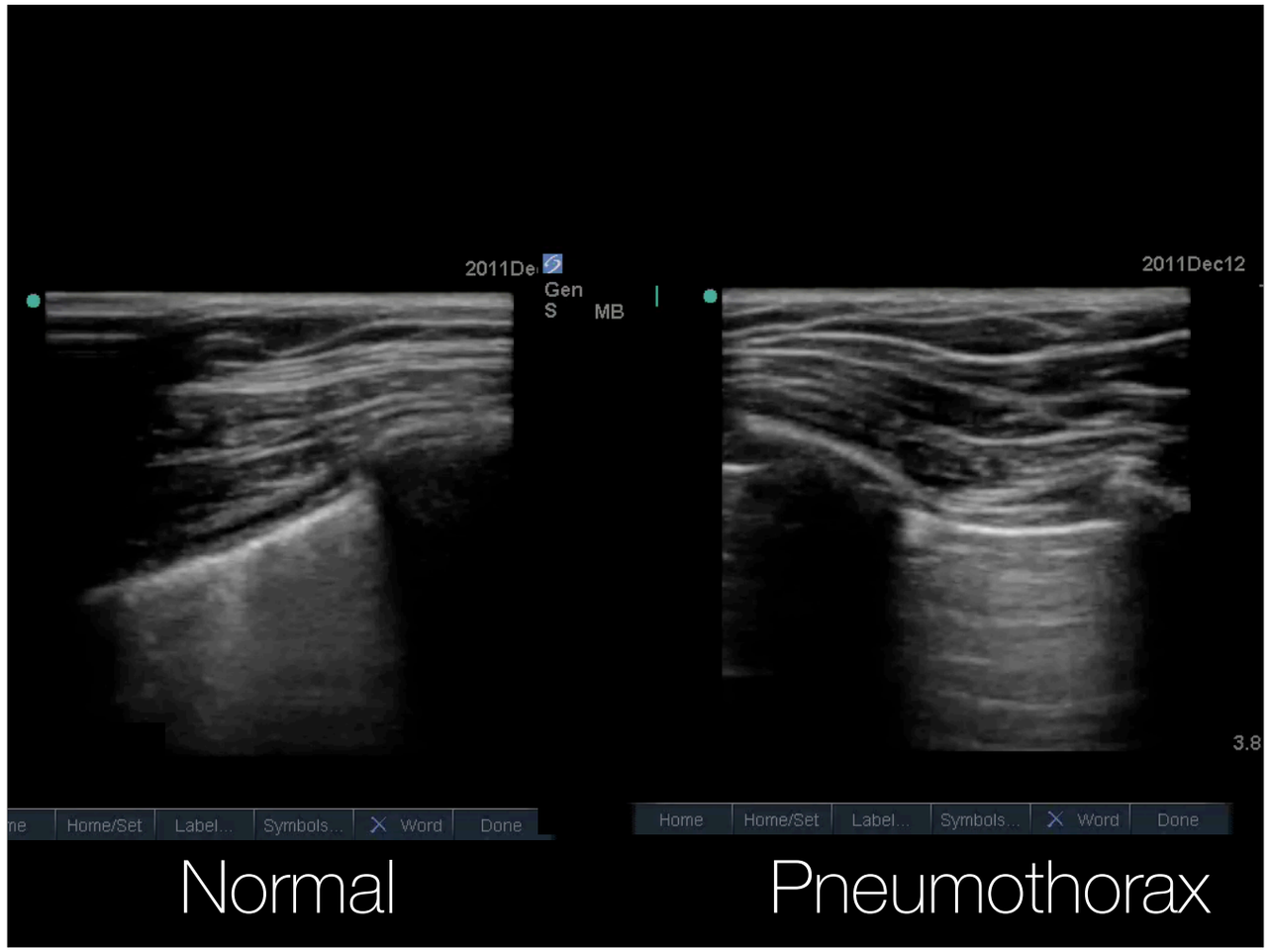

18727305, RIGHT LUNG
2003Feb18 19:08
Gen
Vas
L38
CF
81
MI
0.5
Rib
Rib
4.6
2D
Gen
L/R
U/D
10
Biopsy
Dual


18727305, RIGHT LUNG
2003Feb18 19:08
Gen
– Vas
L38
CF
81
MI
0.5
4.6
2D
Gen
L/R
U/D
10
Biopsy
Dual


18727305, RIGHT LUNG
2003Feb18 19:08
Gen
Vas
L38
CF
81
MI
0.5
Parietal Pleura
Visceral Pleura
4.6
2D
Gen
L/R
U/D
10
Biopsy
Dual

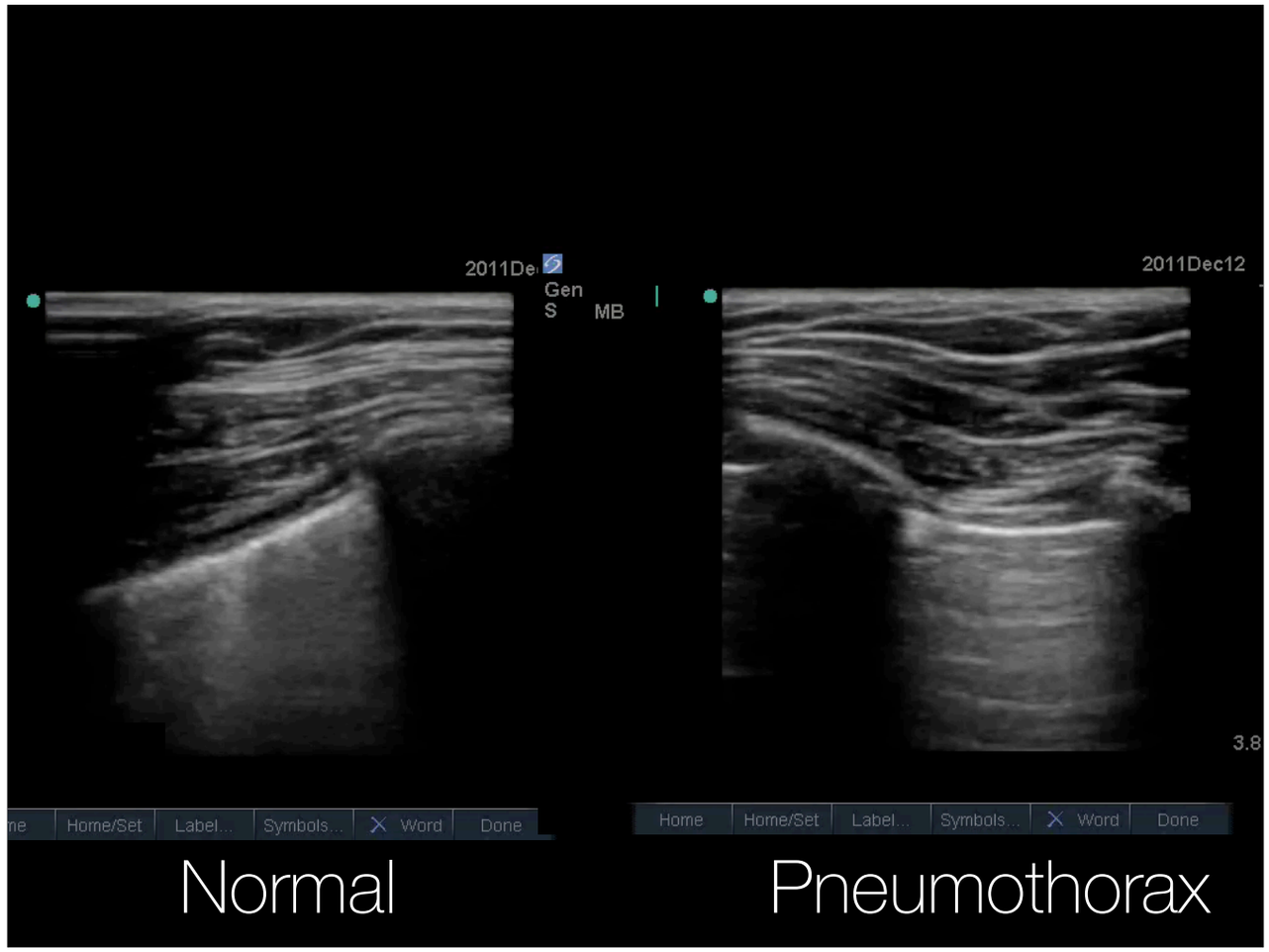

18727305, RIGHT LUNG
2003Feb18 19:08
Gen
Vas
L38
CF
81
MI
0.5
Comet Tails
(Artifact)
4.6
2D
Gen
L/R
U/D
10
Biopsy
Dual


18727305, RIGHT LUNG
2003Feb18 19:08
Gen
– Vas
L38
CF
81
MI
0.5
4.6
2D
Gen
L/R
U/D
10
Biopsy
Dual



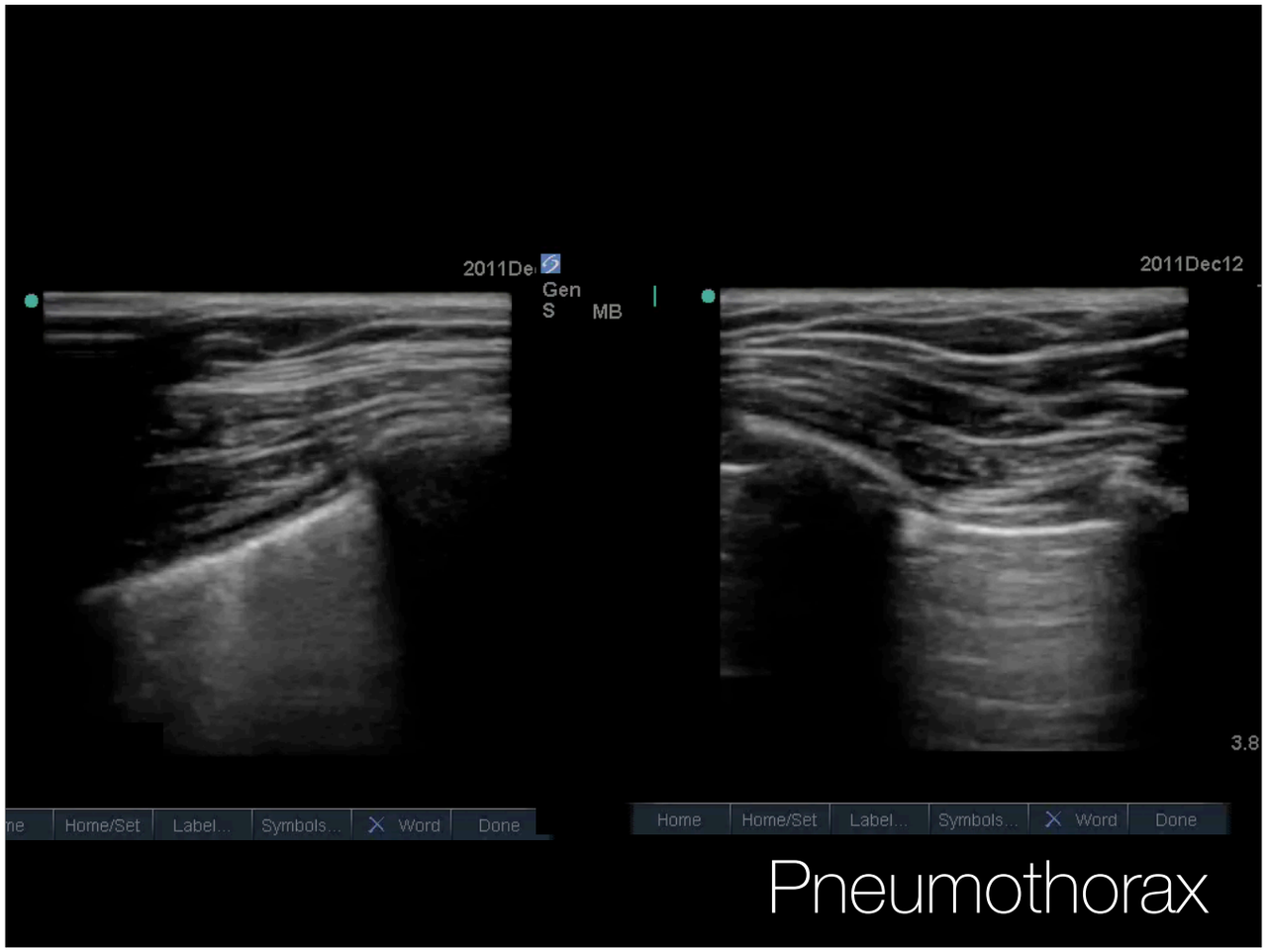

Normal

Pneumothorax

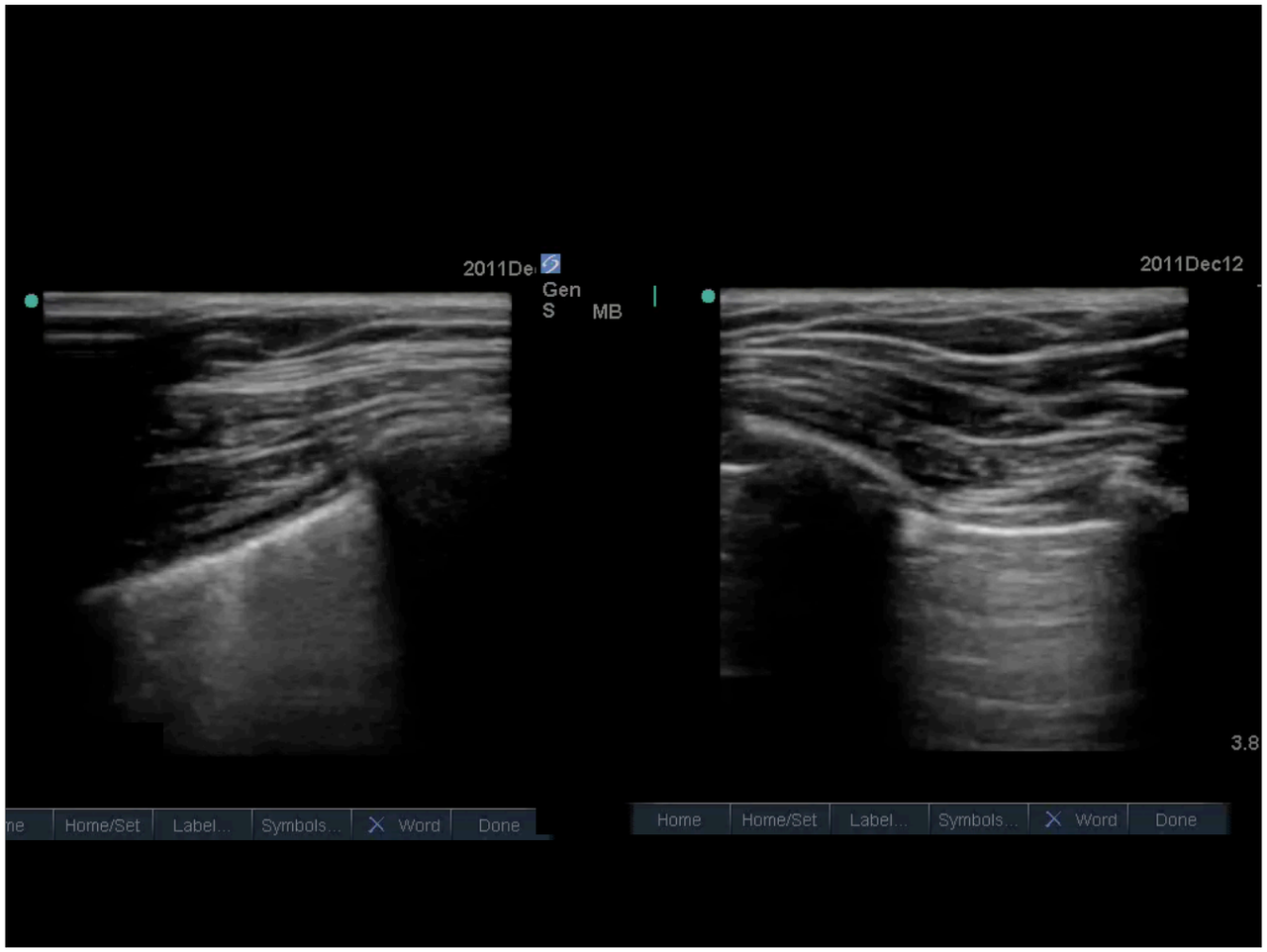



Normal

Pneumothorax




# Pneumothorax


2011De
Gen
S MB
2011Dec12
3.8
ne
Home/Set
Label...
Symbols...
Word
Done
Home
Home/Set
Label...
Symbols...
Word
Done

# Lung Lines

# Lung Lines

A Lines

# Lung Lines

A Lines

B Lines

# Lung Lines

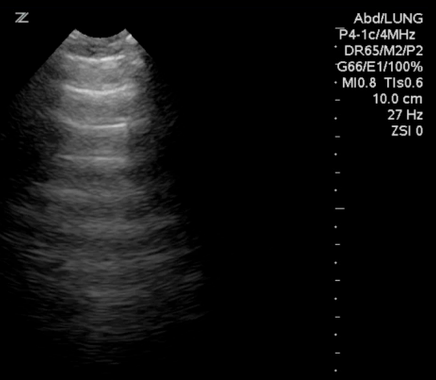
A Lines

B Lines

Z Lines

# Lung Lines

## A Lines




## B Lines

## Z Lines

# Lung Lines

## A Lines

## B Lines

## Z Lines

# Lung Lines

## A Lines

## B Lines

## Z Lines

# Pulmonary Edema

Pump function: Confirm Sys dyfunction (?acute vs chronic). Guide resuscitation
Lung exam: Pulmonary edema (acute vs chronic failure)
IVC eval:

# Pulmonary Edema

# Pulmonary Edema

***B Lines***

# Pulmonary Edema

***B Lines***

***Lung Rockets***

# Pulmonary Edema

## B Lines

- Arise from the pleural line

## Lung Rockets

# Pulmonary Edema

## B Lines

- Arise from the pleural line
- Well-defined

## Lung Rockets

# Pulmonary Edema

## B Lines

- Arise from the pleural line
- Well-defined
- Move with lung sliding

## Lung Rockets

# Pulmonary Edema

## B Lines

- Arise from the pleural line
- Well-defined
- Move with lung sliding
- Reach the edges of the screen

## Lung Rockets

# Pulmonary Edema

## B Lines

- Arise from the pleural line
- Well-defined
- Move with lung sliding
- Reach the edges of the screen
- Obscure A Lines

## Lung Rockets

# Pulmonary Edema

## ***B Lines***

- Arise from the pleural lin
- Well-defined
- Move with lung sliding
- Reach the edges of the
- Obscure A Lines

# Lung Lines

# Lung Lines

A Lines

# Lung Lines

A Lines

B Lines

# Lung Lines

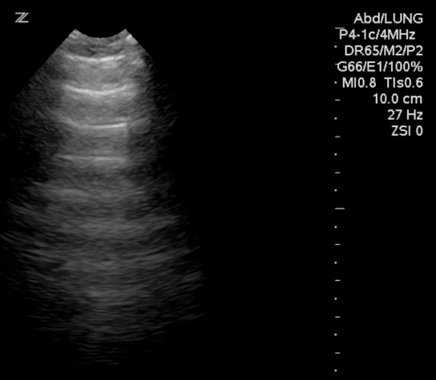
A Lines

B Lines

Z Lines

# Lung Lines

## A Lines




## B Lines

## Z Lines

# Lung Lines

## A Lines

## B Lines

## Z Lines

# Lung Lines

## A Lines

## B Lines

## Z Lines

Protocol

# Protocol

1. Cardiac Ultrasound

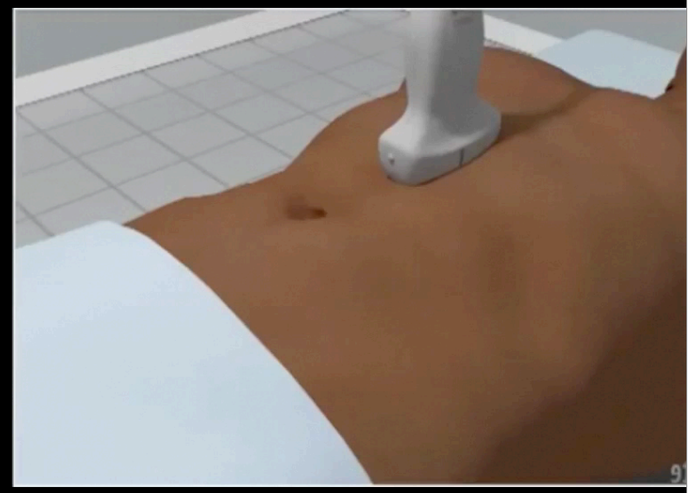
# Protocol

1. Cardiac Ultrasound
2. Lung Ultrasound

# Protocol

1. Cardiac Ultrasound
2. Lung Ultrasound
3. IVC Ultrasound

# IVC Ultrasound Exam



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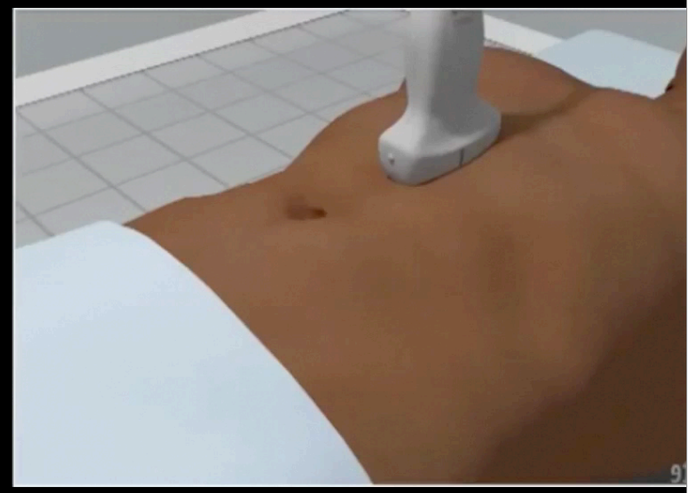
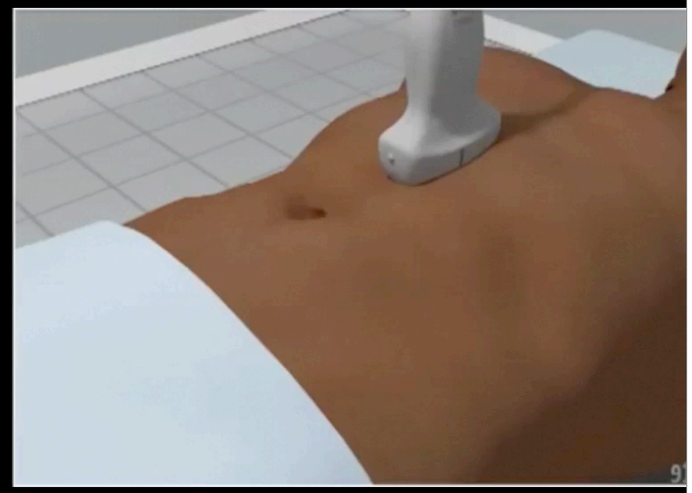


# IVC Ultrasound Exam

- Exam Technique
- Goals of the Exam



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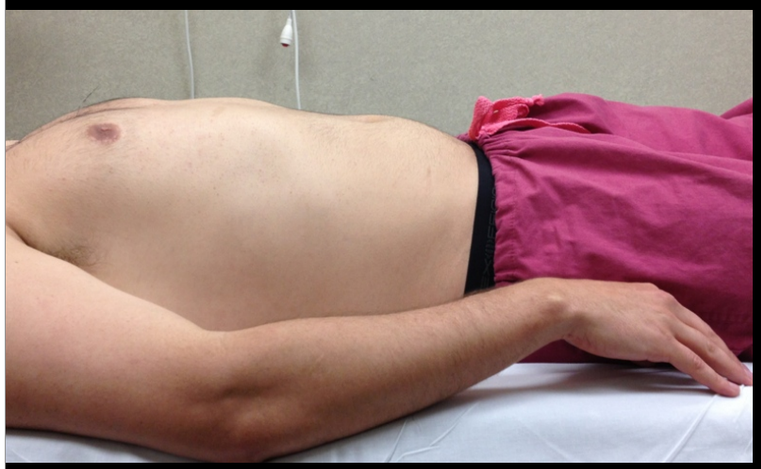
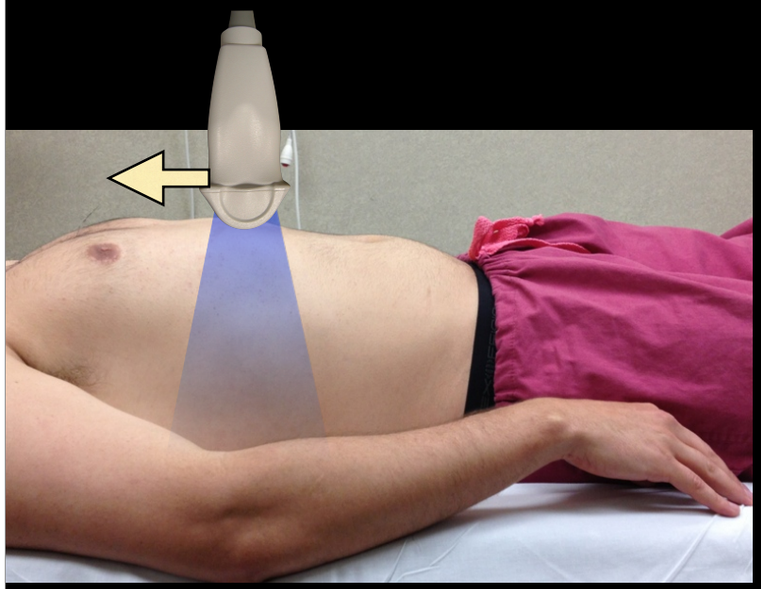


Direct indicator cephalad in a long axis or sagittal plane

# IVC Exam



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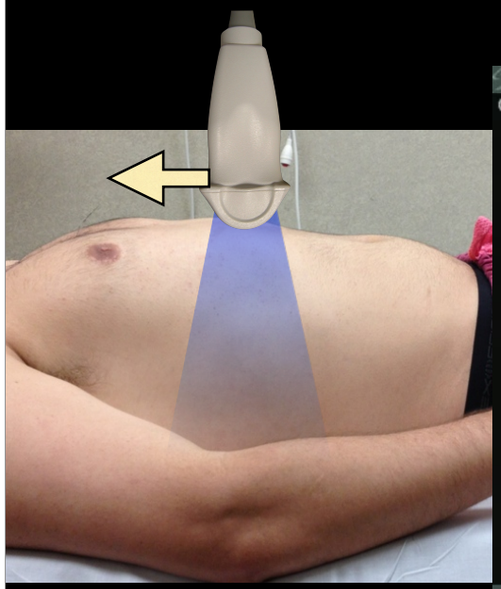
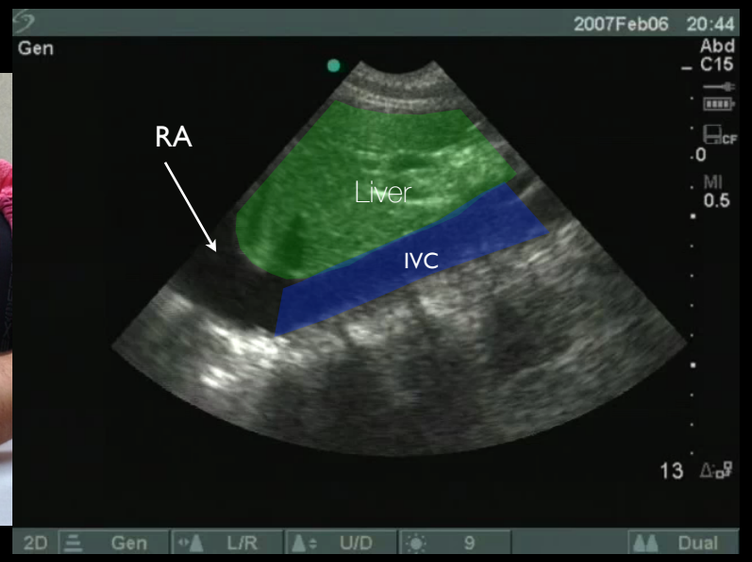
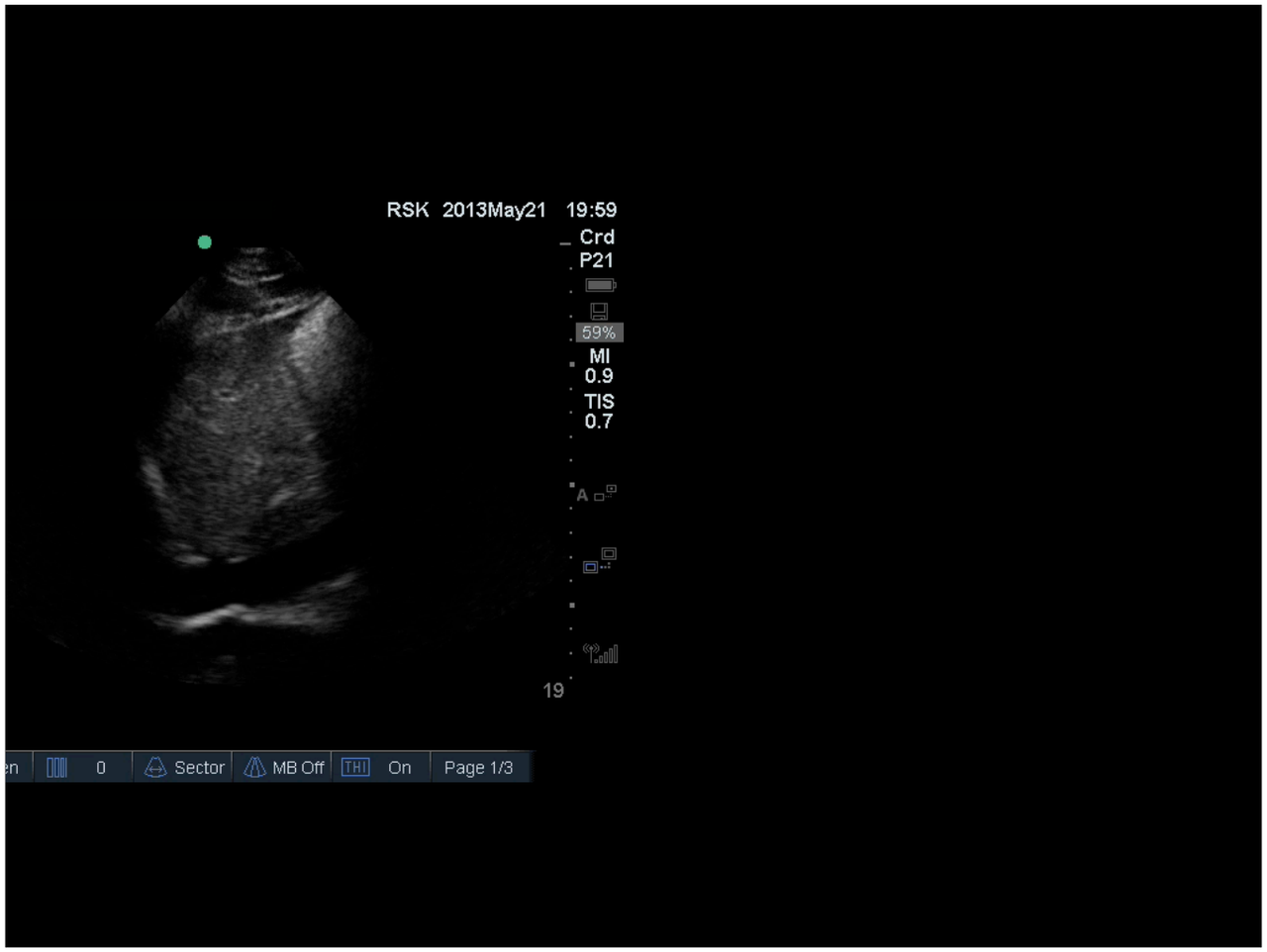
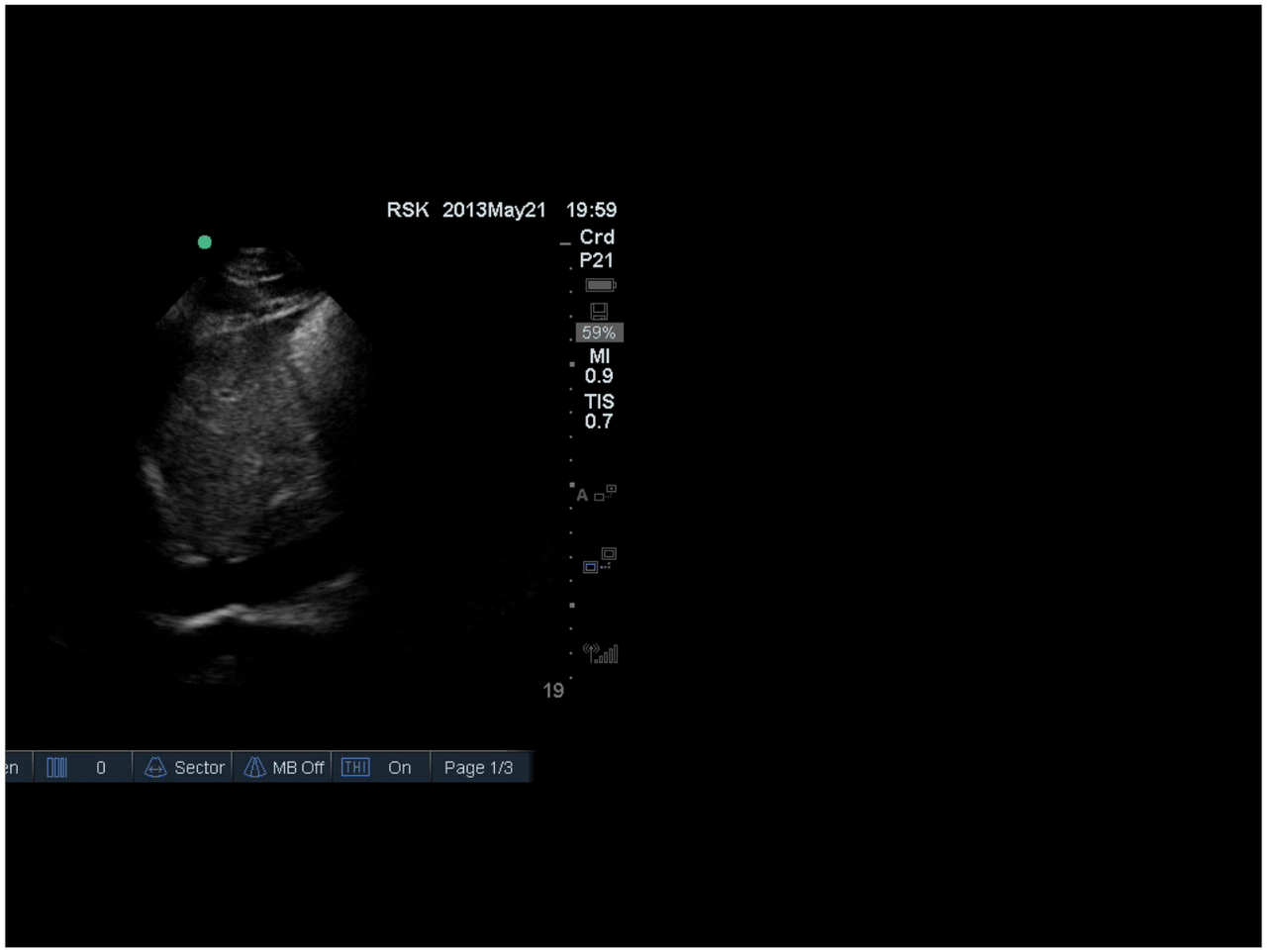



2007Feb06 20:44
Gen
Abd
C15
RA
Liver
IVC
MI
0.5
13
2D
Gen
L/R
U/D
9
Dual


RSK 2013May21 19:59
Crd
P21
59%
MI
0.9
TIS
0.7
A
19
0
Sector
MB Off
THI
On
Page 1/3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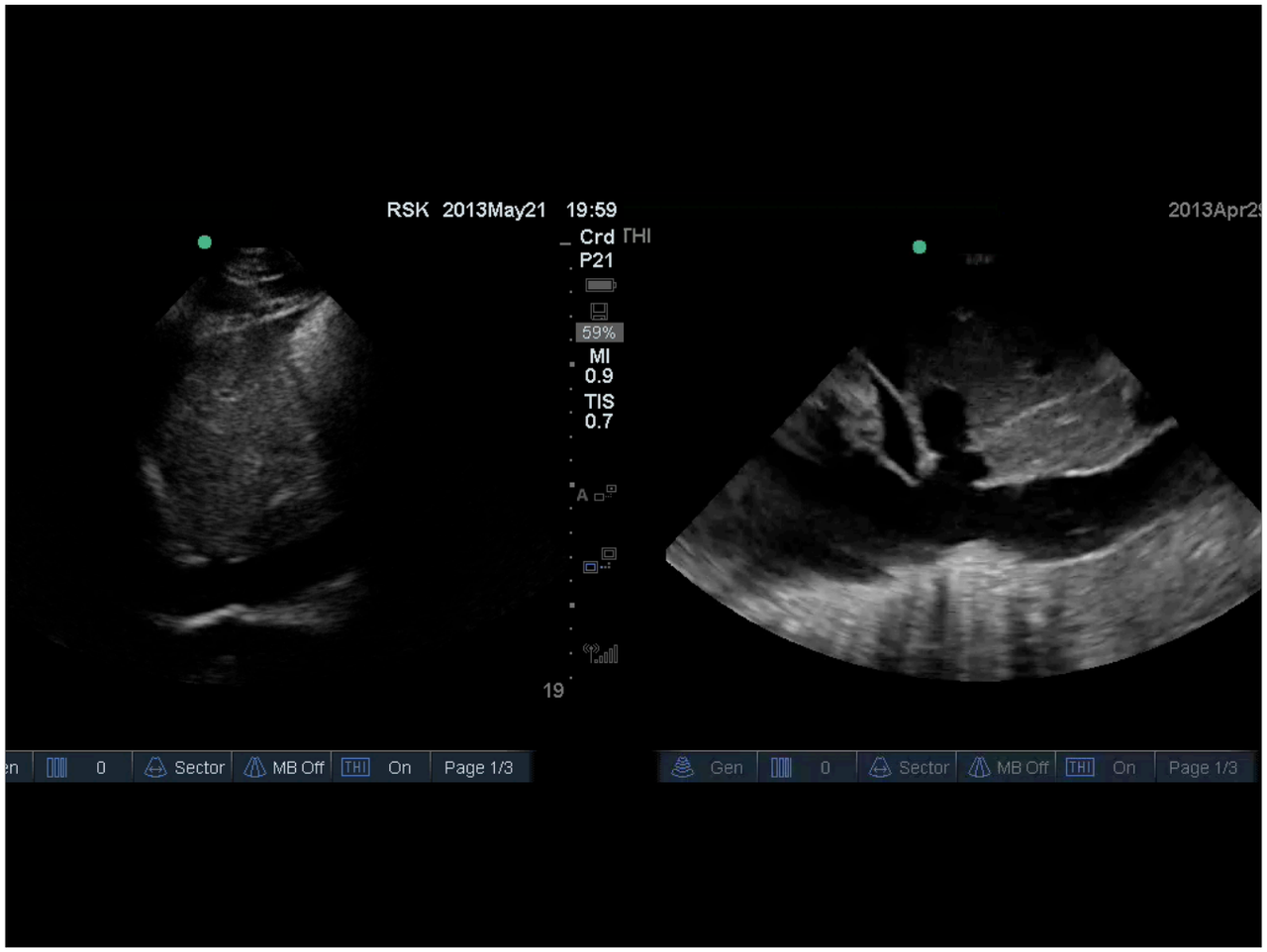
RSK 2013May21 19:59
Crd THI
P21
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MI
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TIS
0.7
A
19
2013Apr2
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Sector
MB Off
THI
On
Page 1/3
Gen
0
Sector
MB Off
THI
On
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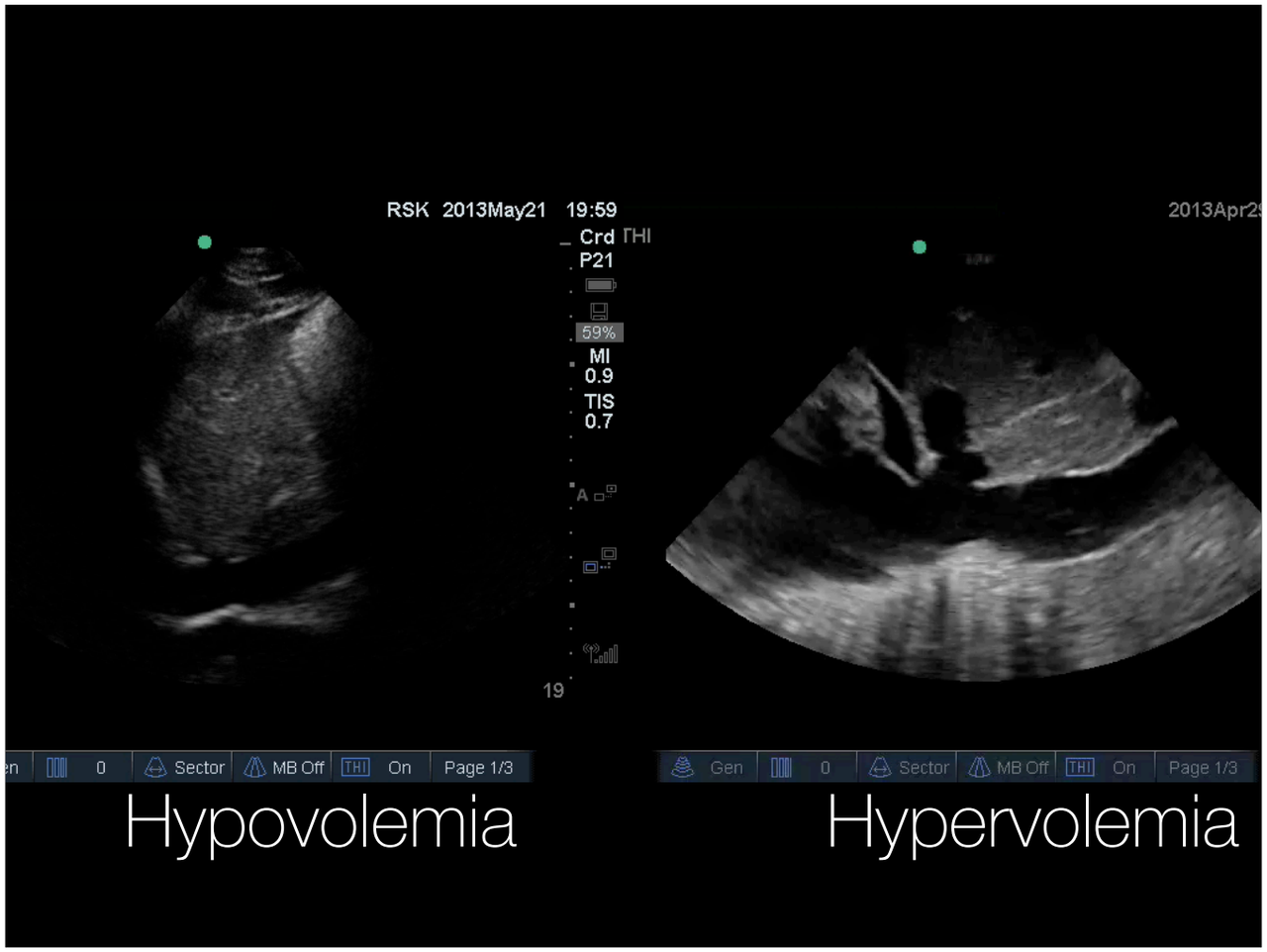


Hypovolemia

Hypervolemia

# The “Sniff” Test

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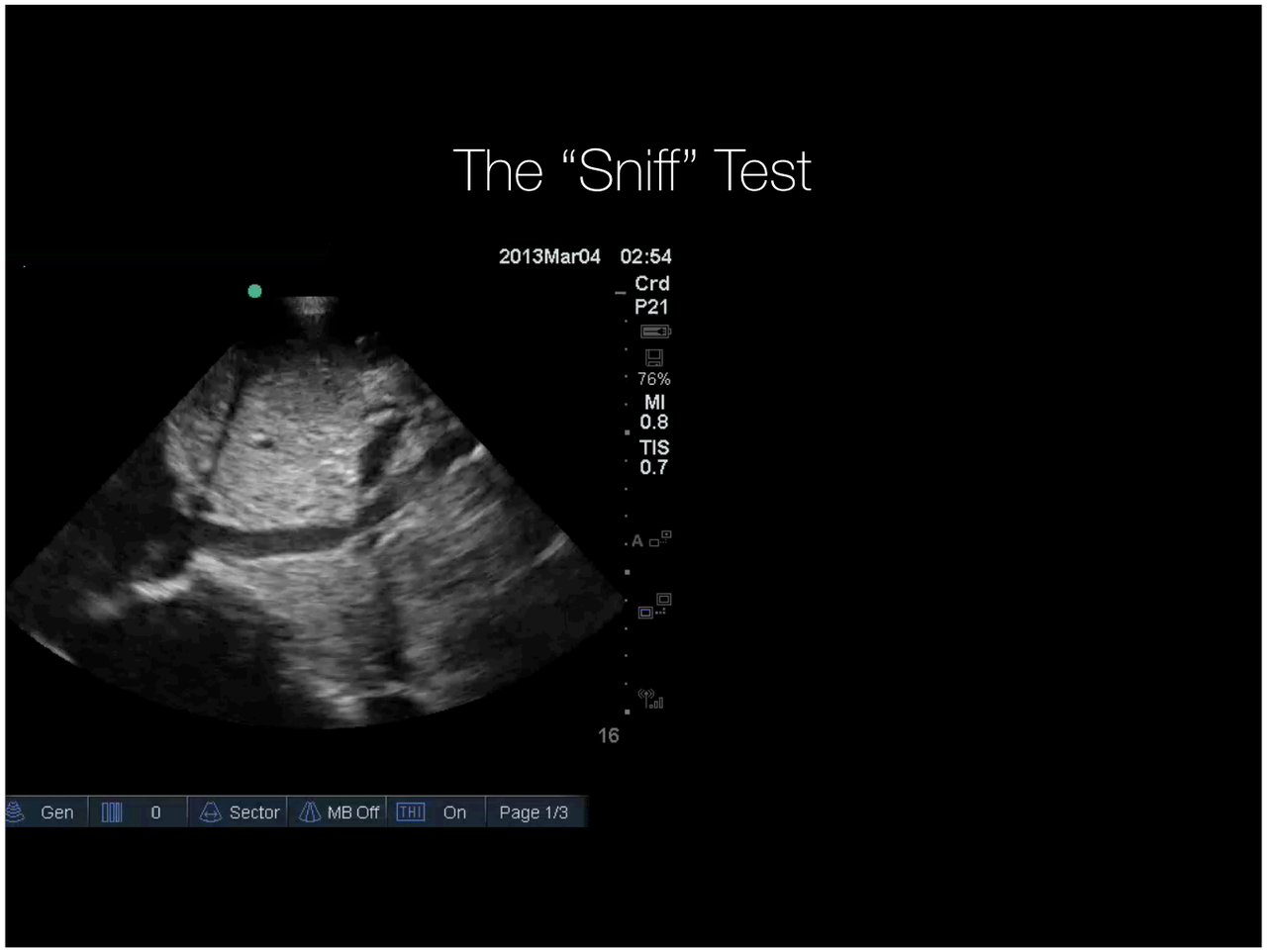

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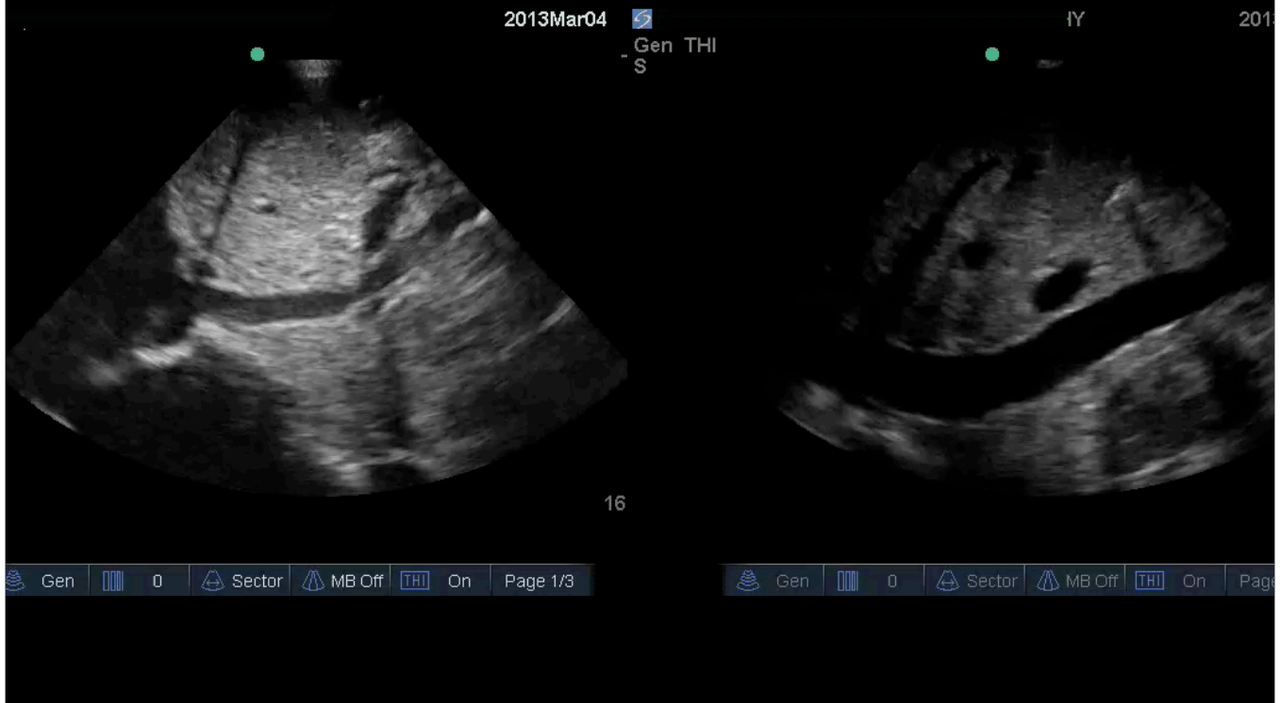

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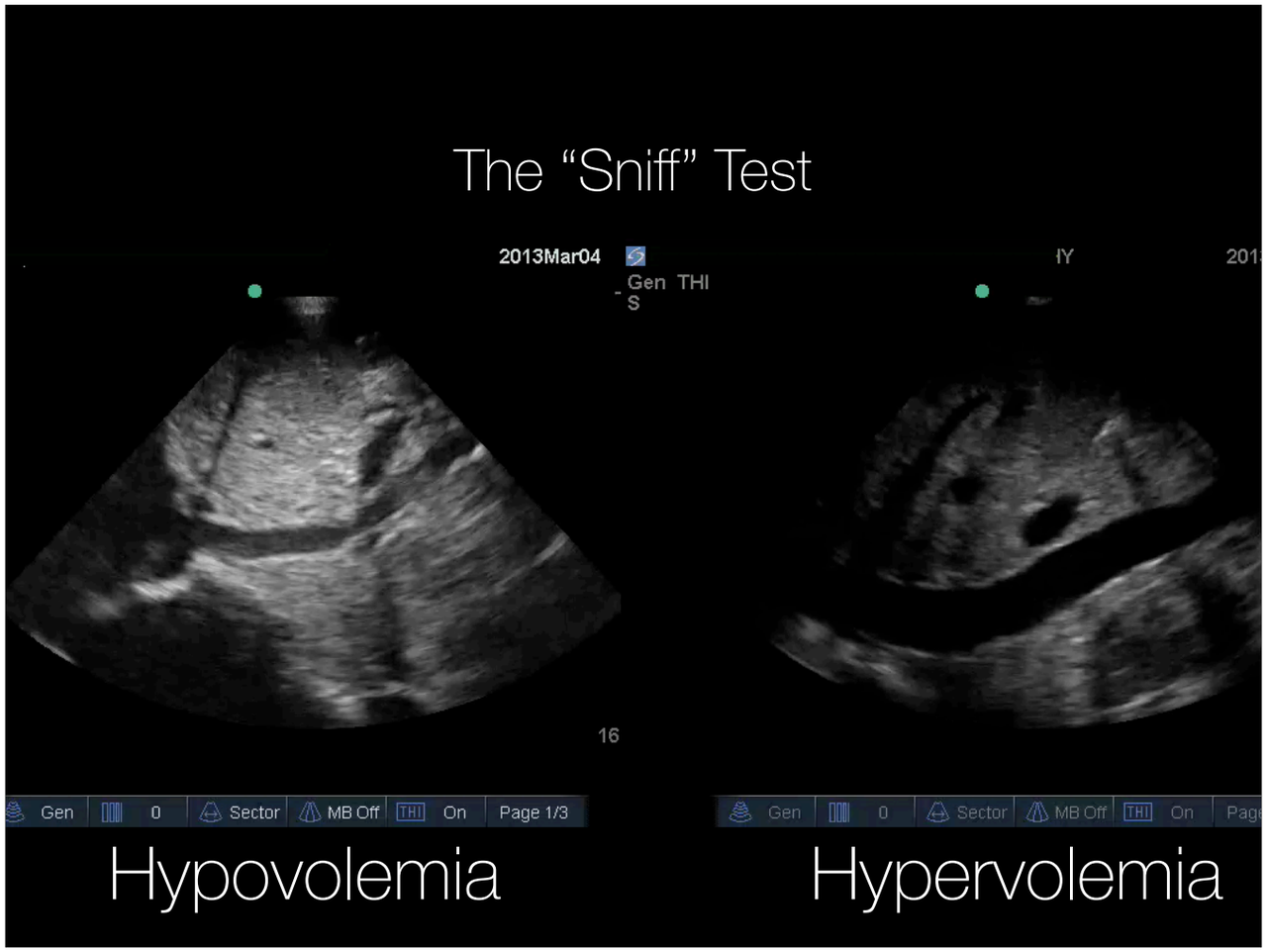



Hypovolemia

Hypervolemia

# Clinical Cases

# Case

- 64 ♀ DM presented with AMS
  - GCS 4 (E1/V1/M2)
  - Obtunded

This case shows reduced LV function. There is in fact an inferior infarct and the basal inferior wall is thinned and bulges outward consistent with an aneurysm (the cause of the persistent ST elevations). IVC is not shown here. There is no effusion and RV function is preserved.

# Case

- 64 ♀ DM presented with AMS
  - GCS 4 (E1/V1/M2)
  - Obtunded

**VS: 36.5 80/70 89 20 93%NRB**

DOB: 31-Jan-1956 64 Years Female

SF General Hospital (1)
SFGH (00)
ER (10)

| | | | |
|---|---|---|---|
| HR | 112 | [RALARV] | . Right and left arm electrode reversal, interpretation assumes no reversal |
| | | [AFIB0] | . Atrial fibrillation |
| QRSD | 81 | [IPMIA] | . Inferoposterior infarct, acute |
| QT | 370 | [LMIA] | . Lateral infarct, acute |
| QTc | 505 | $[ADDV9] | . ST depression V1-V3, suggest recording posterior leads |

-- AXIS --

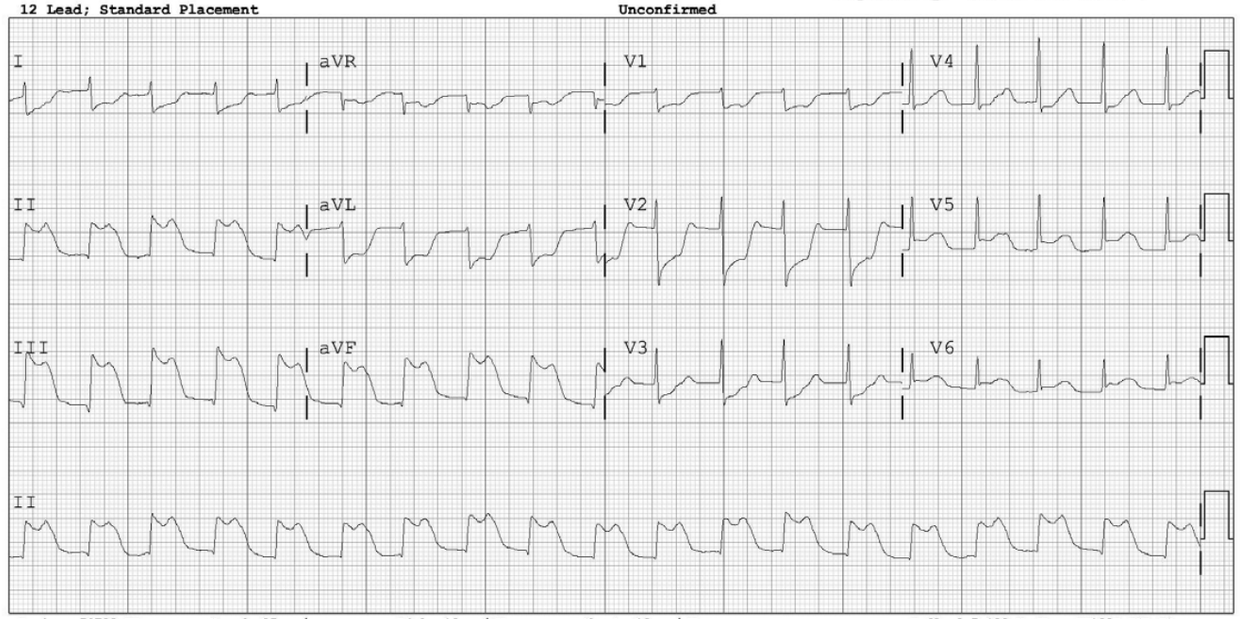
QRS 96
T 99

- ABNORMAL ECG -

Room: RESUS-3

Account #: 300025389650
Order #: 84482577
Enc ID: 300025389650
Reason: Chest pain
Requested By: ^CHRISTOPHER^^COLWELL^

12 Lead; Standard Placement Unconfirmed




Device: 58703 ED Speed: 25 mm/sec Limb: 10 mm/mV Chest: 10 mm/mV F 60~ 0.5-100 Hz W PH100B BCL P?

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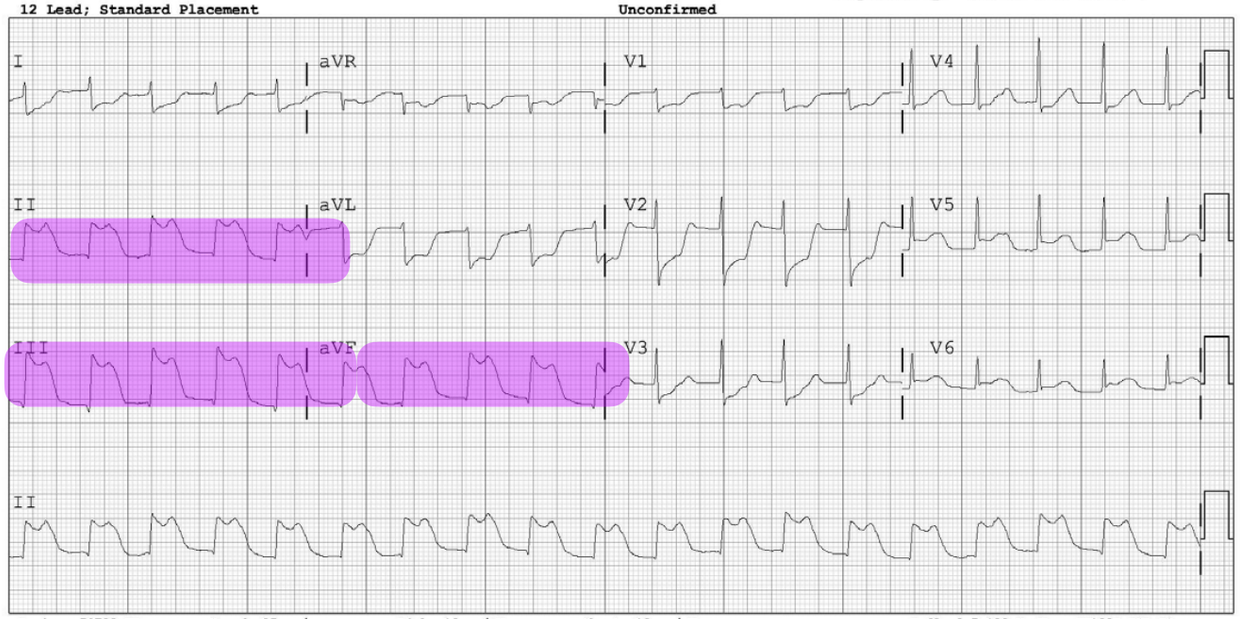


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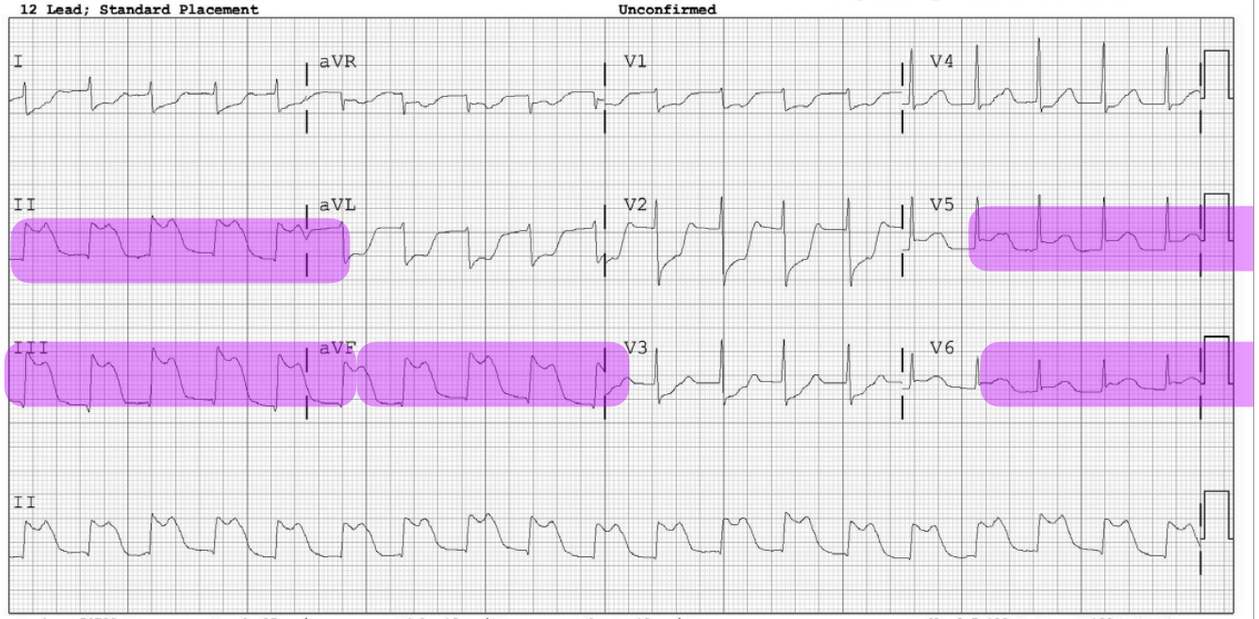


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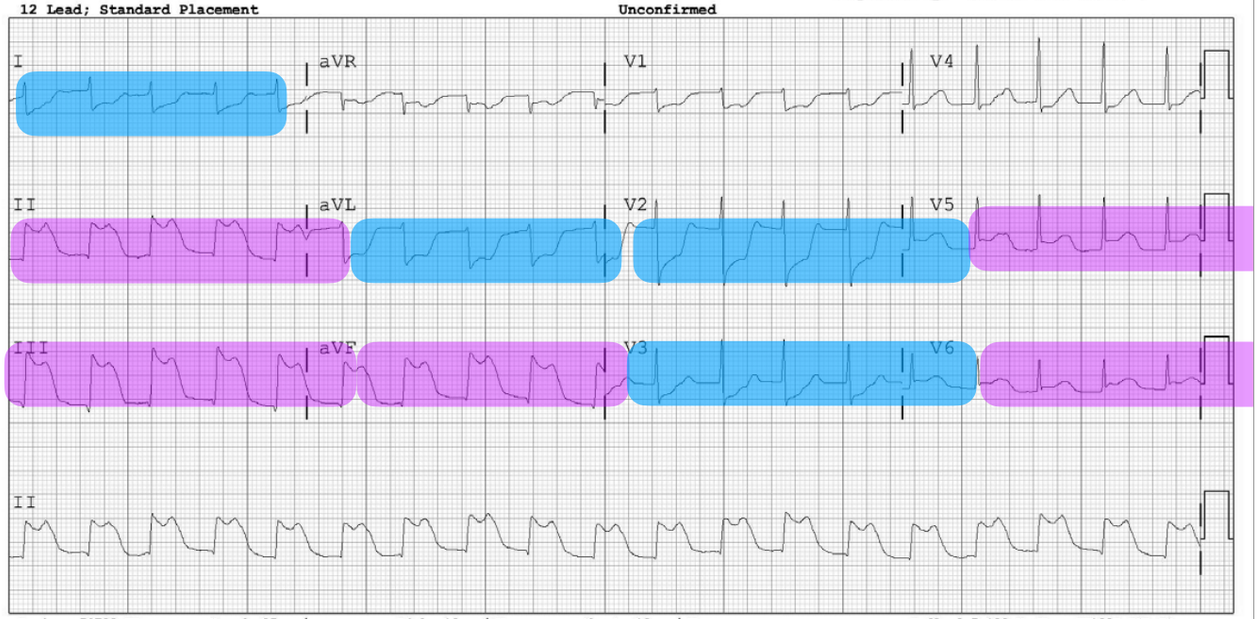


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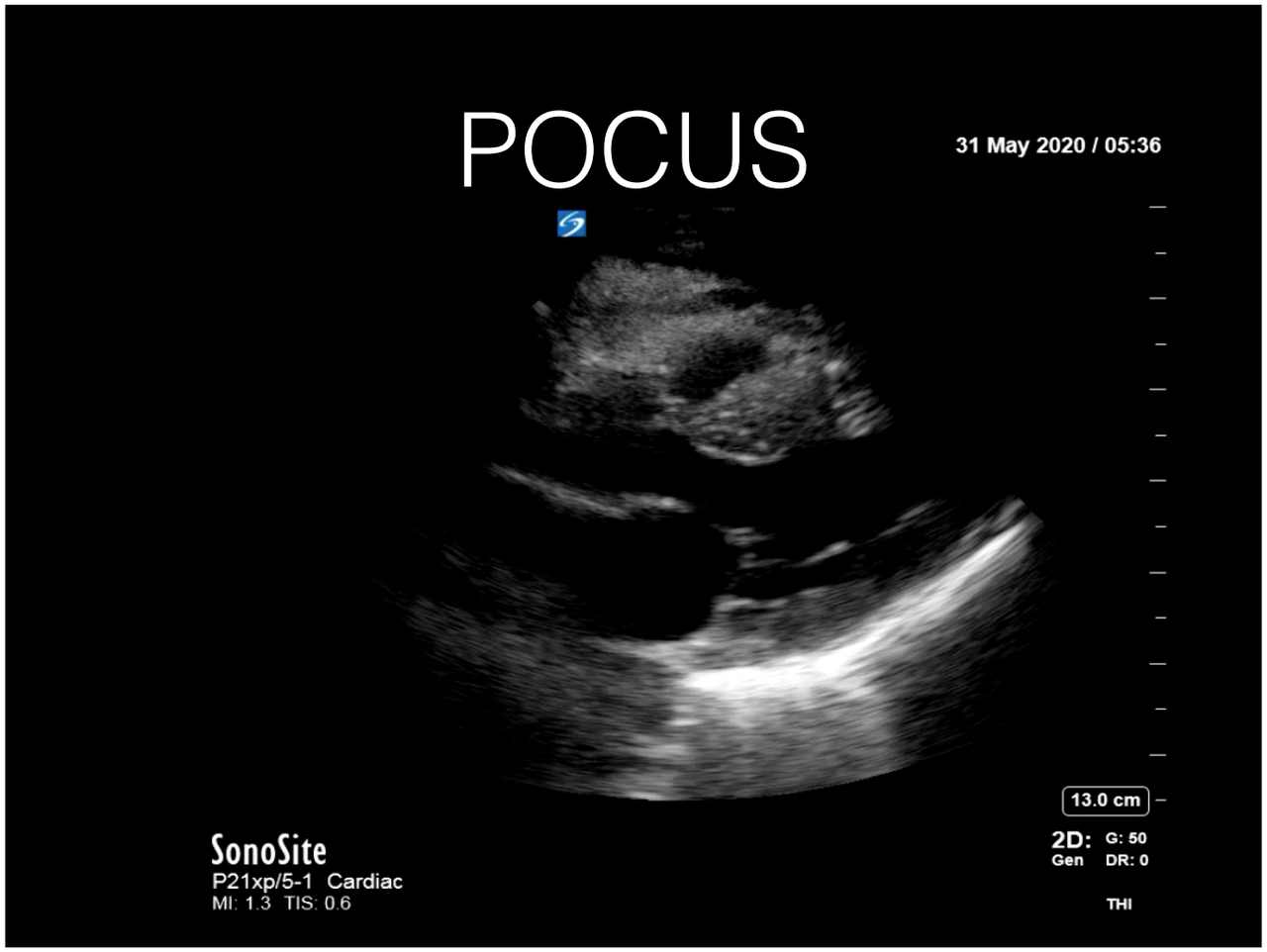
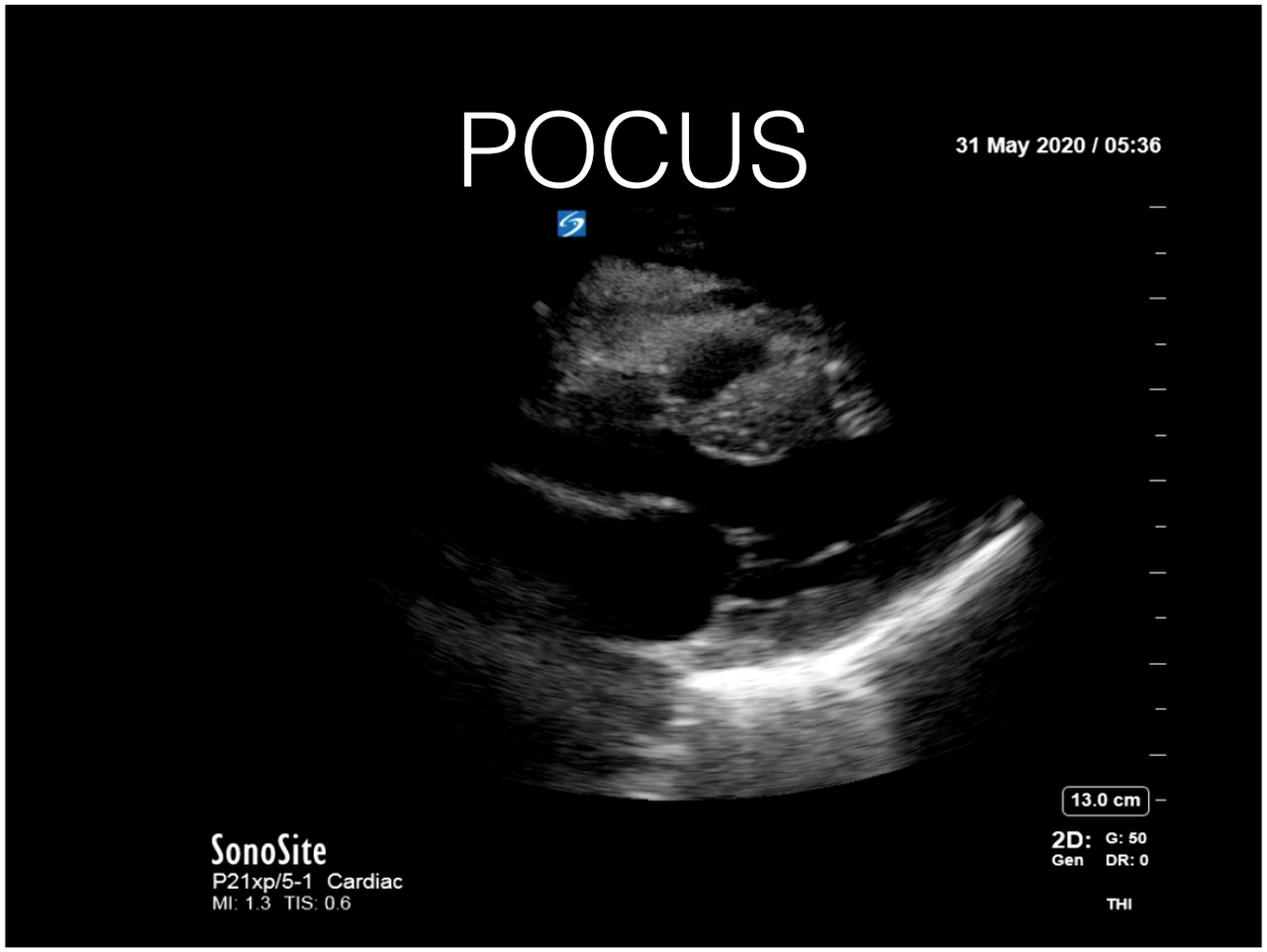

POCUS
31 May 2020 / 05:36
13.0 cm
SonoSite
P21xp/5-1 Cardiac
MI: 1.3 TIS: 0.6
2D: G: 50
Gen DR: 0
THI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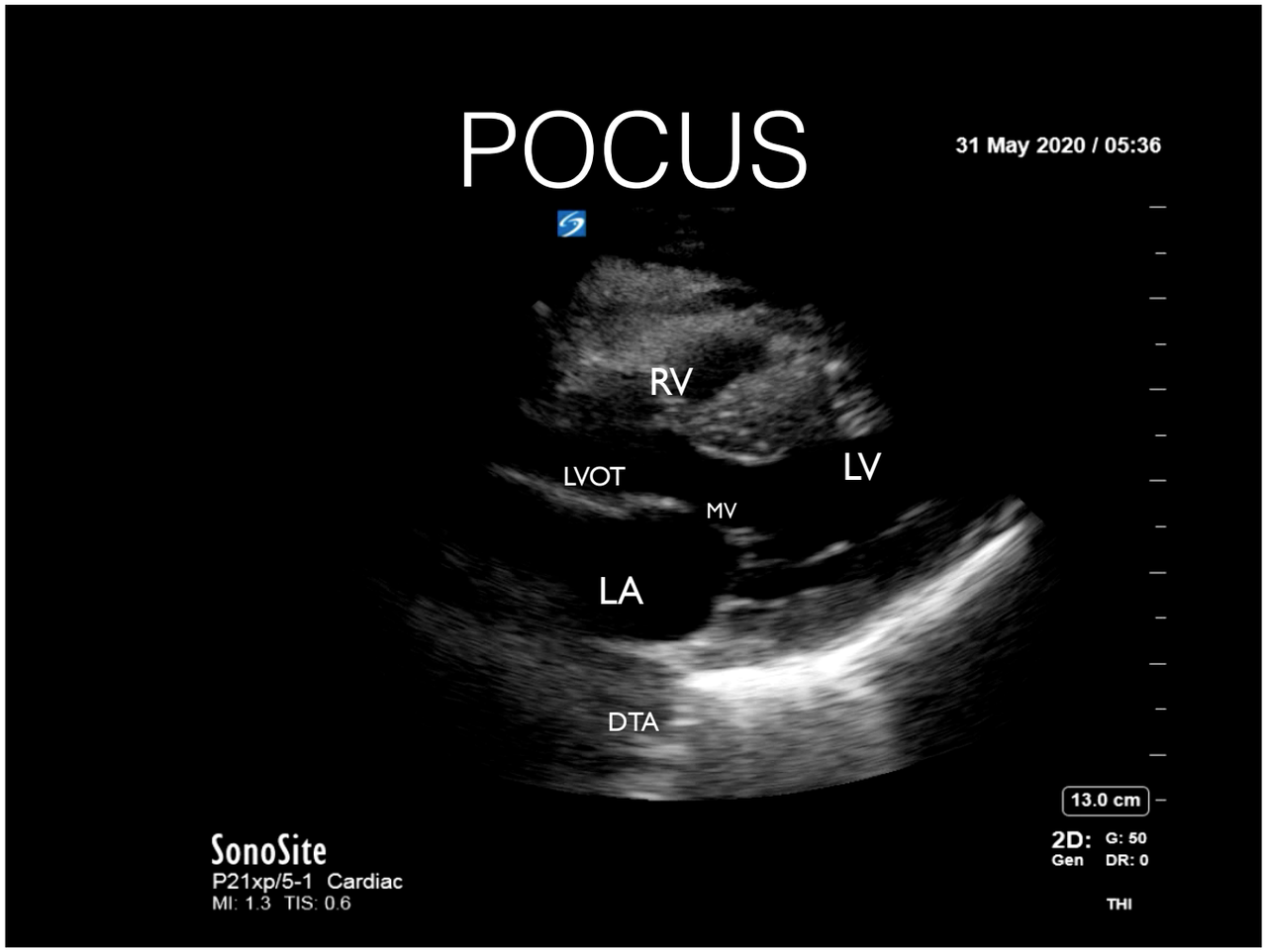
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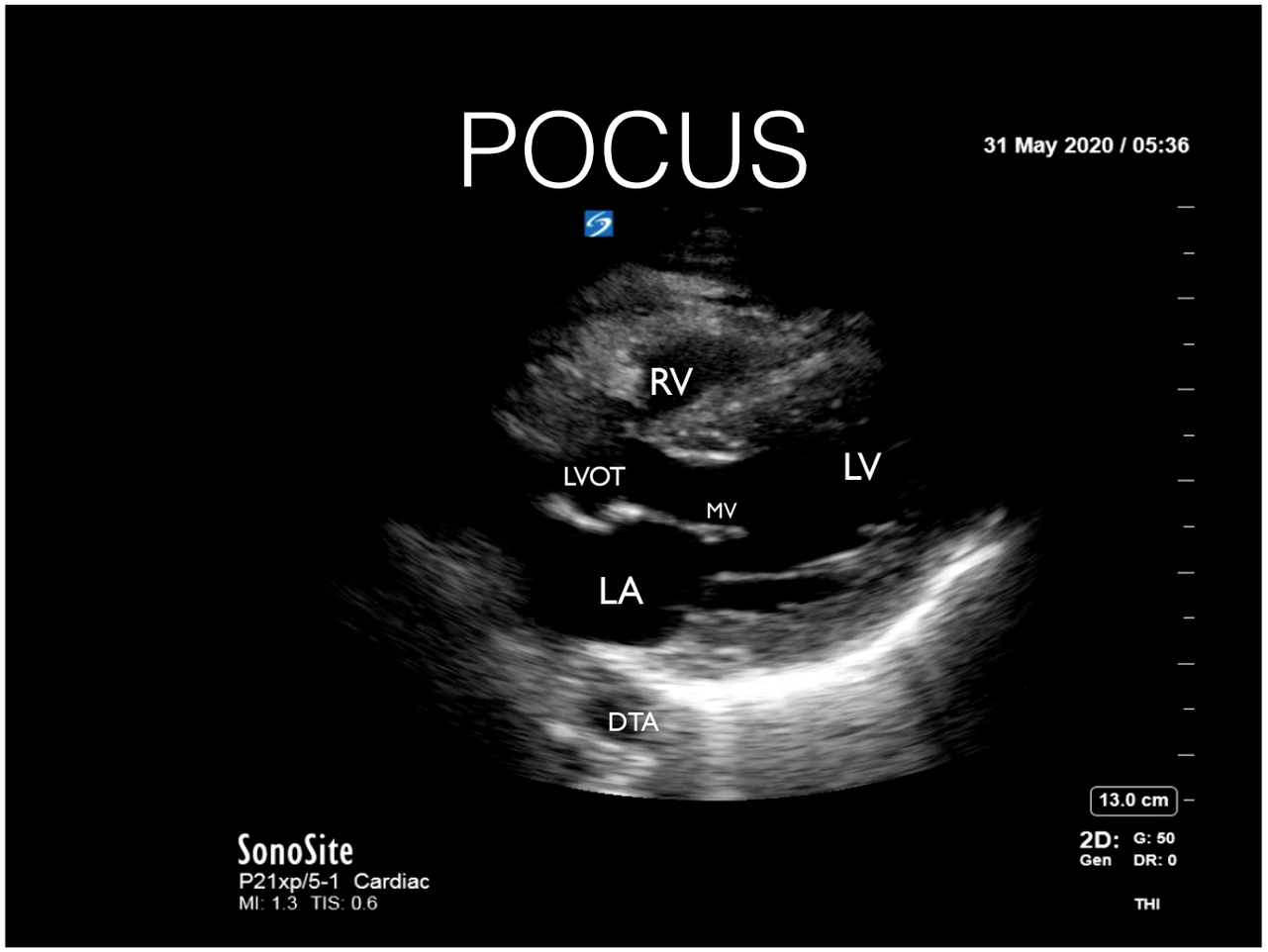
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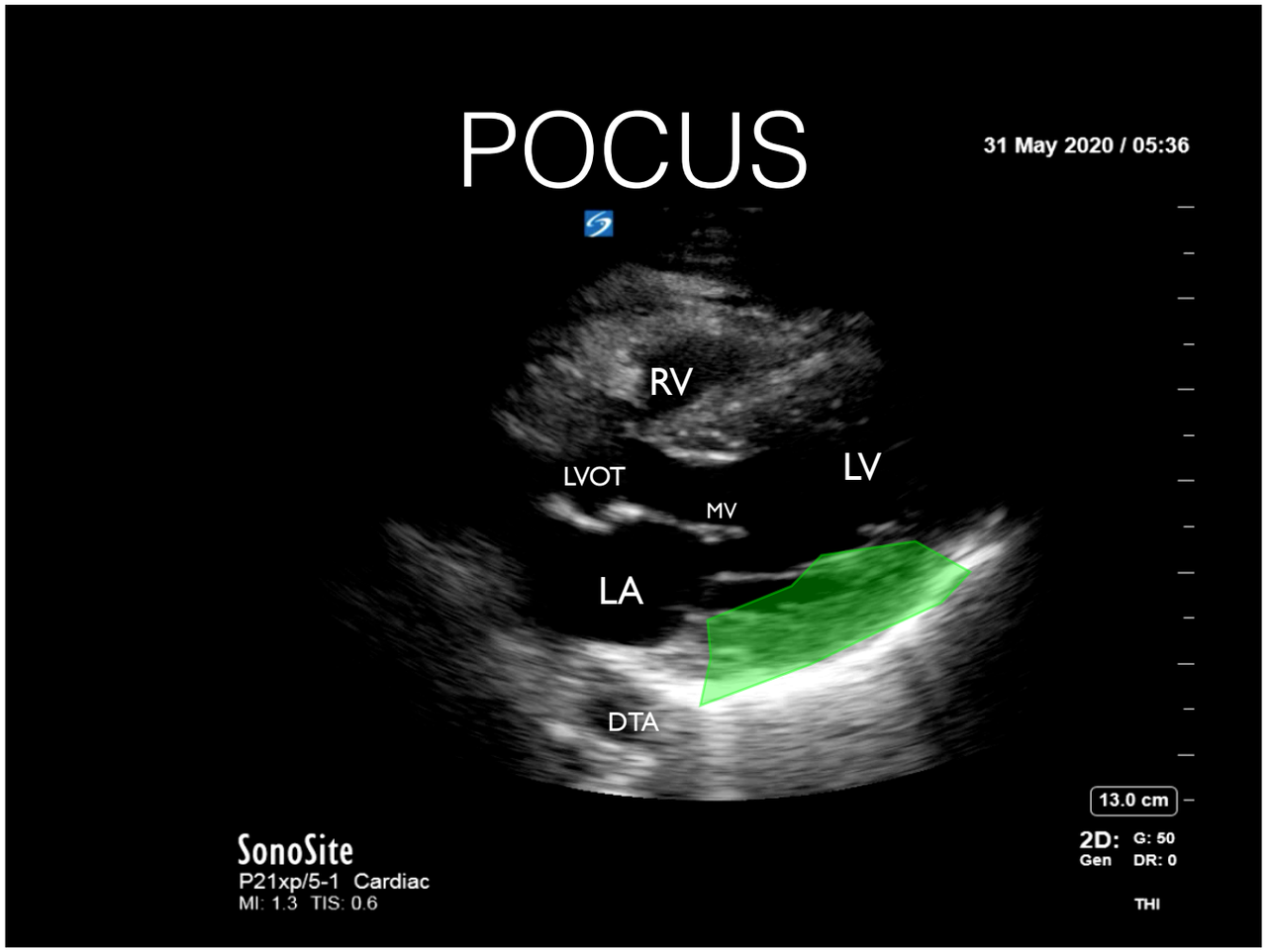
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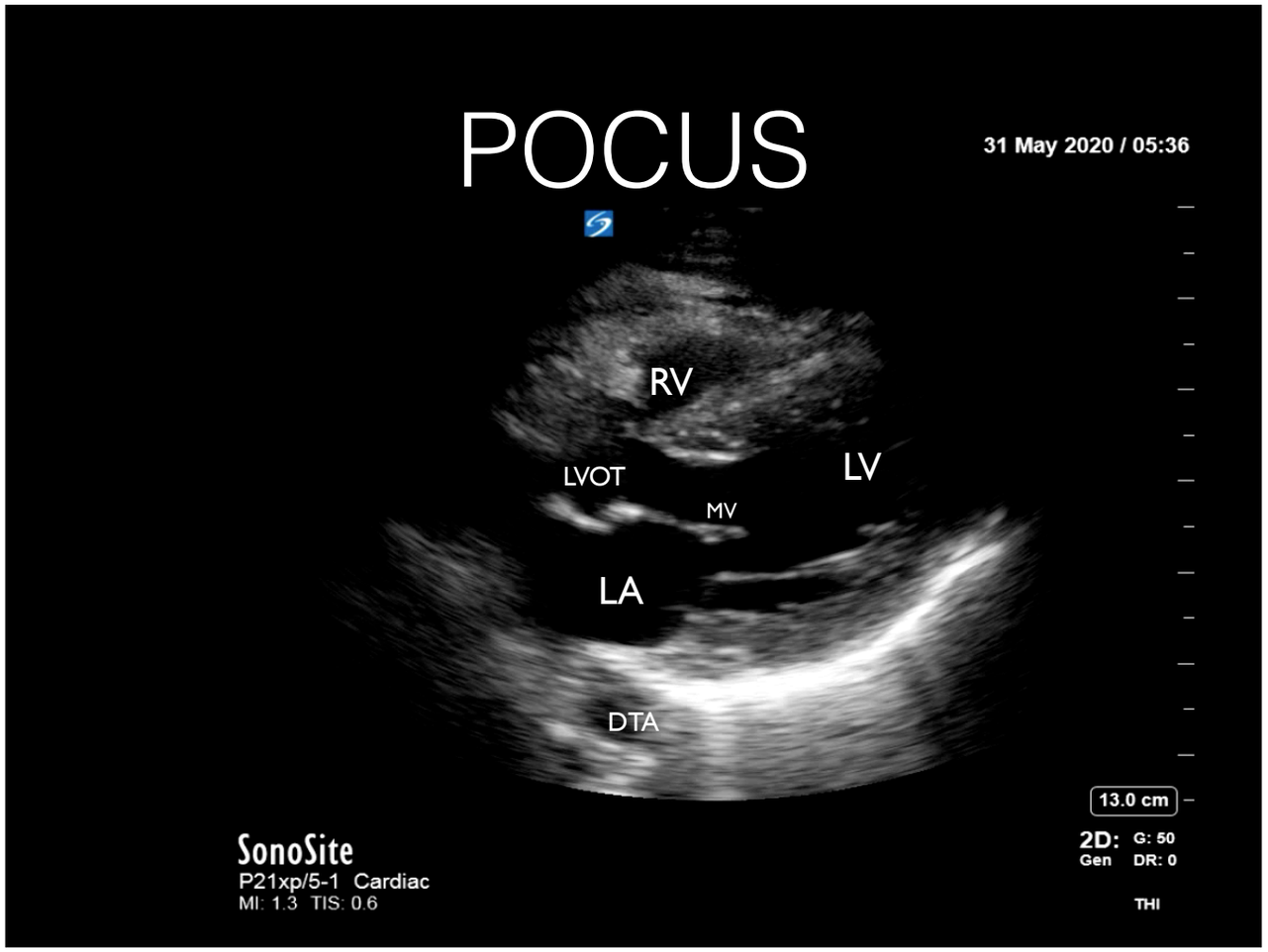
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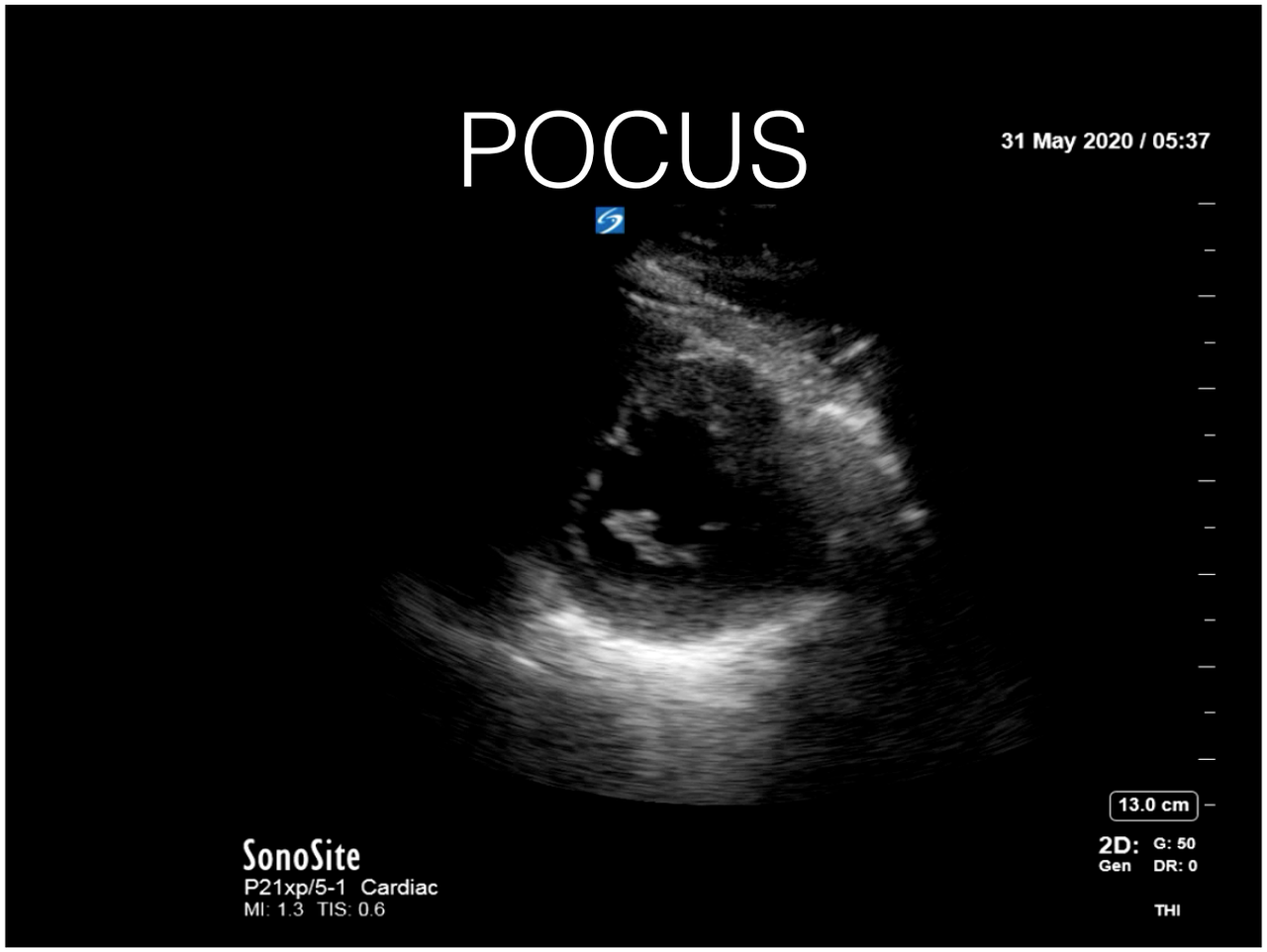
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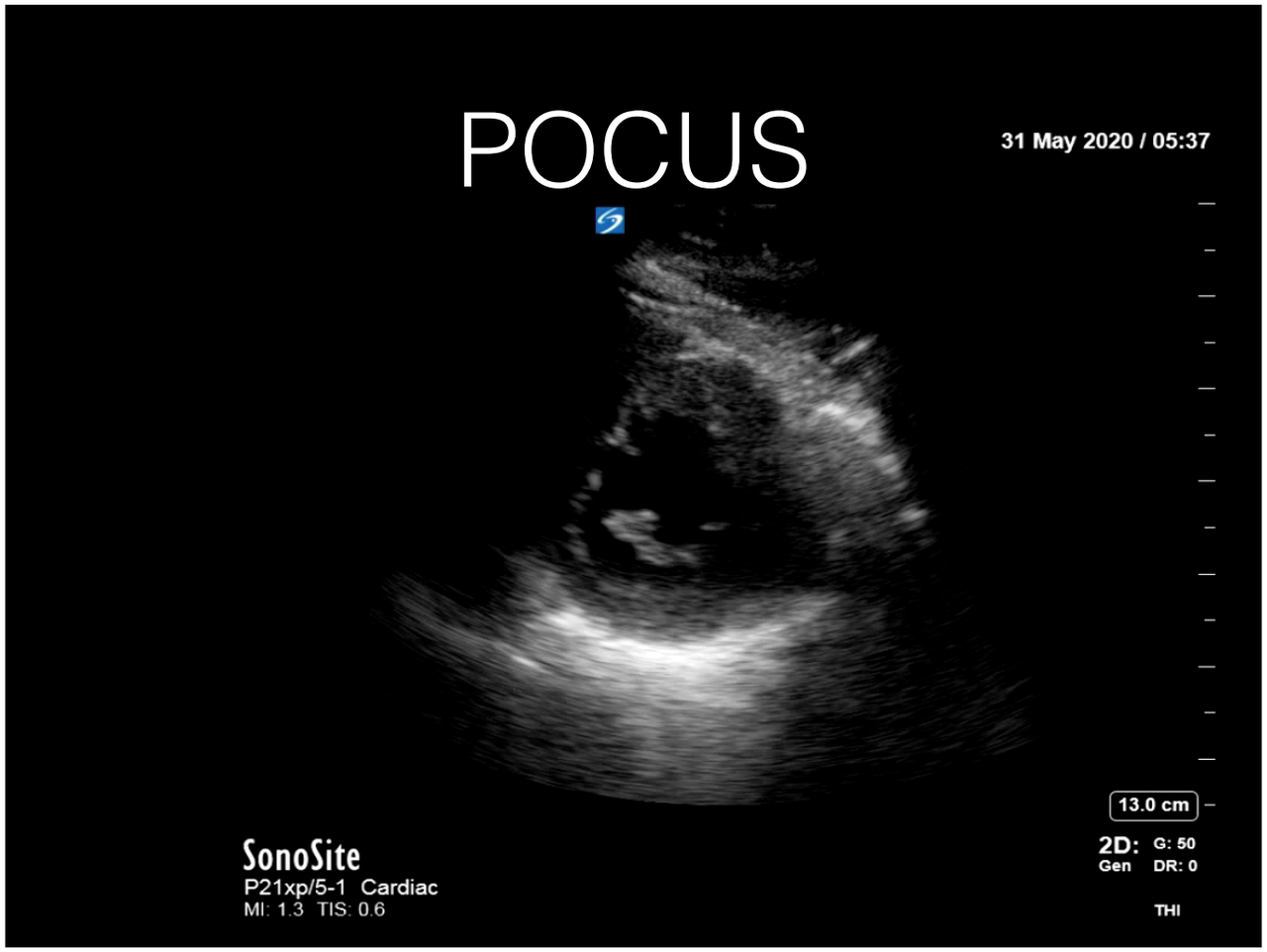
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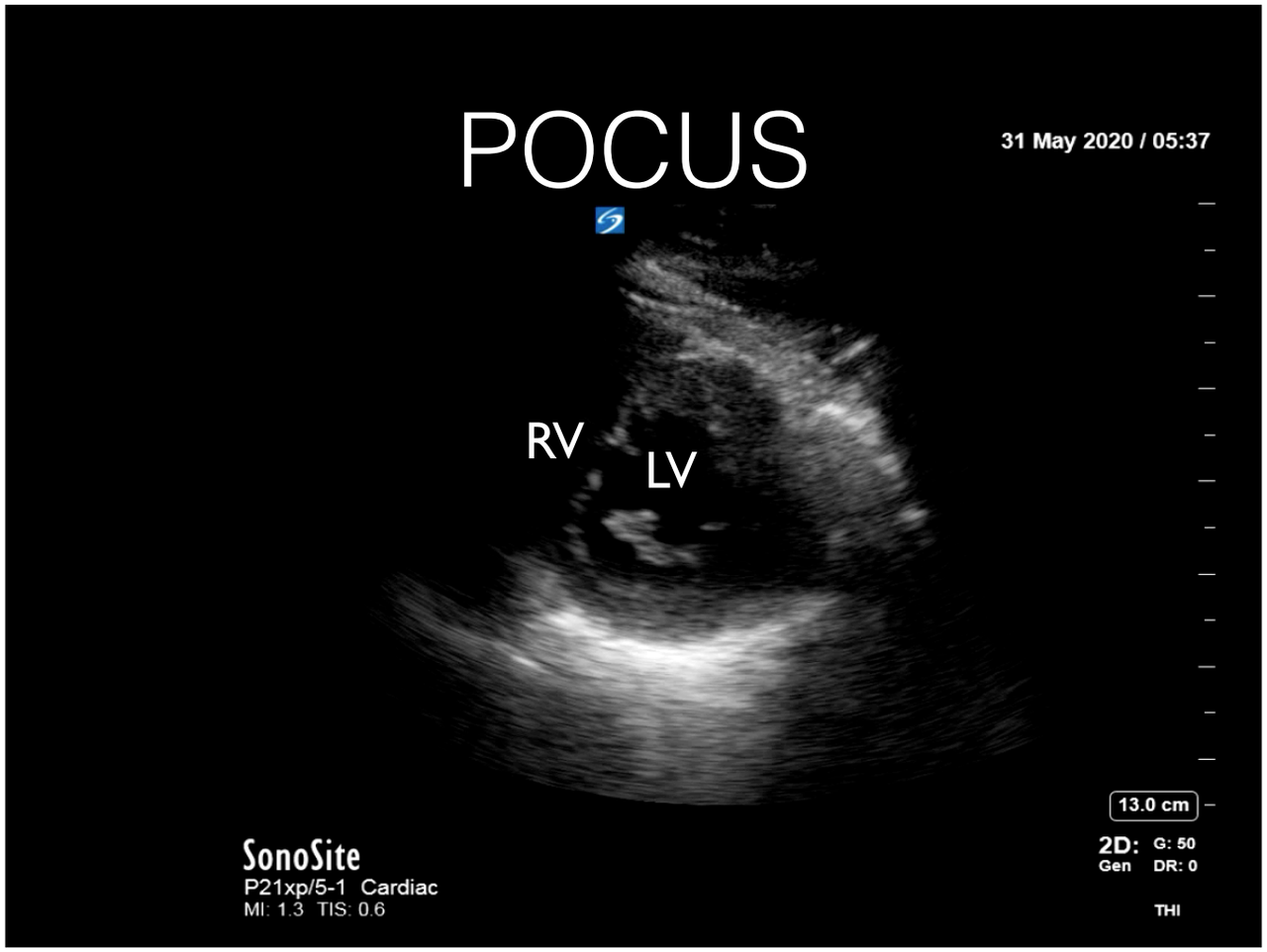
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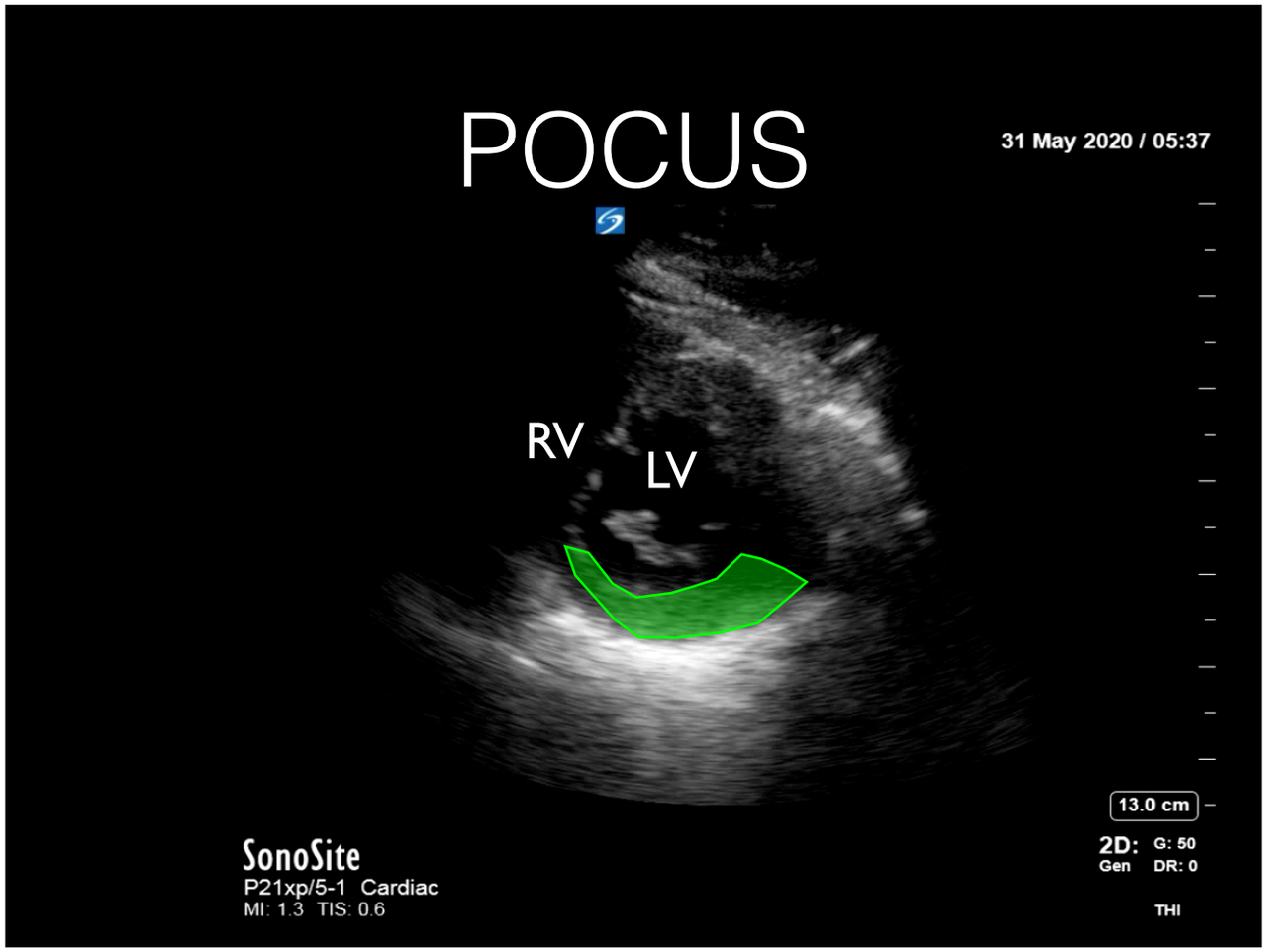
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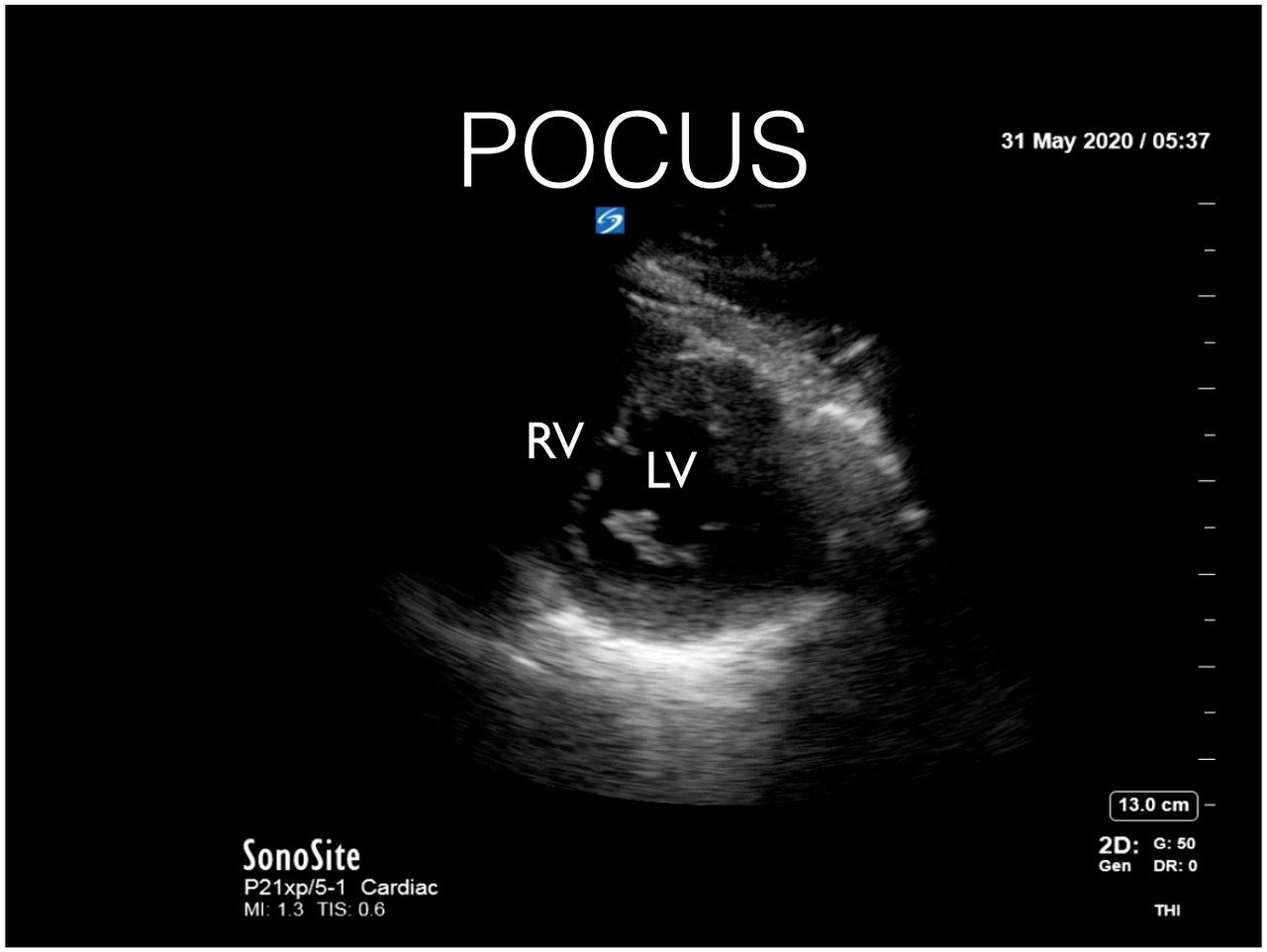
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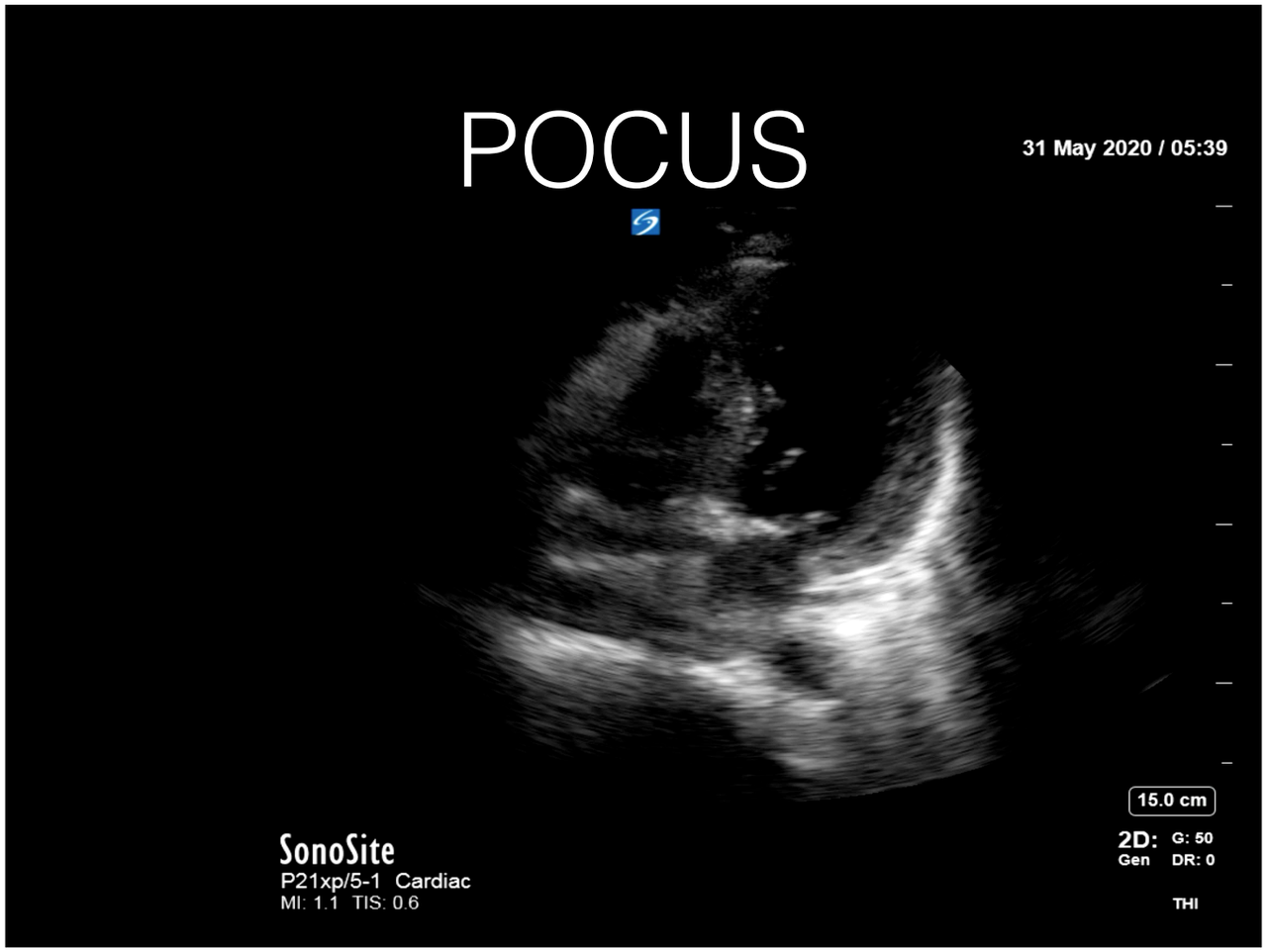
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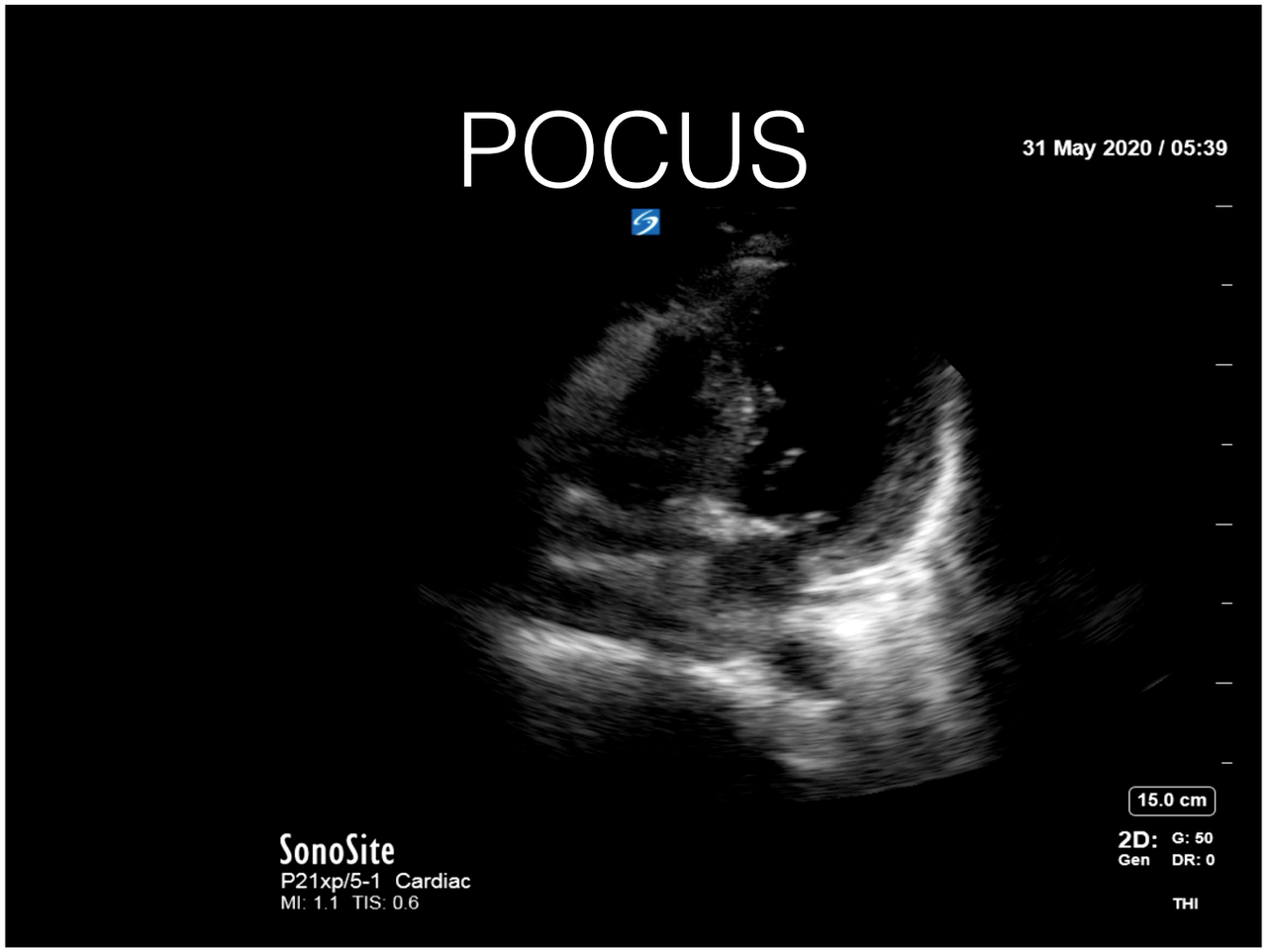
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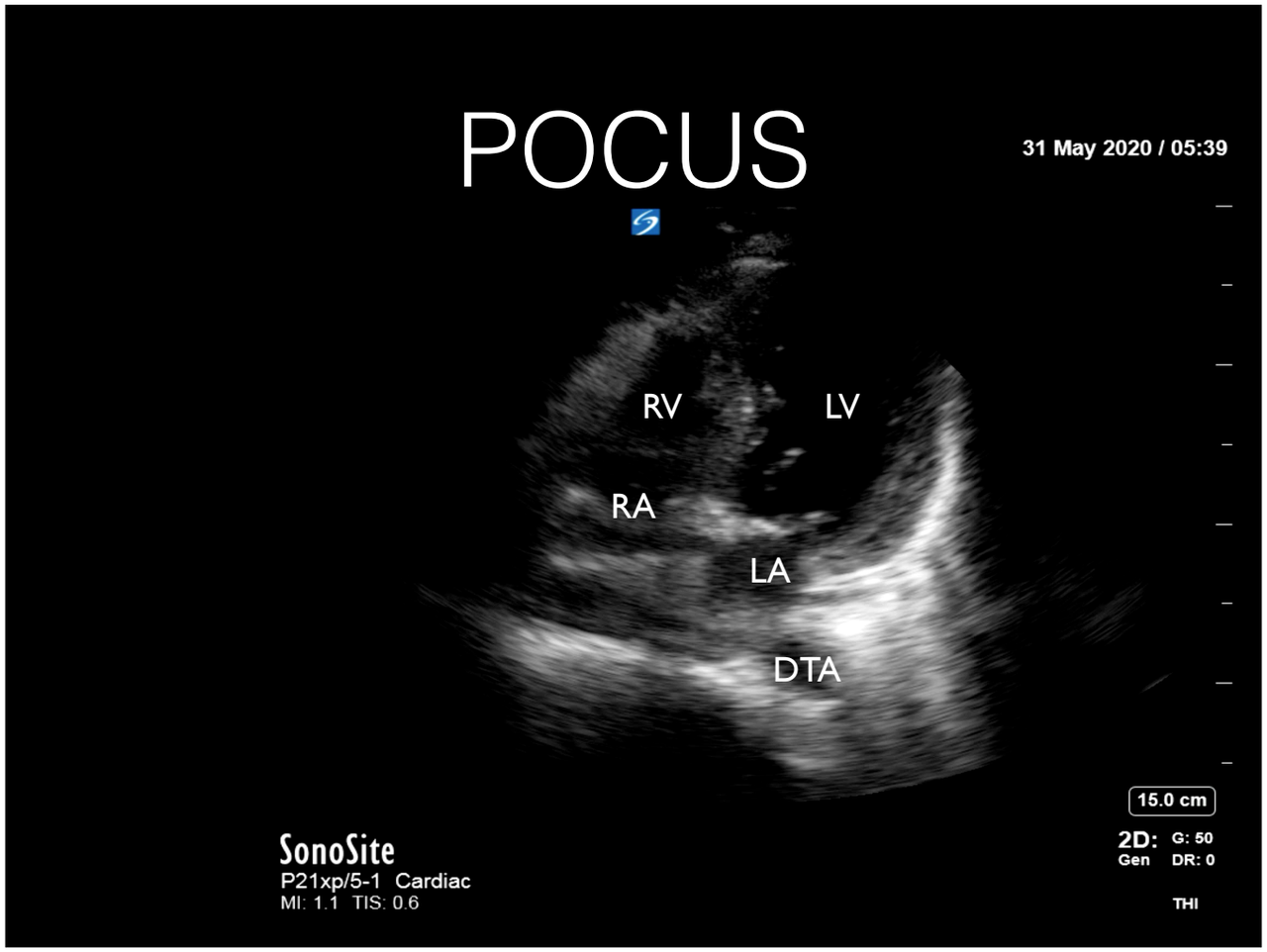
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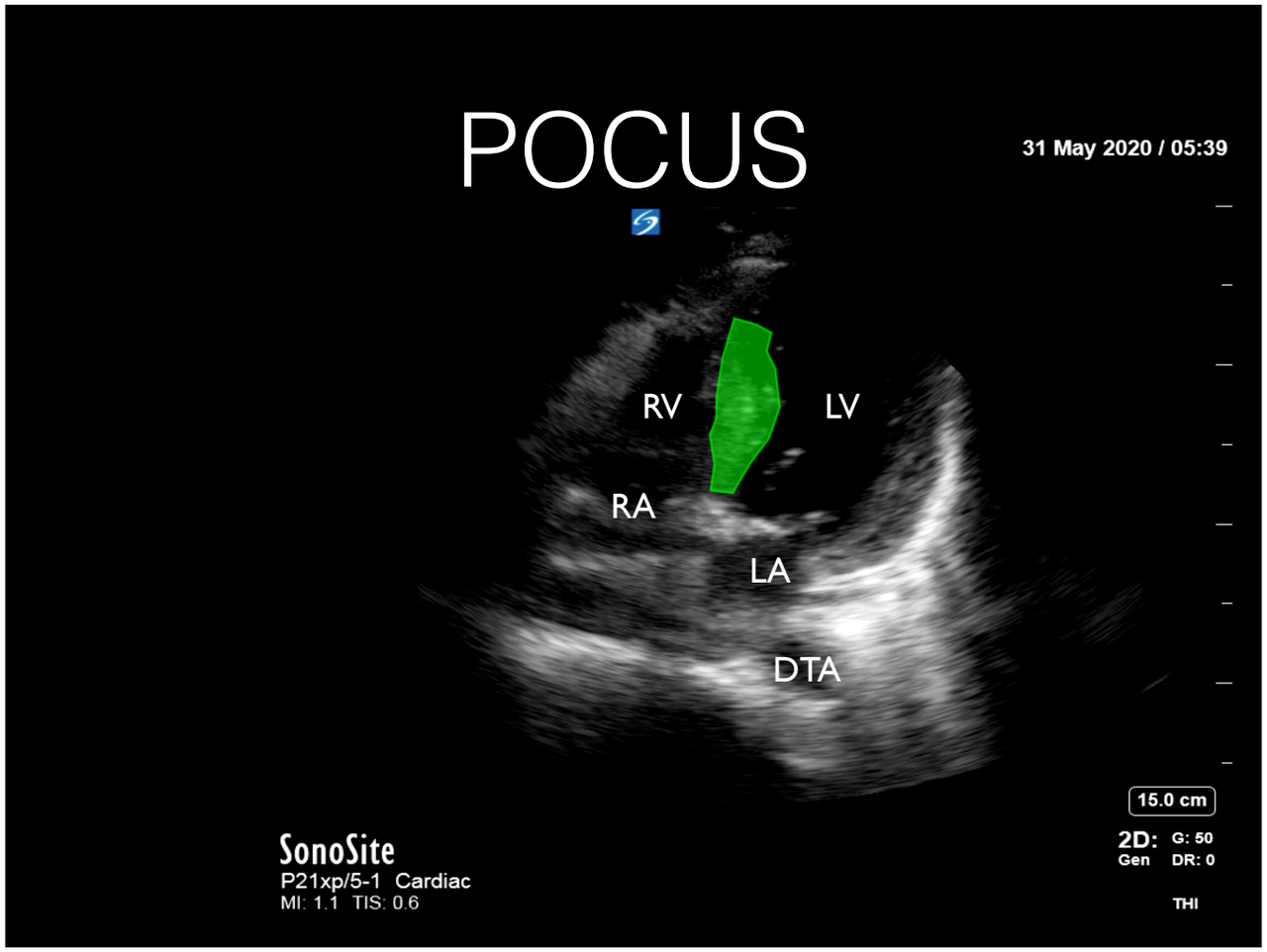
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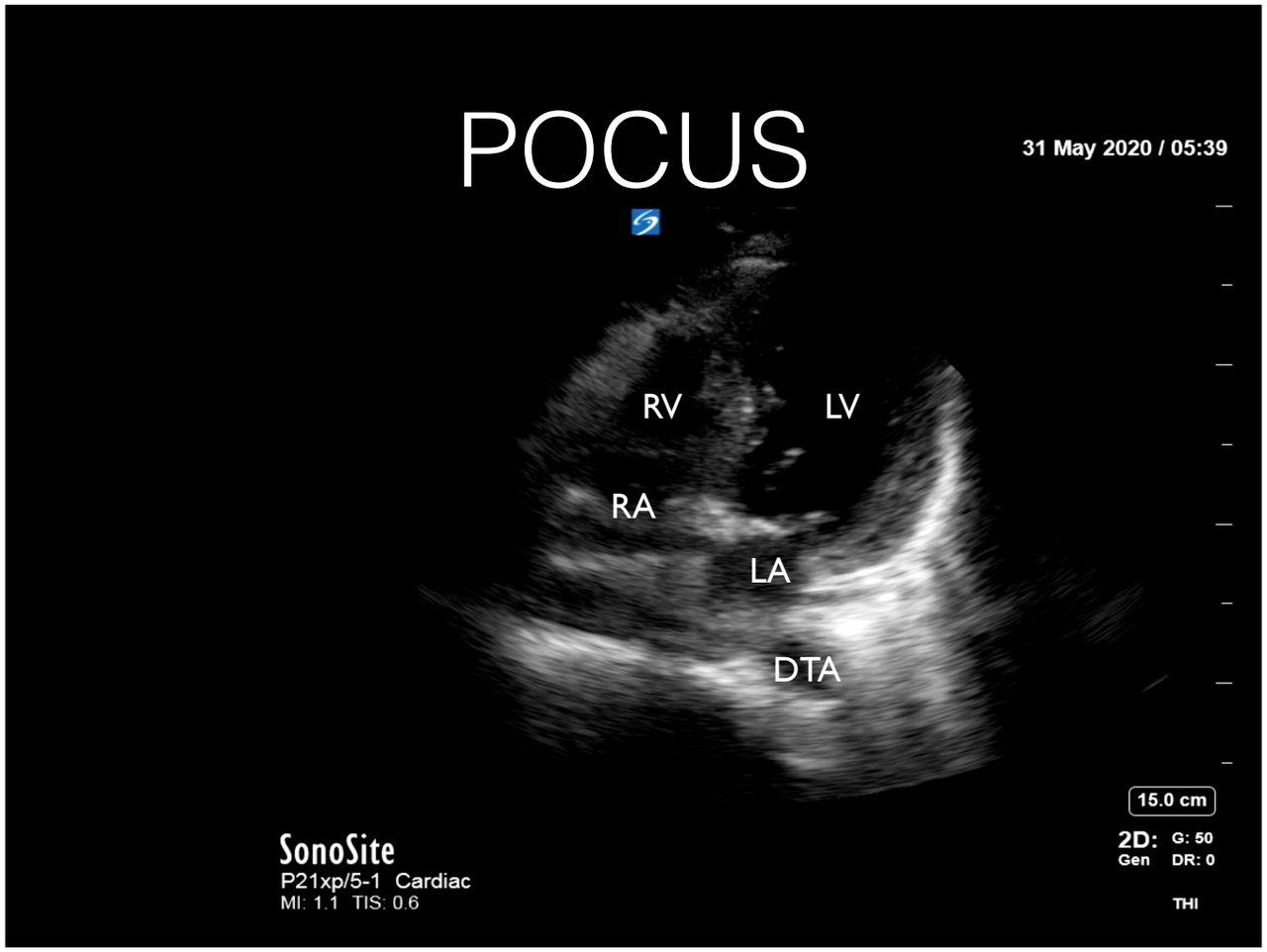
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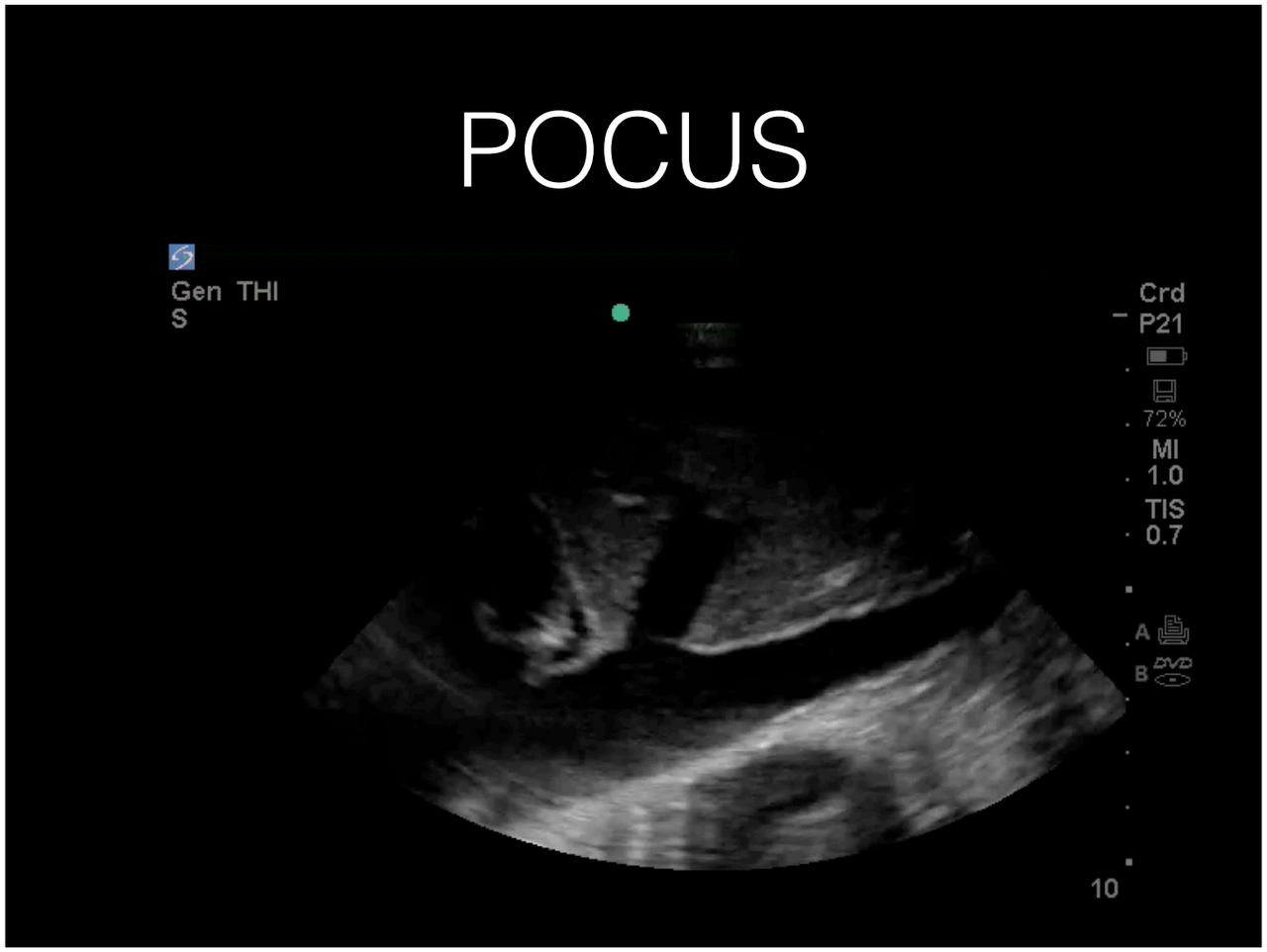


IVC less collapsible likely 2/2 RV strain form septal hypokinesis

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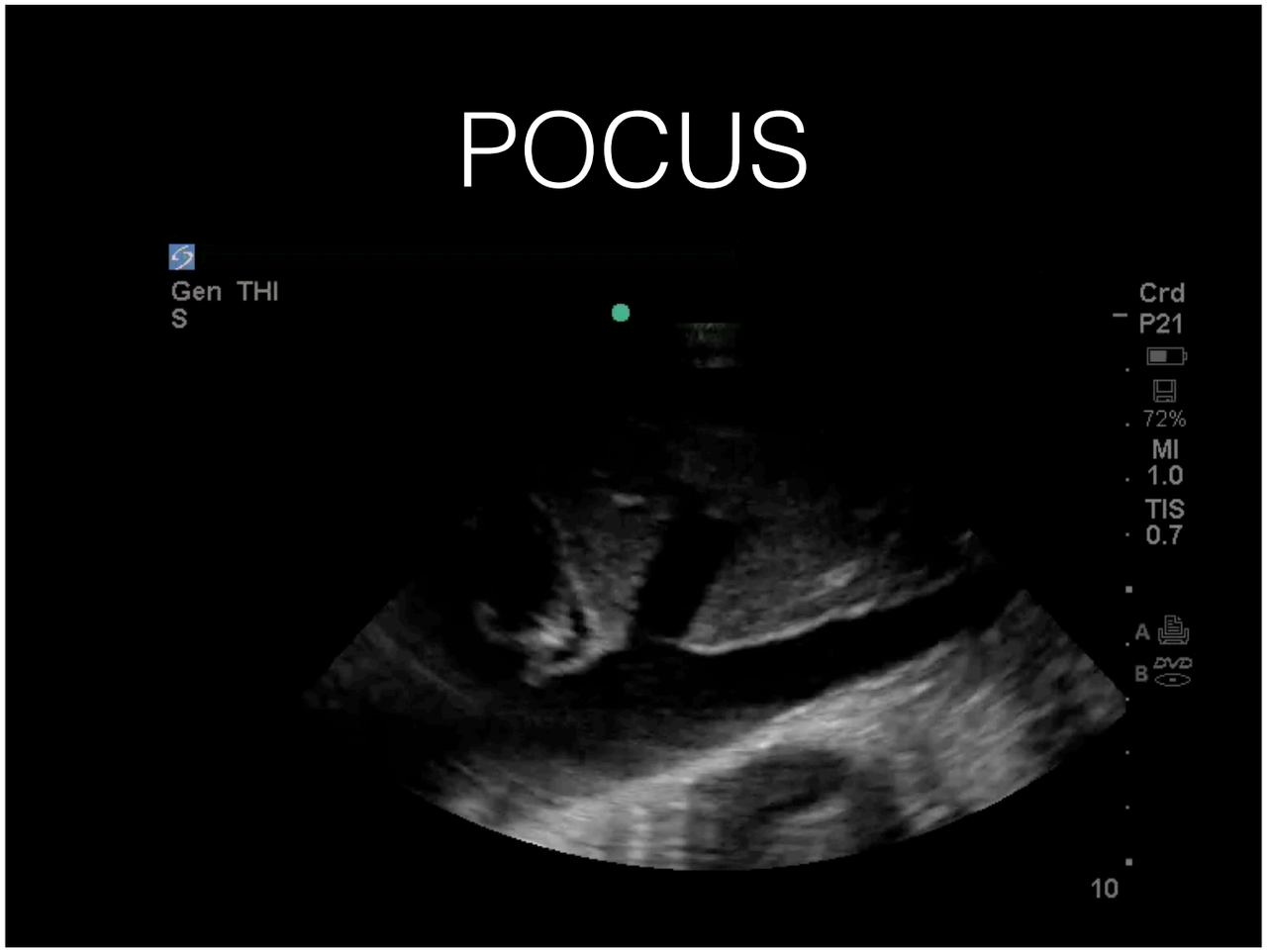

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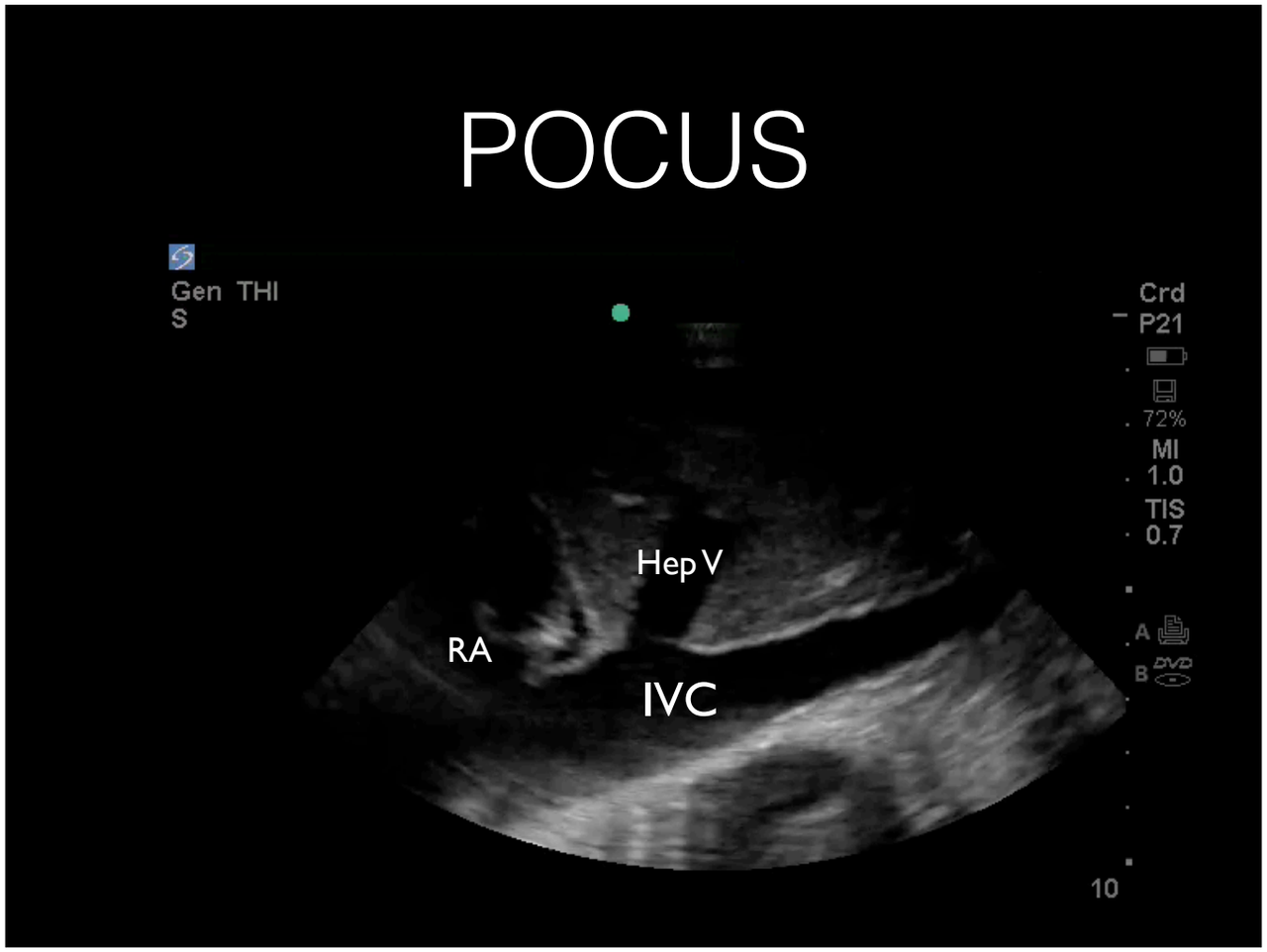
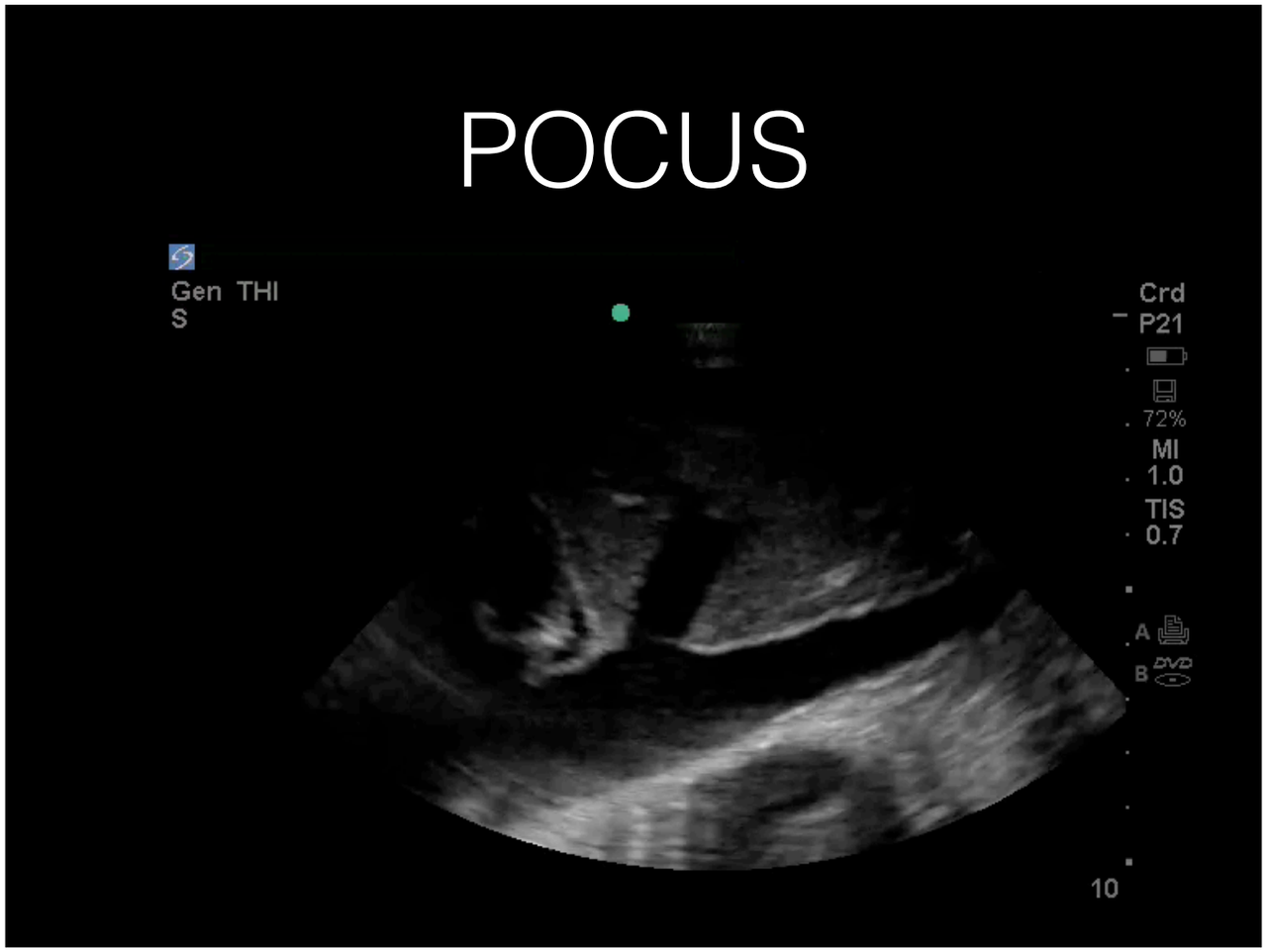
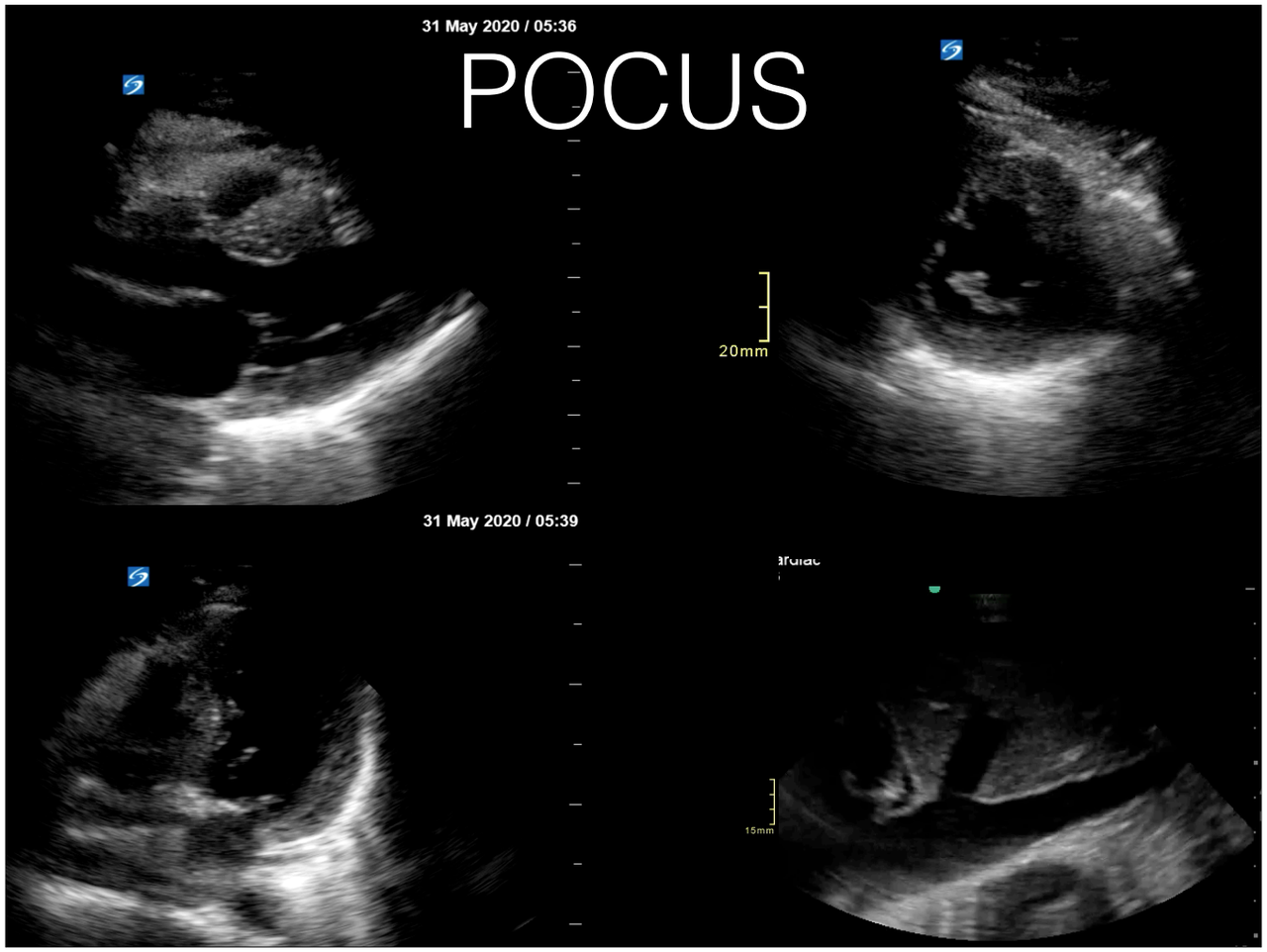
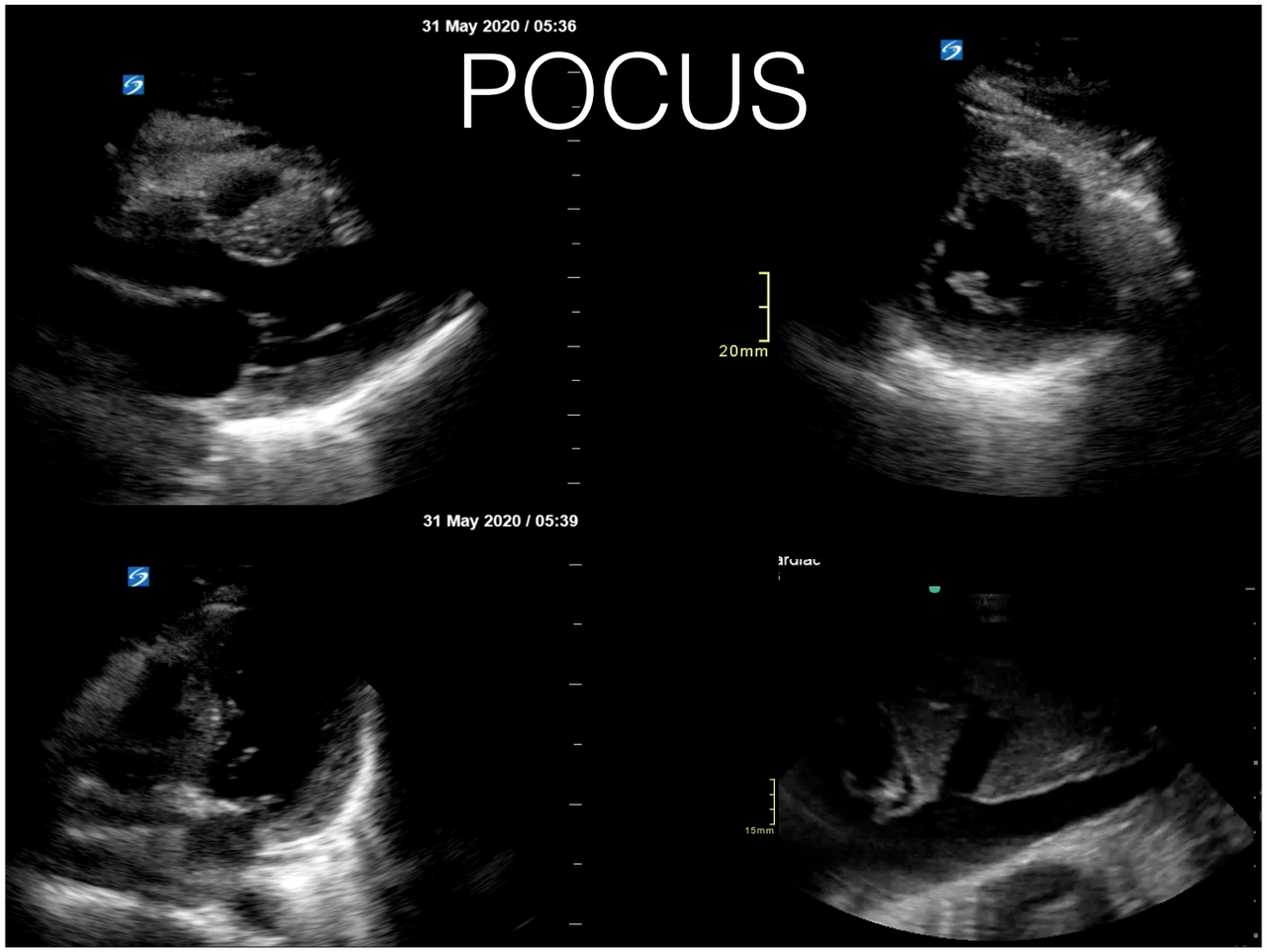


# POCUS




31 May 2020 / 05:36
POCUS
20mm
31 May 2020 / 05:39
15mm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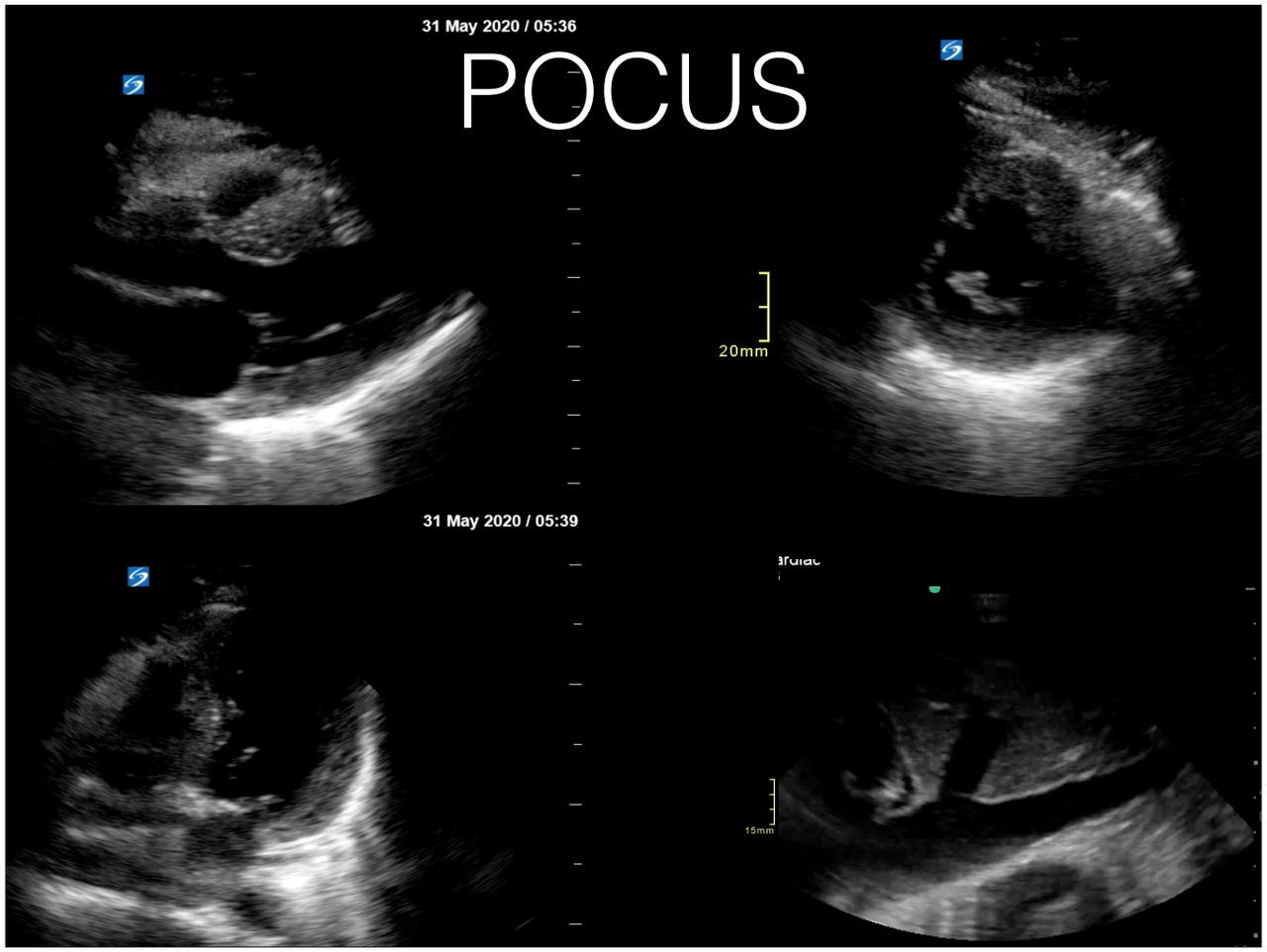
31 May 2020 / 05:36
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20mm
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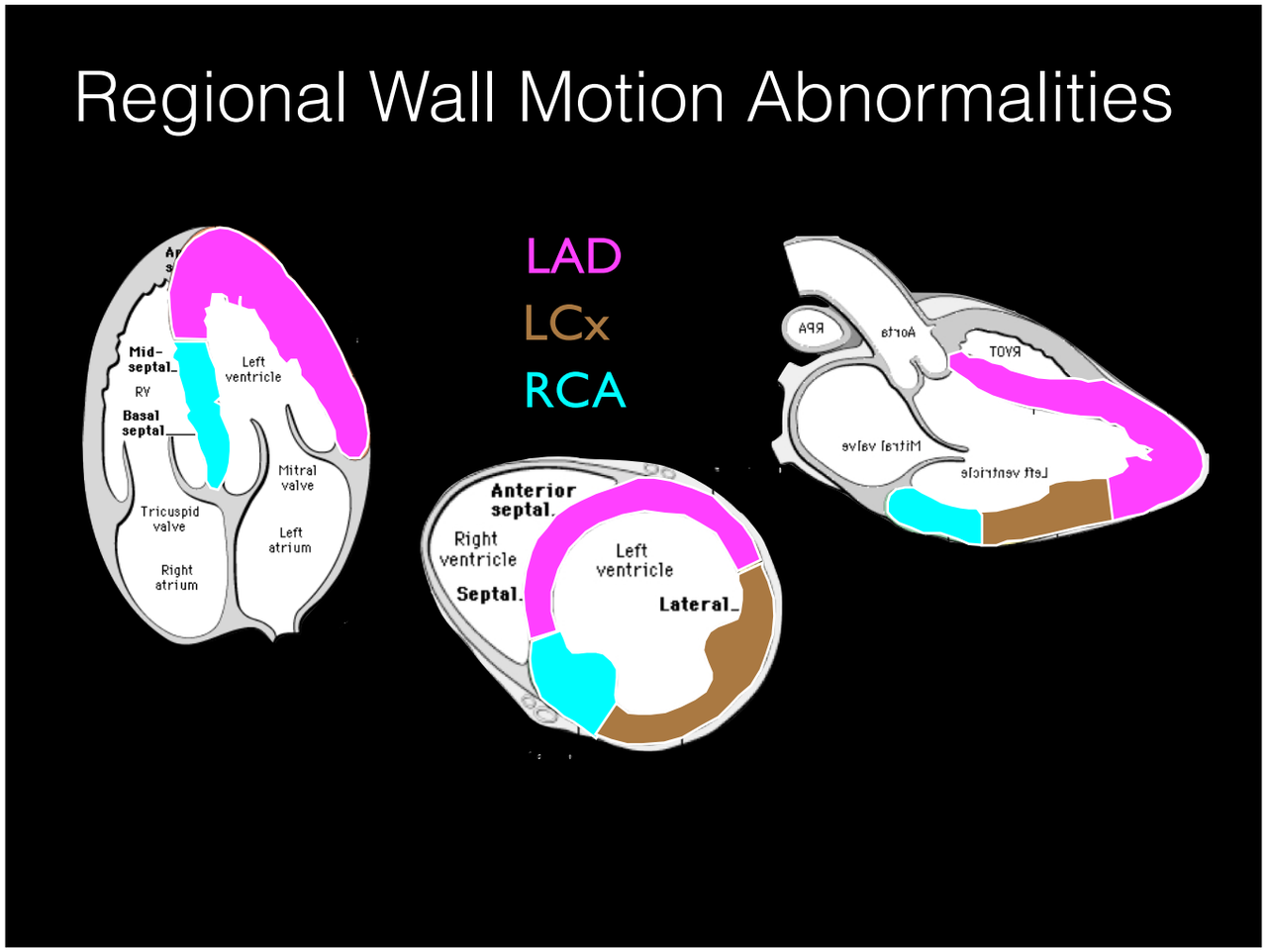
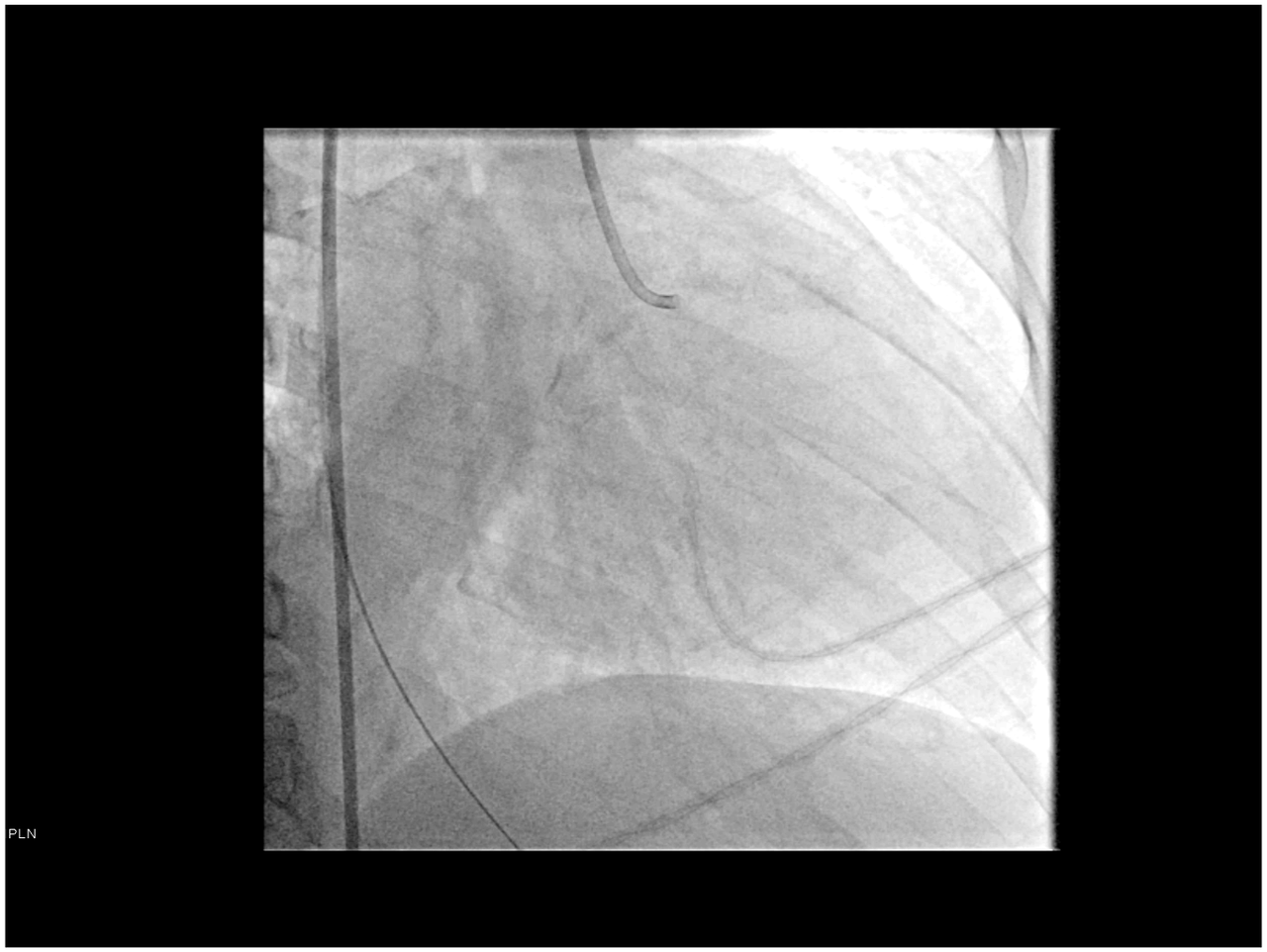
15mm

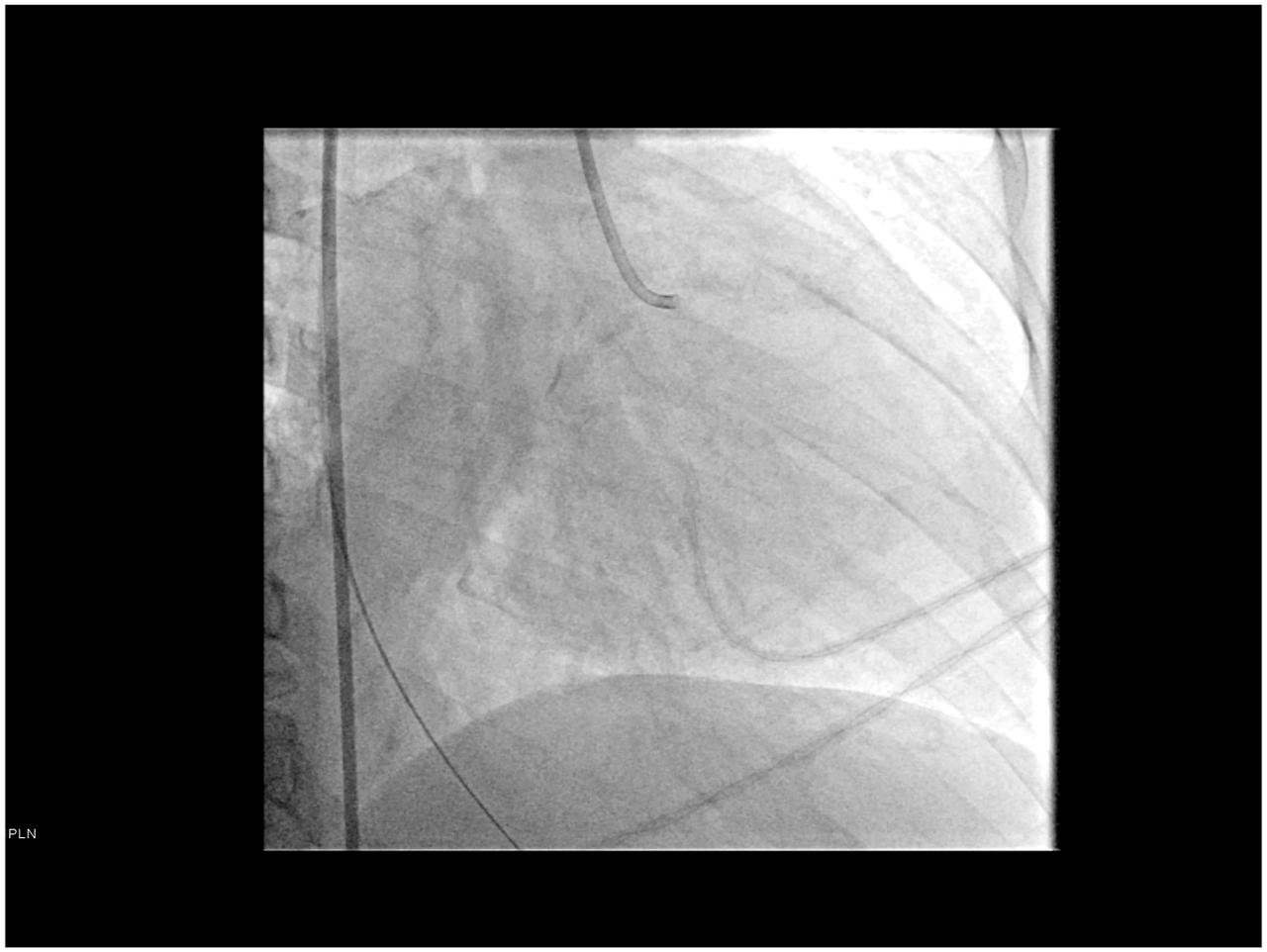



So, let's discuss RWMA. First, a review of anatomy as it relates to the echo windows we obtain. The easiest view to start with in my opinion is the short axis because it relates most easily to the surface EKG that we obtain. We know that the LAD supplies the anterior wall, the circ supplies the lateral and posterior walls and the RCA supplies the inferior wall. When we obtain a 4chamber view, we are essentially cutting the short axis at this angle. We see then that the LAD supplies the distal septal wall and the apex as well as the lateral wall on the 4 chamber view. On the PSLA view we see the LAD again supplying the anterior wall and the portion of the apex. The LCX supplies the posterior wall and the RCA supplies this little portion of the inferior wall as well. Again, the short axis is what is easiest to reconcile with your EKG distribution.

L main open—> LAD and LCX patent




Complete RCA occlusion—> With restoration of flow s/p stent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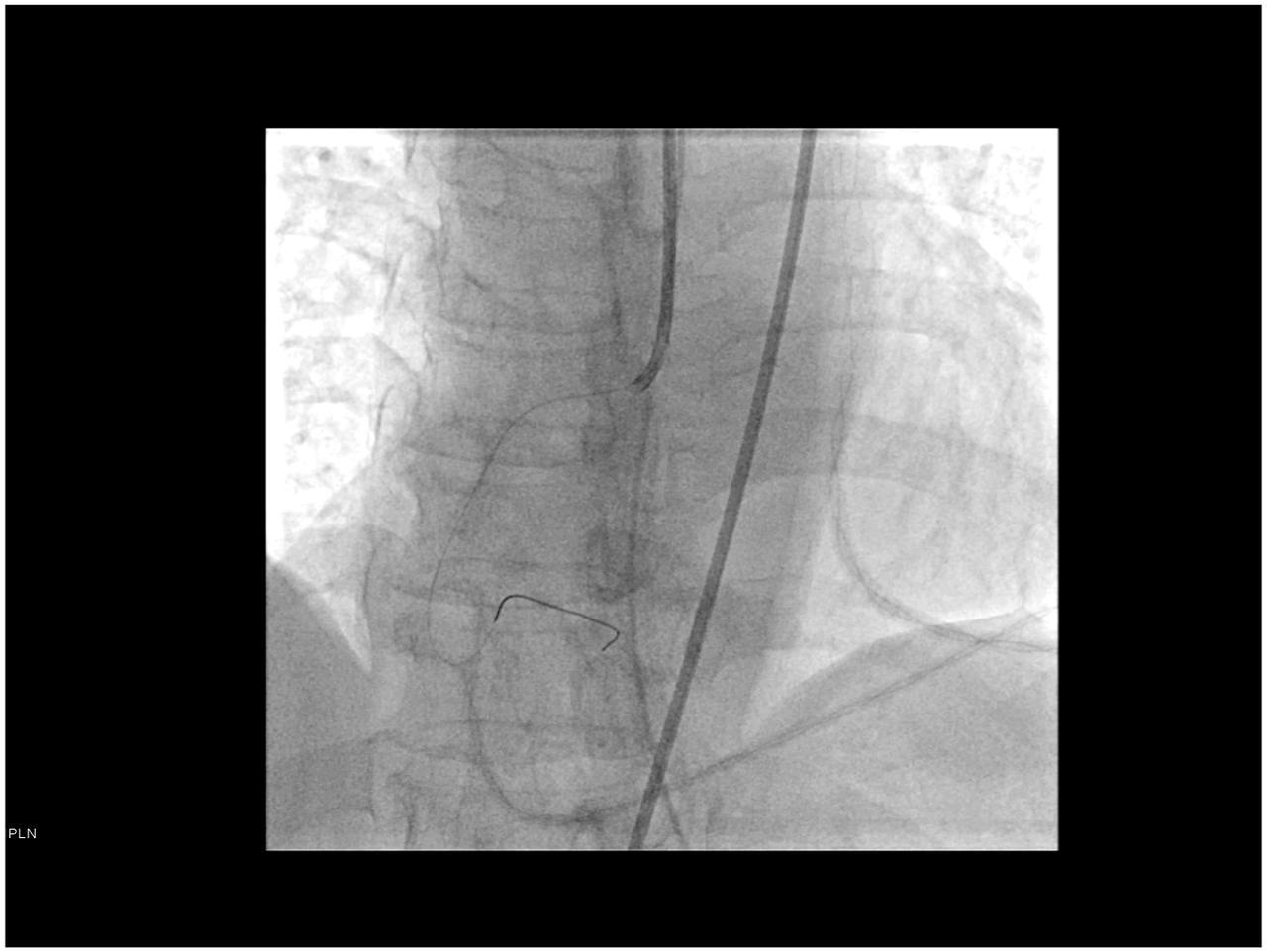

PLN

# Case

# Case

- 70 ♂ h/o CAD c/o syncope after a BM

# Case

- 70 ♂ h/o CAD c/o syncope after a BM
  - Post-syncopal CP

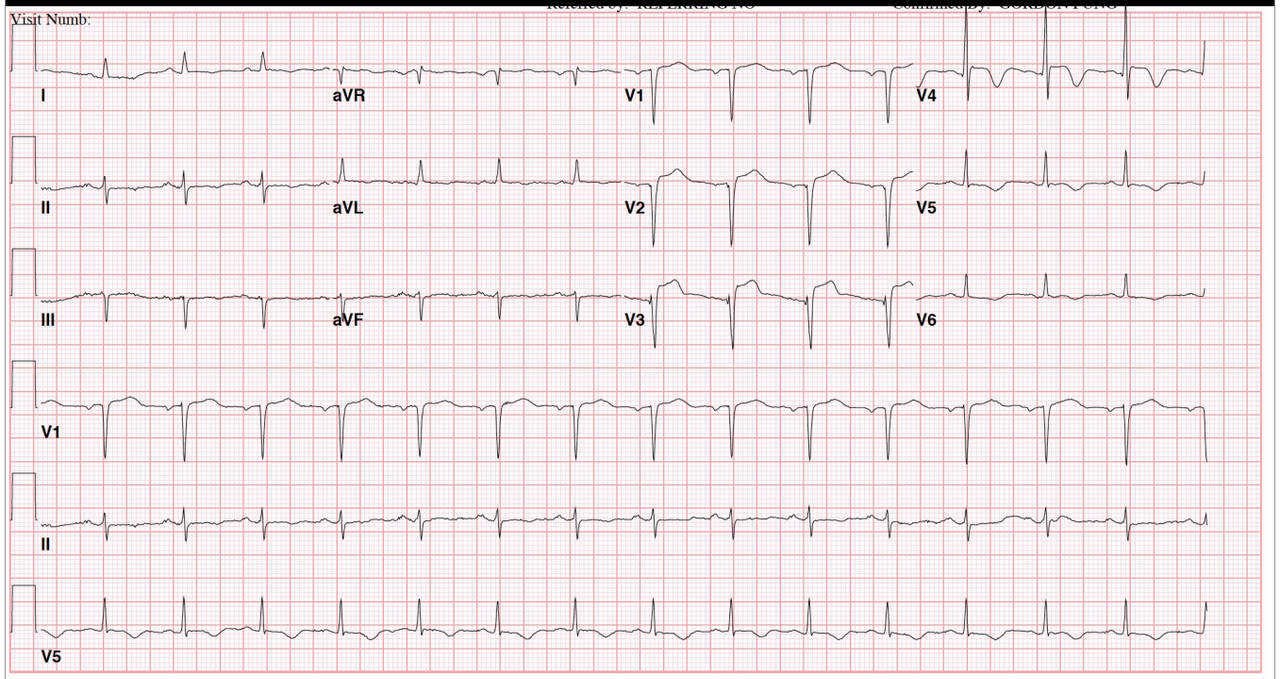
# Case

- 70 ♀ h/o CAD c/o syncope after a BM
  - Post-syncopal CP

***VS: 36.5 90/50 90 25 96%RA***

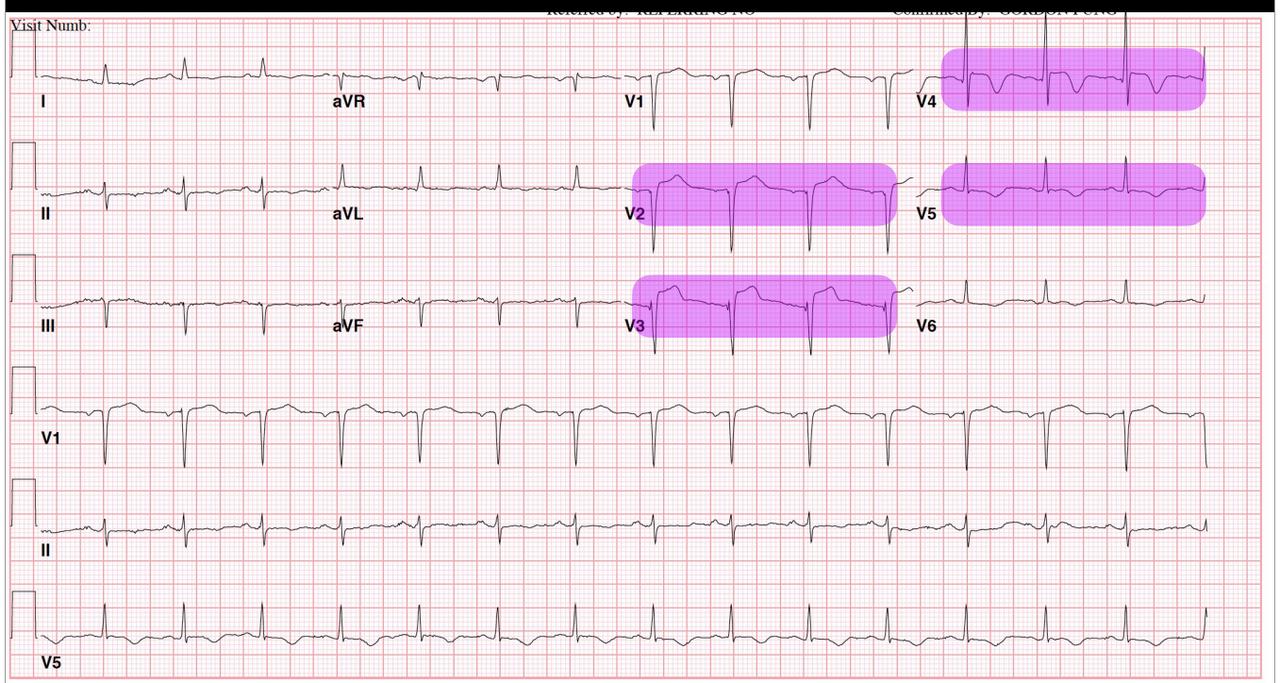
ECG

# ECG




25mm/s 10mm/mV 150Hz 7.1.1 12SL 239 CID: 1 EID:188 EDT: 21:01 12-NOV-2012 ORDER: ACCOUNT: 61244996

# ECG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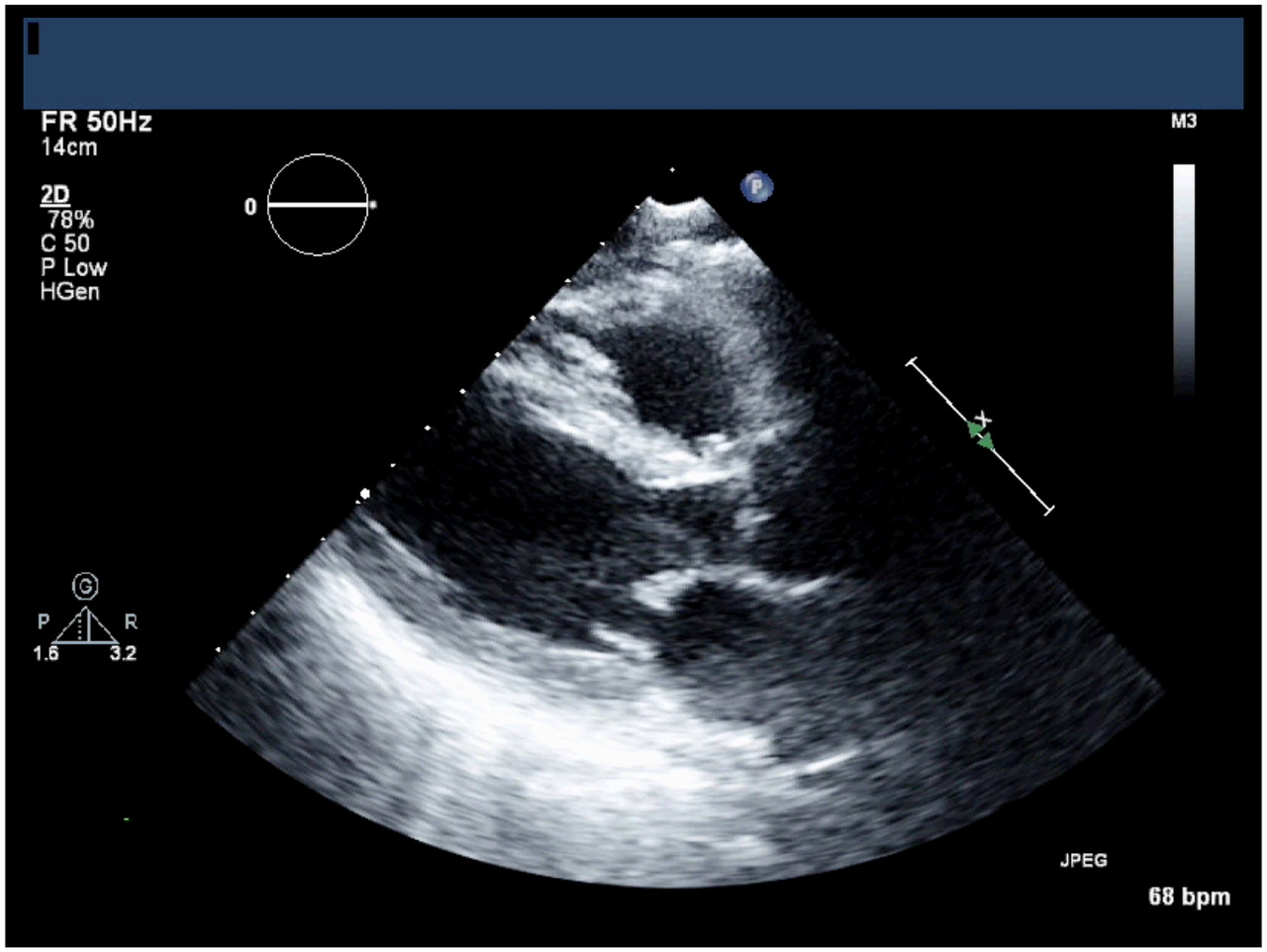
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 150Hz 7.1.1 12SL 239 CID: 1
EID:188 EDT: 21:01 12-NOV-2012 ORDER:
ACCOUNT: 61244996

This is a classic stress cardiomyopathy. There is reduced LV function (only the basal segments move) with apical ballooning. The RV apex is also hypokinetic and so RV function is reduced. IVC doesn't collapse at all and is dilated consistent with an RA pressure of 15 and there is no pericardial effusion.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M3
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P
R
1.6
3.2
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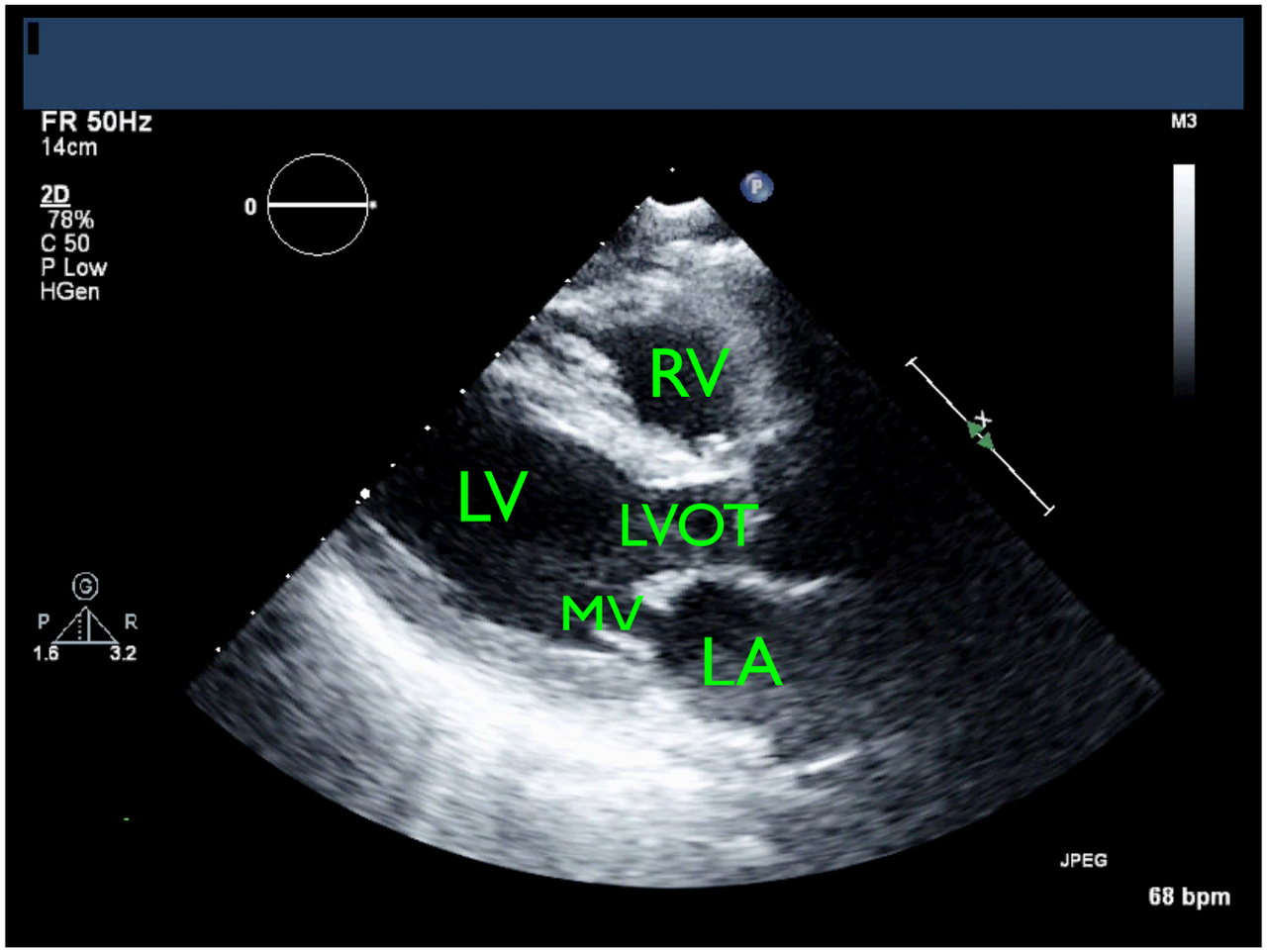
68 bpm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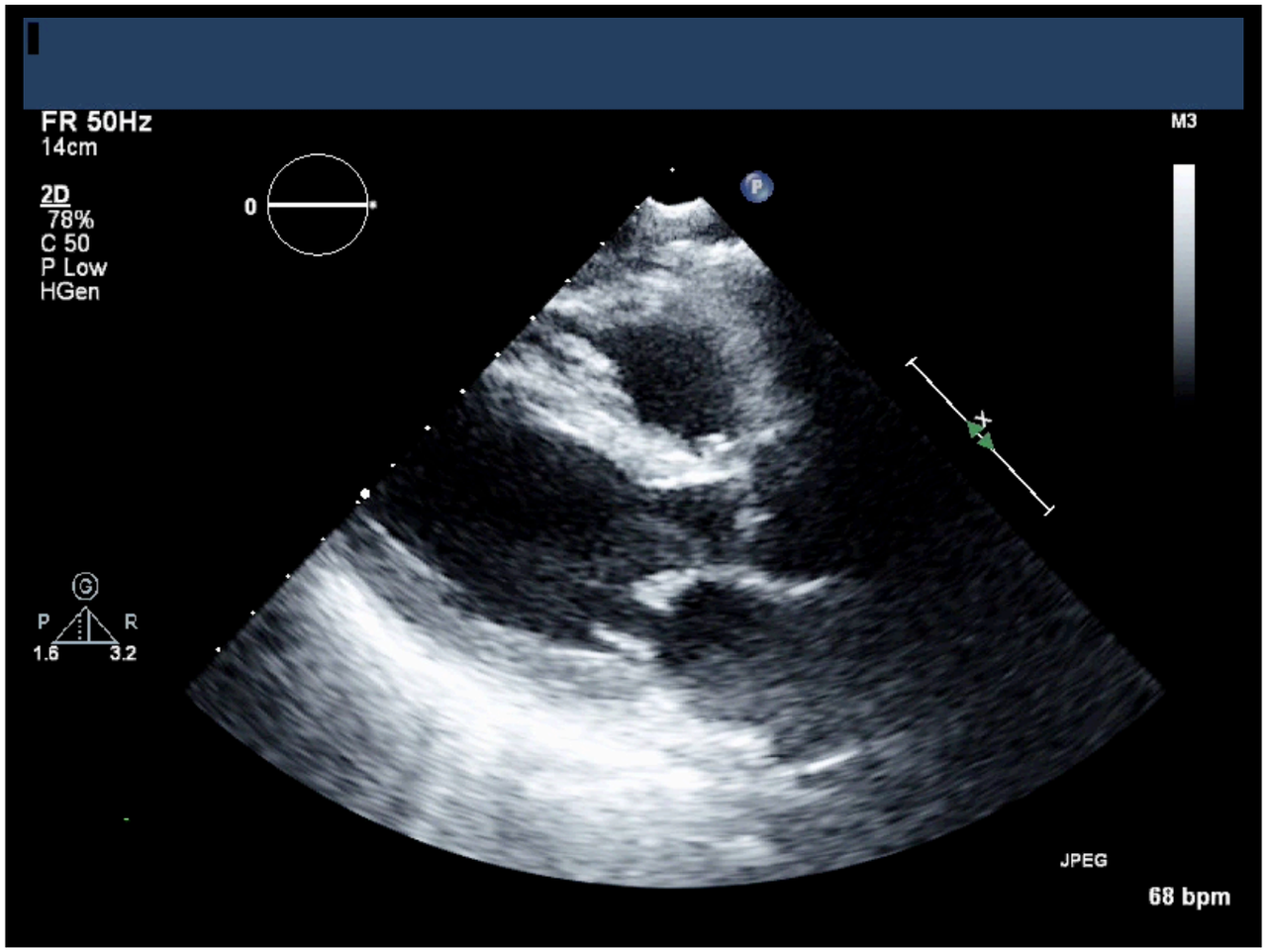
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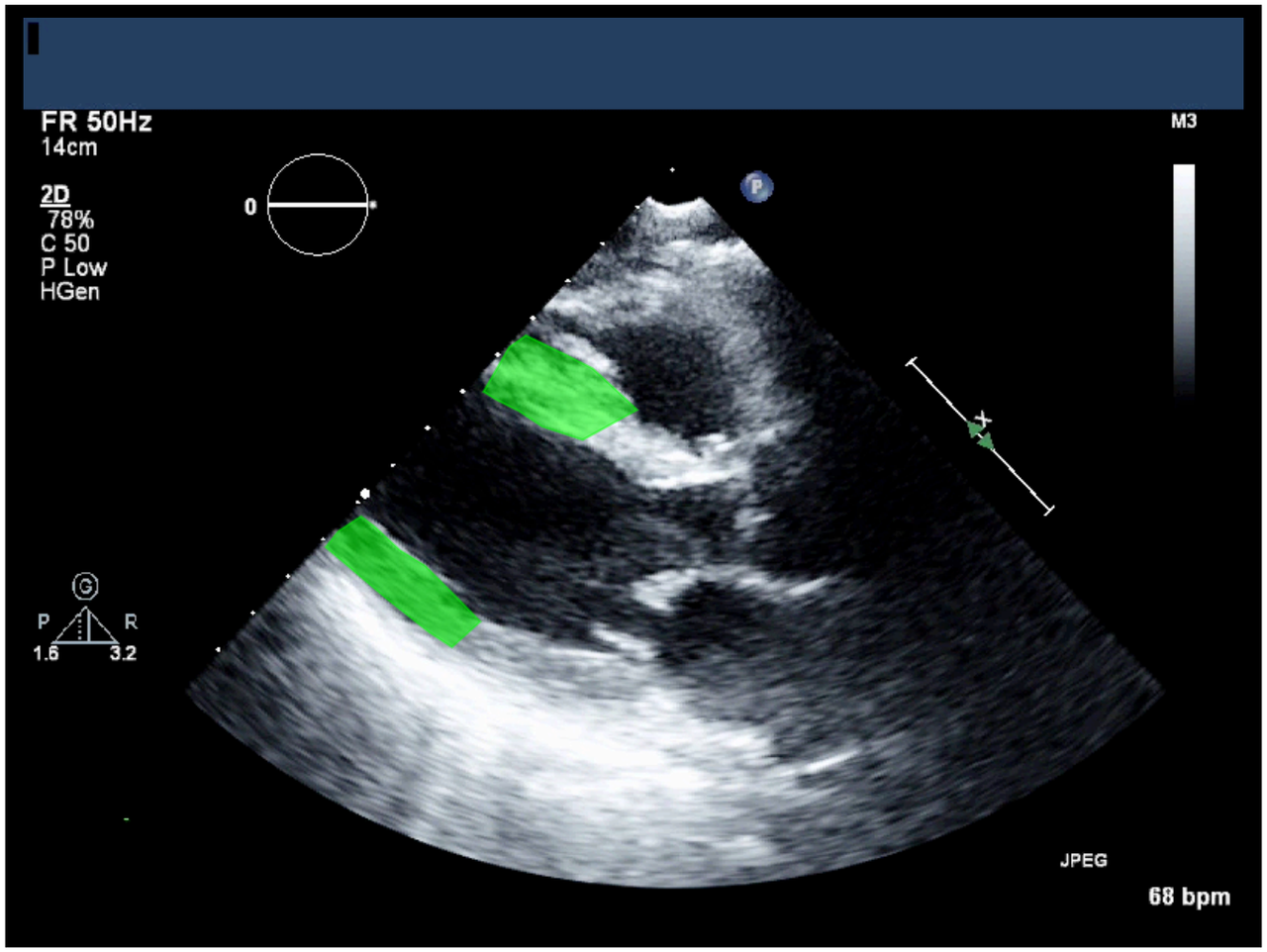
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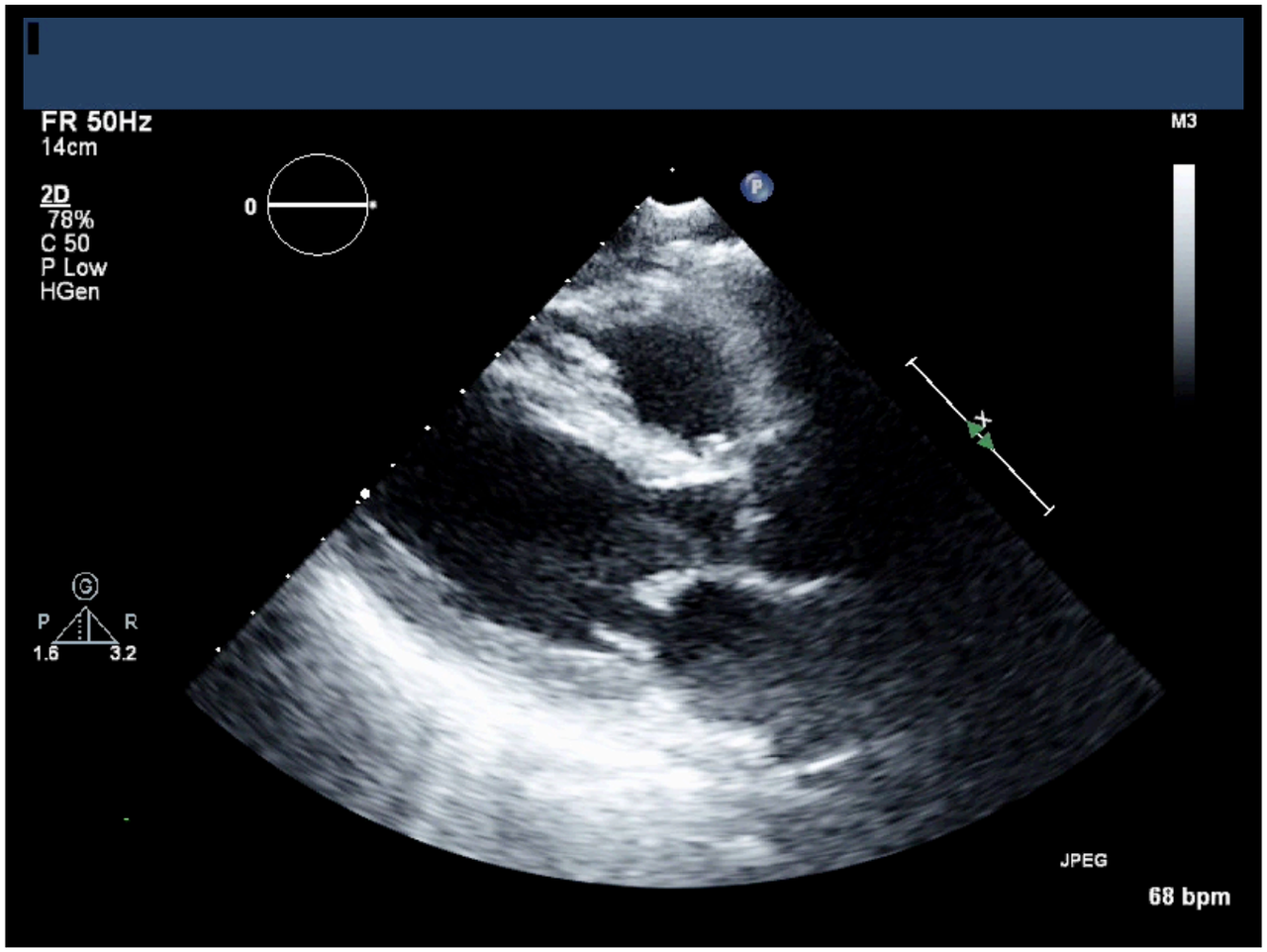
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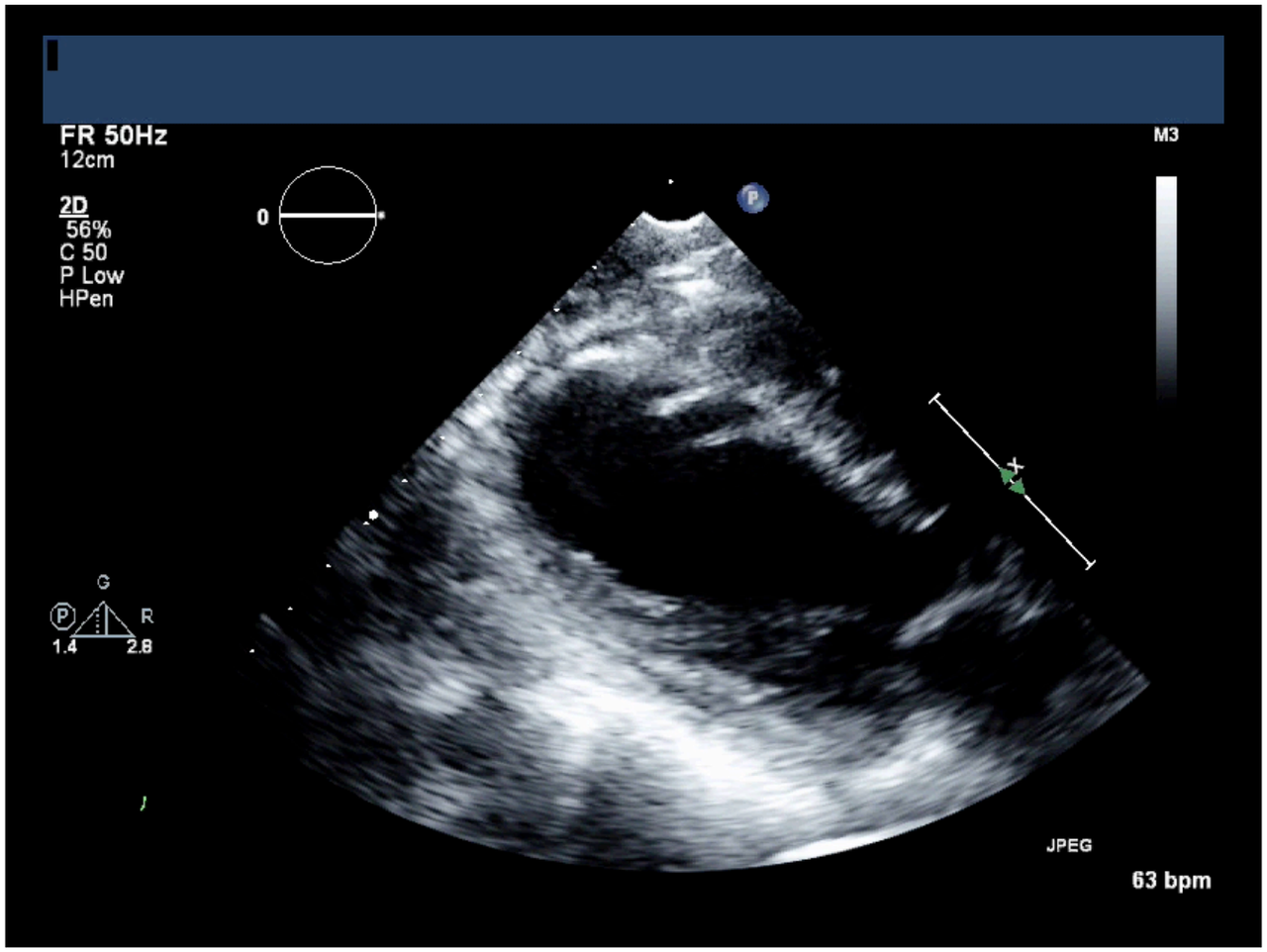
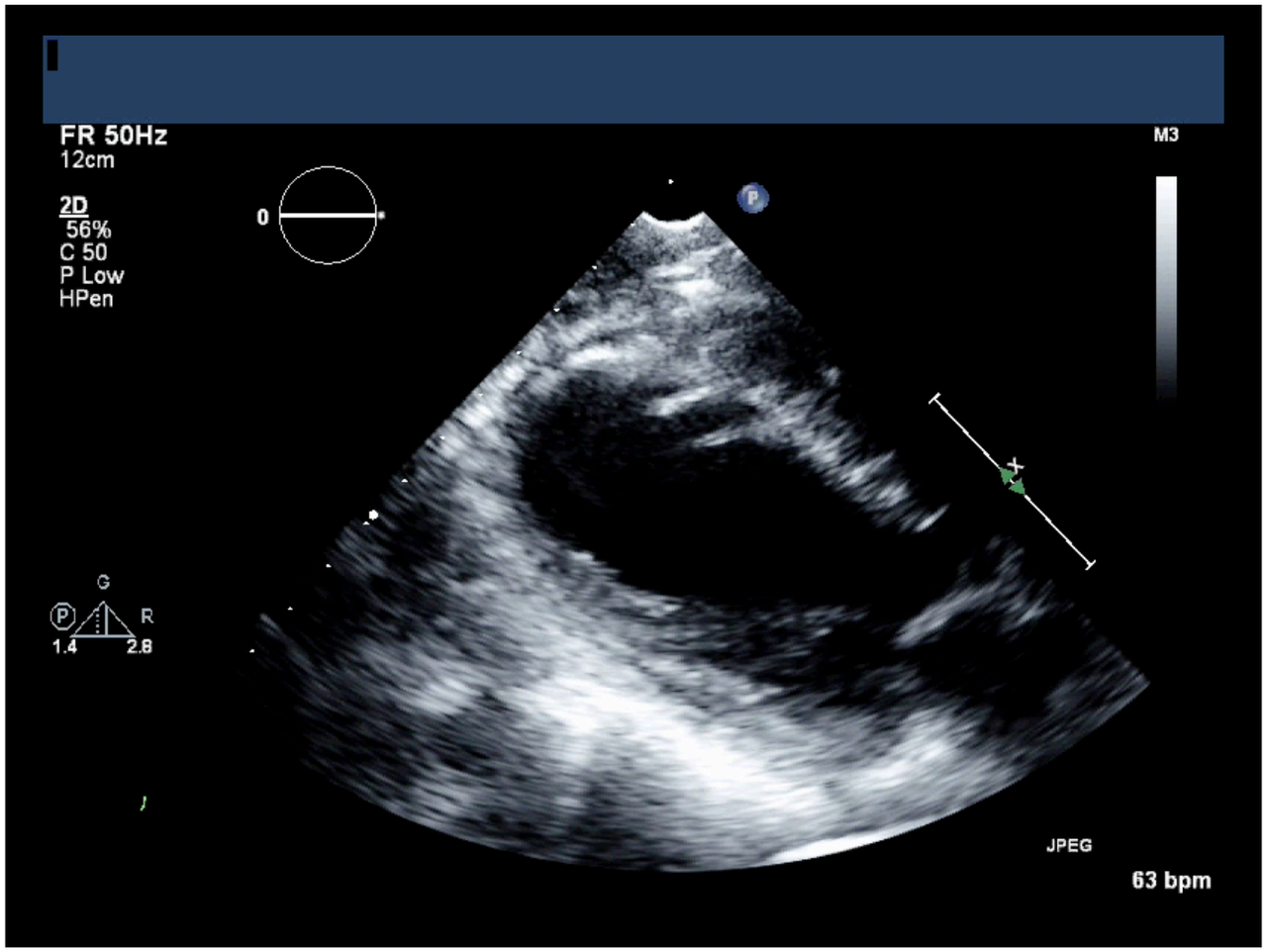



Extends beyond Coronary distribution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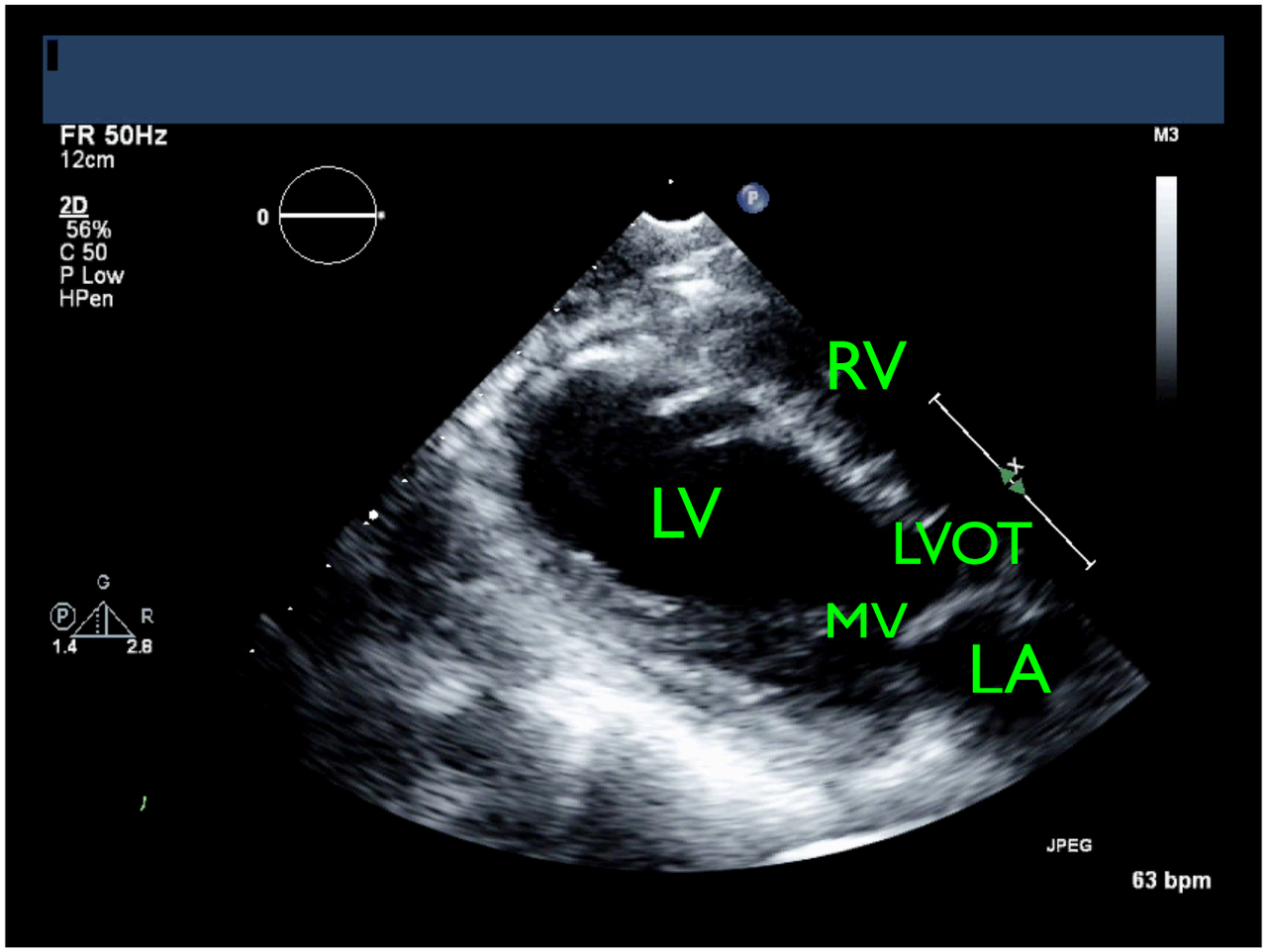
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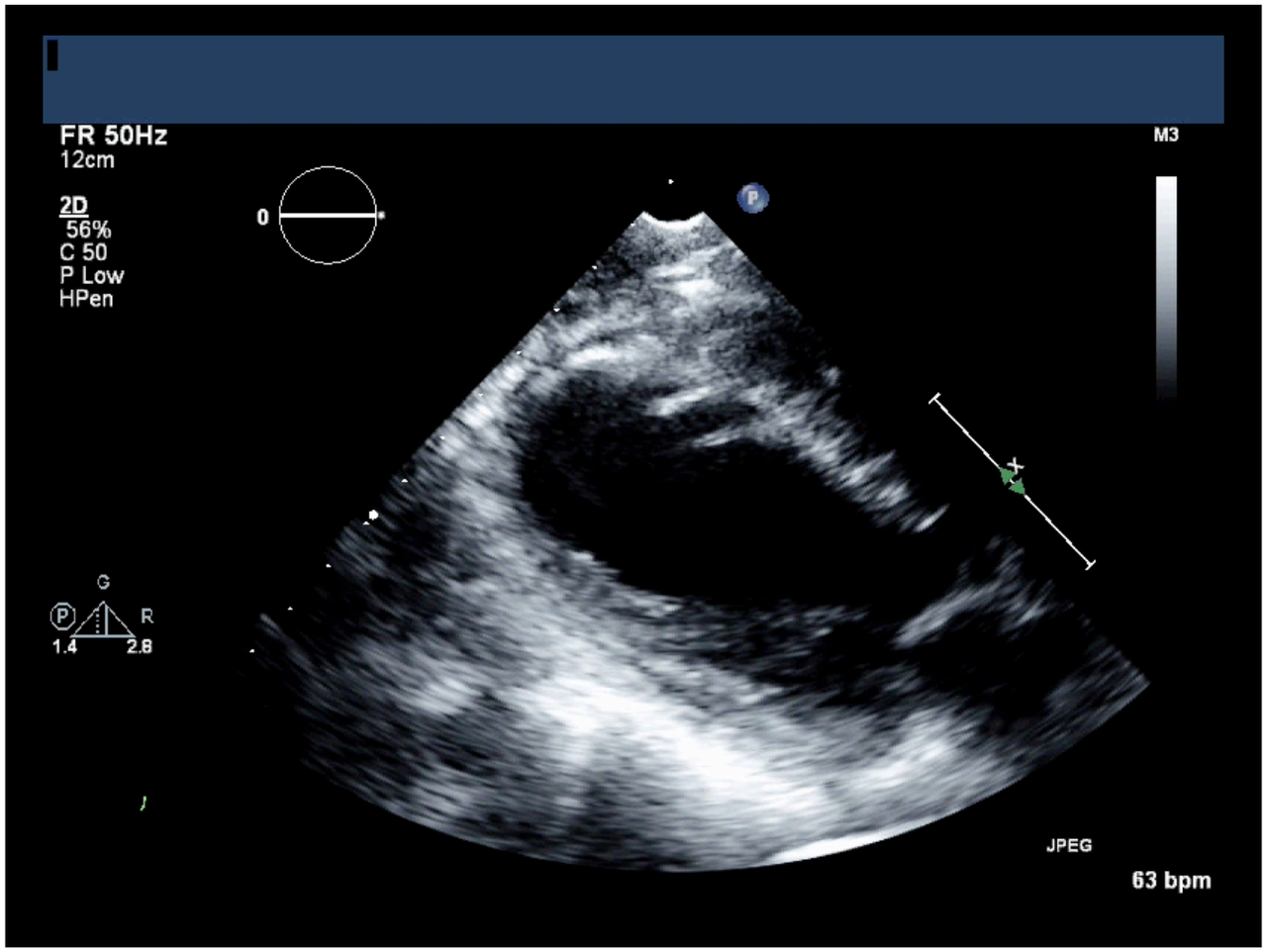
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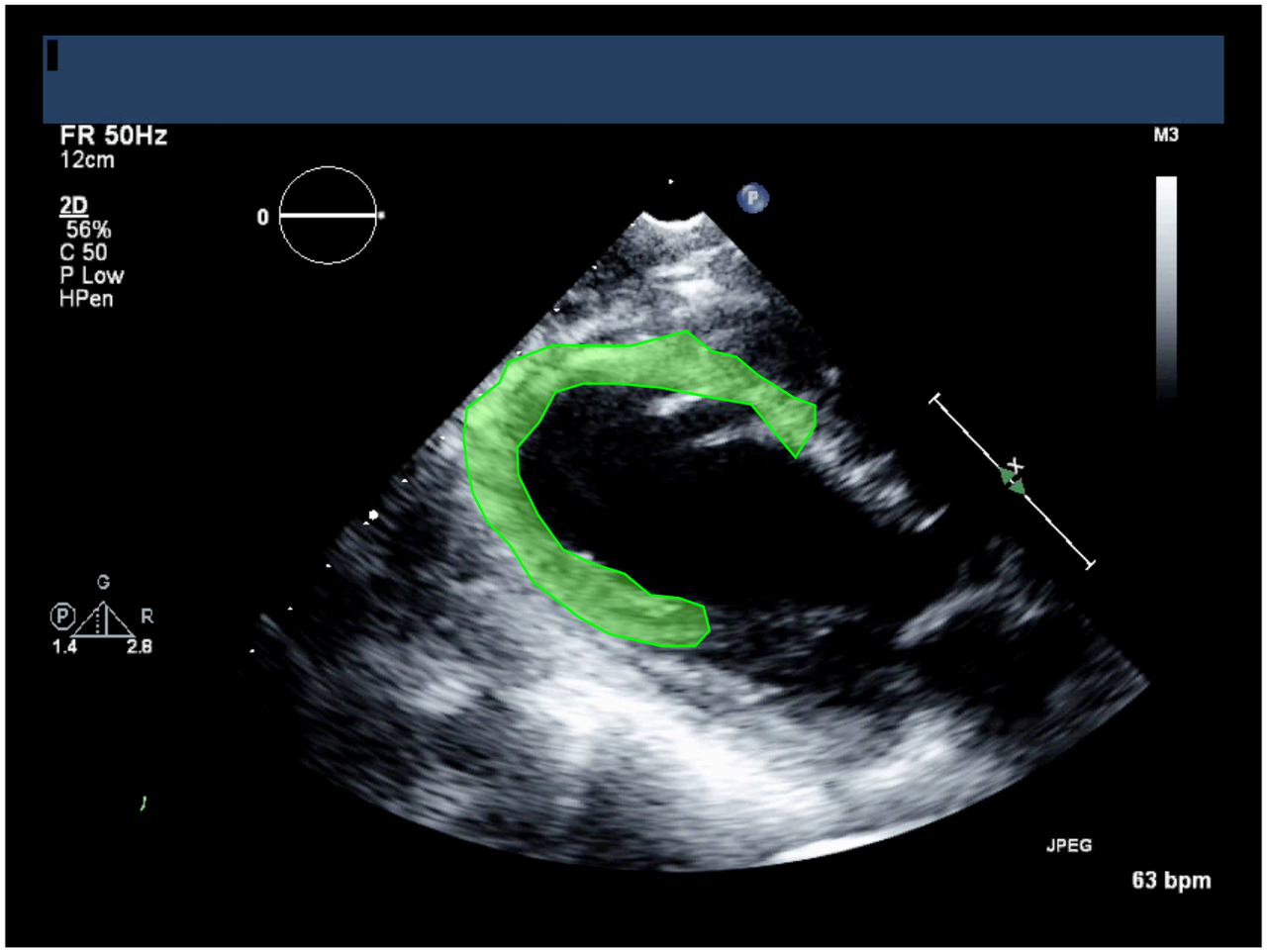
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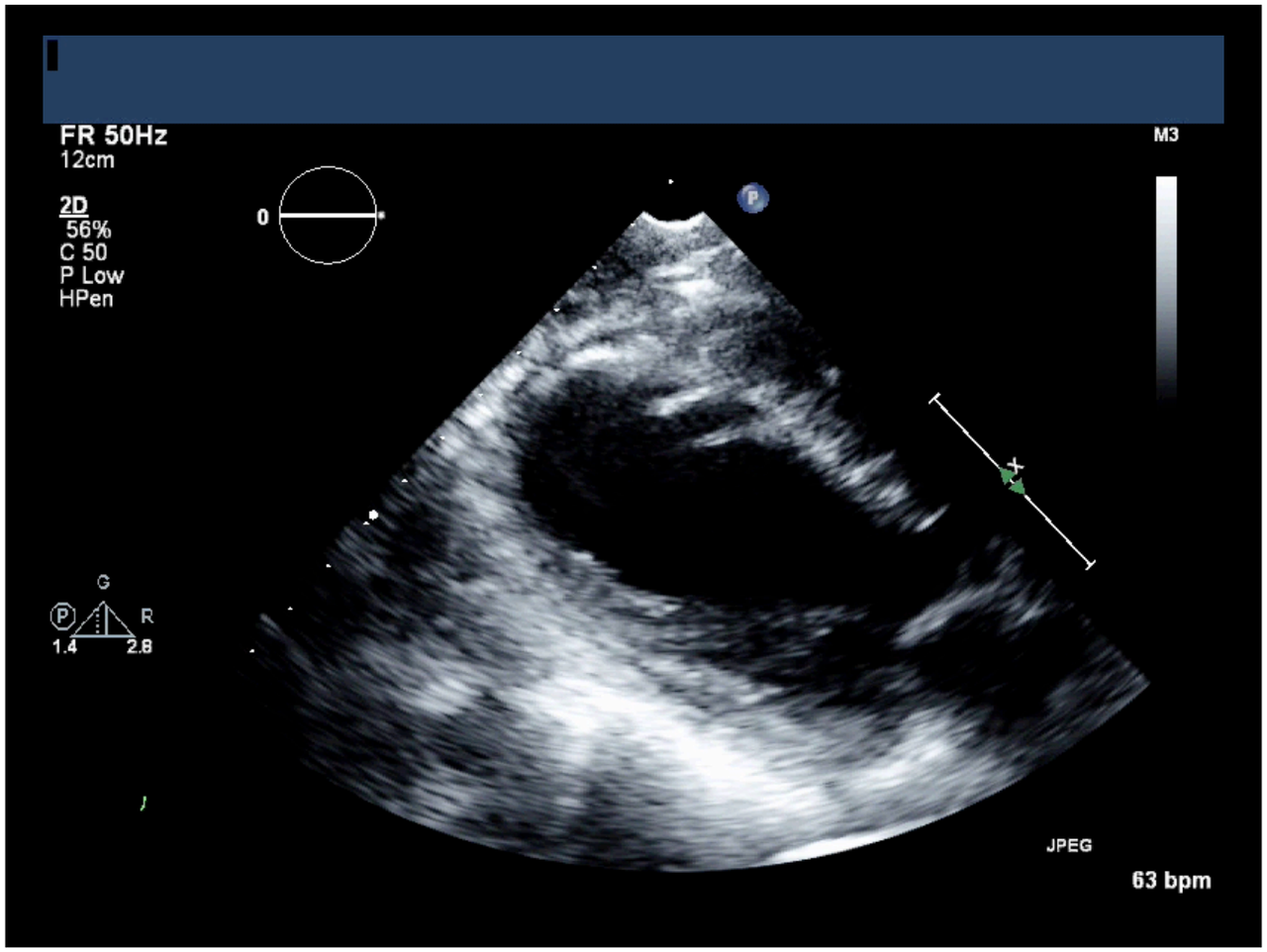
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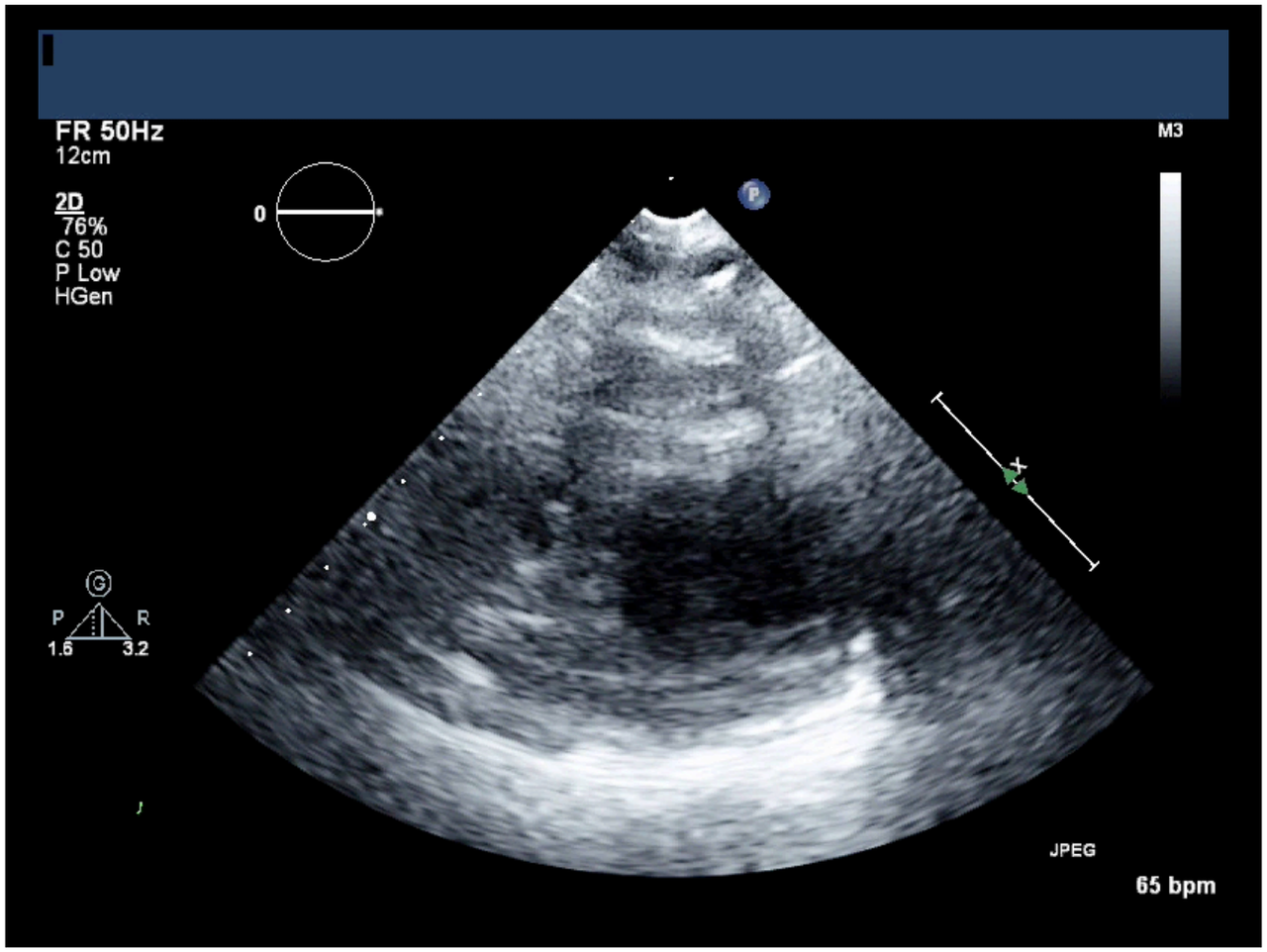
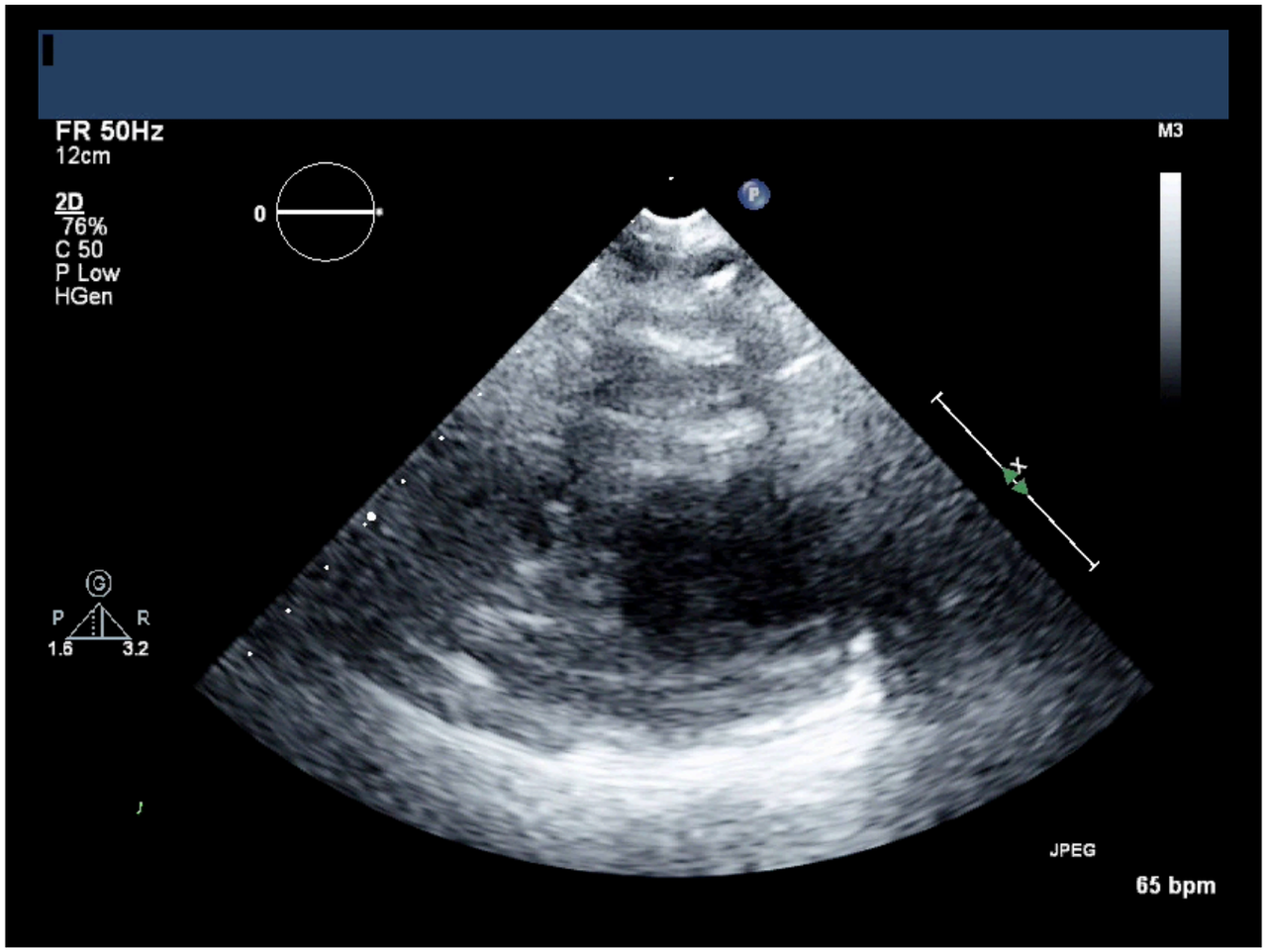



PSS—> distal to pap muscles toward apical LV—>globally hypokinetic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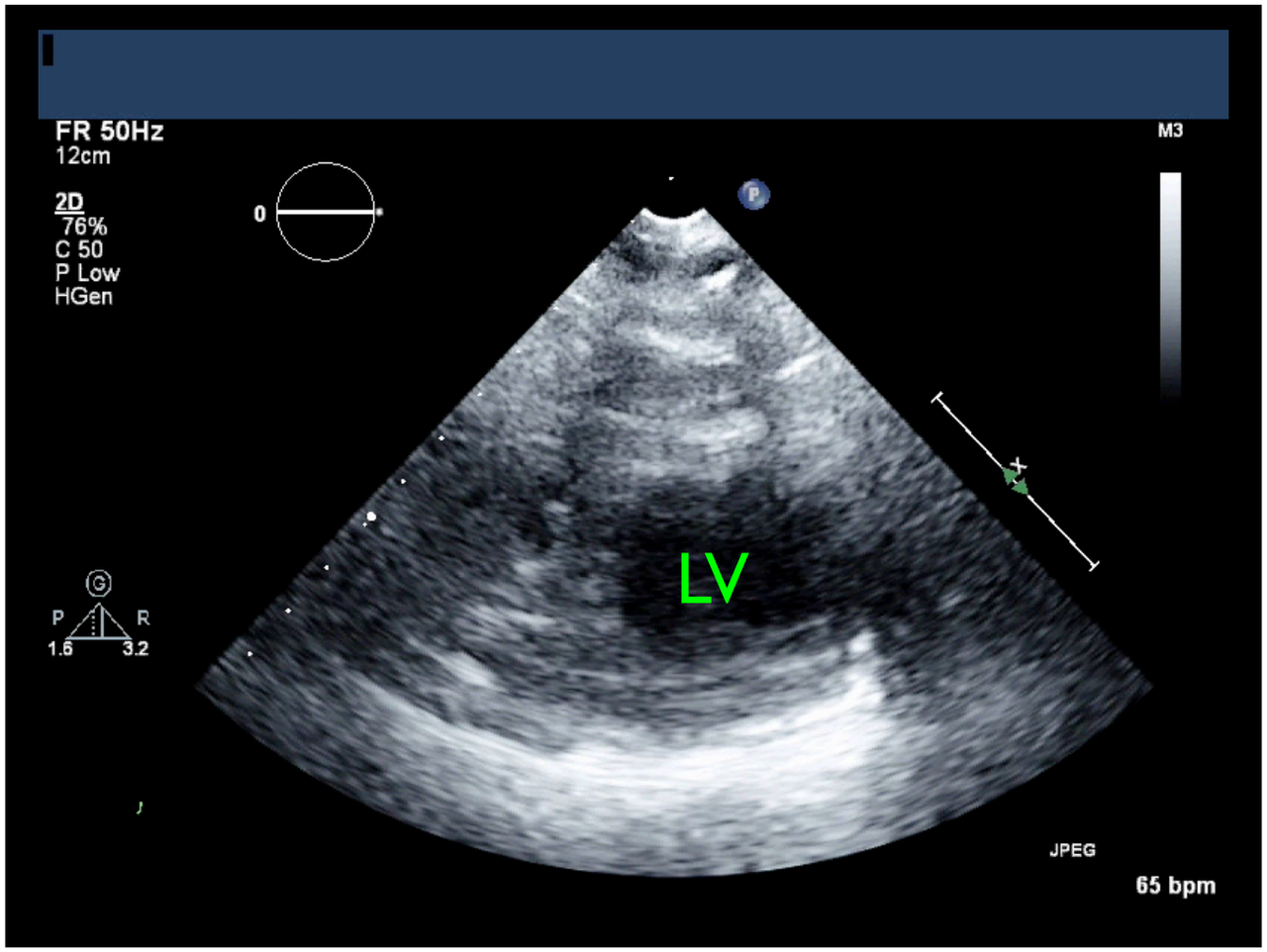
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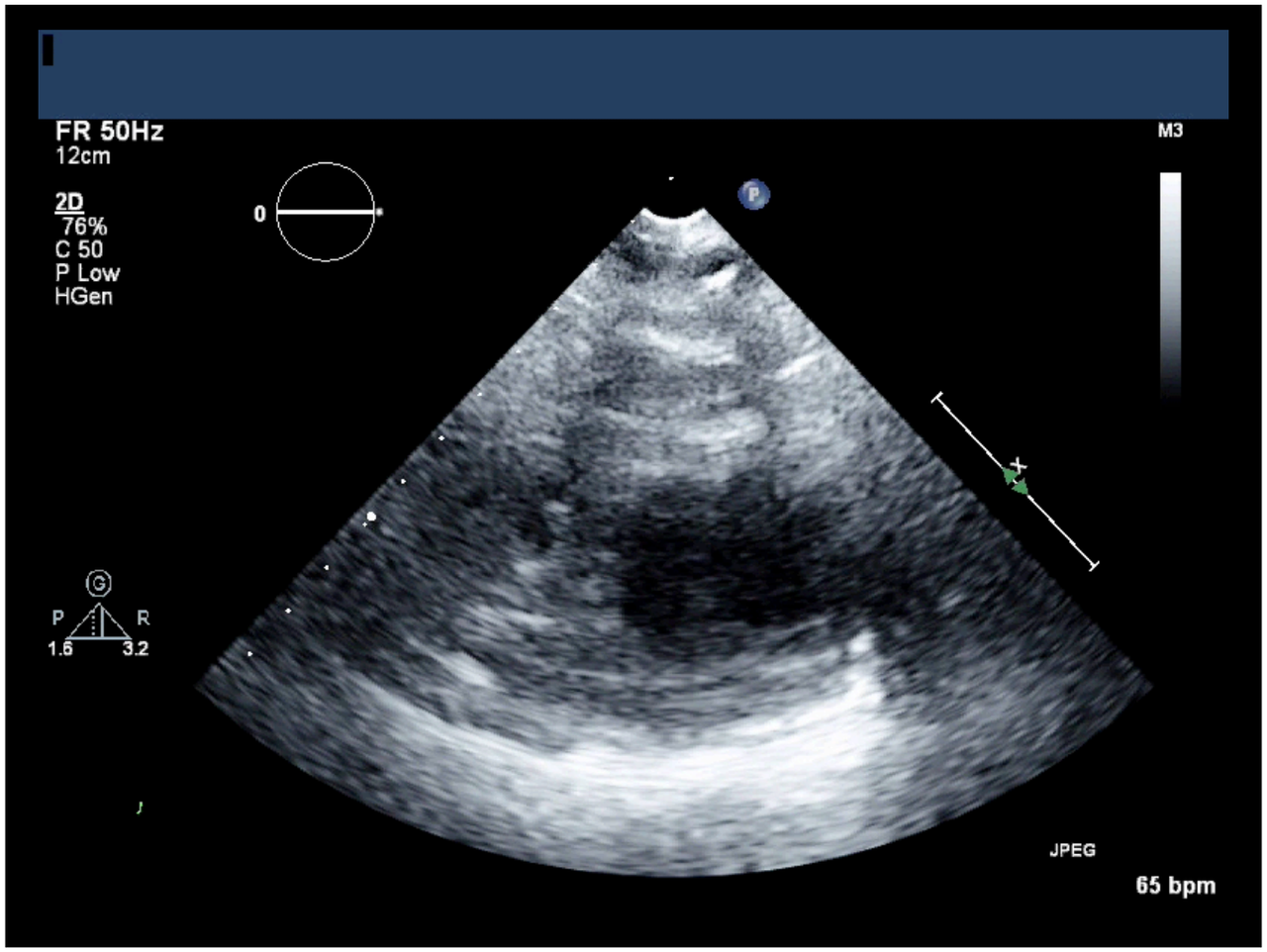
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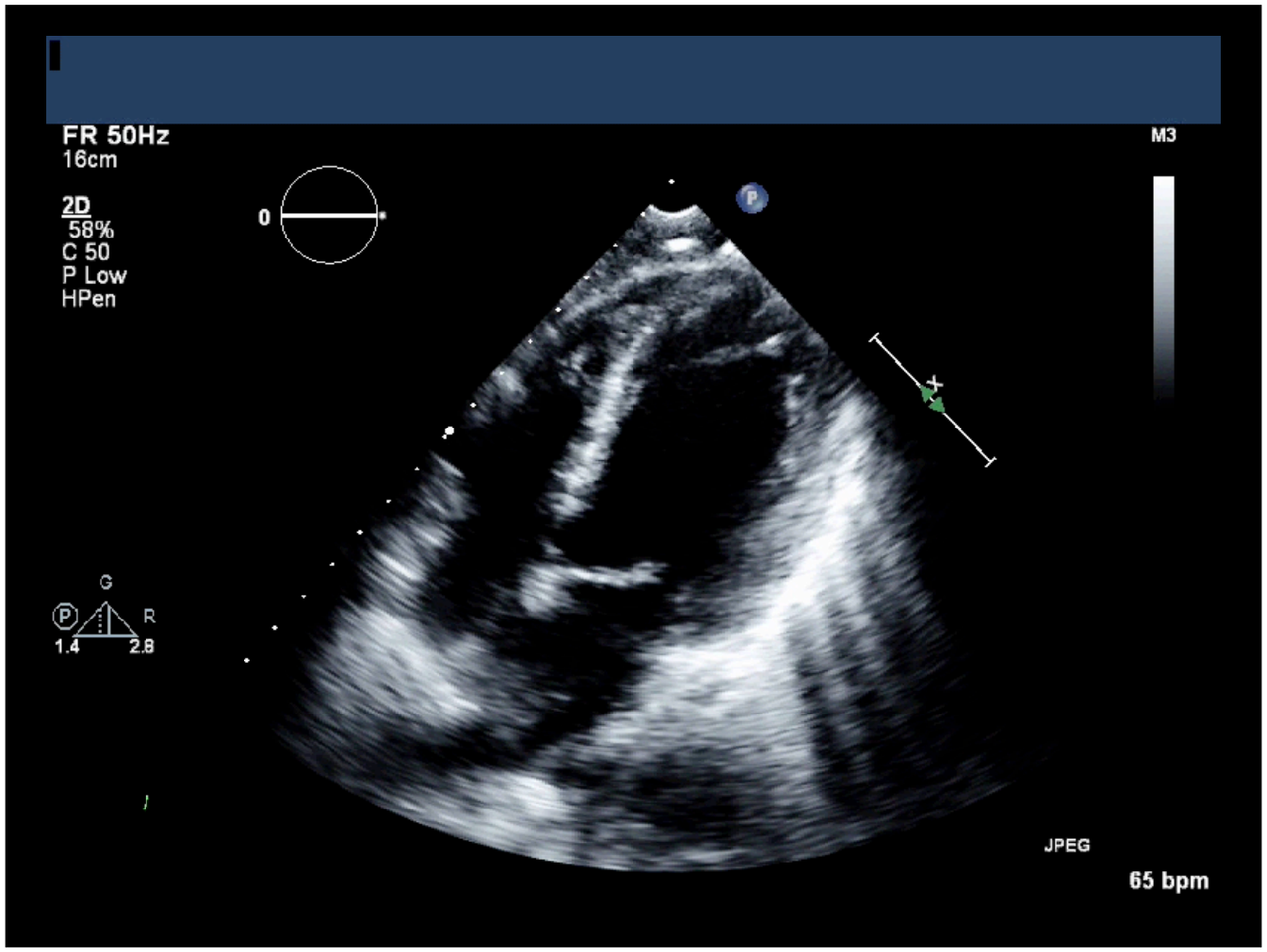
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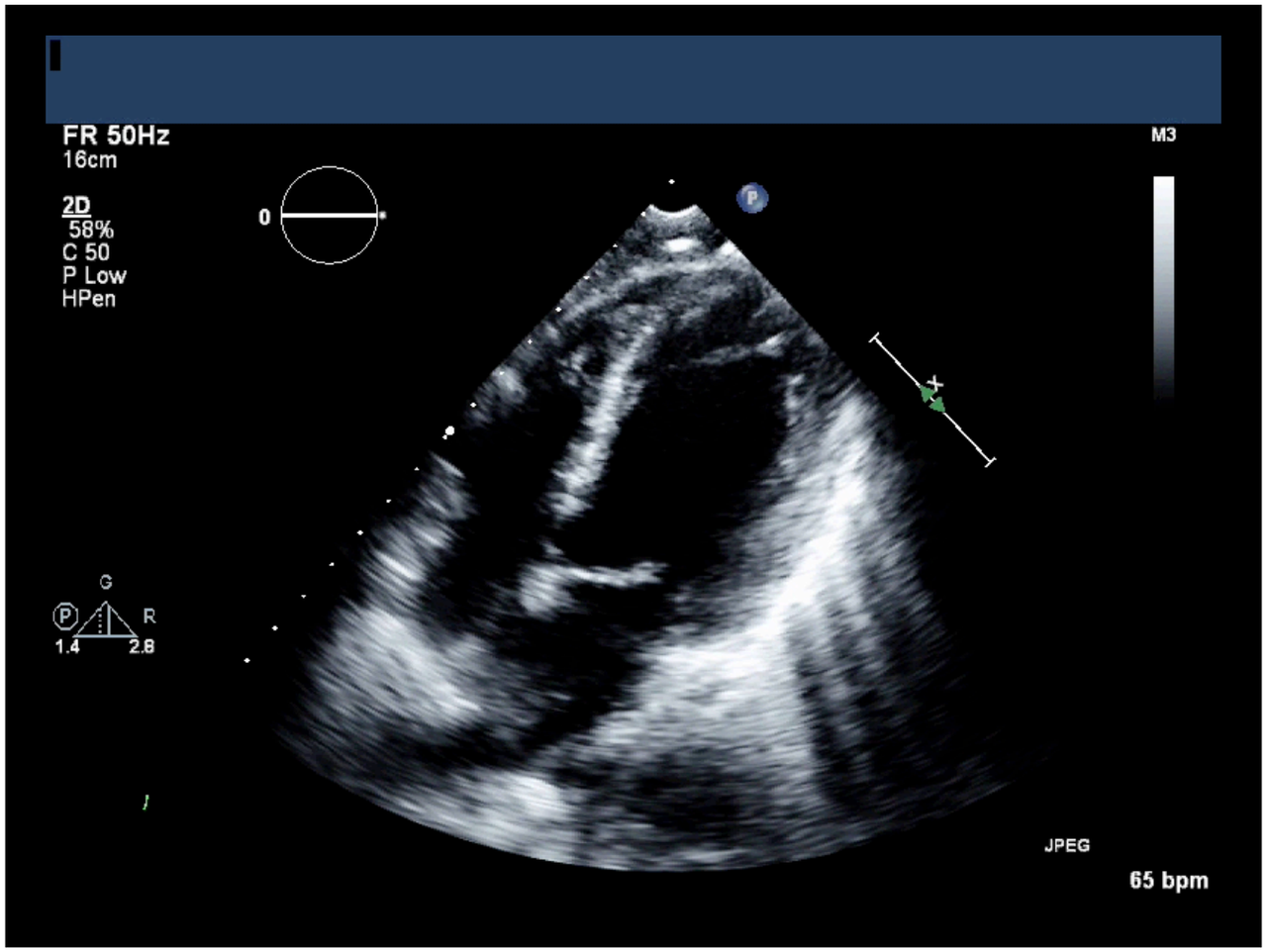
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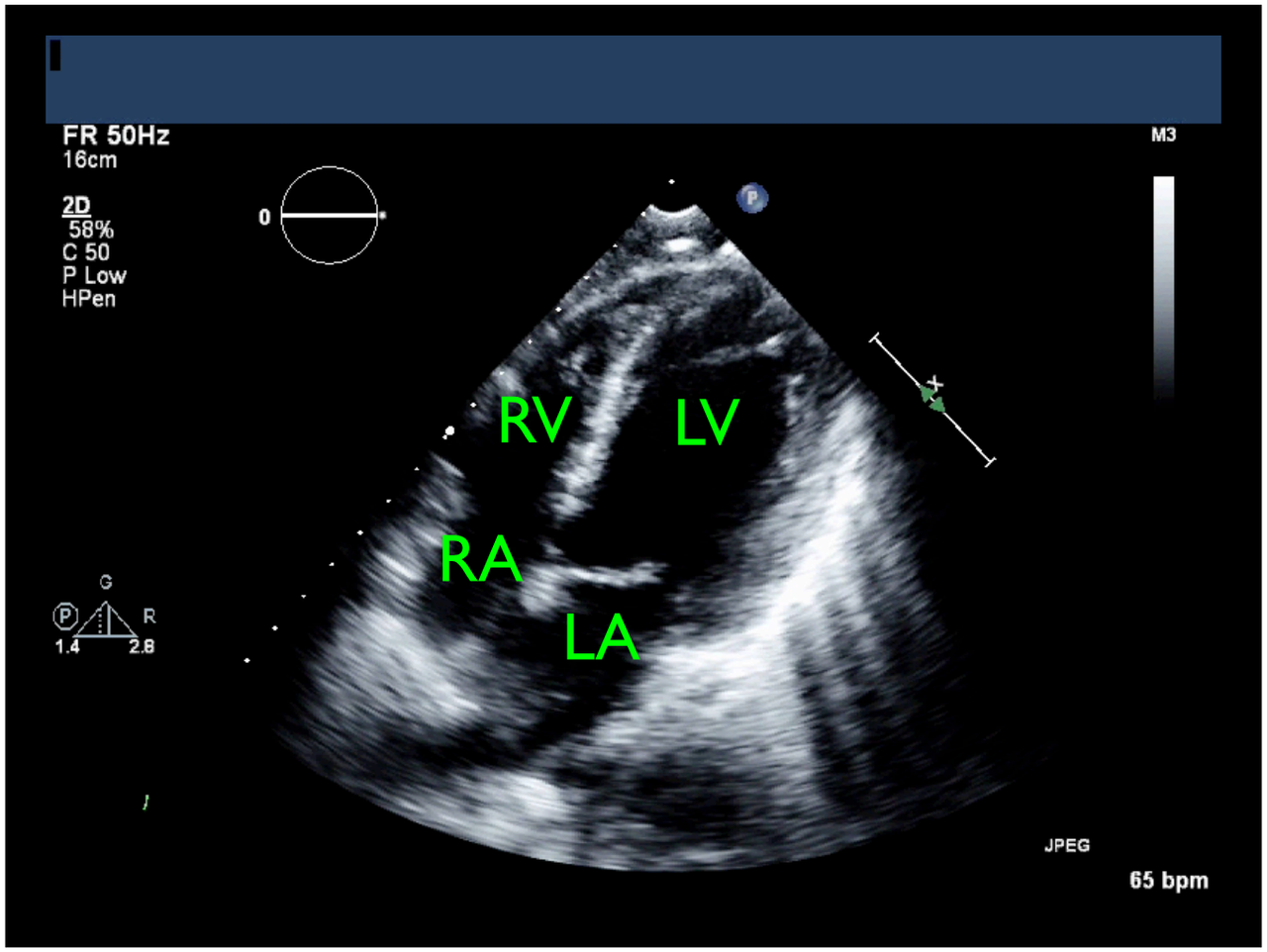
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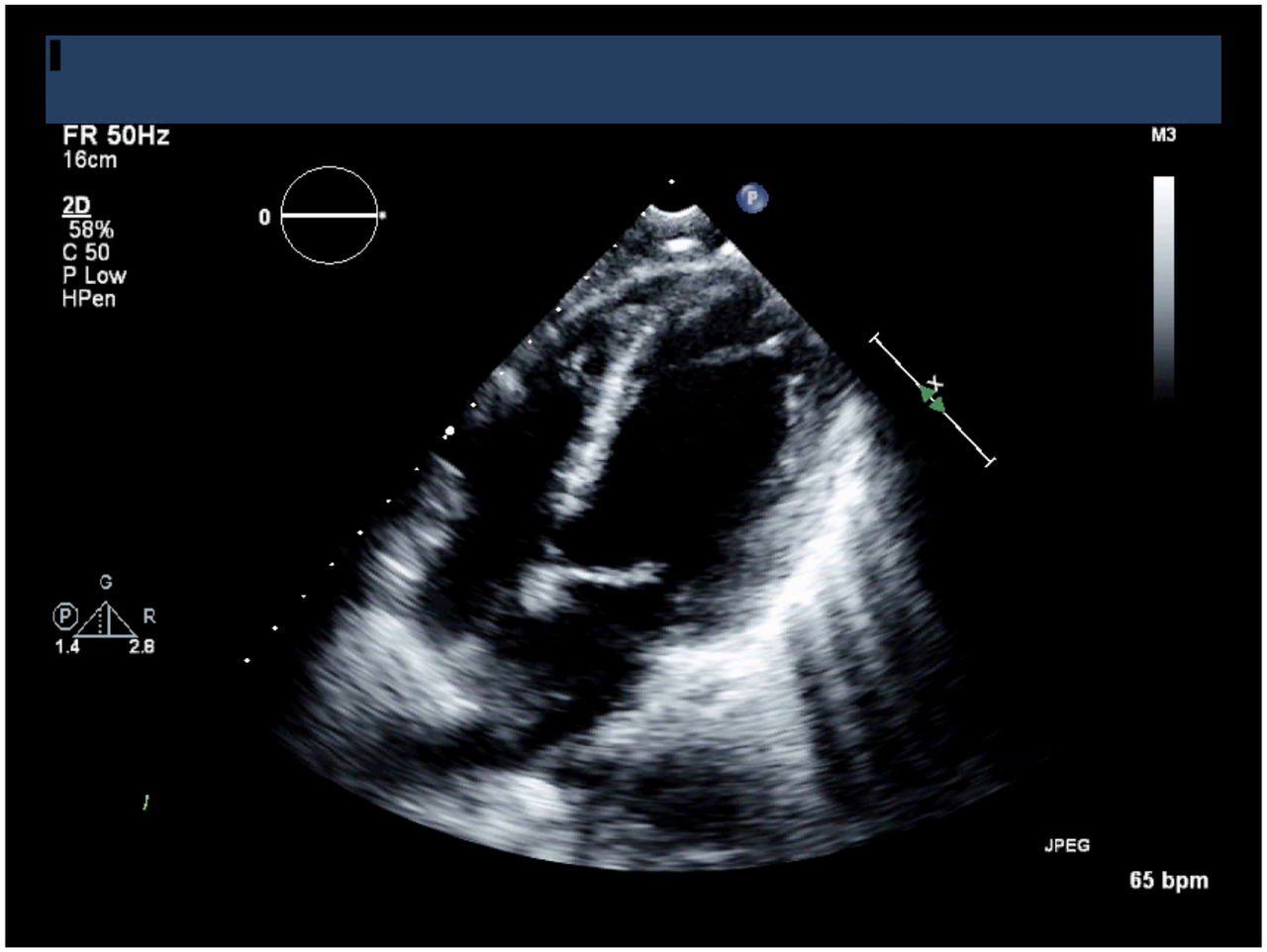
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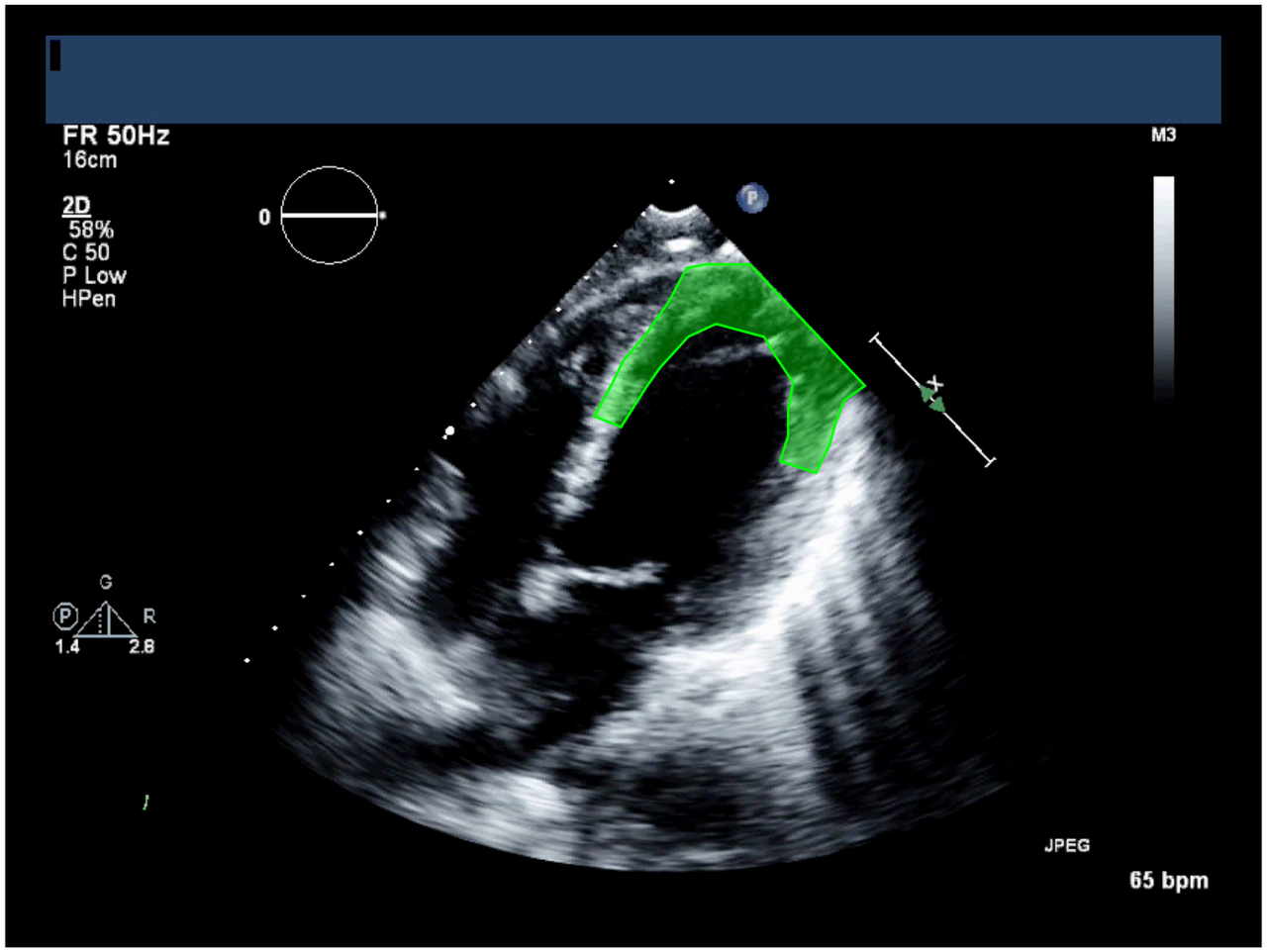
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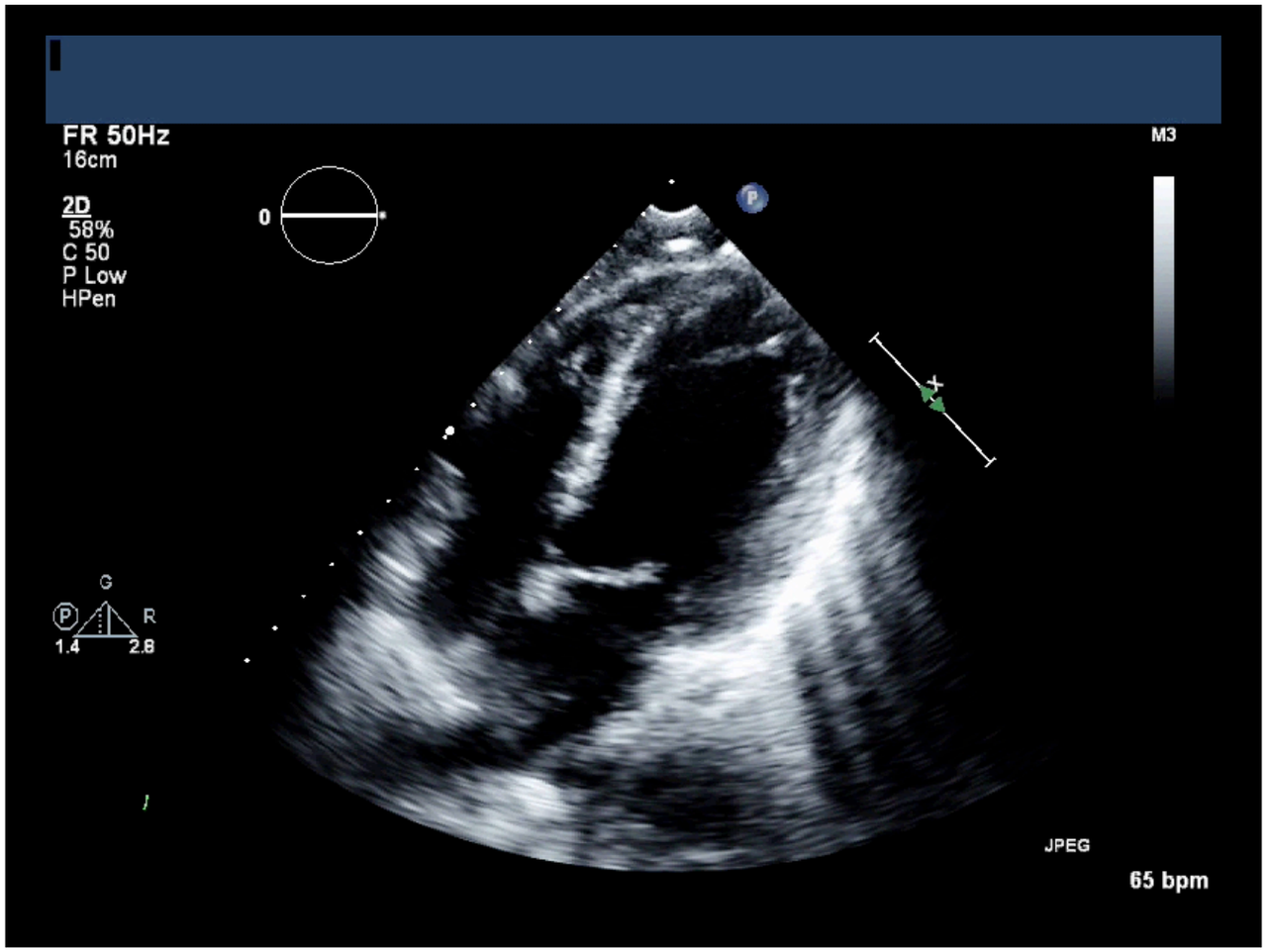
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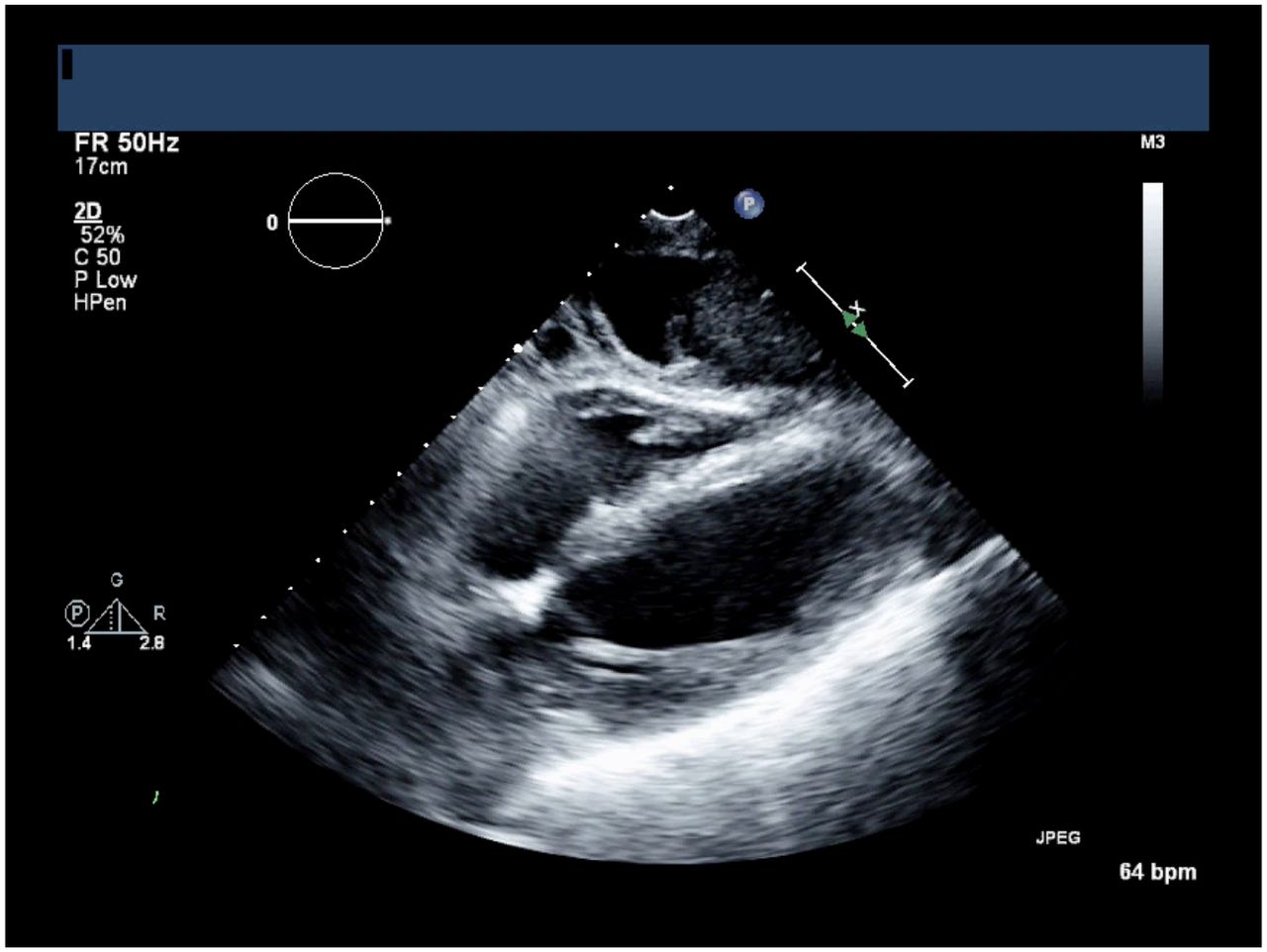
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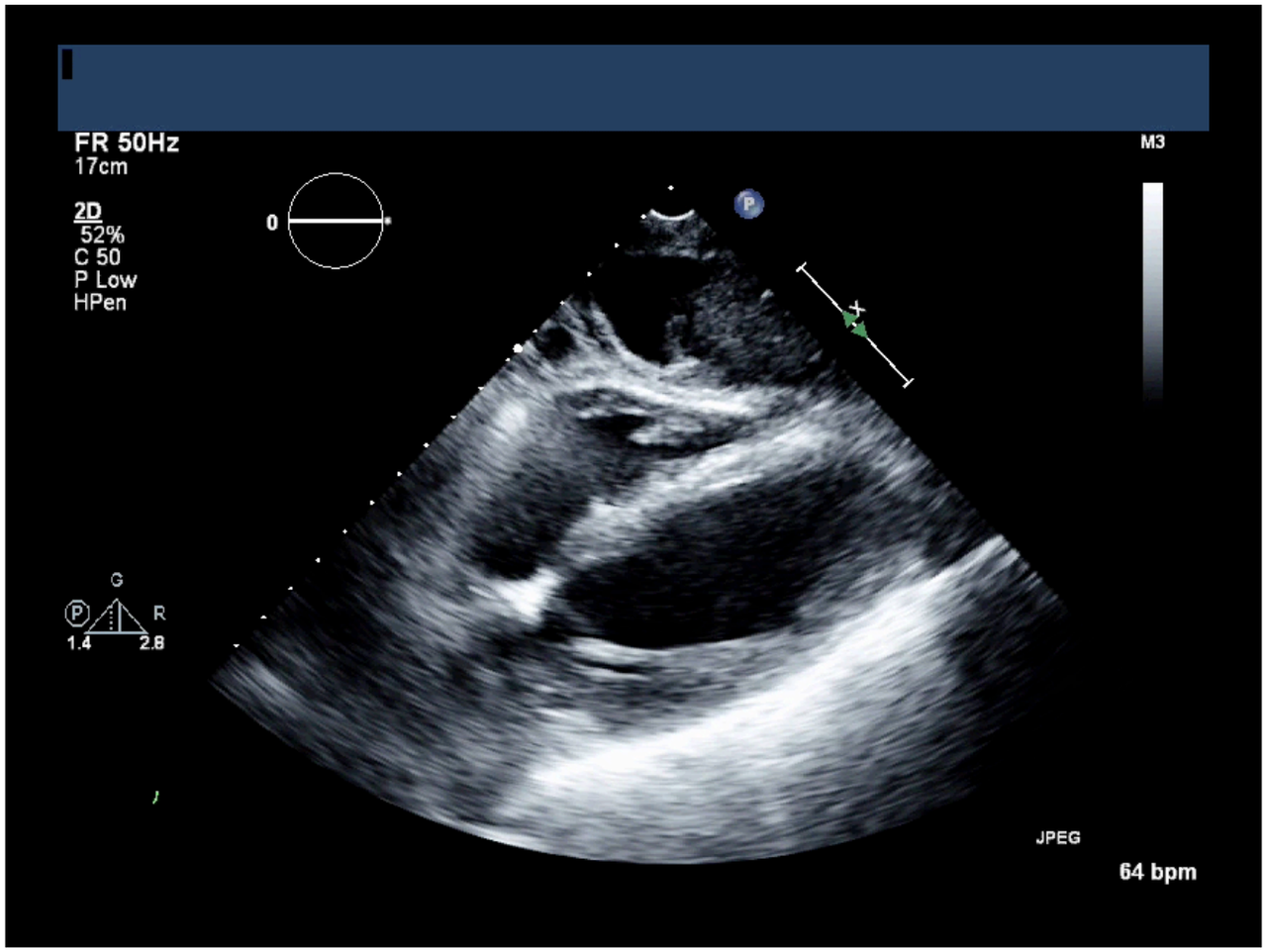
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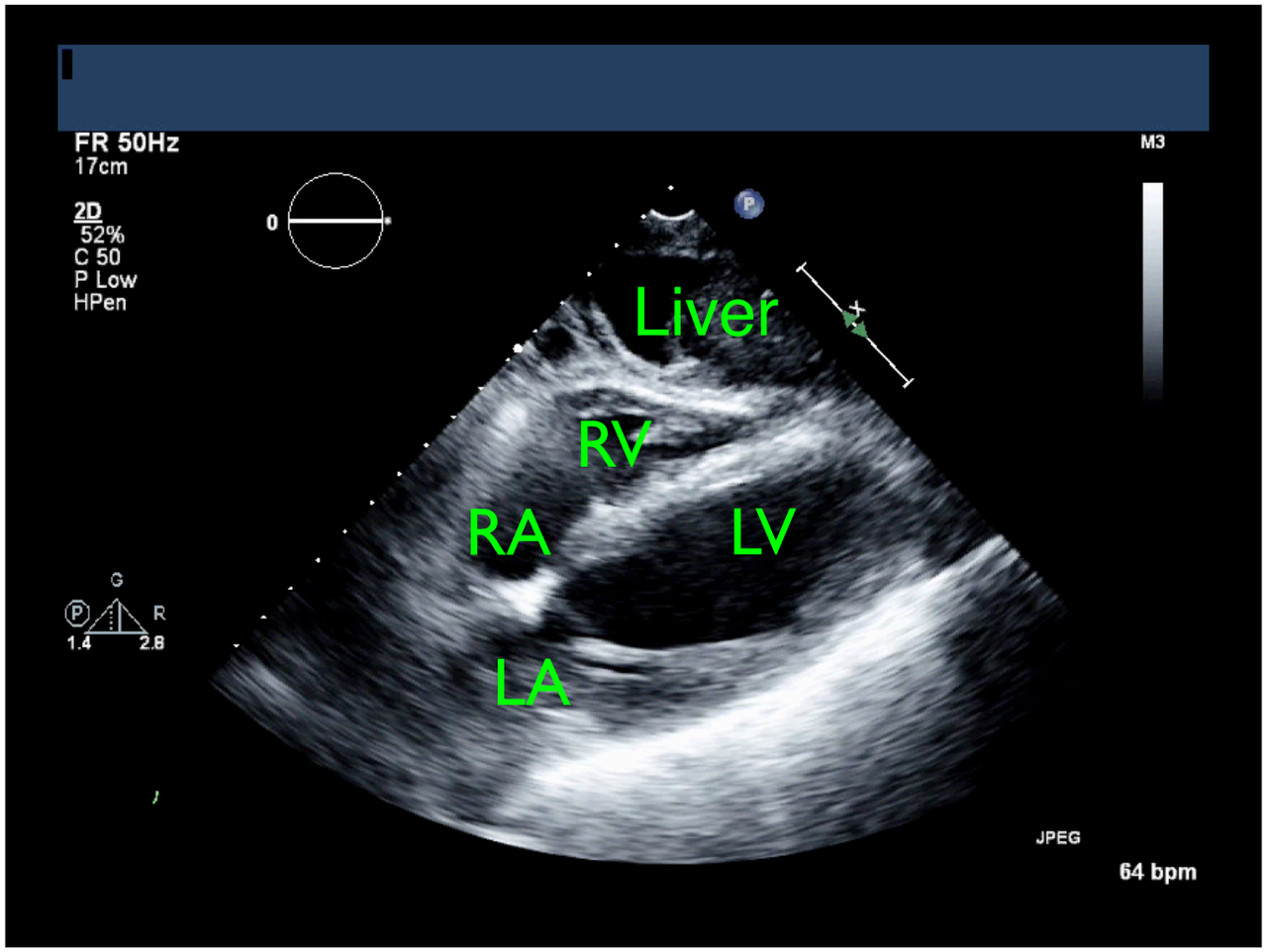
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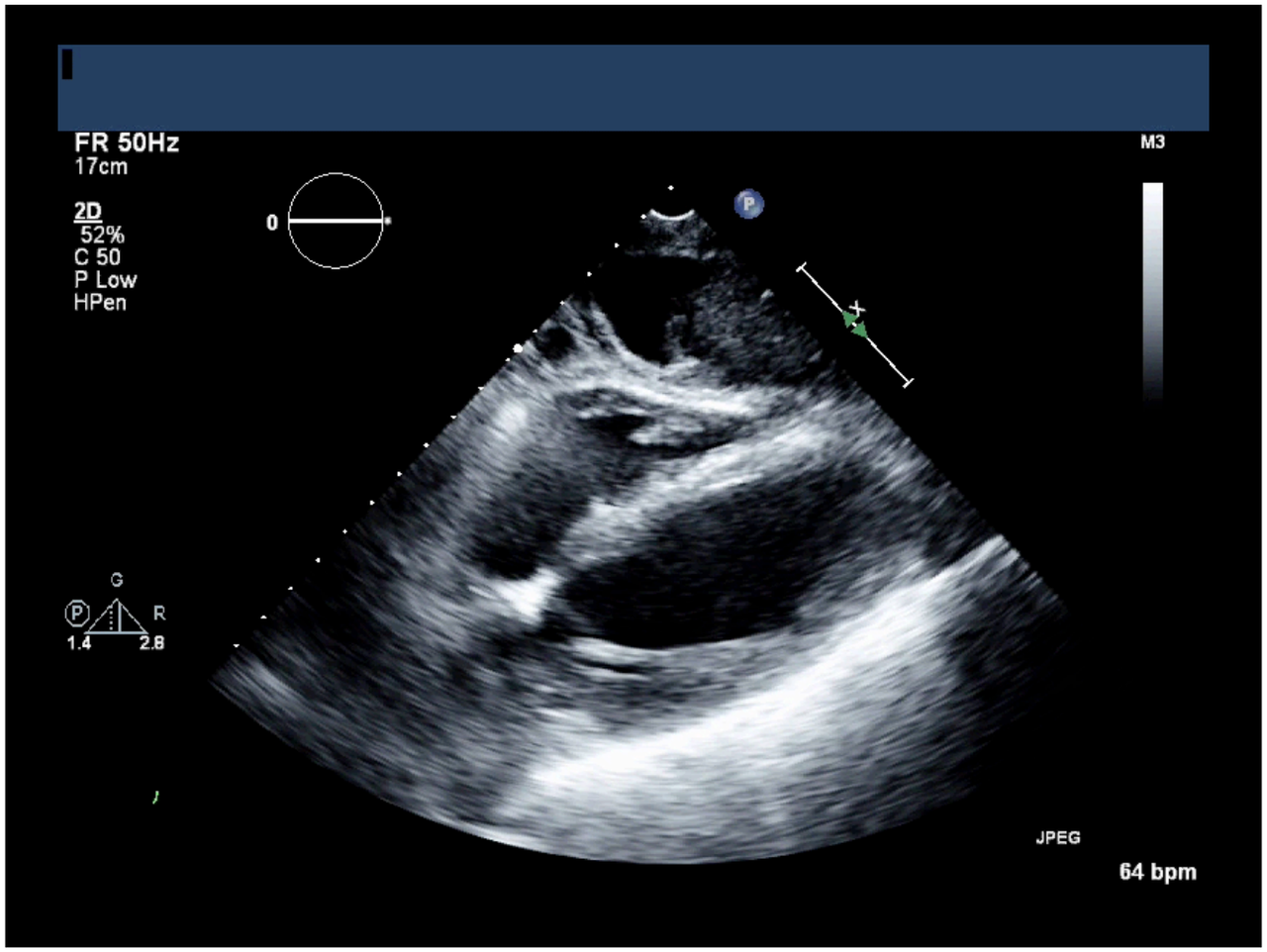
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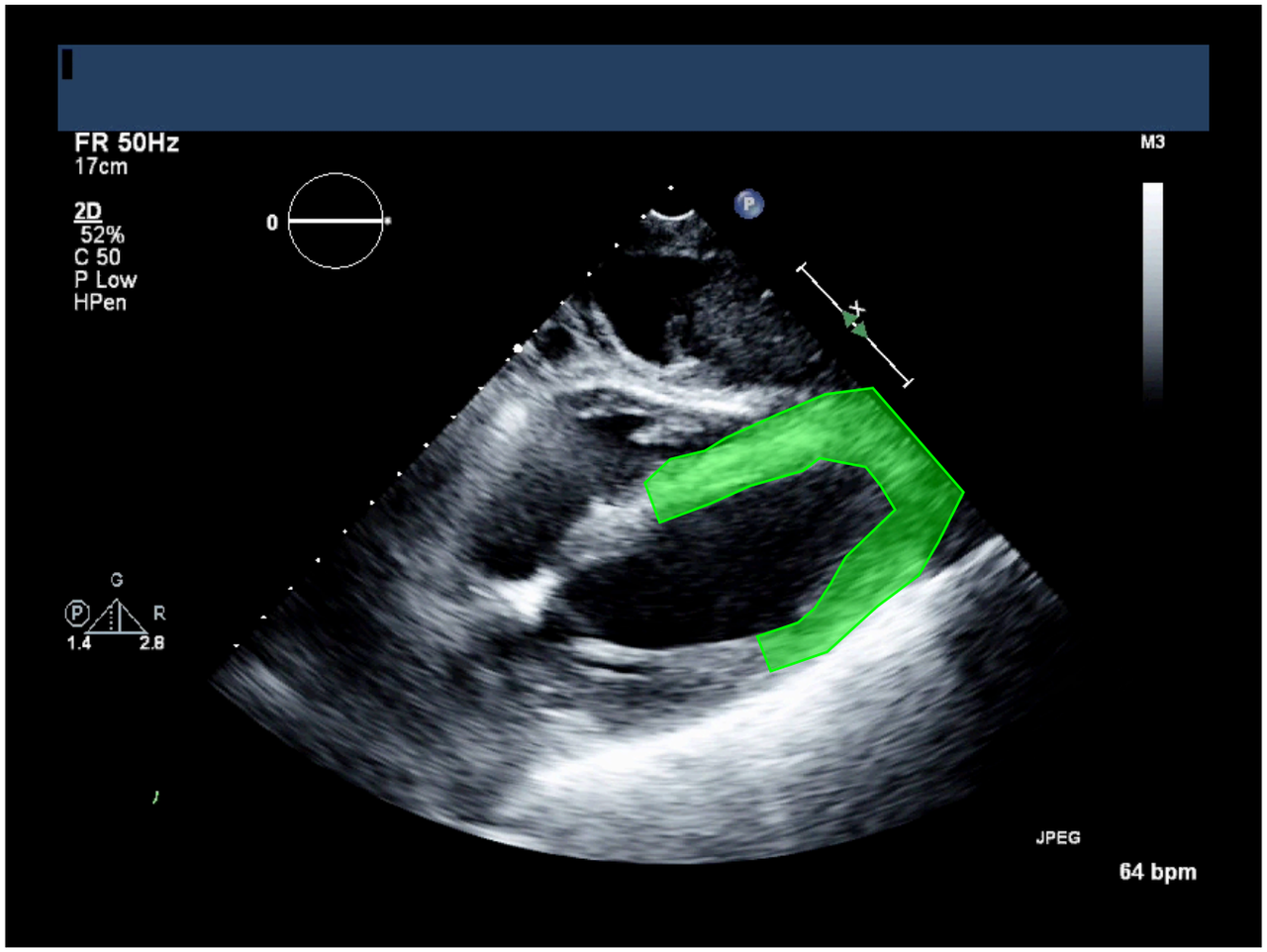
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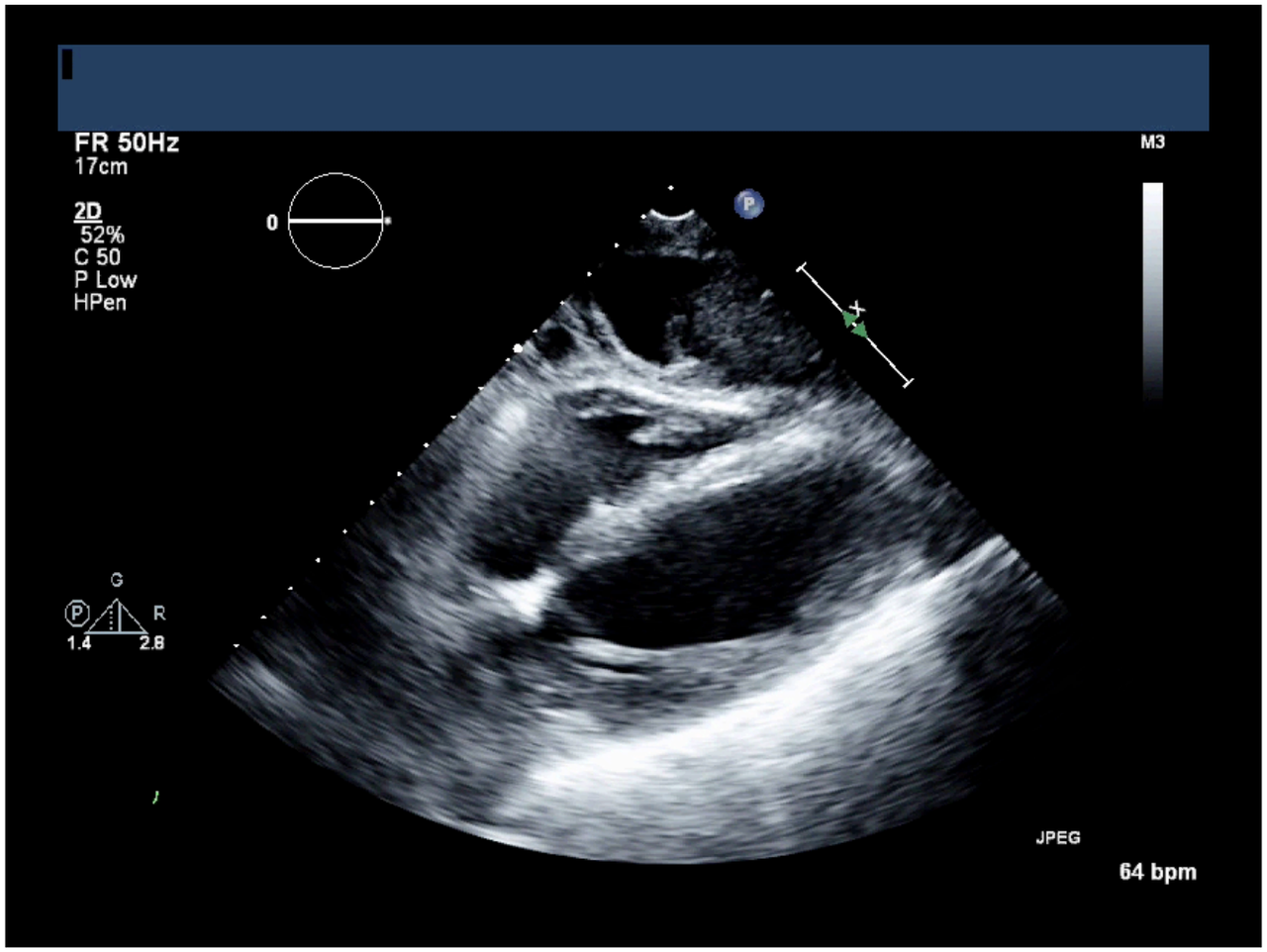
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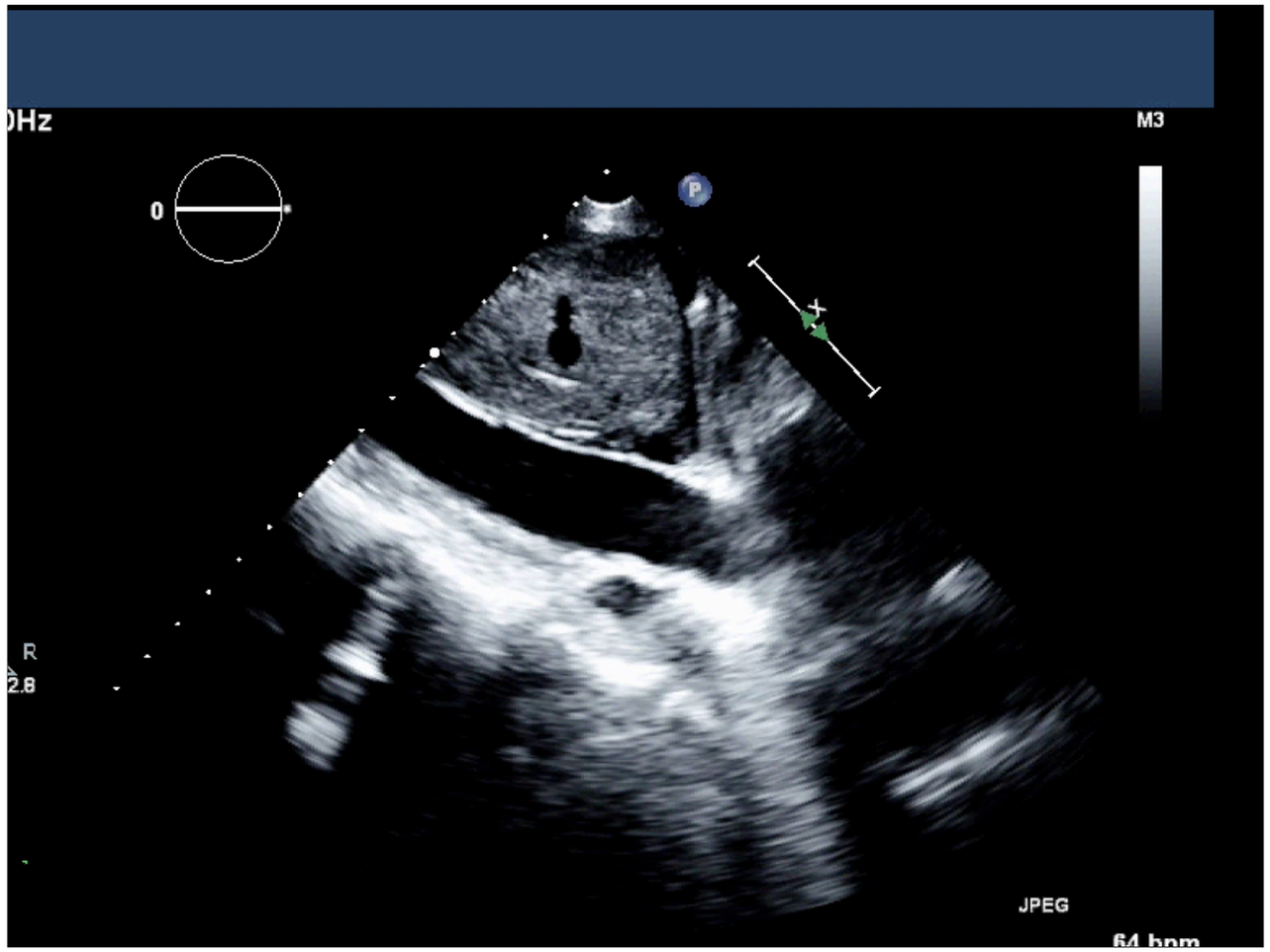
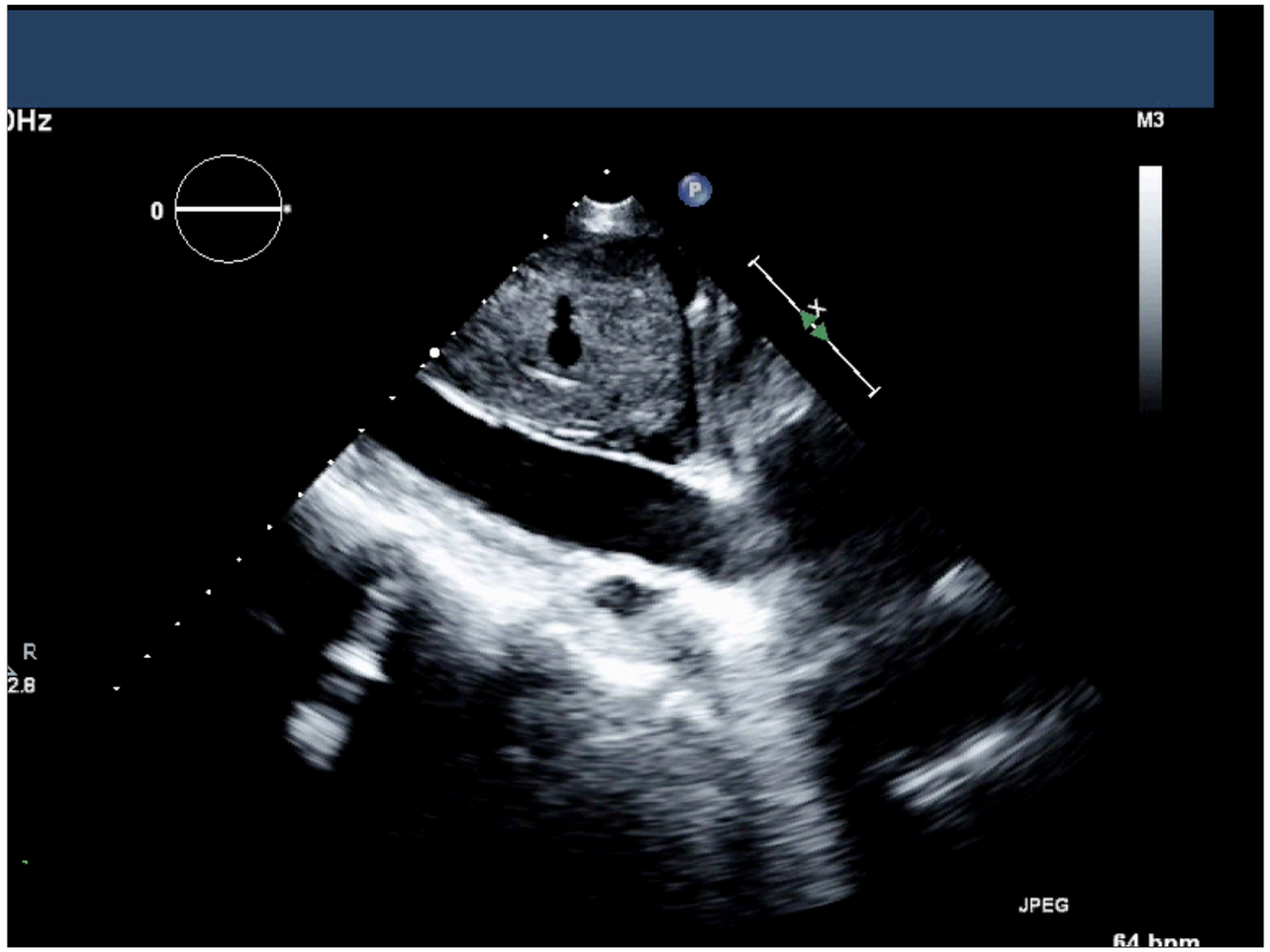



IVC less collapsible likely 2/2 RV strain form septal hypokinesis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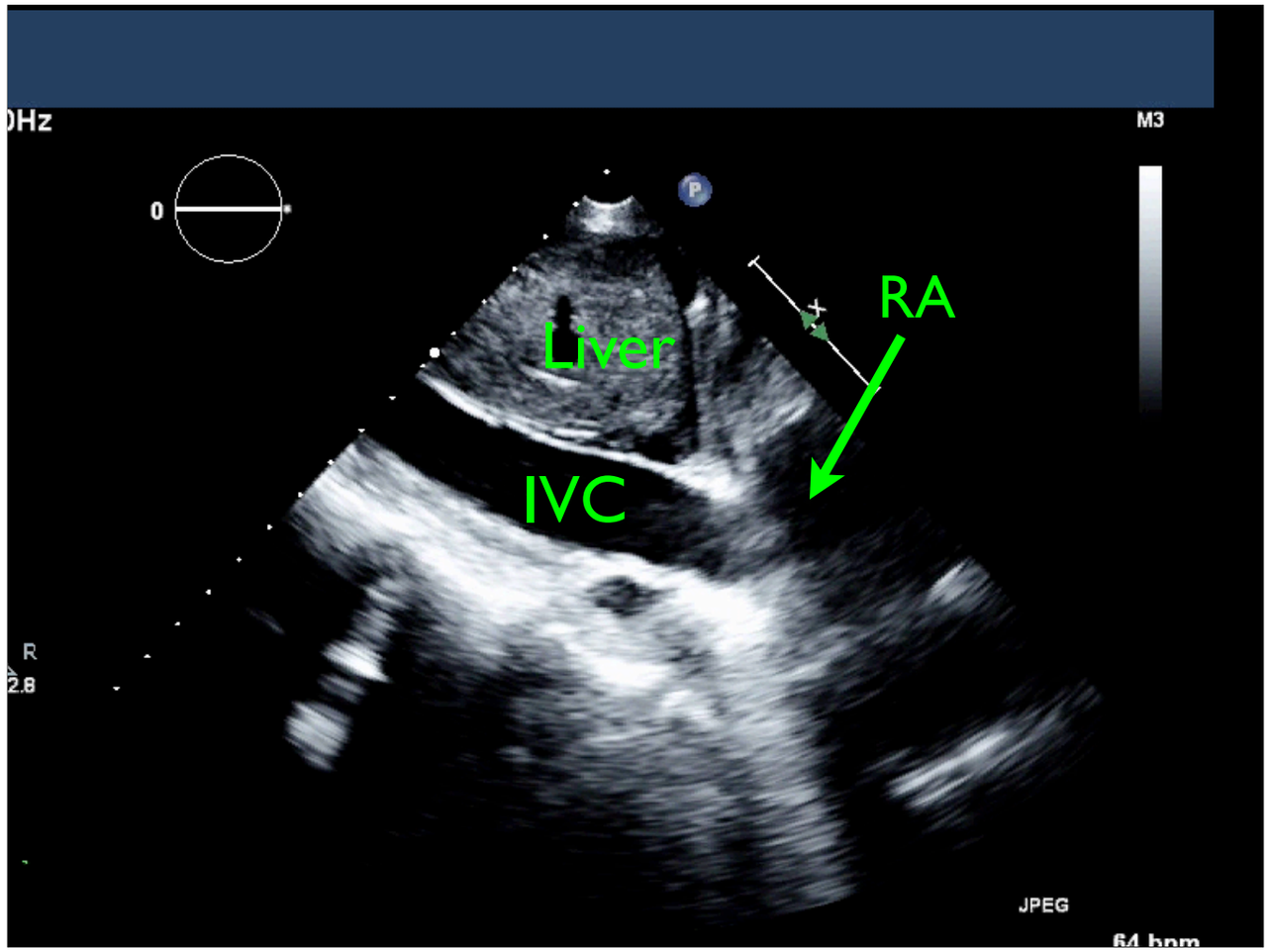
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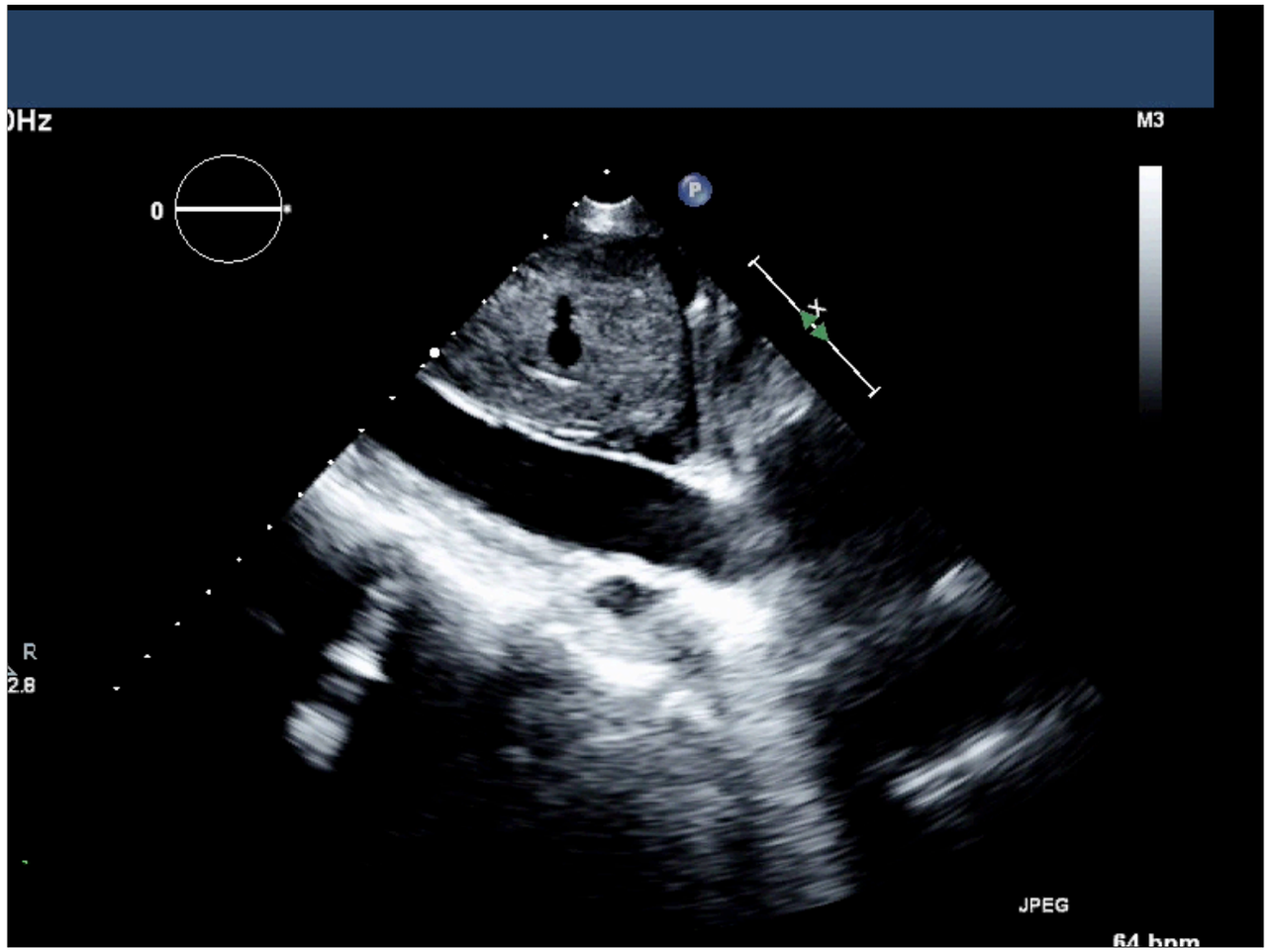
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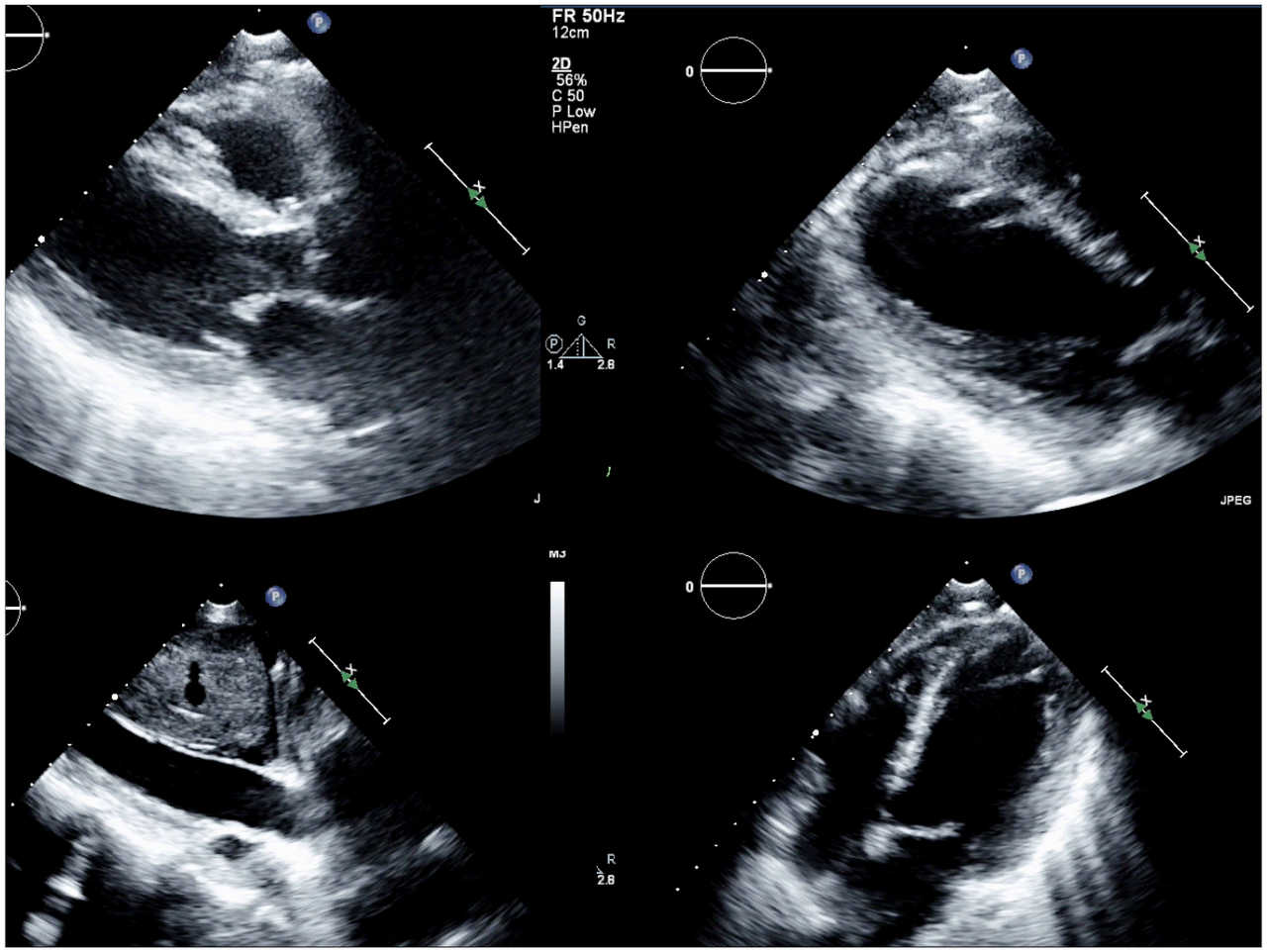
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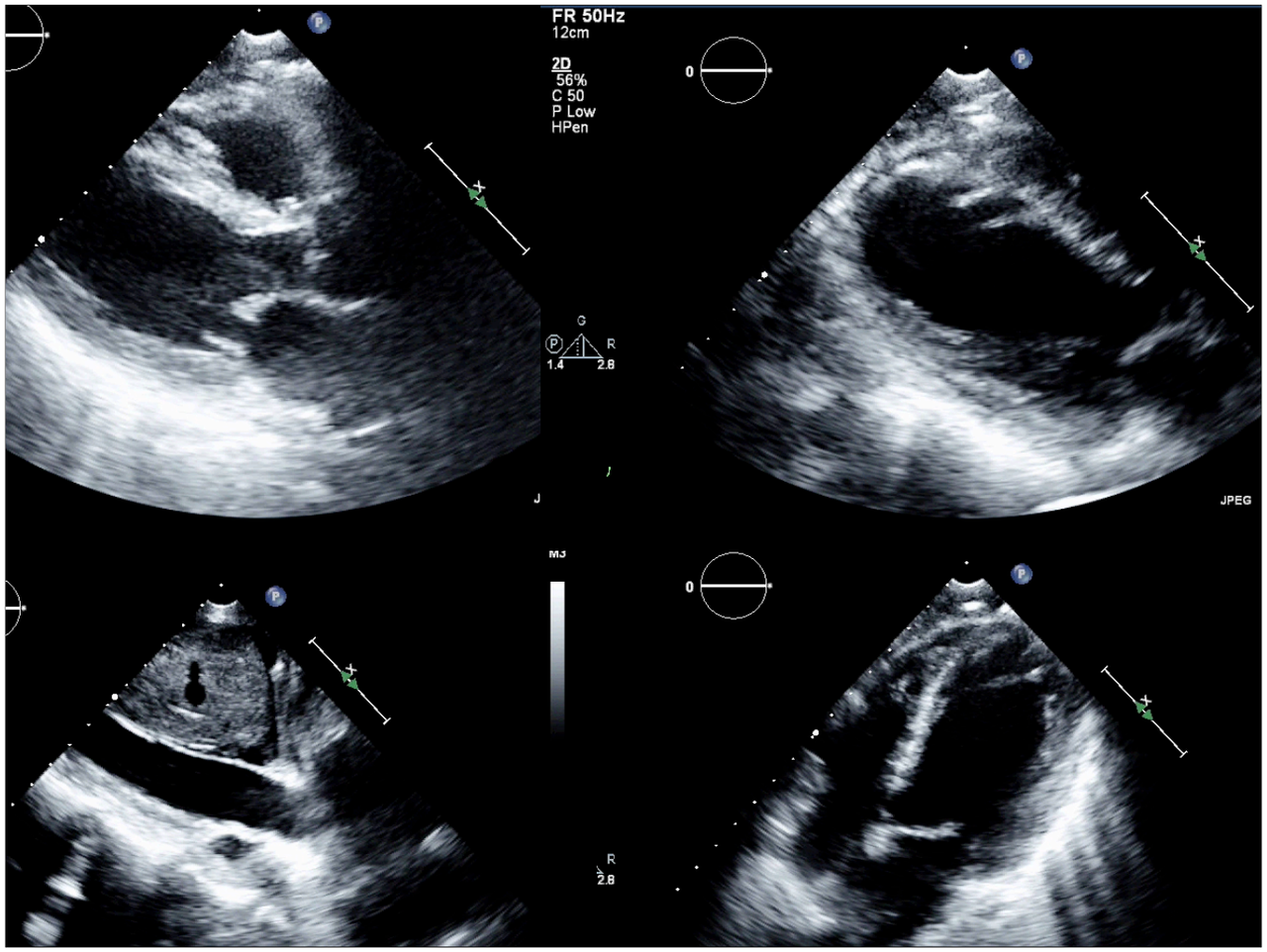
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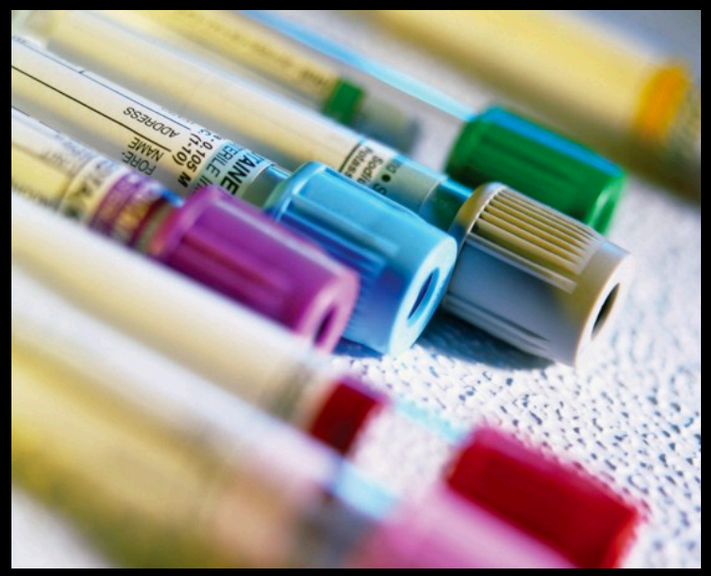
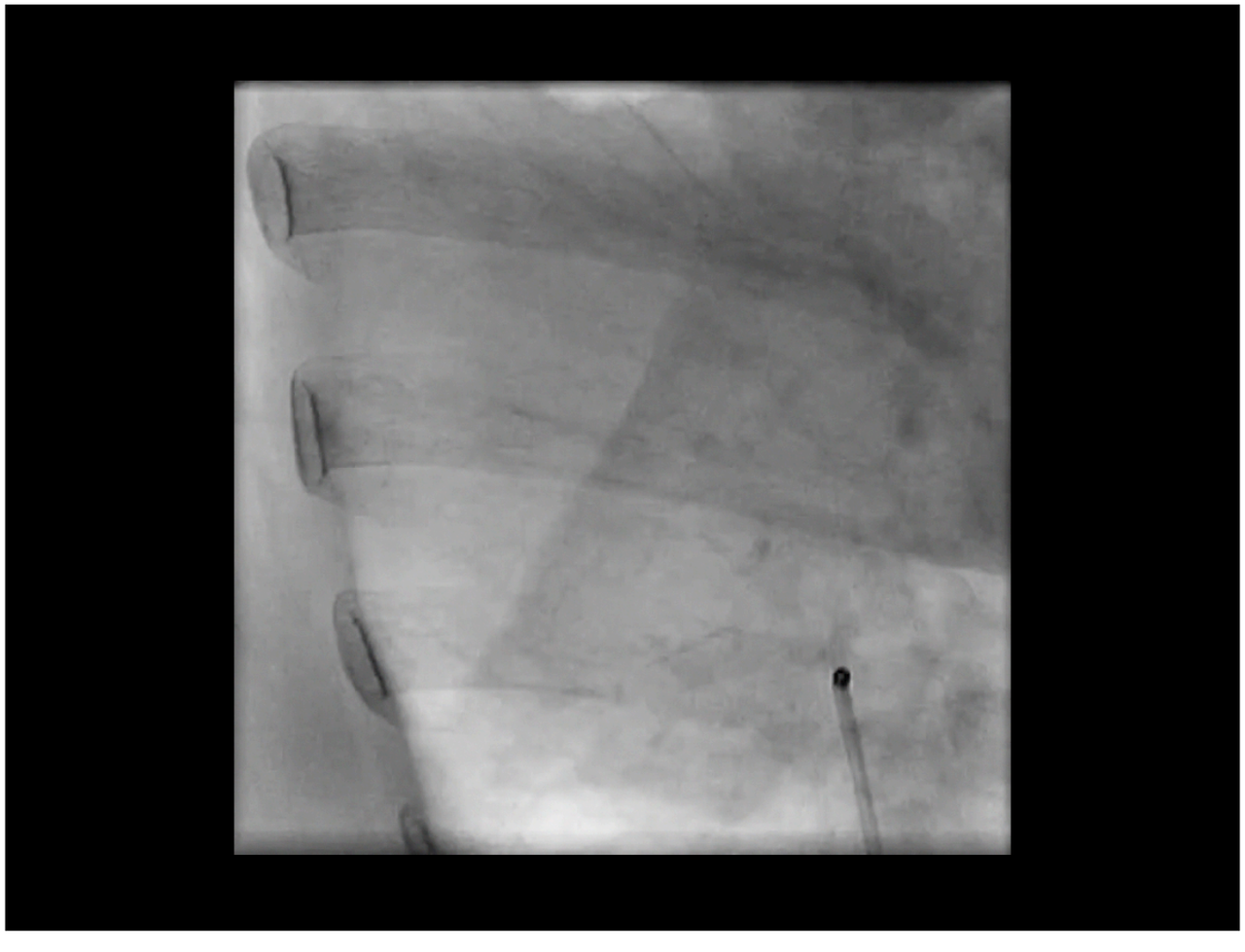
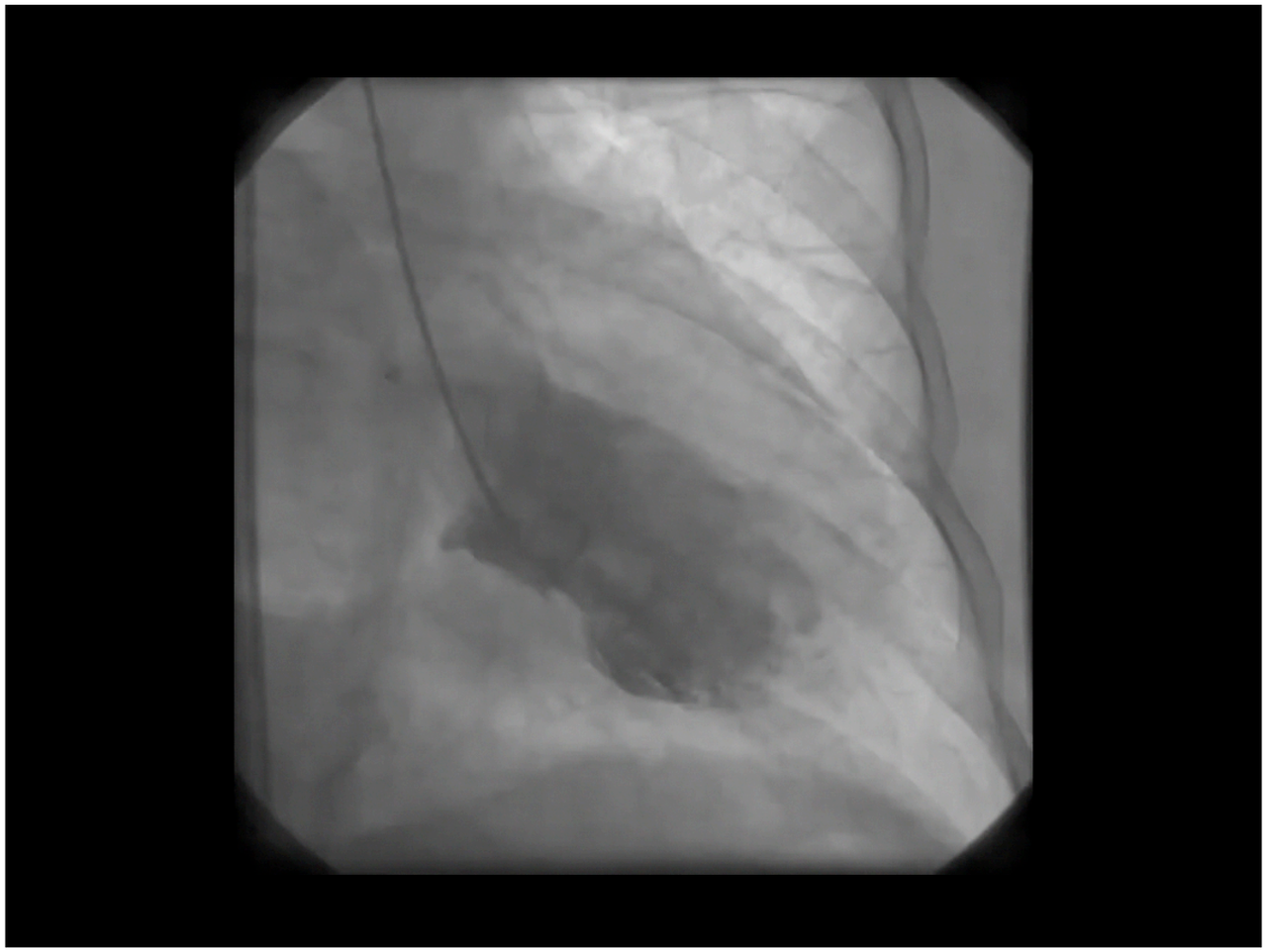


Cath: Mild Coronary Disease unchanged from Cath 6 months prior



Apical Ballooning



Described in 1990 in Japan; ♀>♂ (89% F in Int'l TK Registry 1750pts)
patho: Catecholamine induced spasm—>myocard stunning vs catechol direct toxicity
CP; syncope; DOE
ECG: ST↑ (most common); TWI (2nd most common);
One small study—> Consecutive MICU patient (non-cardiac illness)—> 25% prevalence
—- resolved within 7 days; highest risk factor SEPSIS in this cohort.

# Takotsubo Cardiomyopathy

# Takotsubo Cardiomyopathy

Broken Heart Syndrome

# Takotsubo Cardiomyopathy

Broken Heart Syndrome

Stress-Induced Cardiomyopathy

# Takotsubo Cardiomyopathy

# Takotsubo Cardiomyopathy

# Takotsubo Cardiomyopathy

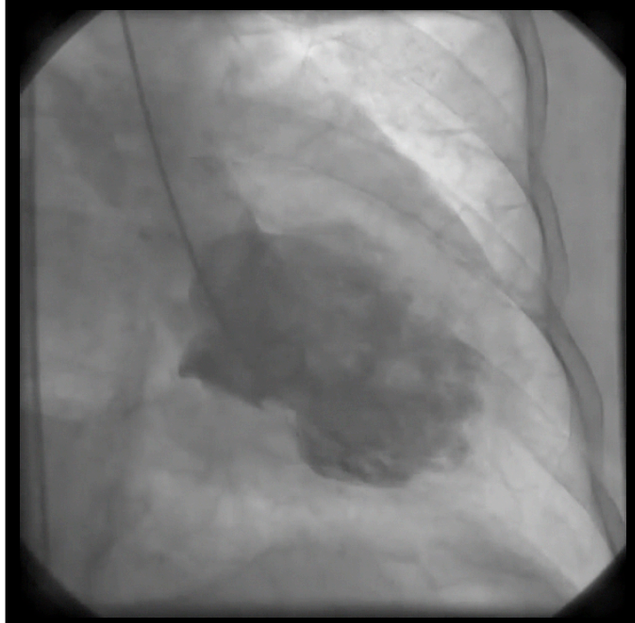
Tako

# Takotsubo Cardiomyopathy

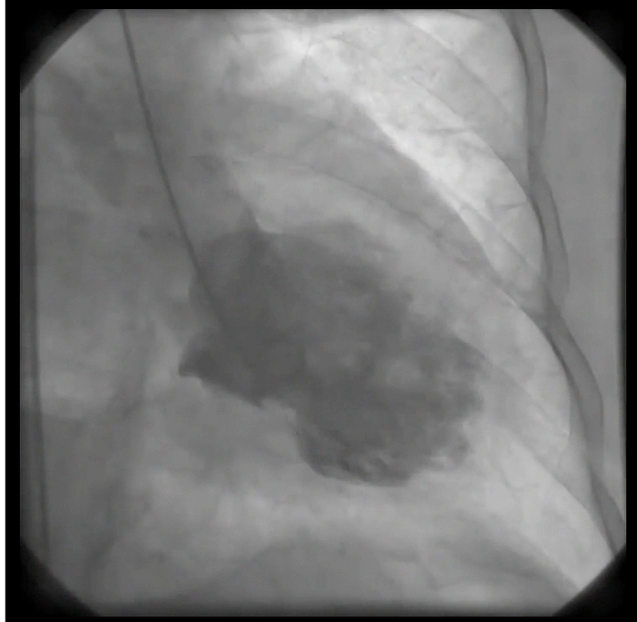
# Takotsubo Cardiomyopathy

# Takotsubo Cardiomyopathy

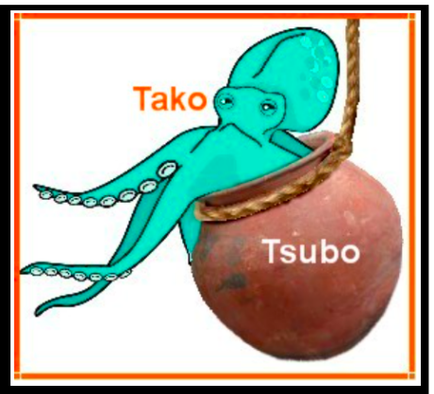
# Takotsubo Cardiomyopathy



# Takotsubo Cardiomyopathy



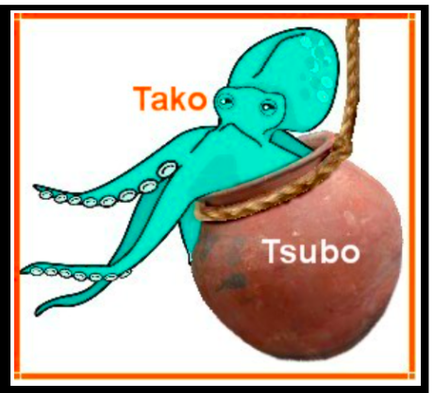
# Takotsubo Cardiomyopathy




No angiographic coronary dz (or dz c/w wall motions abnormalities)—> some pts will have concurrent CAD (15% in TK Registry)

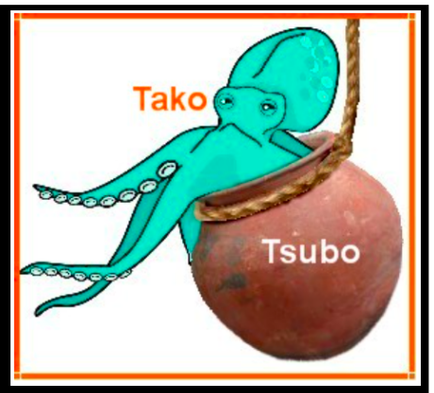
LV dysfunction (apical segment most common; mid LV; Basal; focal are less common)

# Takotsubo Cardiomyopathy



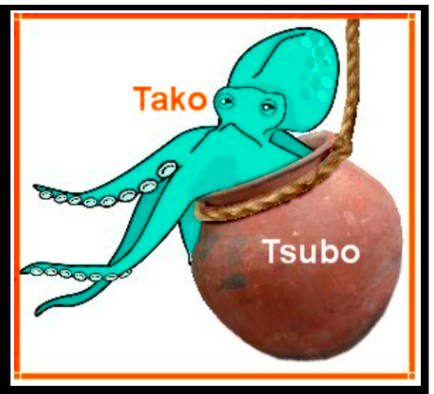

- New ECG Findings or Elevated Trop

# Takotsubo Cardiomyopathy



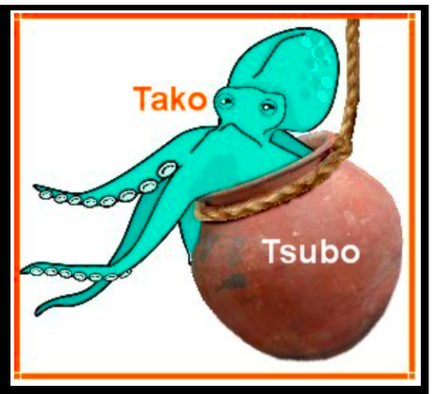

- New ECG Findings or Elevated Trop
- Transient LV Dysfunction

# Takotsubo Cardiomyopathy



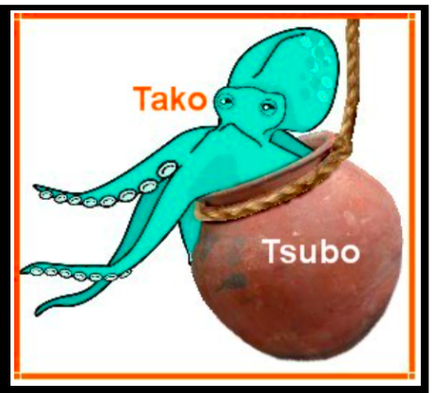

- New ECG Findings or Elevated Trop
- Transient LV Dysfunction
  - Hypokinesis in apical and mid segments

# Takotsubo Cardiomyopathy



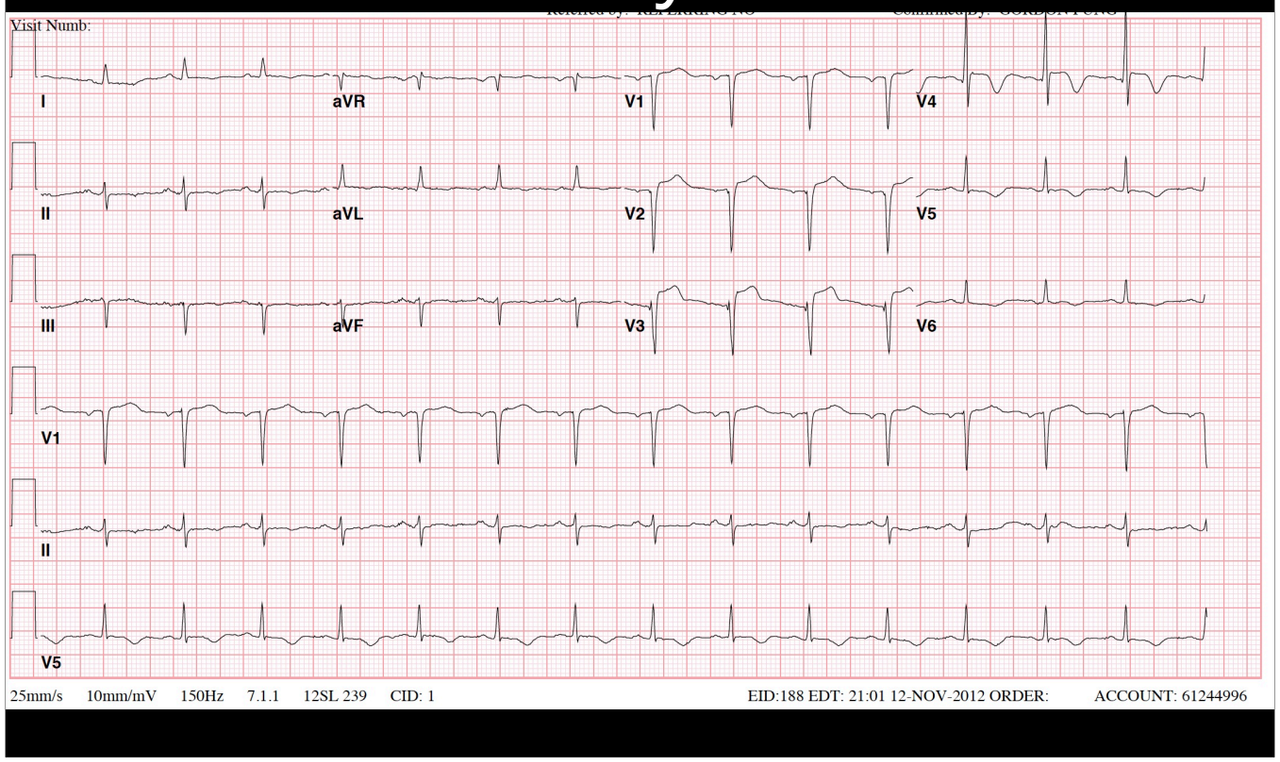

- New ECG Findings or Elevated Trop
- Transient LV Dysfunction
  - Hypokinesis in apical and mid segments
- No angiographic coronary disease

# Takotsubo Cardiomyopathy

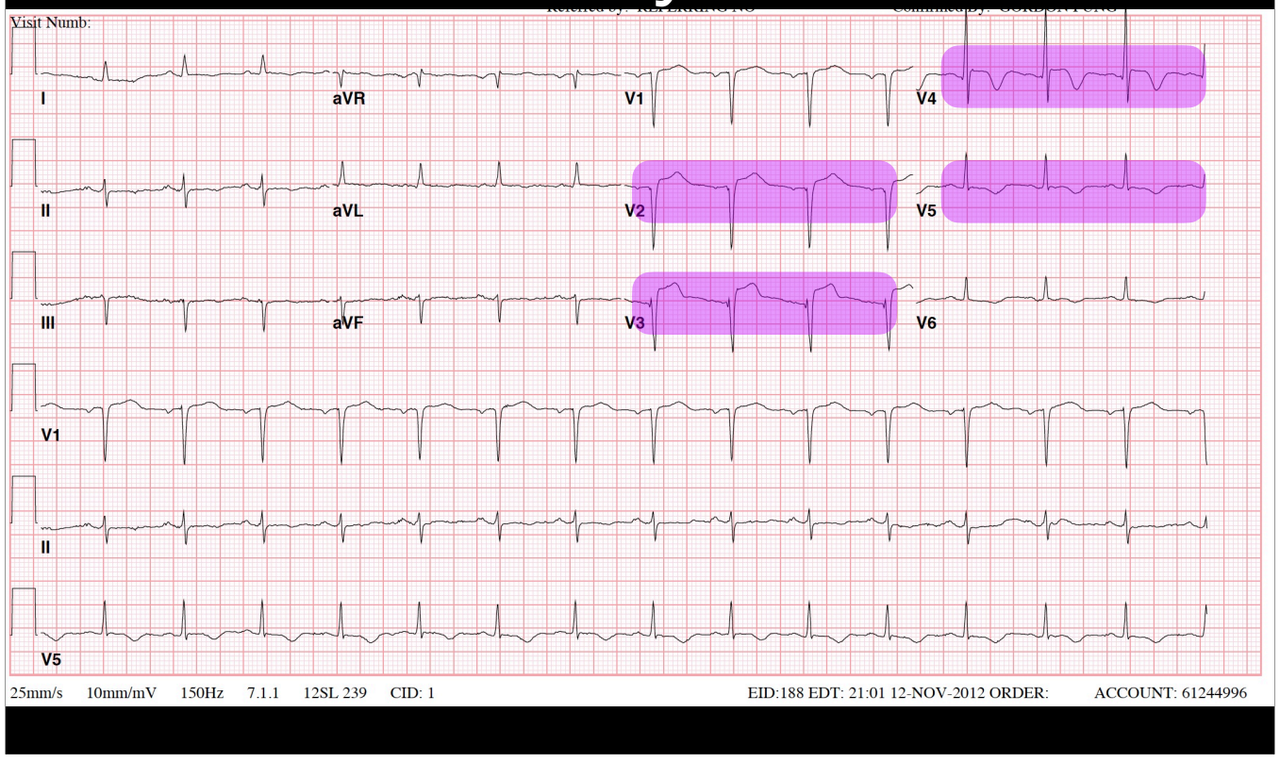



- New ECG Findings or Elevated Trop
- Transient LV Dysfunction
  - Hypokinesis in apical and mid segments
- No angiographic coronary disease
- No Myocarditis or pheochromocytoma

# Day 1


Visit Numb:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 150Hz 7.1.1 12SL 239 CID: 1
EID:188 EDT: 21:01 12-NOV-2012 ORDER:
ACCOUNT: 61244996

# Day 1


Visit Numb:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 150Hz 7.1.1 12SL 239 CID: 1
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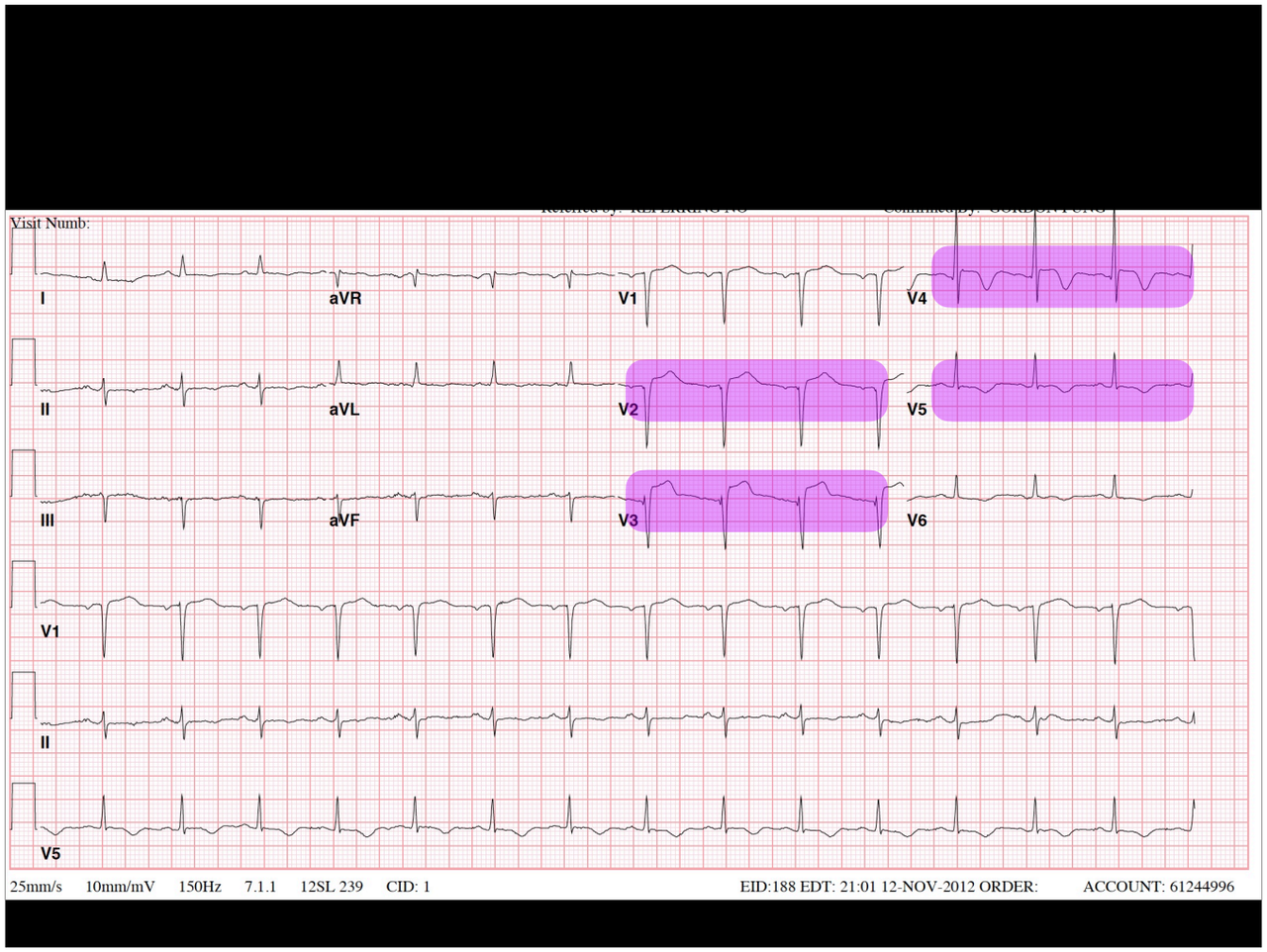
Visit Numb:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 150Hz 7.1.1 12SL 239 CID: 1
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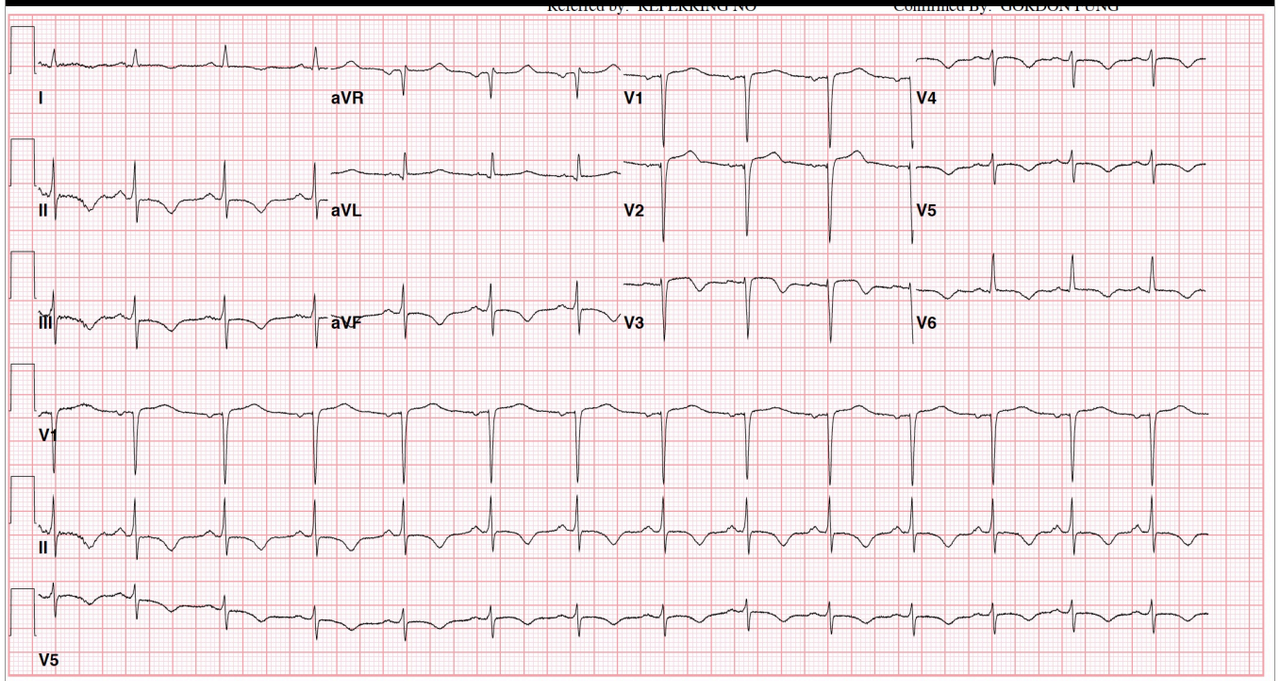
ACCOUNT: 61244996

[redacted]

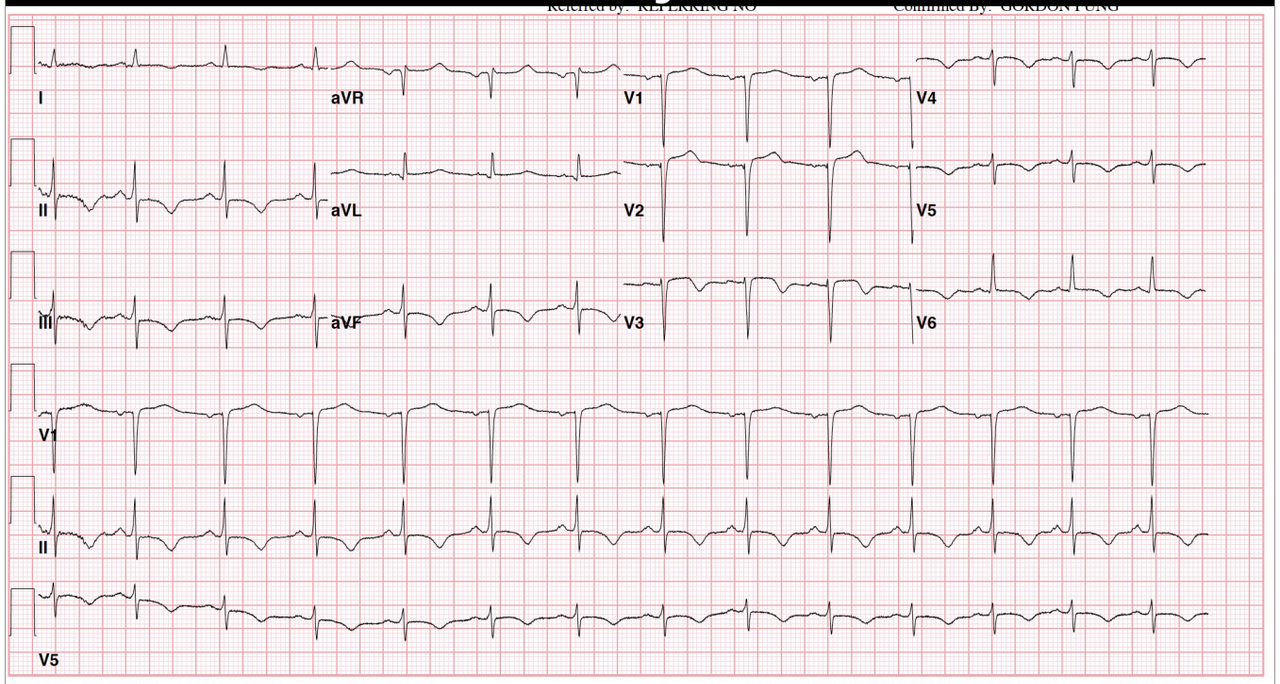
Referred By: REFERRING MD Confirmed By: GORDON FUNG



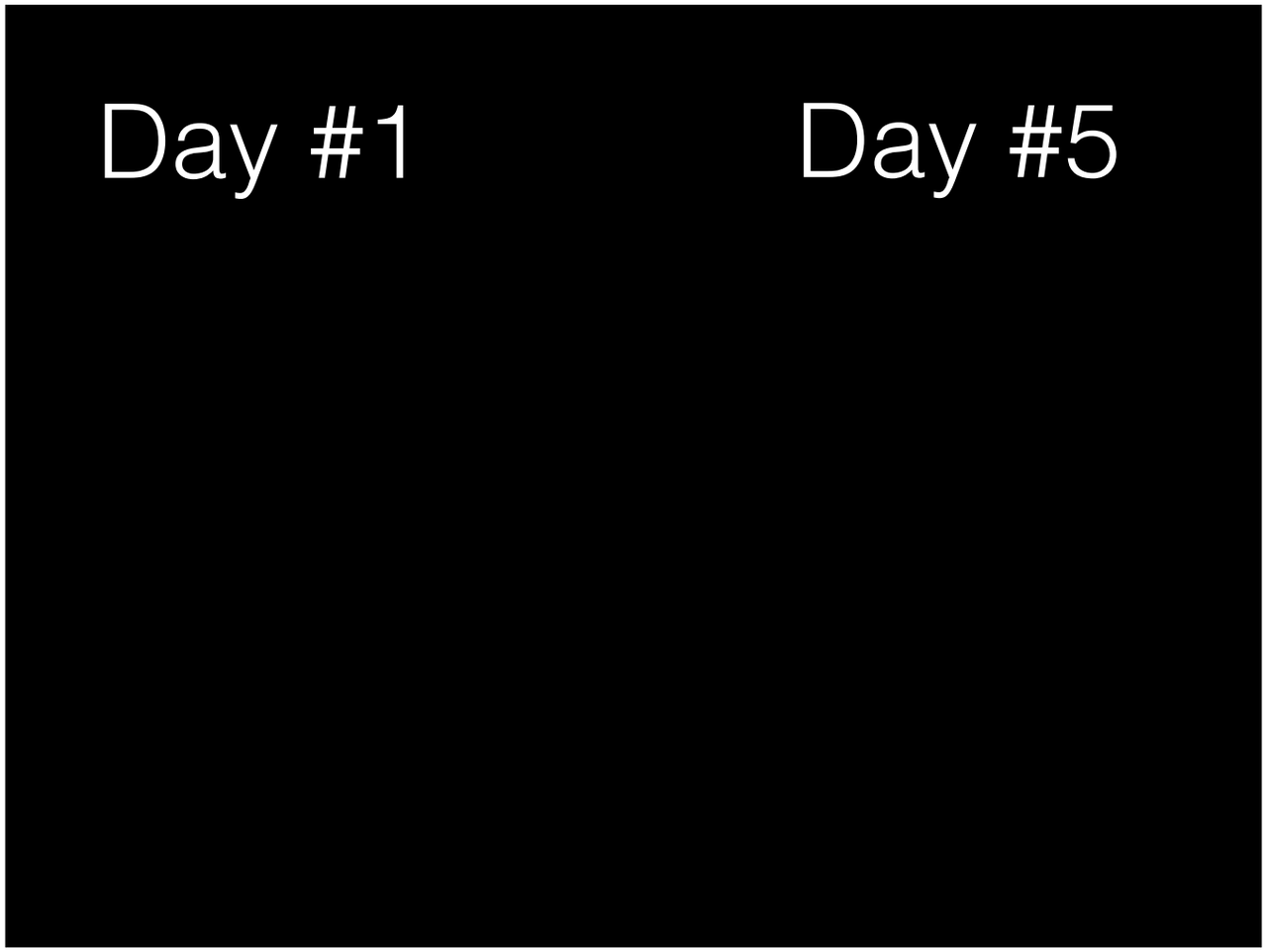

25mm/s 10mm/mV 150Hz 7.1.1 12SL 239 CID: 1 EID:188 EDT: 21:02 12-NOV-2012 ORDER: ACCOUNT: 61244996

[redacted]

# Day 2




25mm/s 10mm/mV 150Hz 7.1.1 12SL 239 CID: 1 EID:188 EDT: 21:02 12-NOV-2012 ORDER: ACCOUNT: 61244996



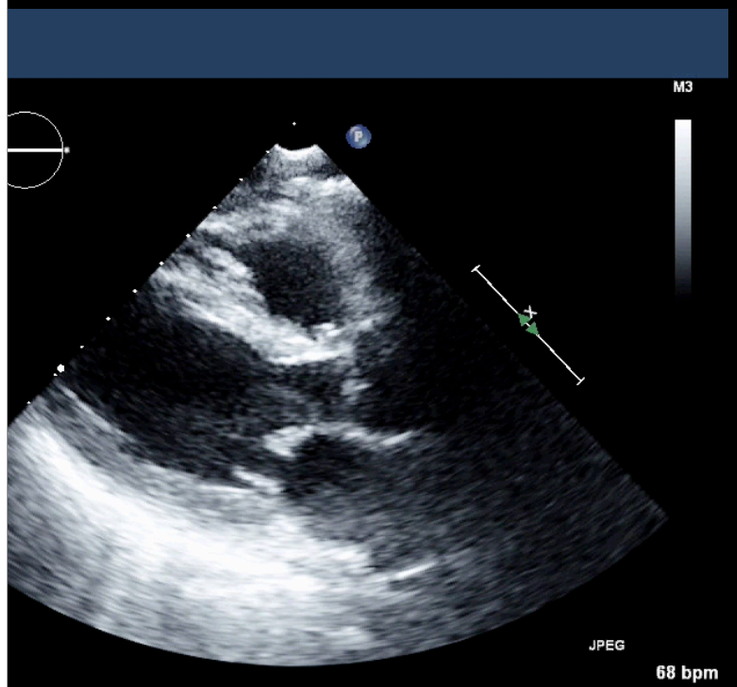

PSS AP4 DAY VS RECOVERY

Tako—> Mimicker of MI—> Dx of Exclusion after AMI ruled out

ST changes; Wall motion abnml;

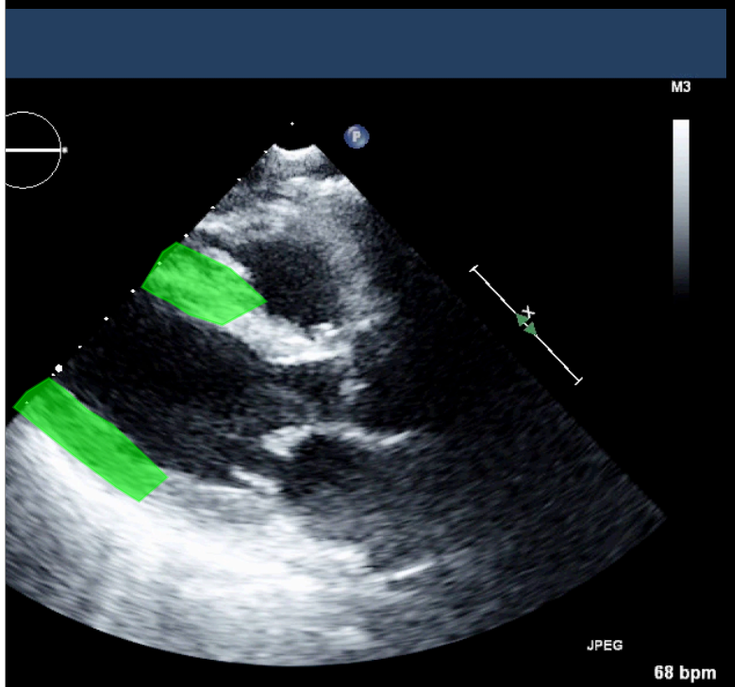
# Day #1

# Day #5



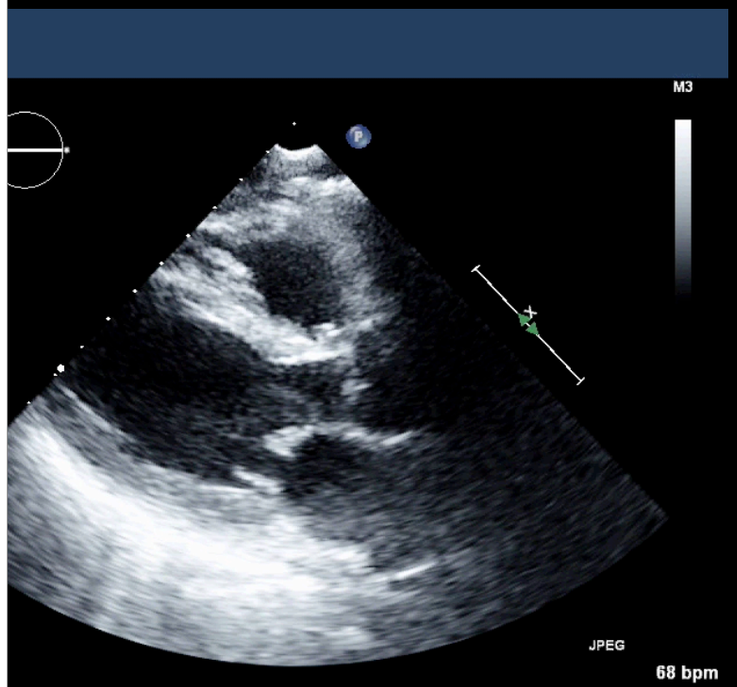
Day #1

Day #5



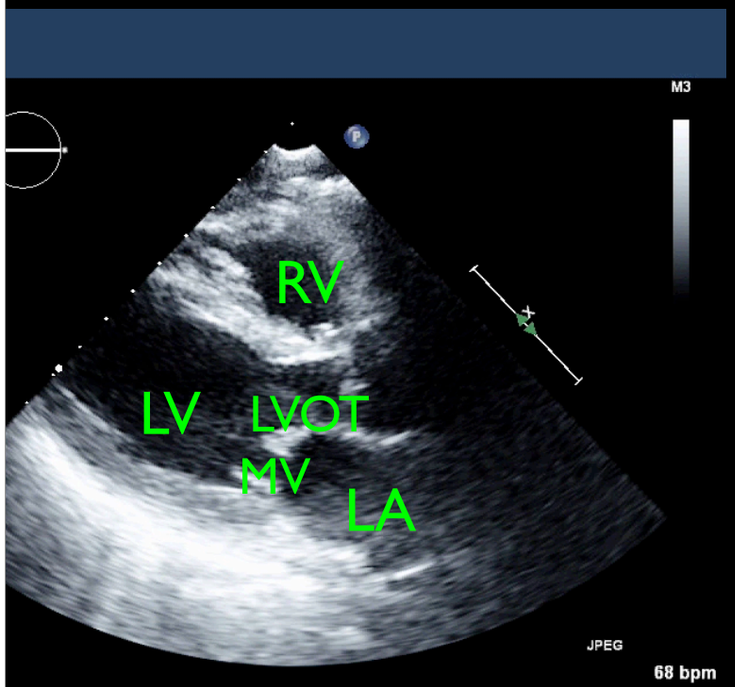
# Day #1

# Day #5



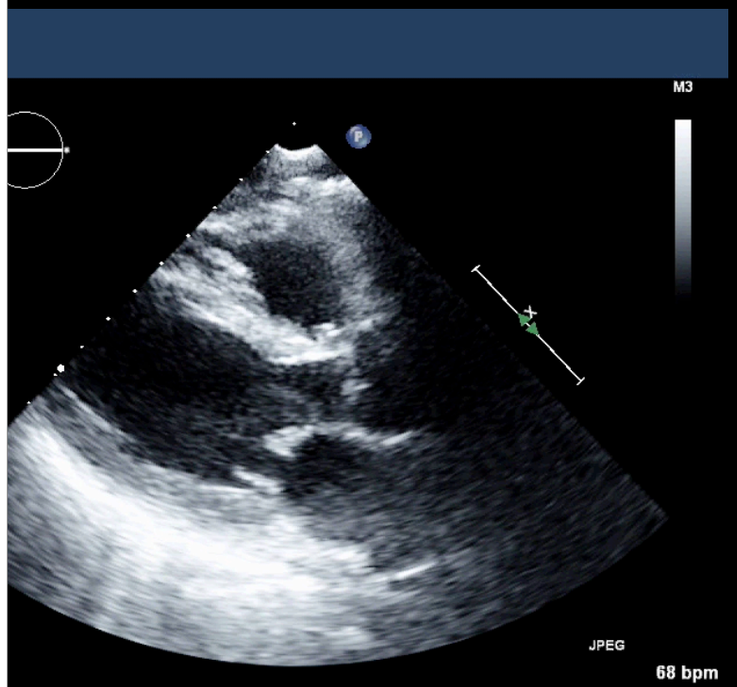
# Day #1

# Day #5



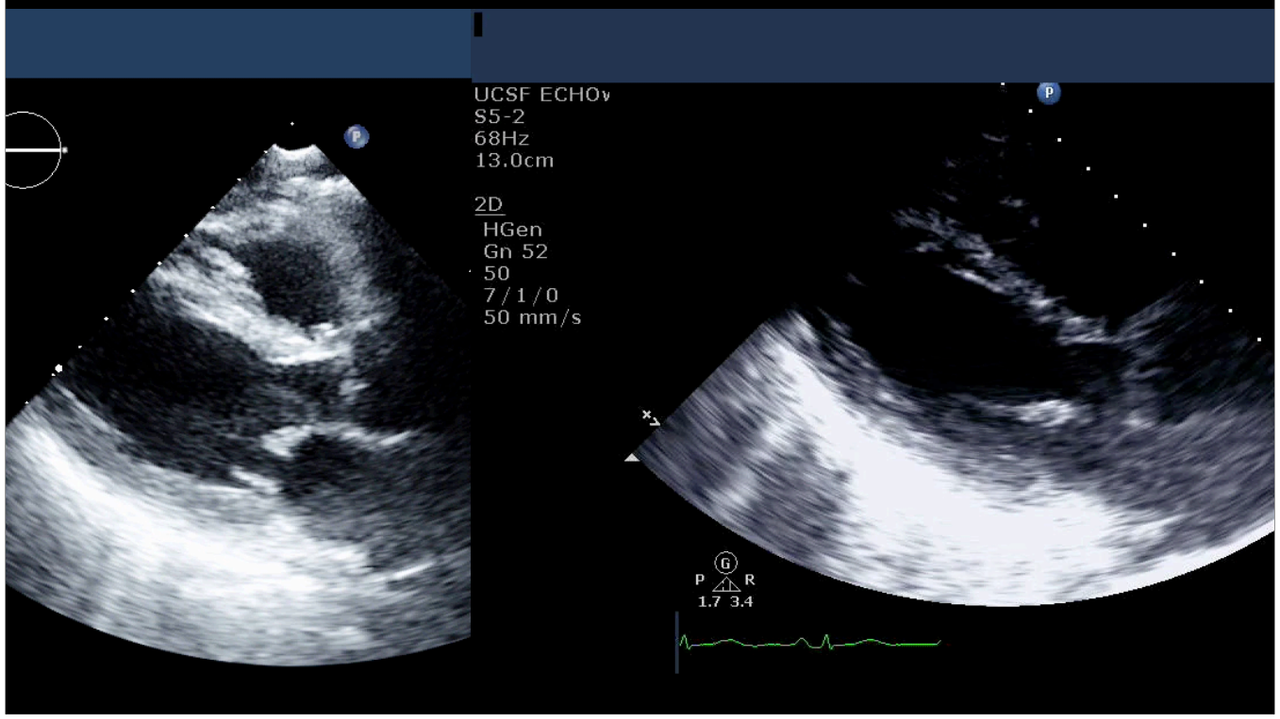
# Day #1

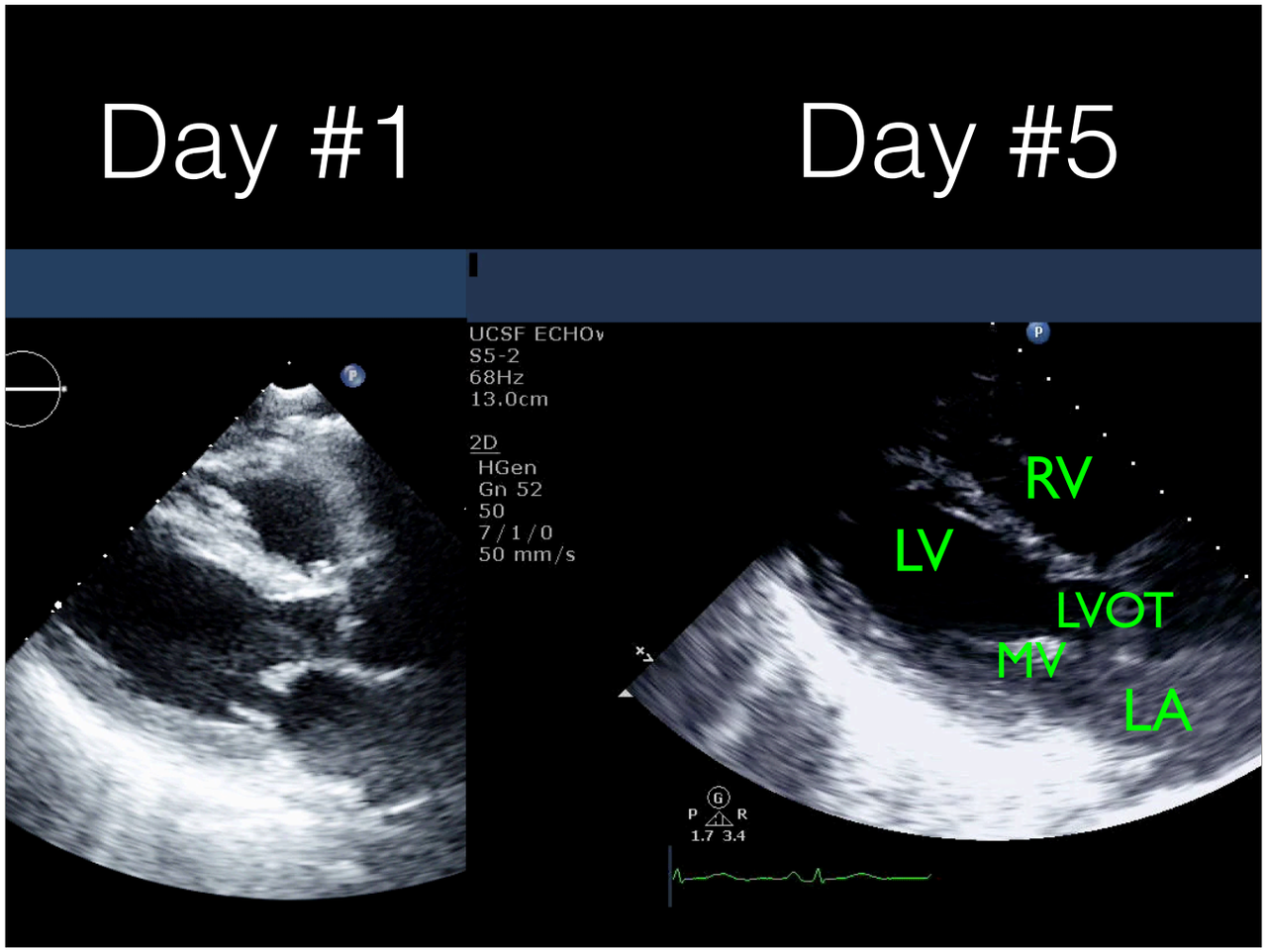
# Day #5



# Day #1

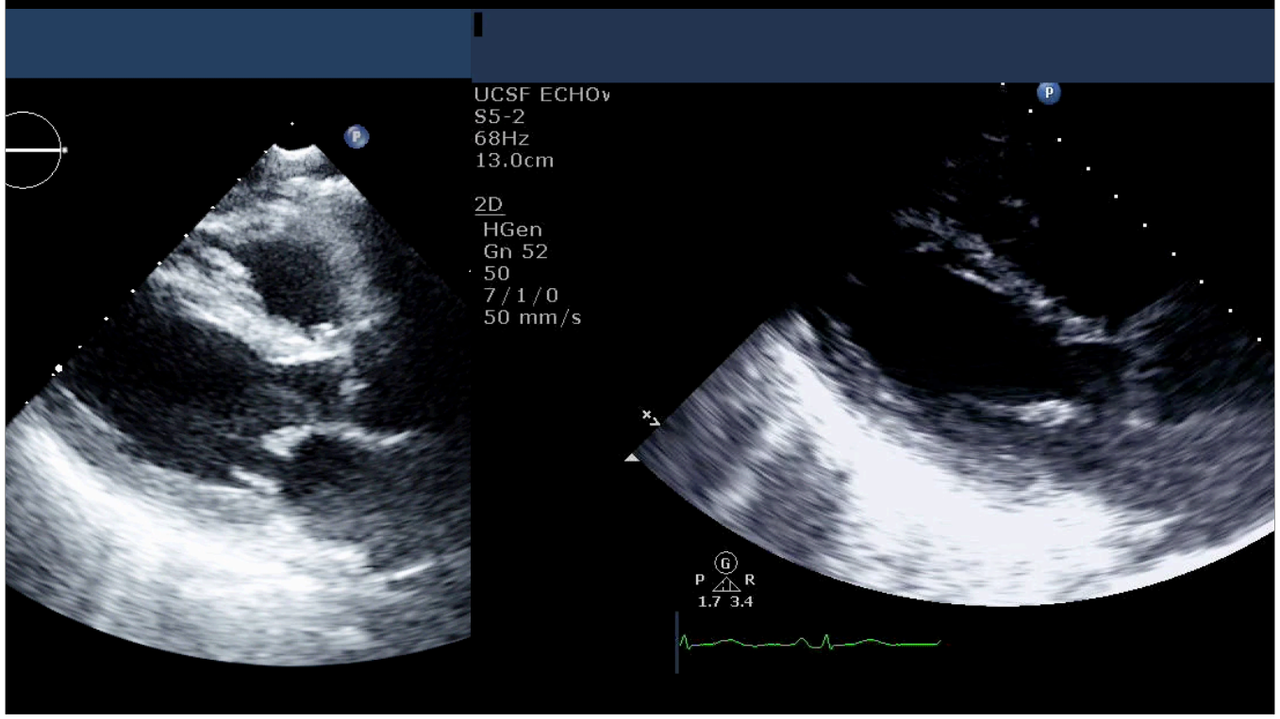
# Day #5




Day #1
Day #5
UCSF ECHOv
S5-2
68Hz
13.0cm
2D
HGen
Gn 52
50
7/1/0
50 mm/s
RV
LV
LVOT
MV
LA
P R
1.7 3.4

# Day #1

# Day #5



# Case

Baseline BP: 170-180s
Beta-Blocker: Unable to mount tachycardia response

# Case

- 63 ♀ HTN, DM, HLD c/o 4 days of DOE.

# Case

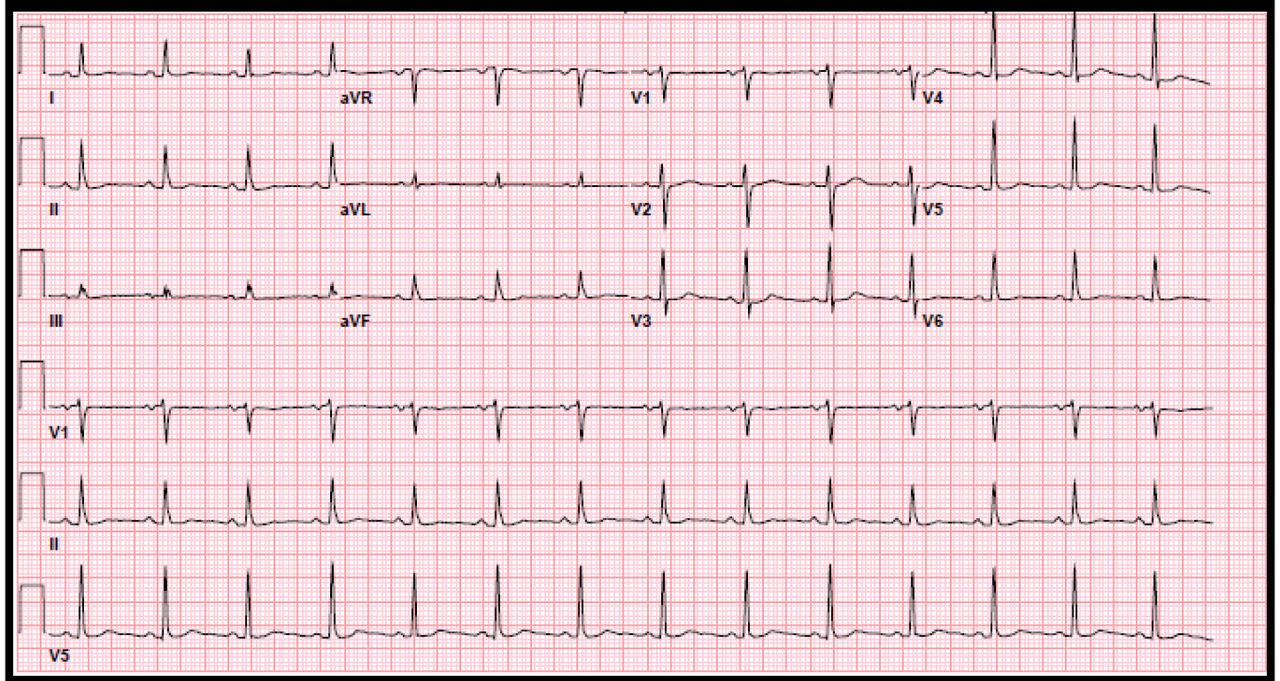
- 63 ♂ HTN, DM, HLD c/o 4 days of DOE.
  - Denies SOB at rest, CP or syncope

# Case

- 63 ♀ HTN, DM, HLD c/o 4 days of DOE.
  - Denies SOB at rest, CP or syncope

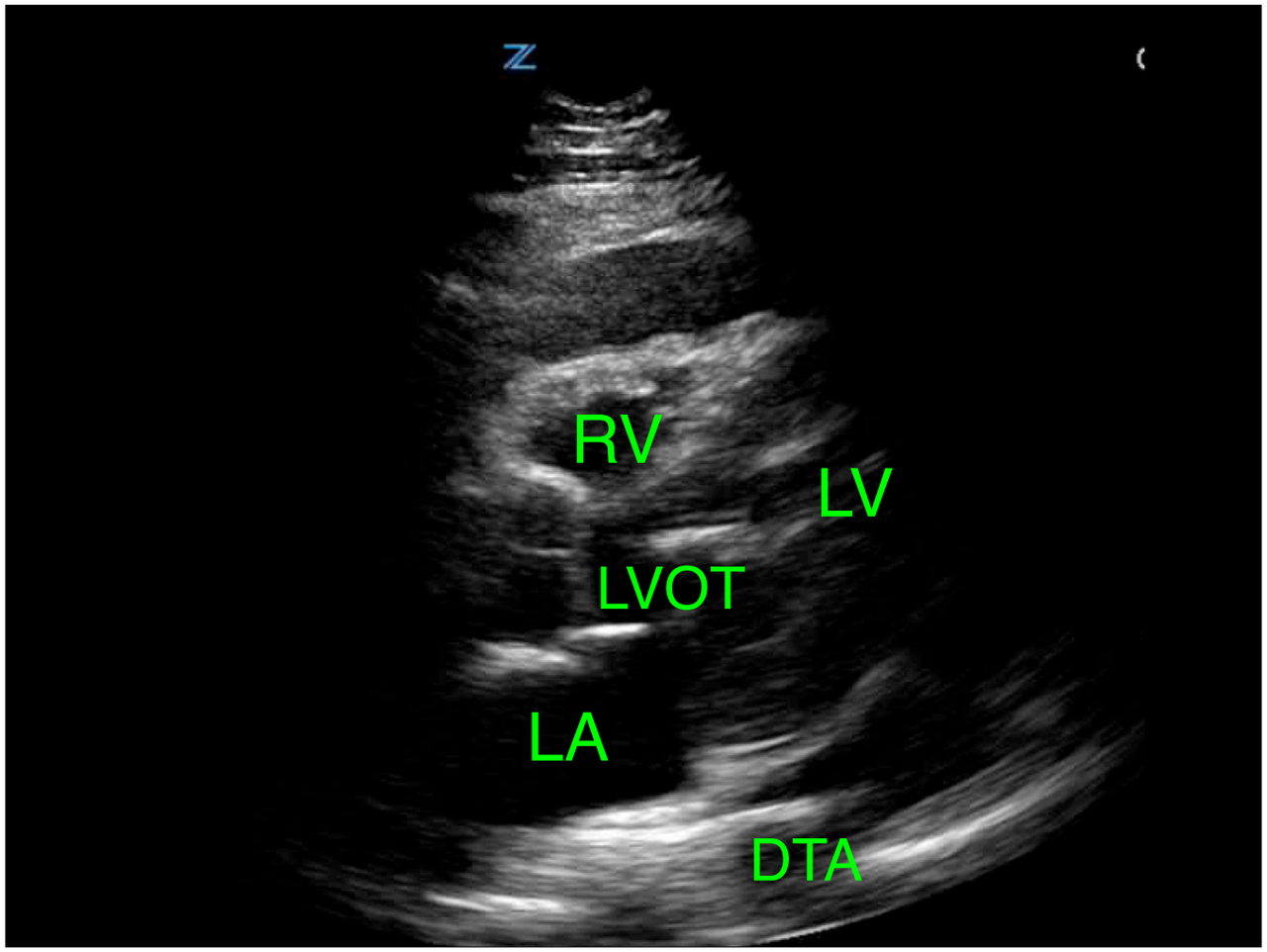
***VS: 37.1 90/60 70 20 98%RA***

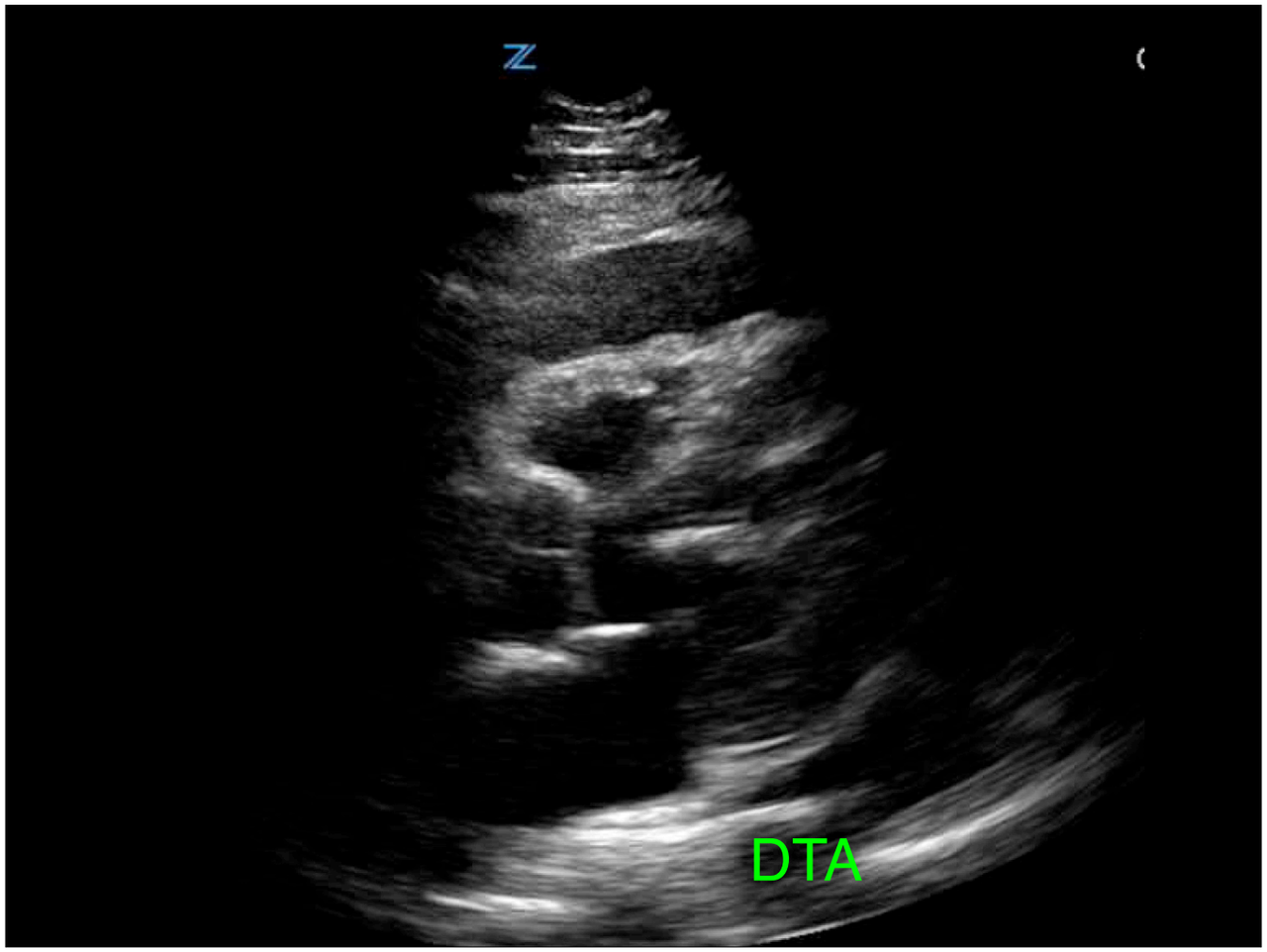
# ECG

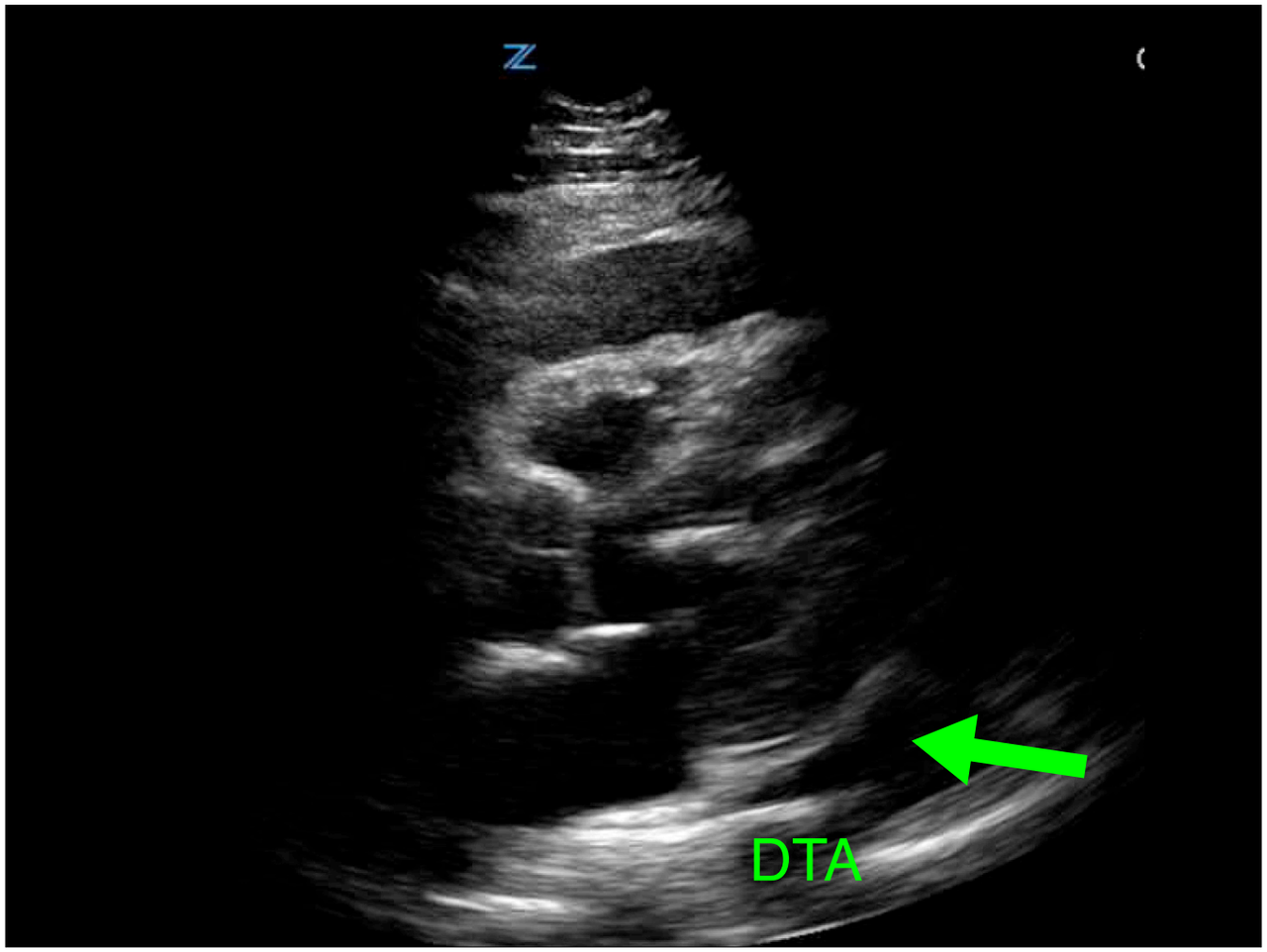


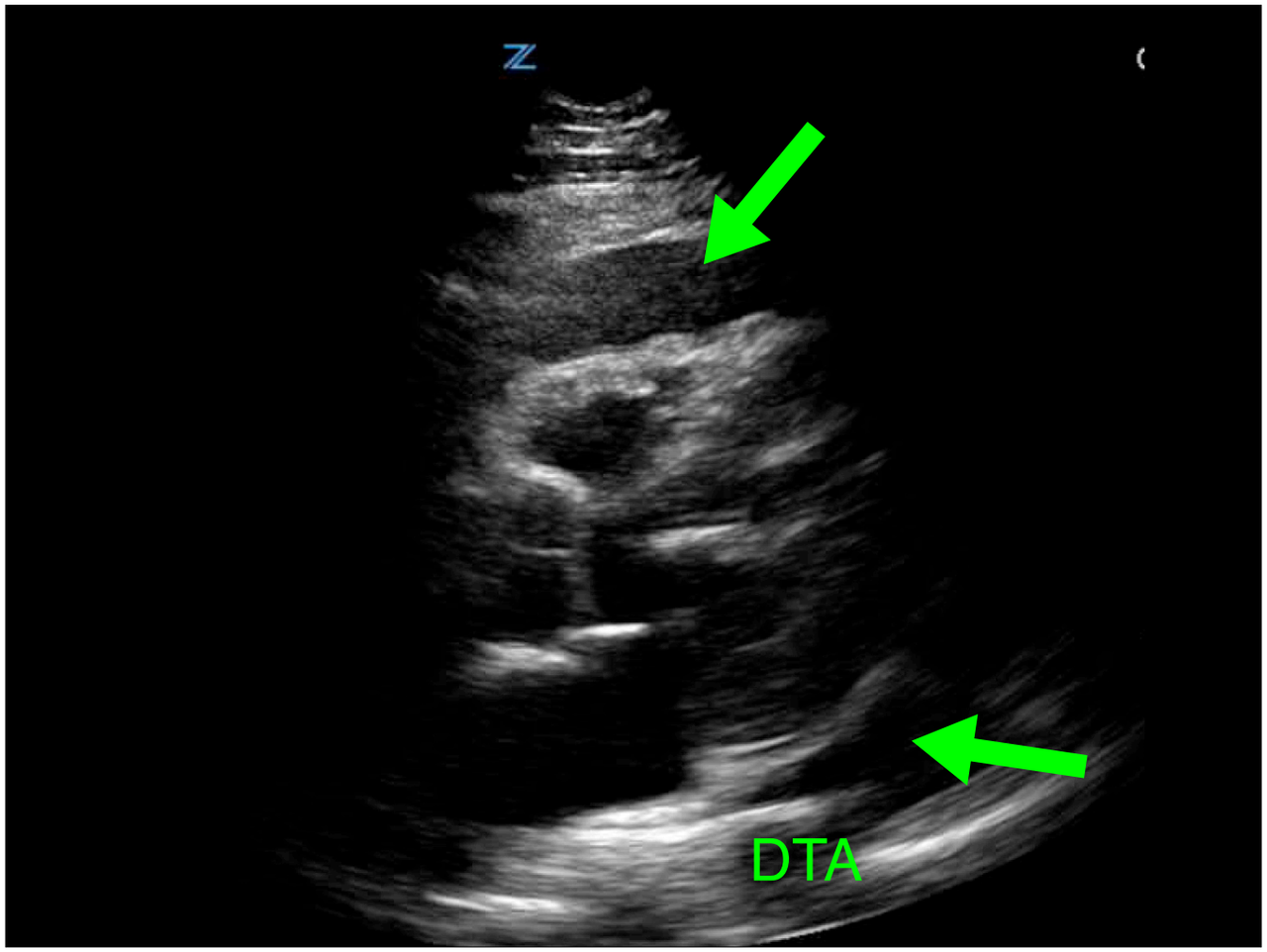

Diffuse TW flattening

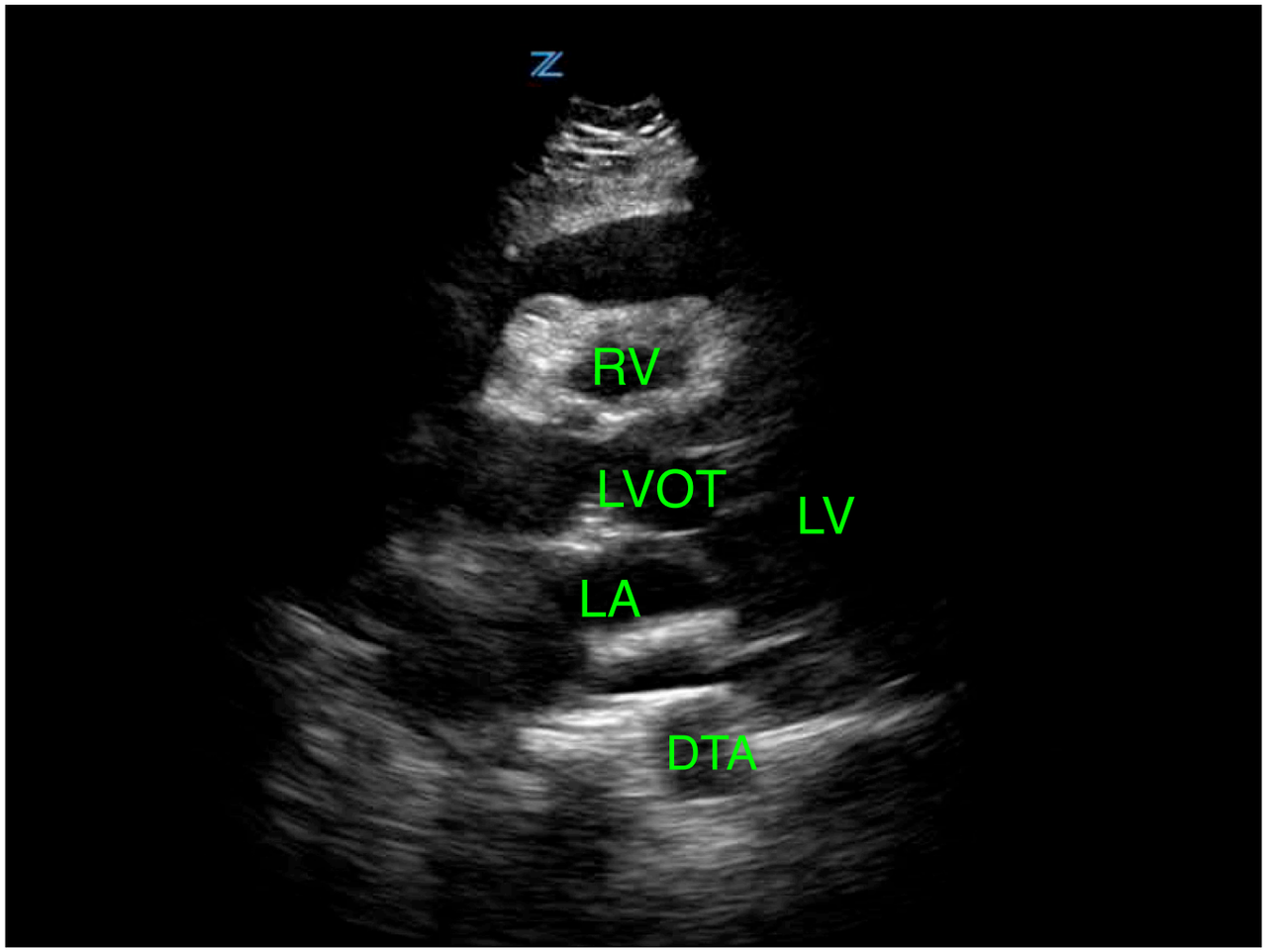
Significant pericardial effusions are seen in diastole and systole

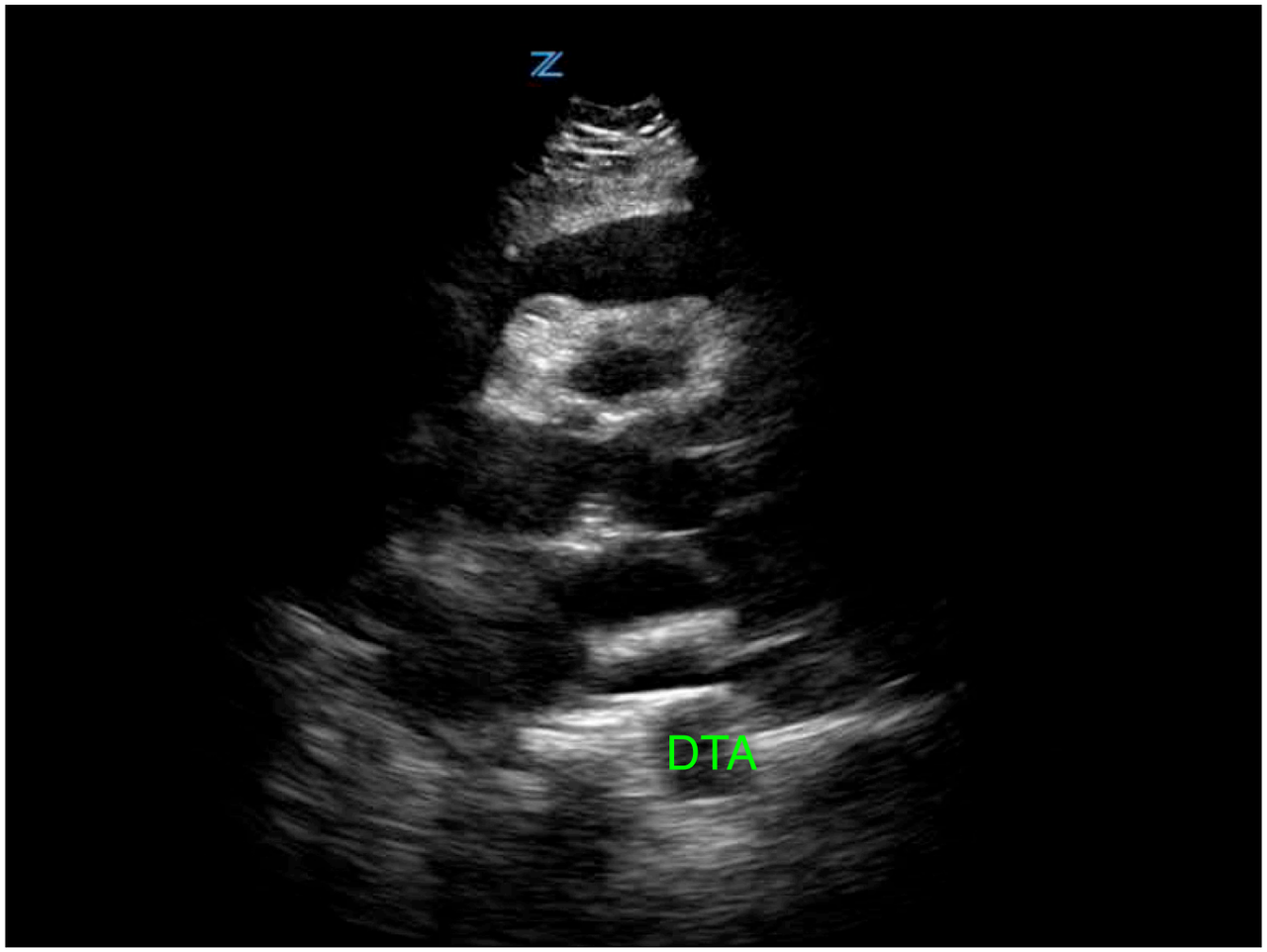

RV
LV
LVOT
LA
DTA

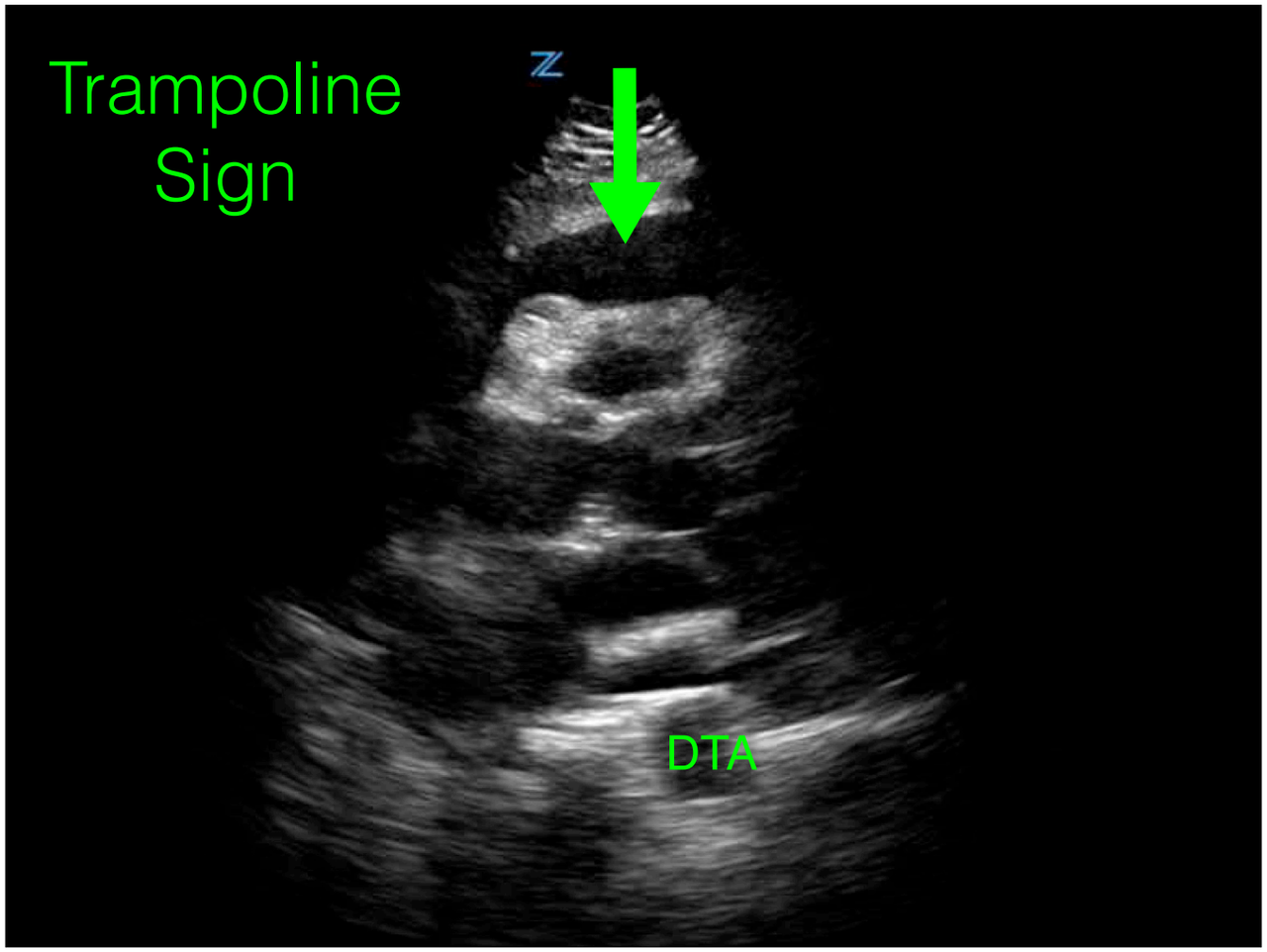

DTA

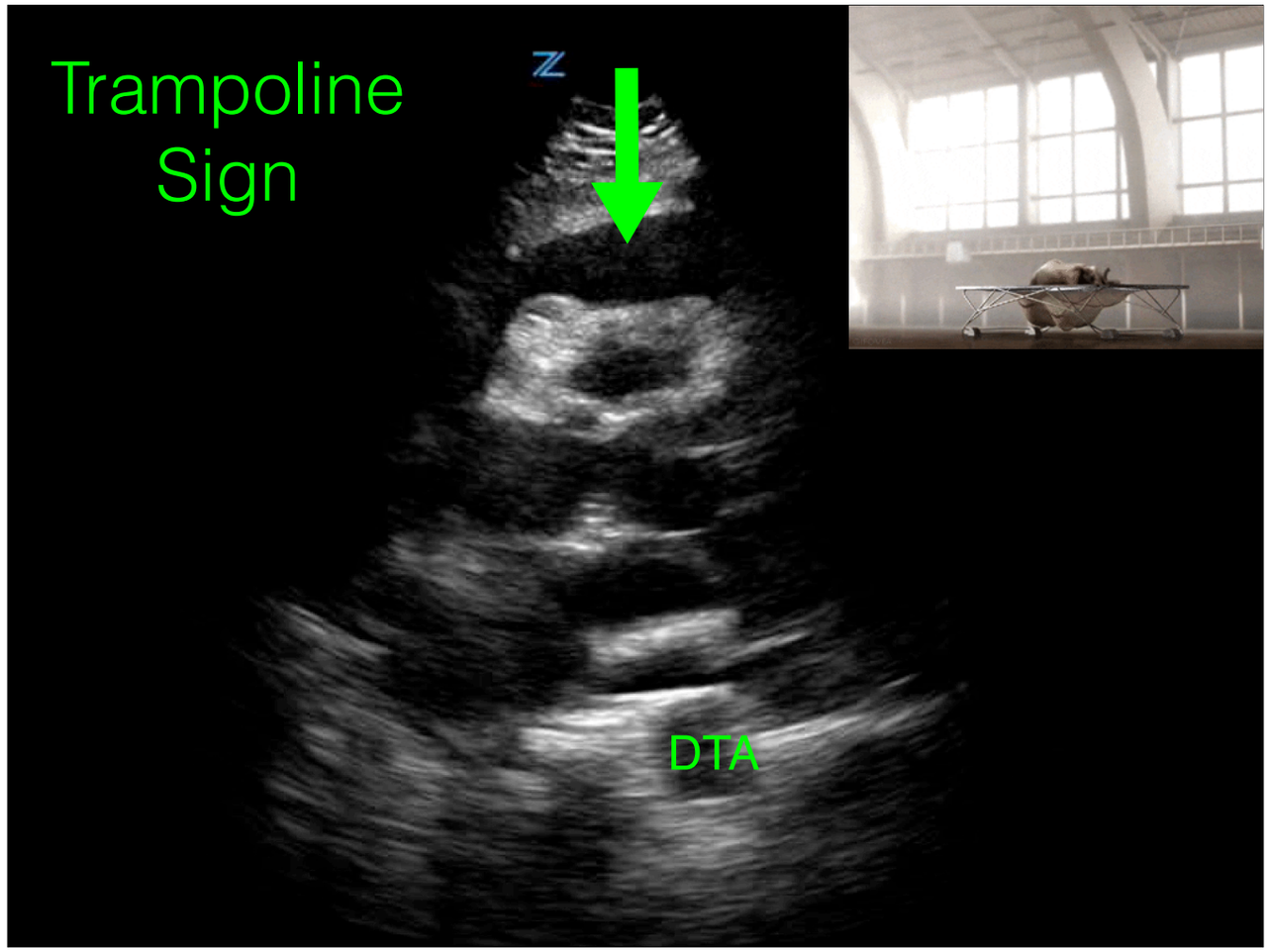

DTA

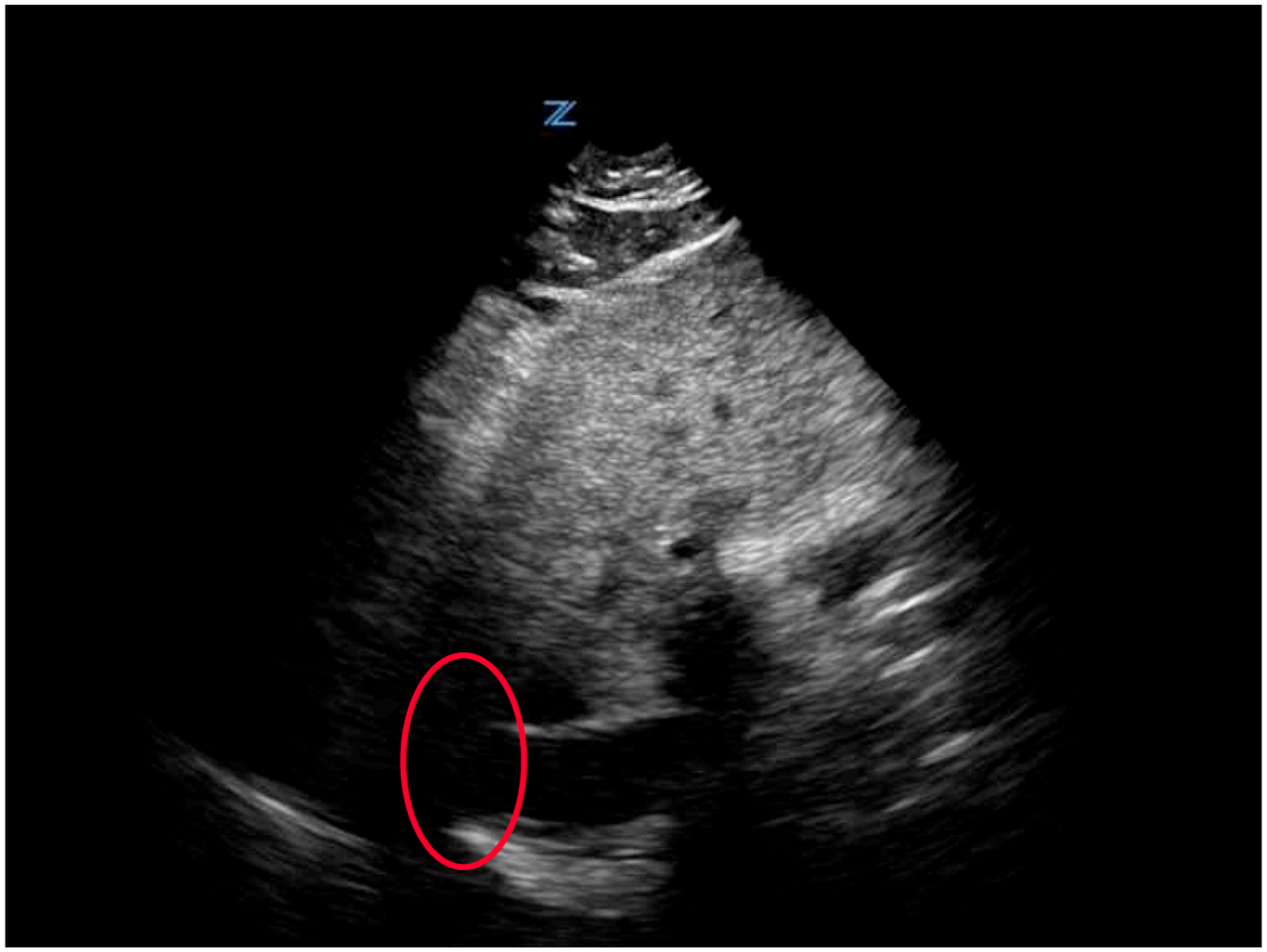

DTA

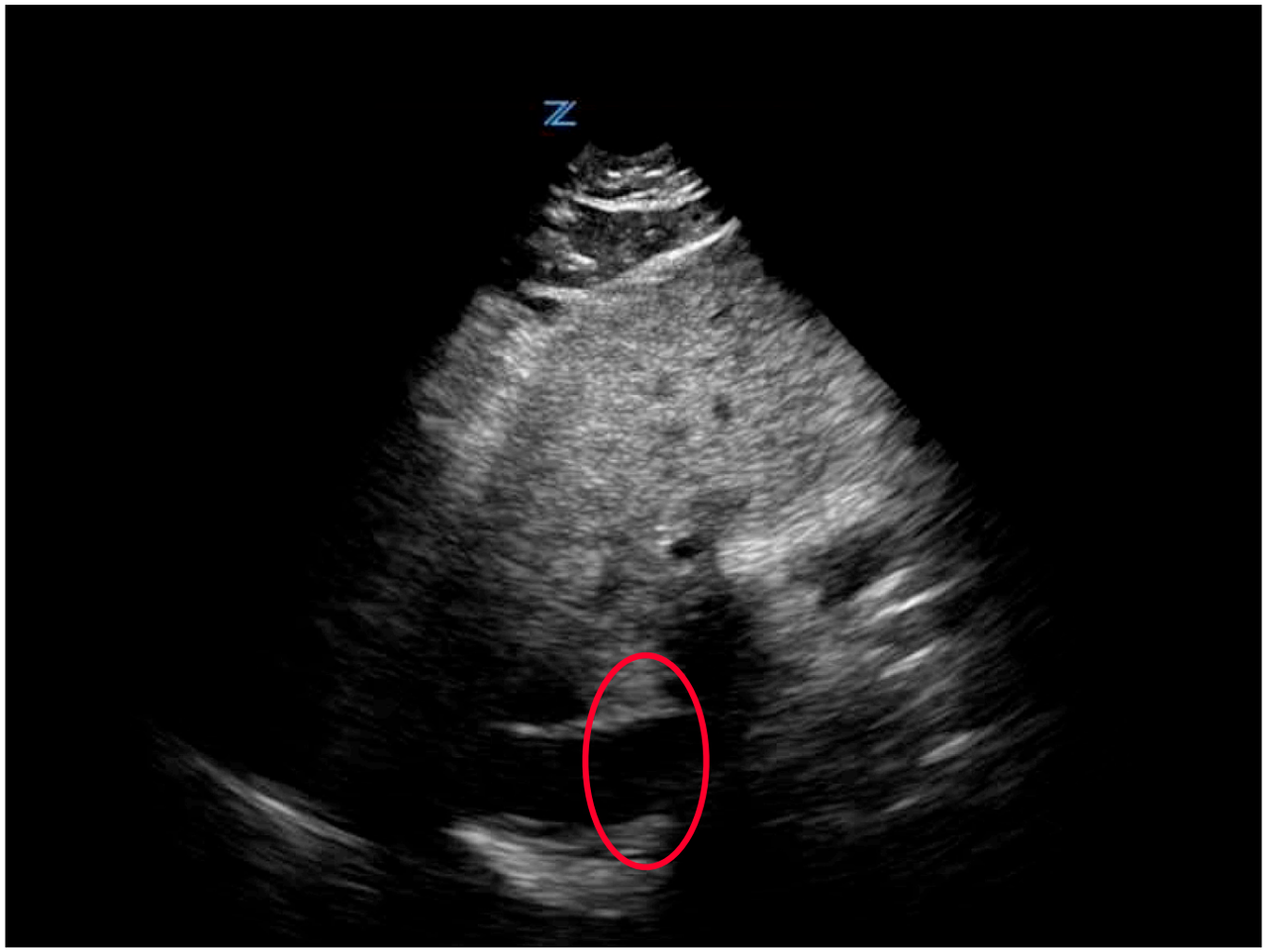

RV
LVOT
LV
LA
DTA

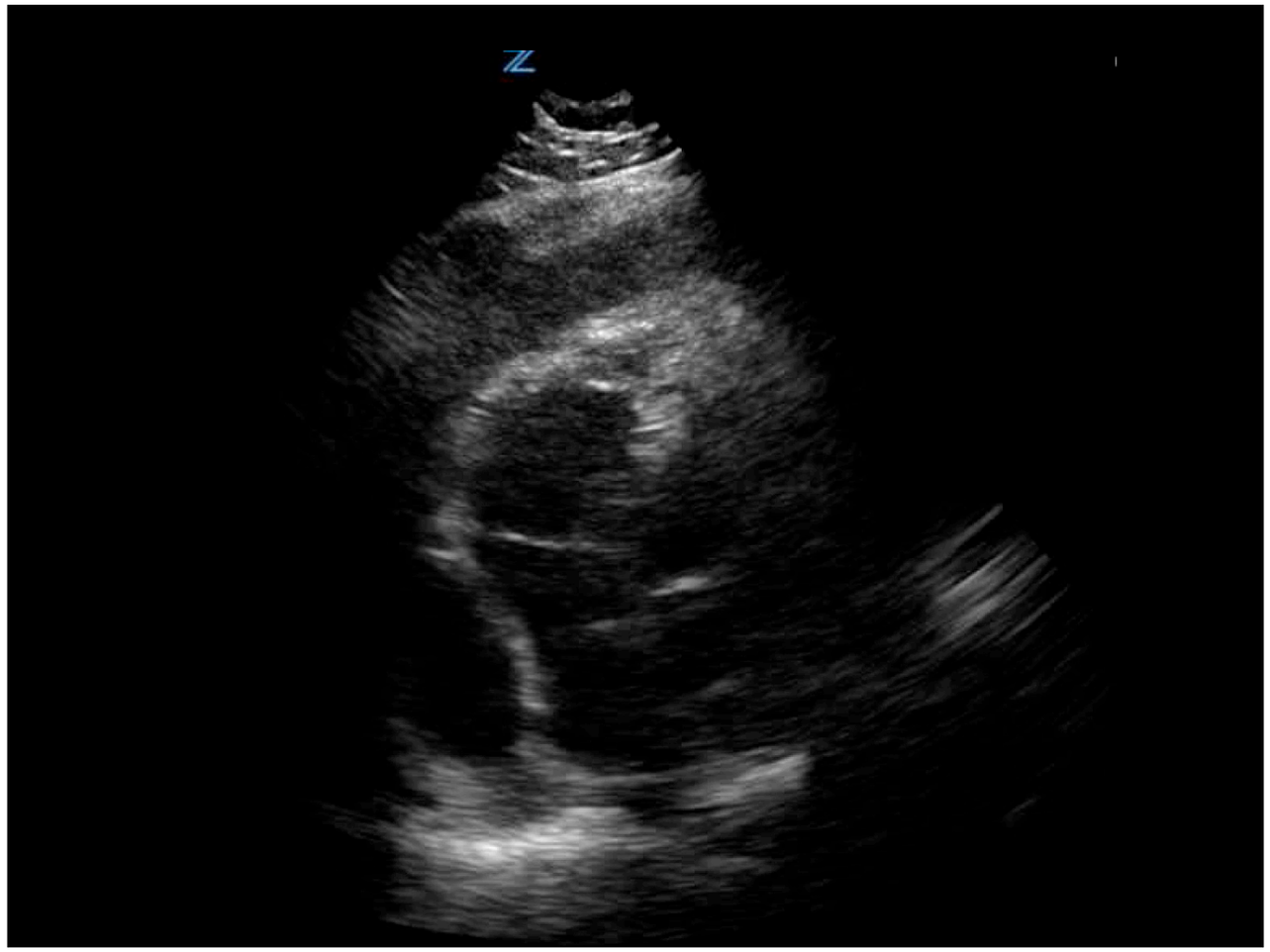

DTA


Trampoline
Sign
DTA

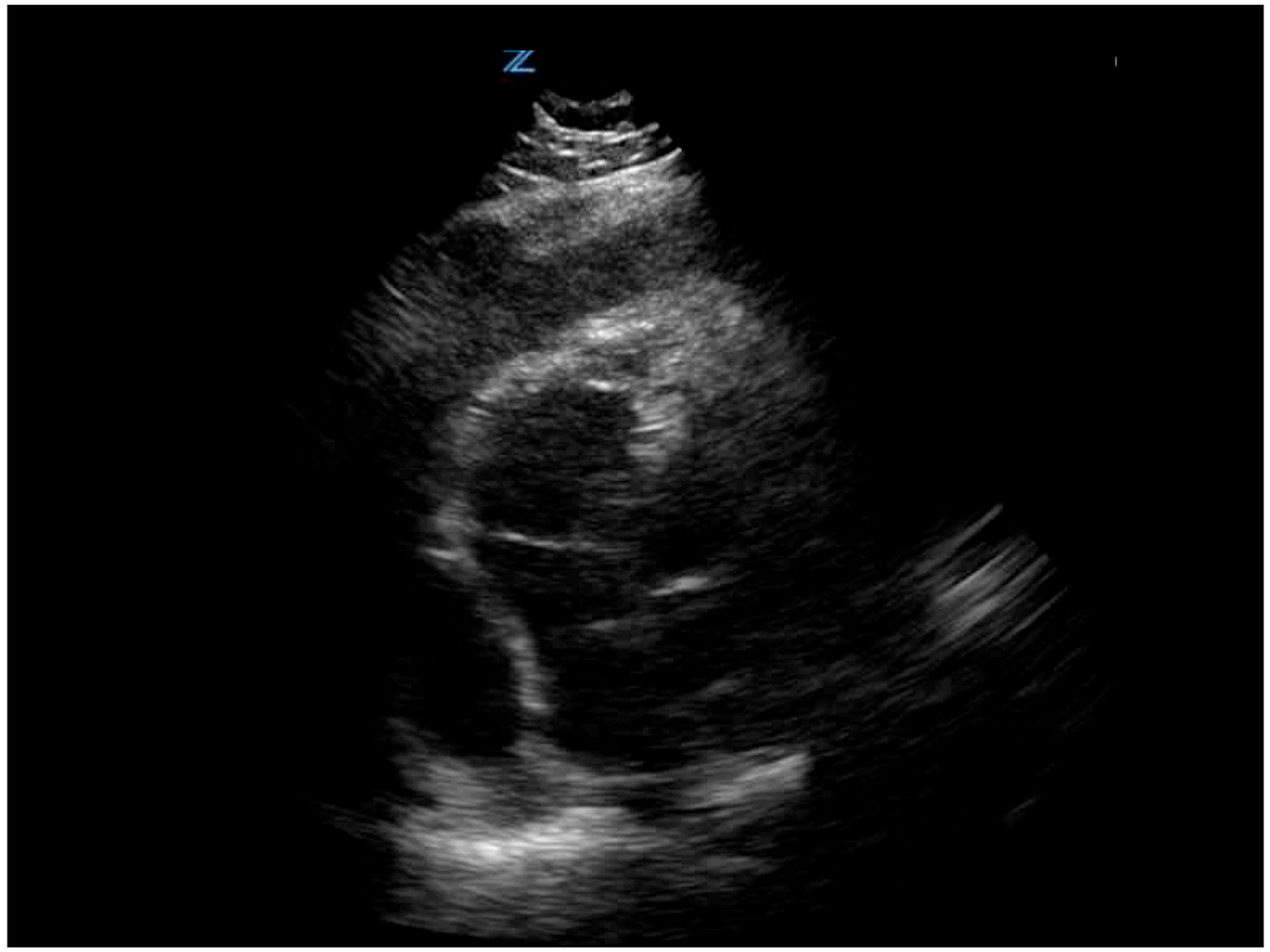

Trampoline
Sign
DTA

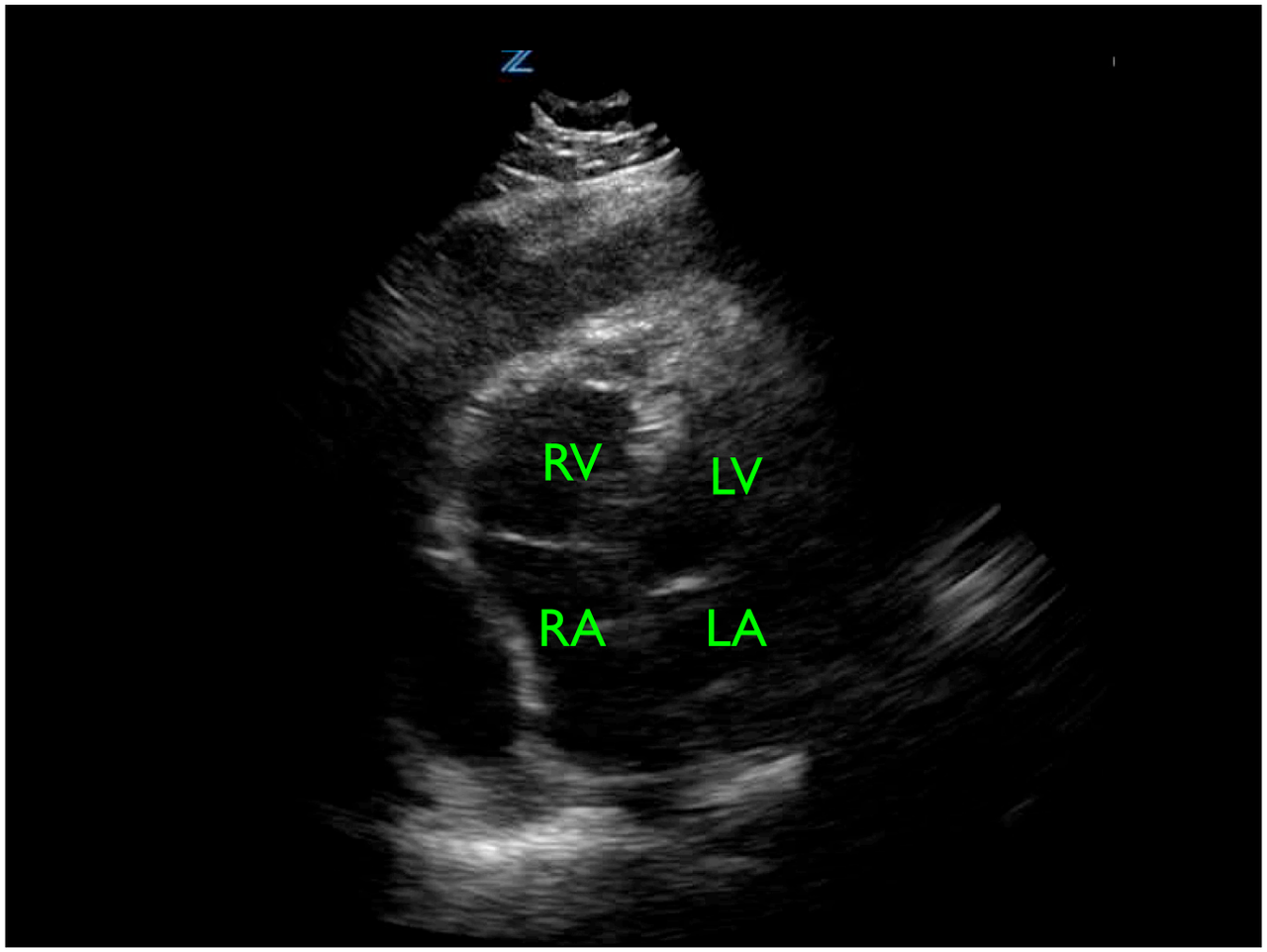


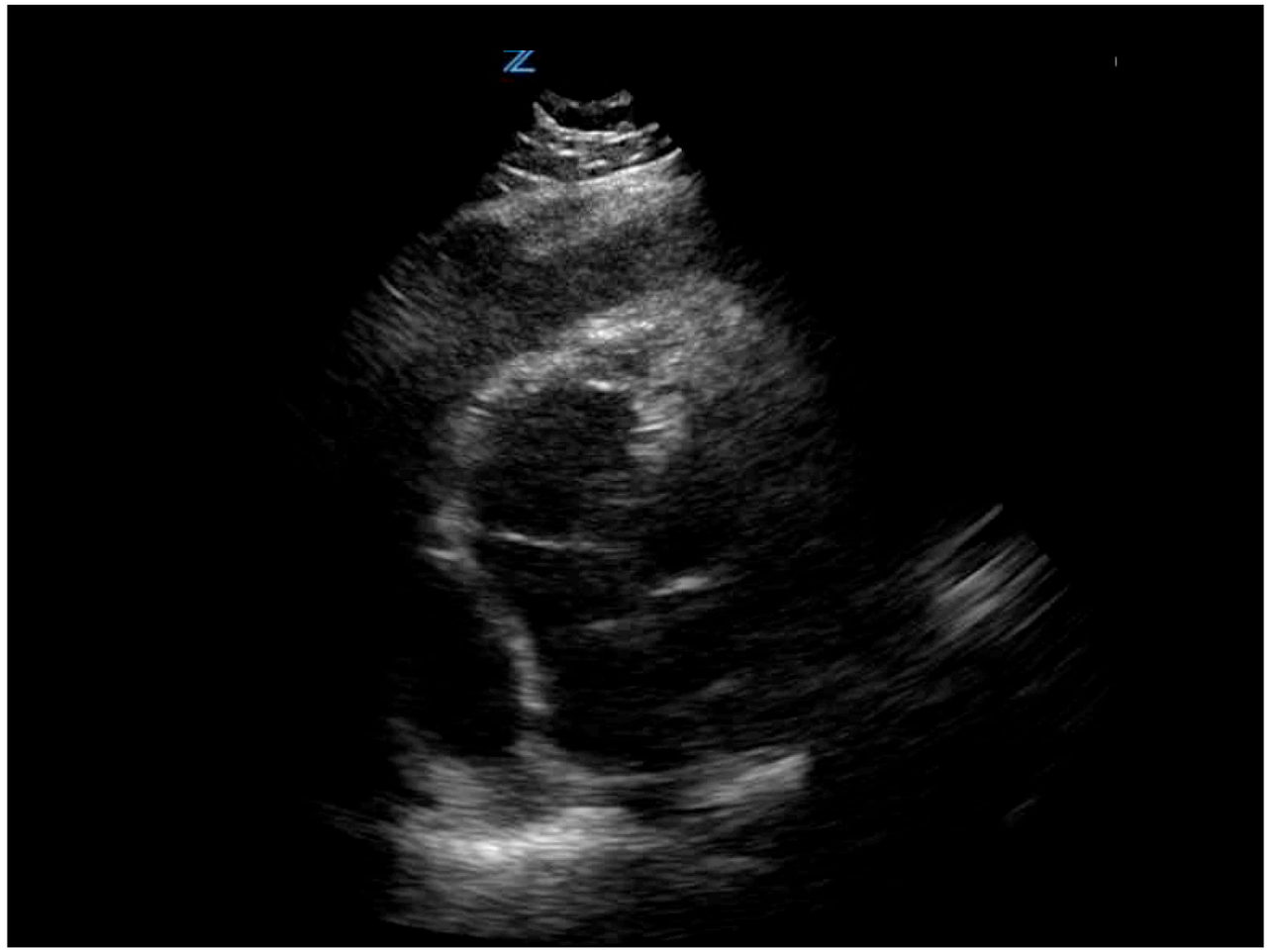


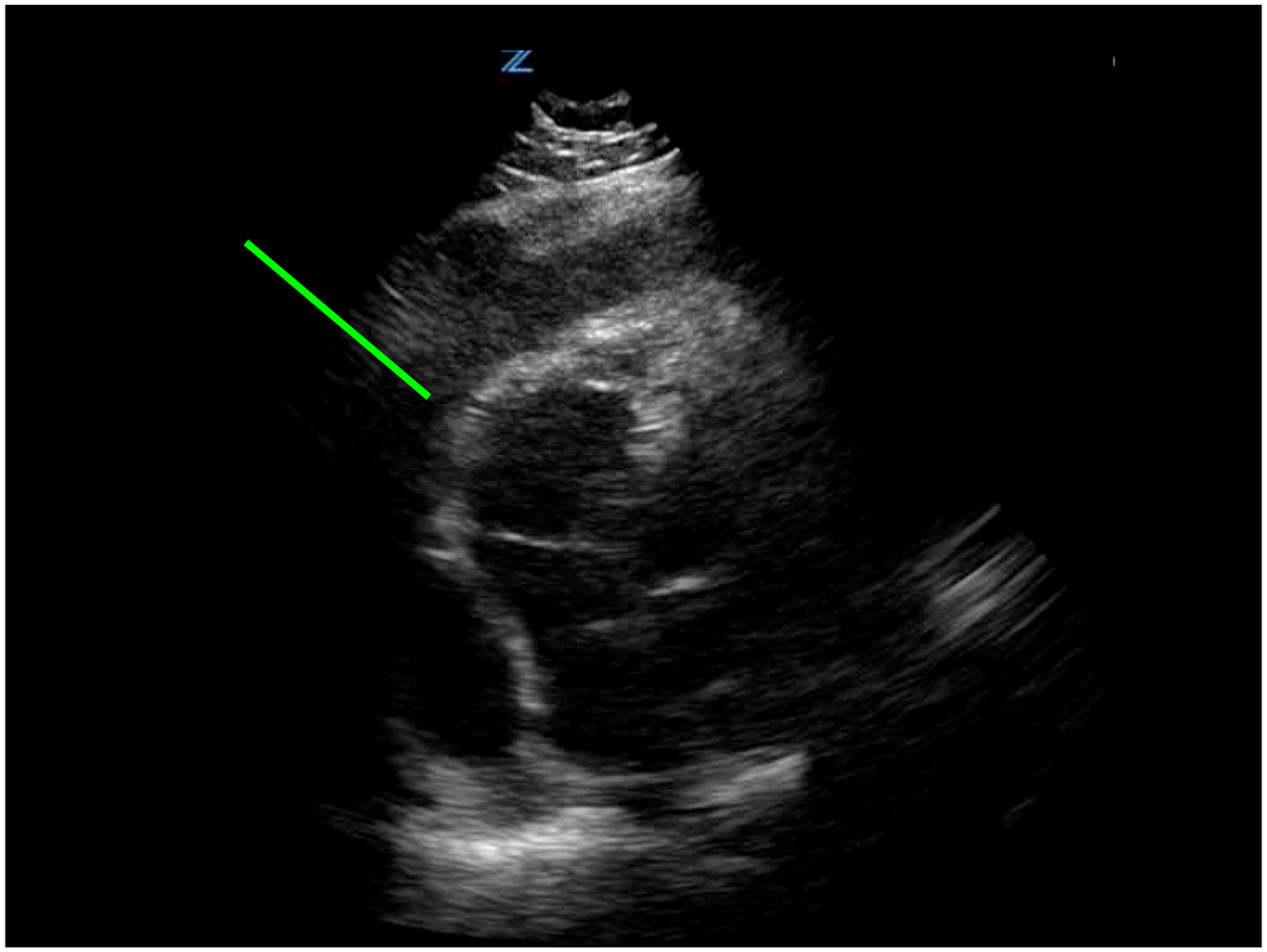


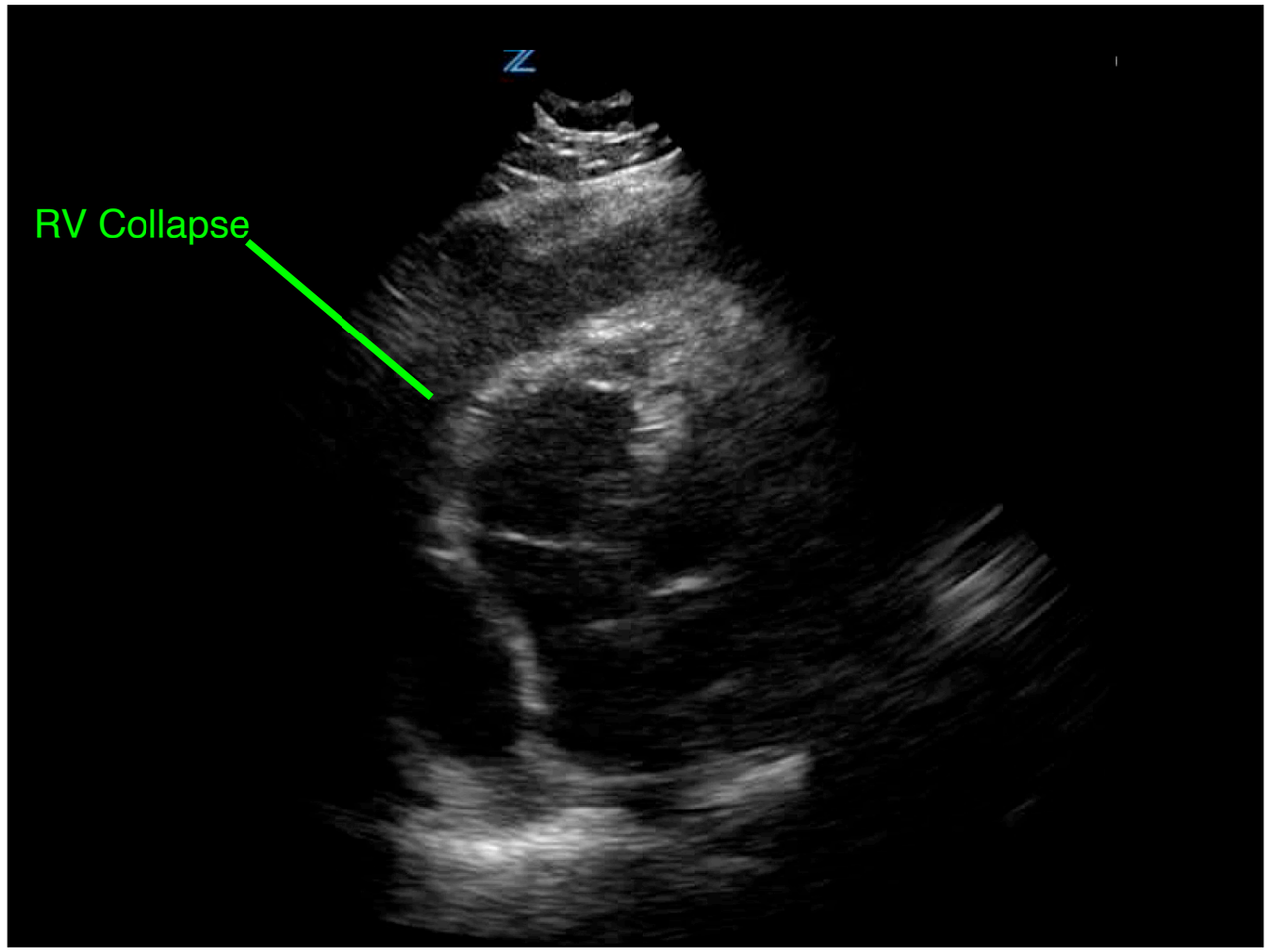
Pulsus Alternans
Concern for Tamponade—> rel HoTN; Cardiology to admit. Fellow rec Pulsus Paradoxus

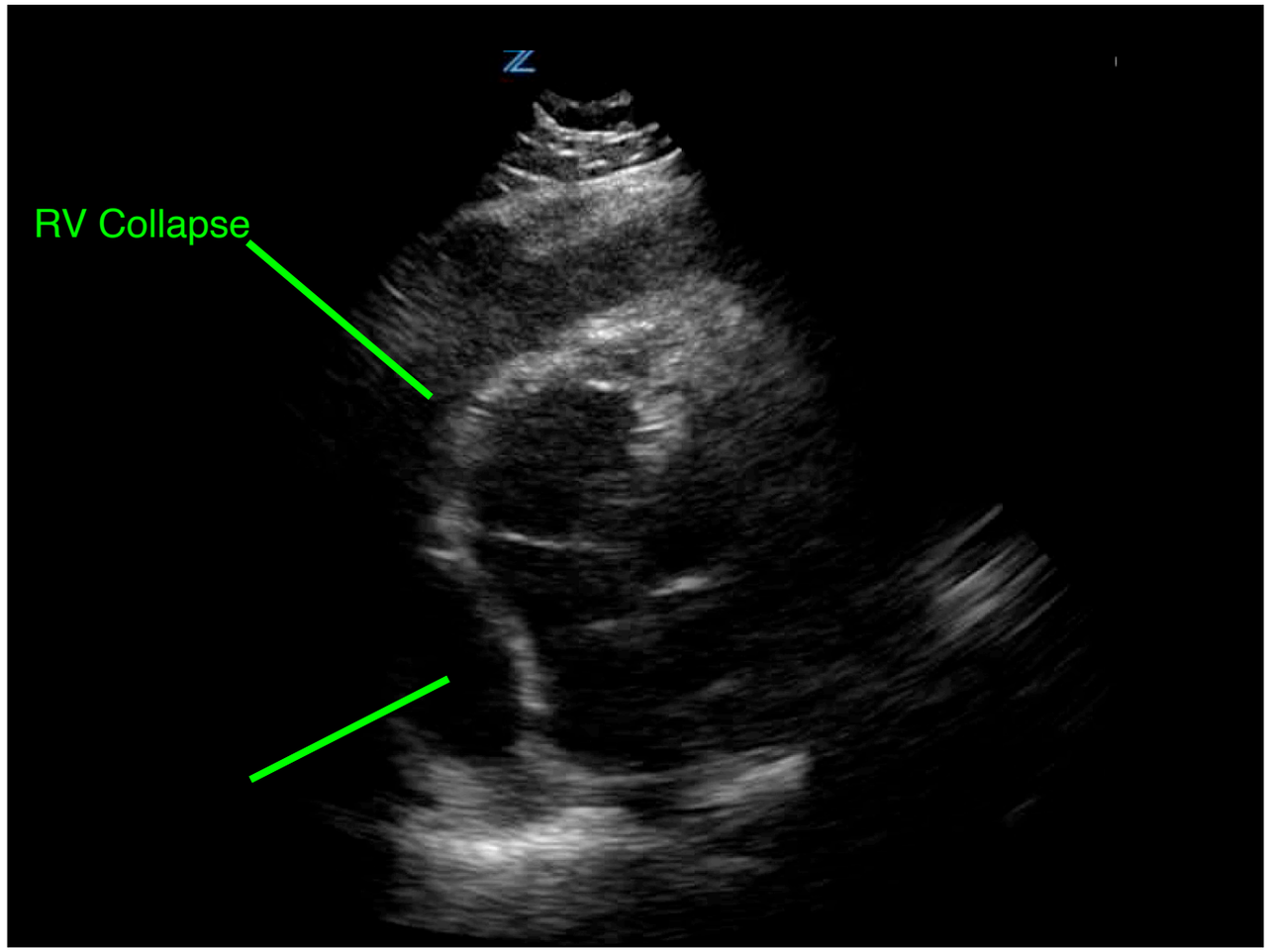


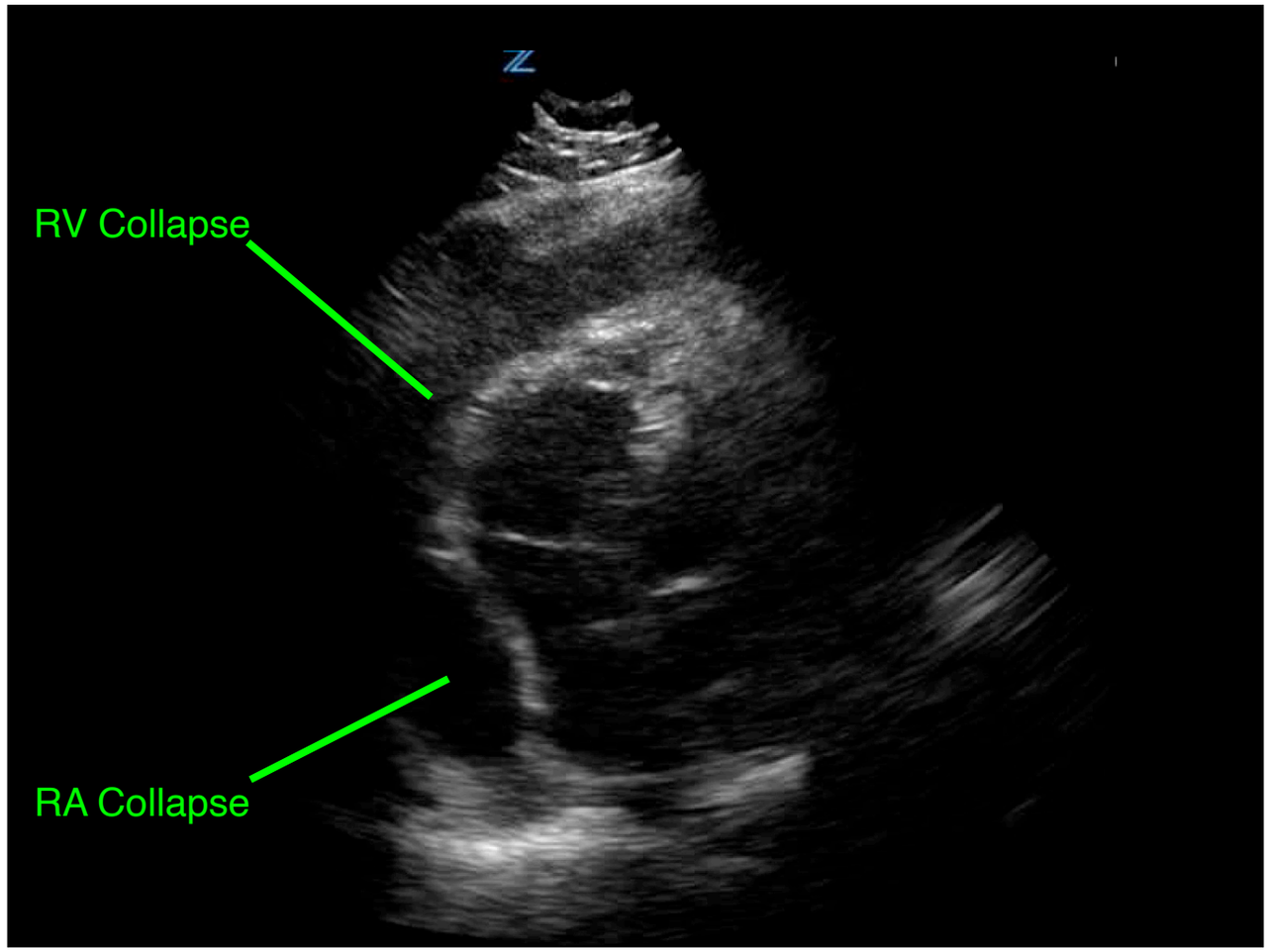

RV
LV
RA
LA

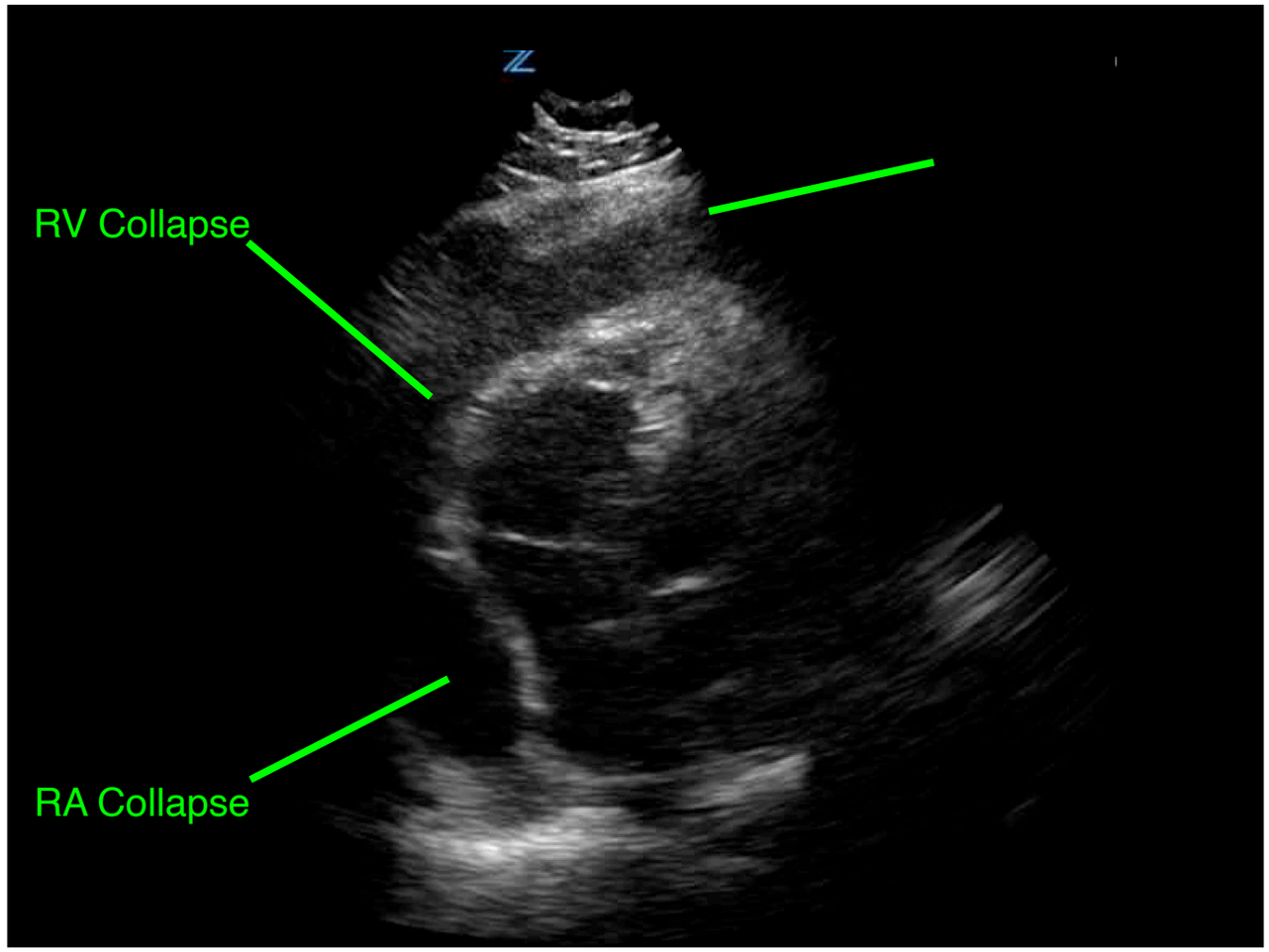


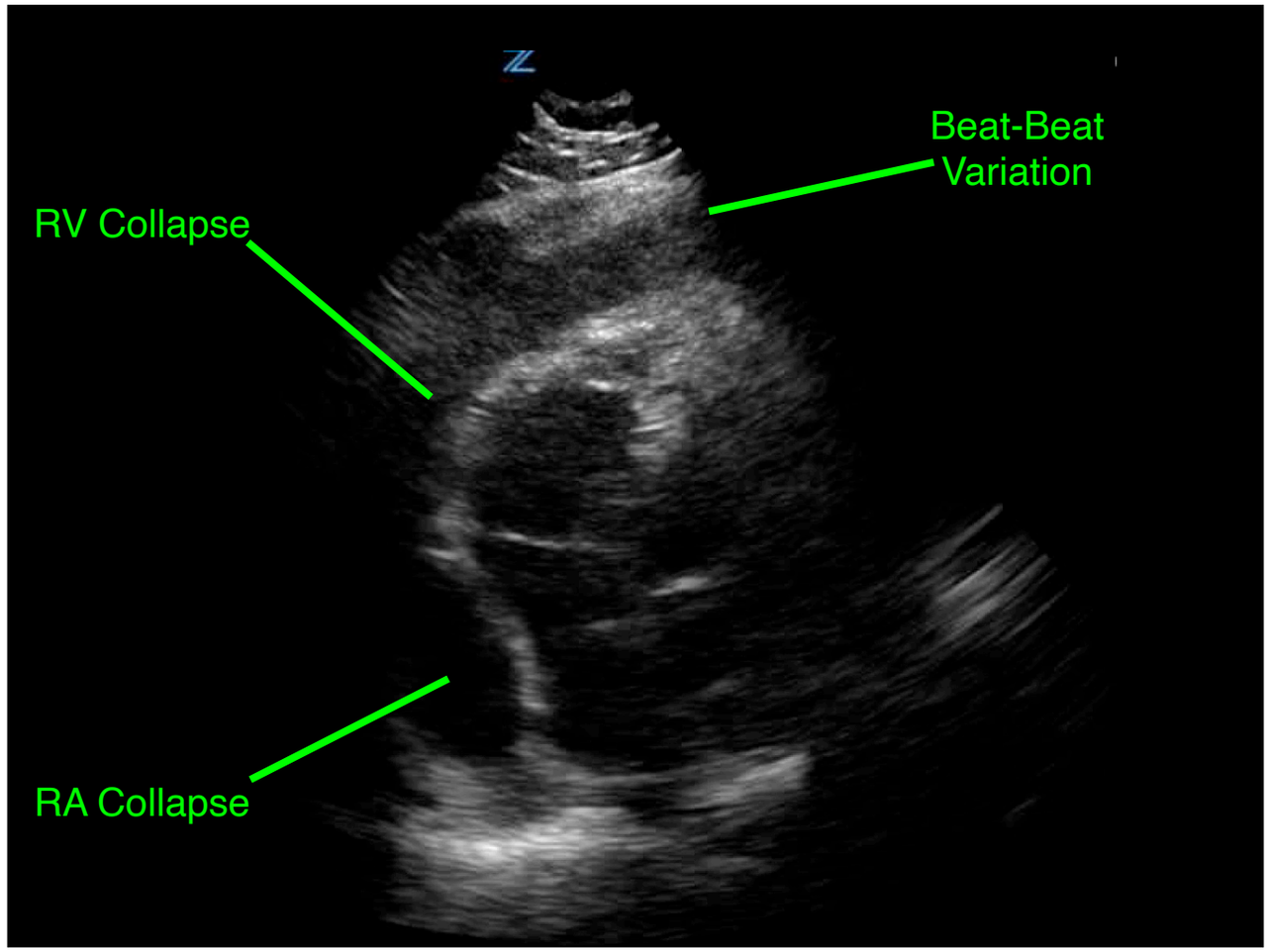



RV Collapse


RV Collapse


RV Collapse
RA Collapse

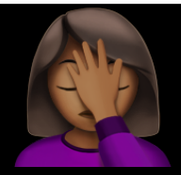

RV Collapse
RA Collapse


Beat-Beat
Variation
RV Collapse
RA Collapse

# Pulsus Paradoxus

Normal Inspiration: BP decreases <10%—> Neg Intrahoracic pressure—>

-Inspiration—>Neg intrathoracic pressure—> ↑ VR to RV/RA=> ↓ flow to LV/LA (interventricular dependence)
- Tamponade exaggerates this difference due to IV dependence;

# Pulsus Paradoxus 

# Pulsus Paradoxus

# Pulsus Paradoxus

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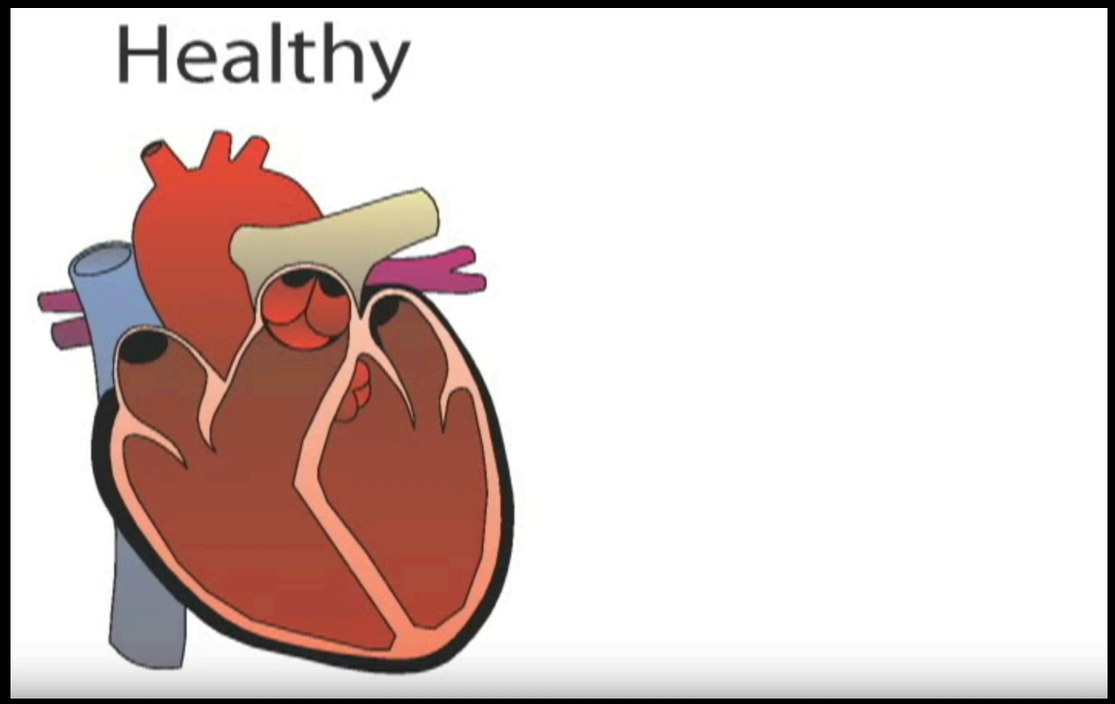
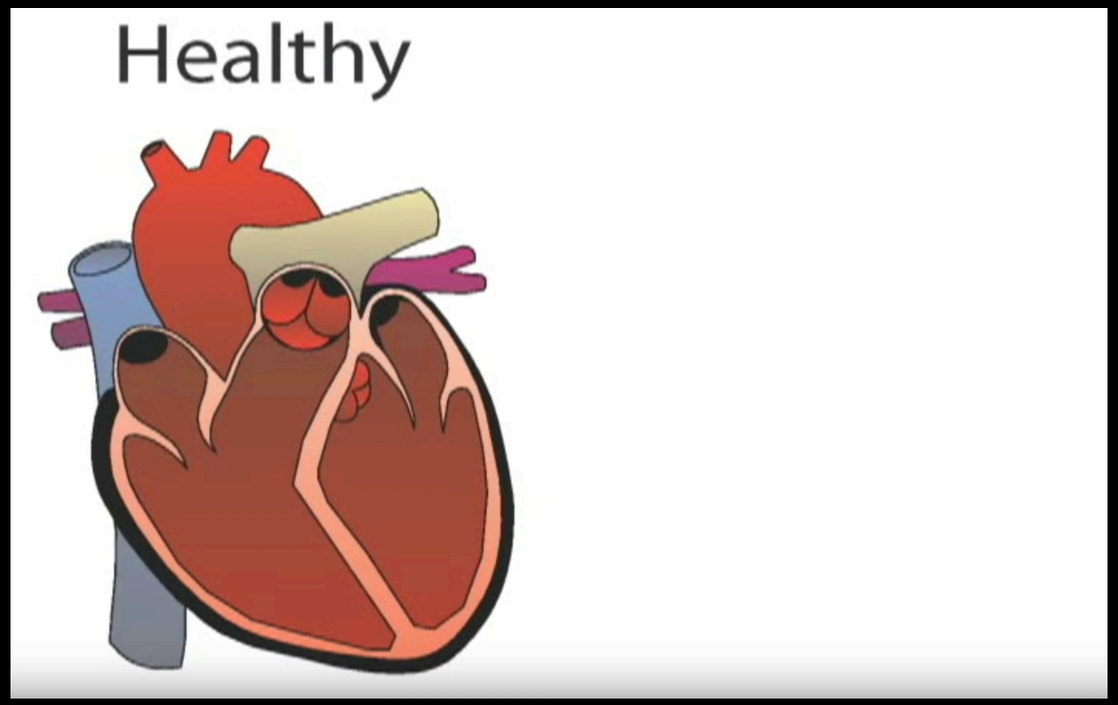
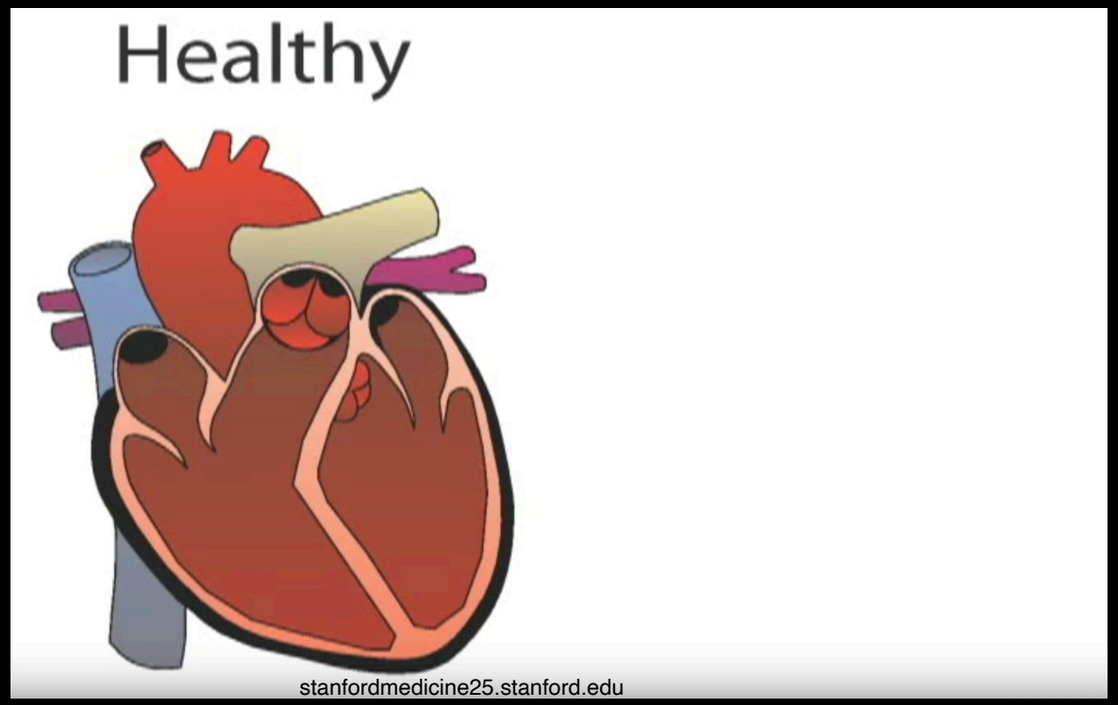


# Pulsus Paradoxus




***>10% decrease in BP with inspiration***

# Pulsus Paradoxus

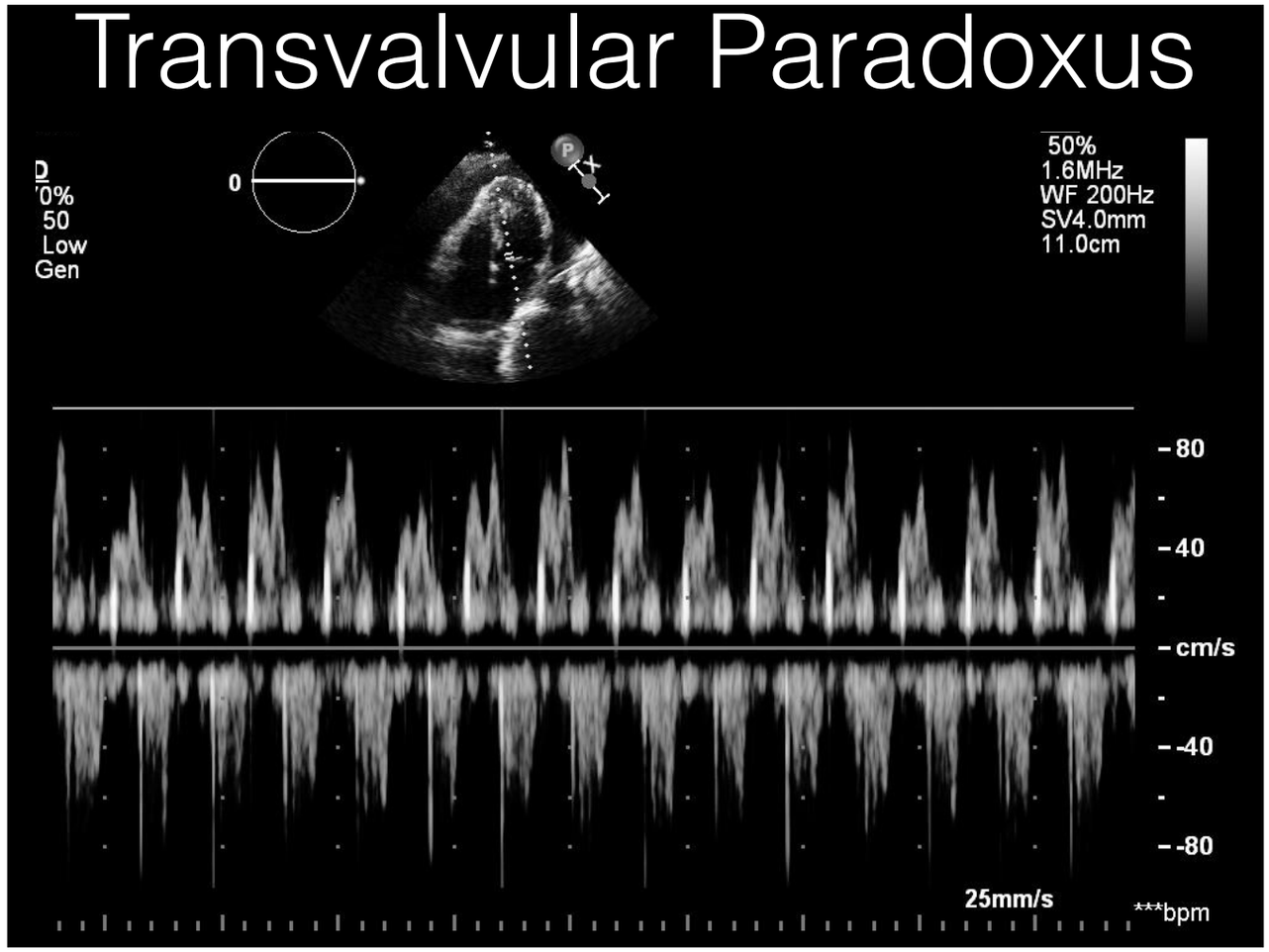



***>10% decrease in BP with inspiration***

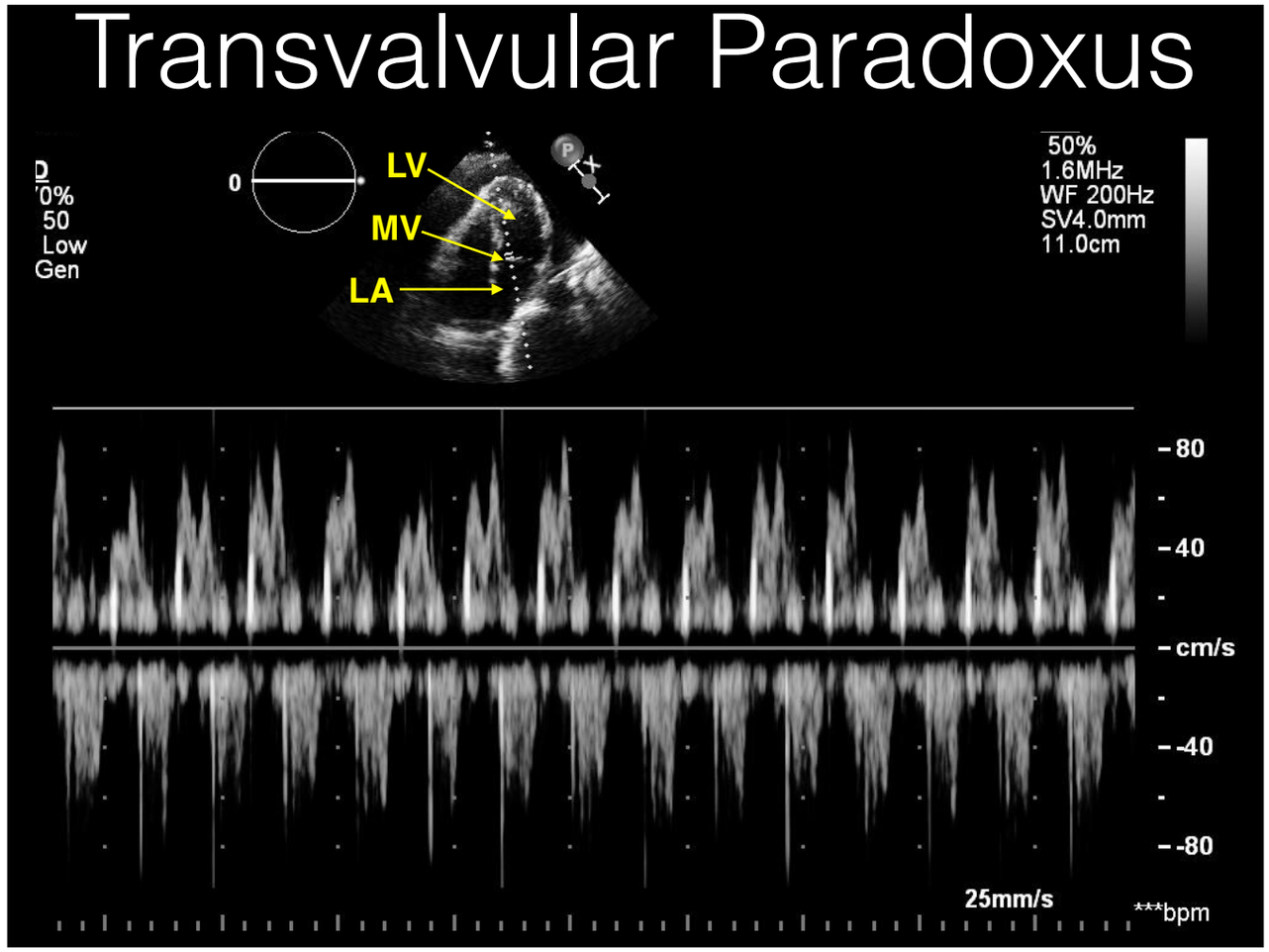
# Transvalvular Paradoxus

MV inflow velocities—> Respiratory variation
-normally <10% ↓ in the inflow across bel across MV
-Inspiration—>Neg intrathoracic pressure—> ↑ VR to RV/RA=> ↓ flow to LV/LA (interventricular dependence)

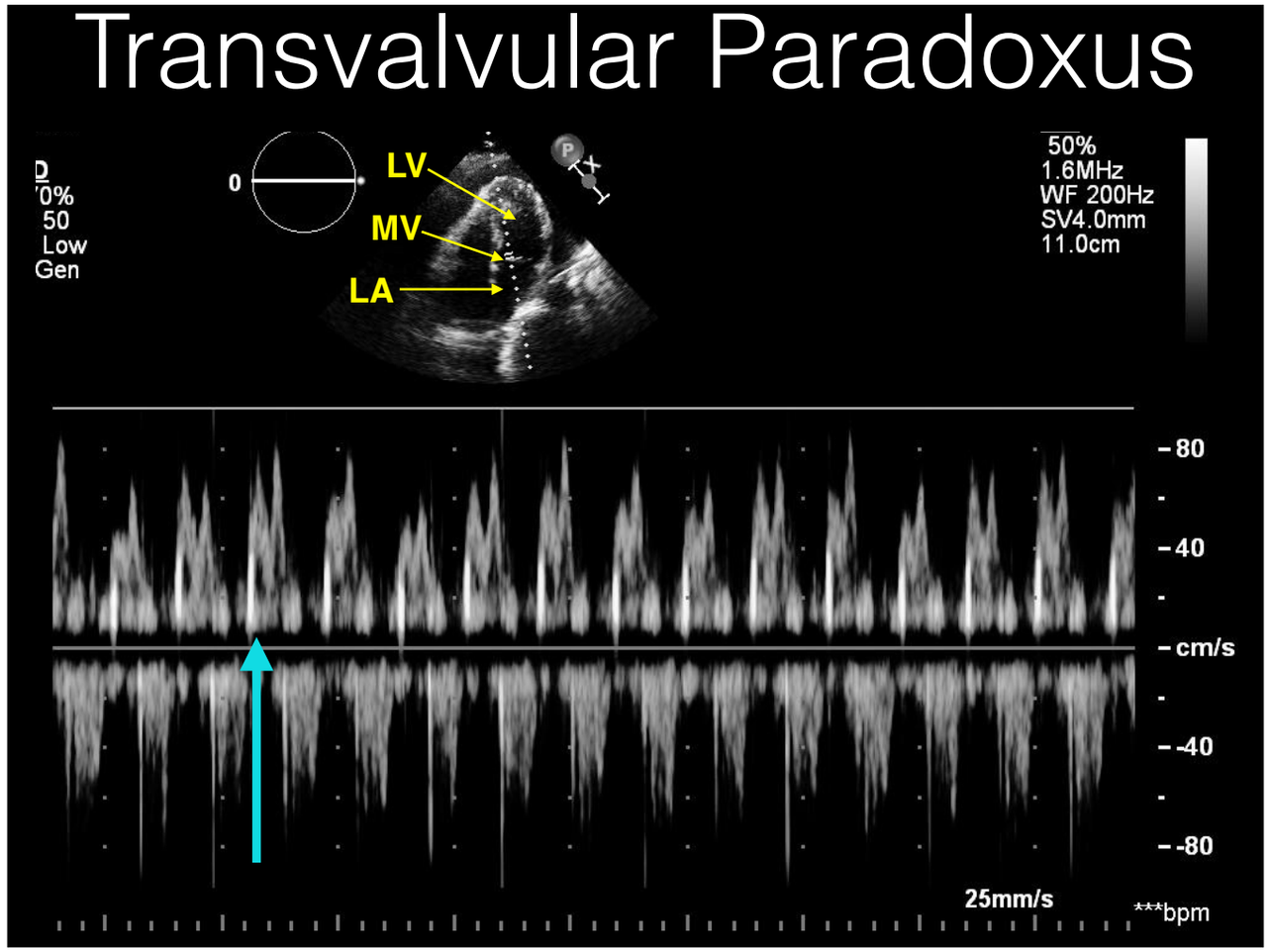
# Transvalvular Paradoxus



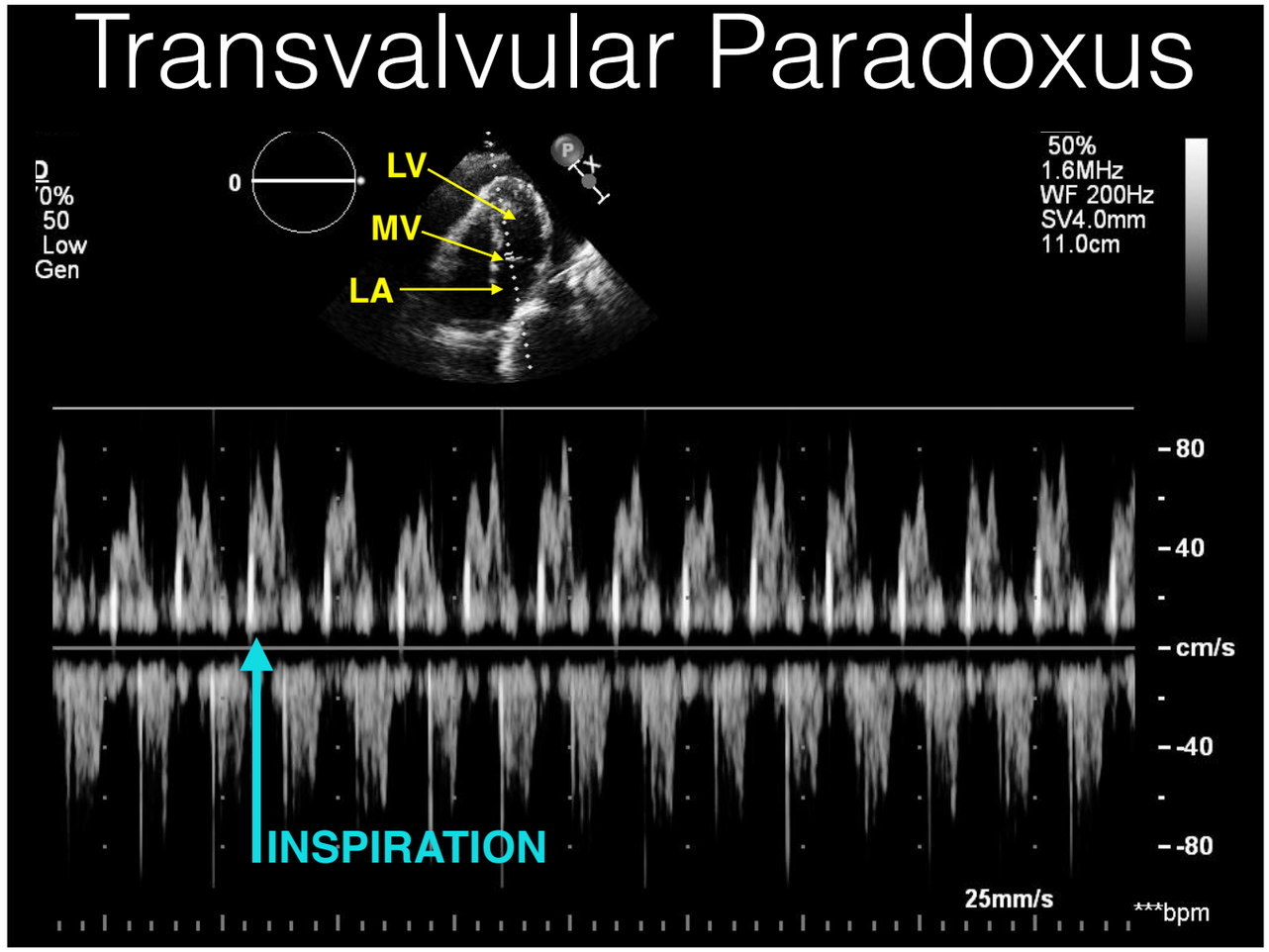
# Transvalvular Paradoxus



# Transvalvular Paradoxus



# Transvalvular Paradoxus



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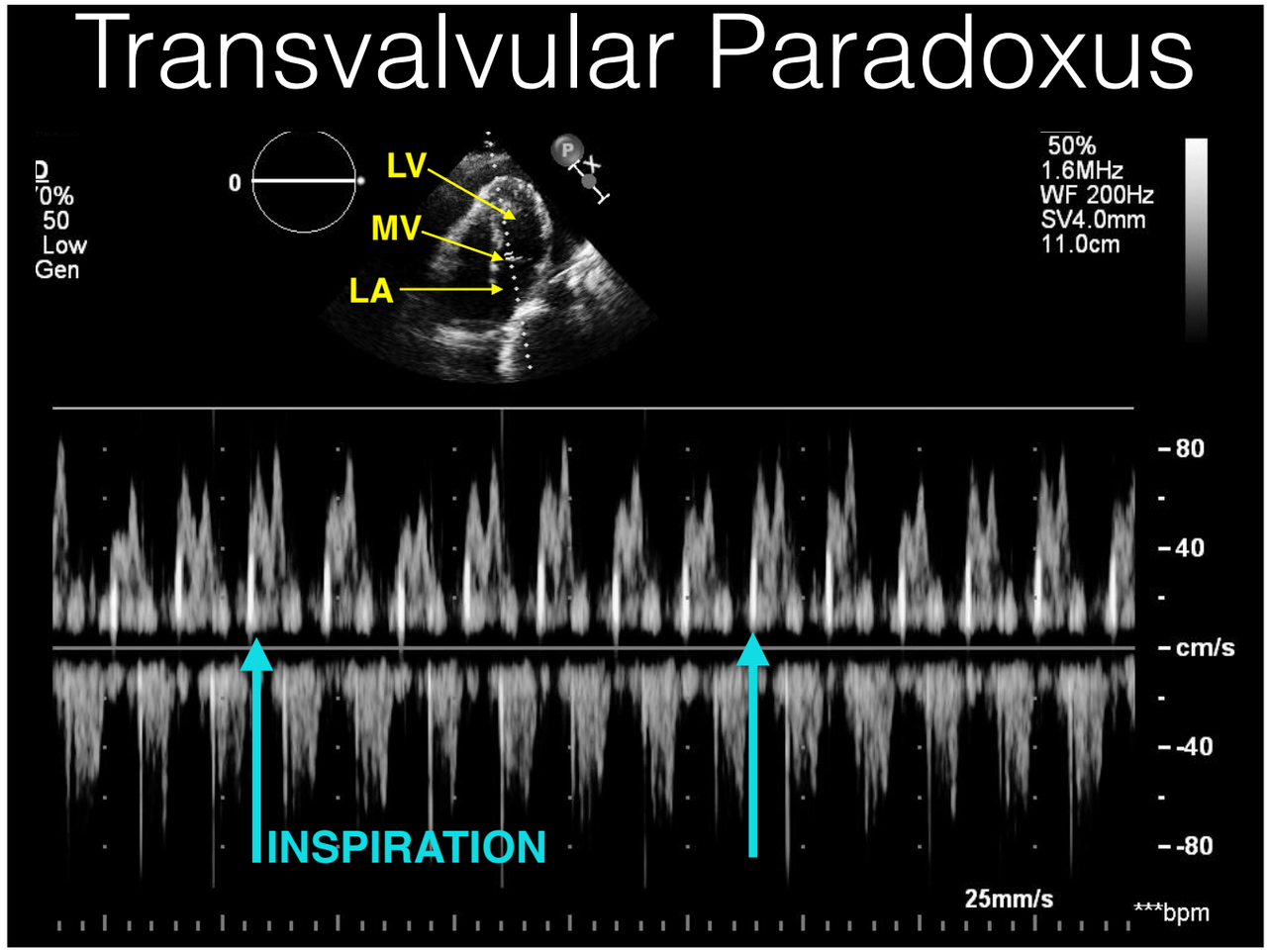
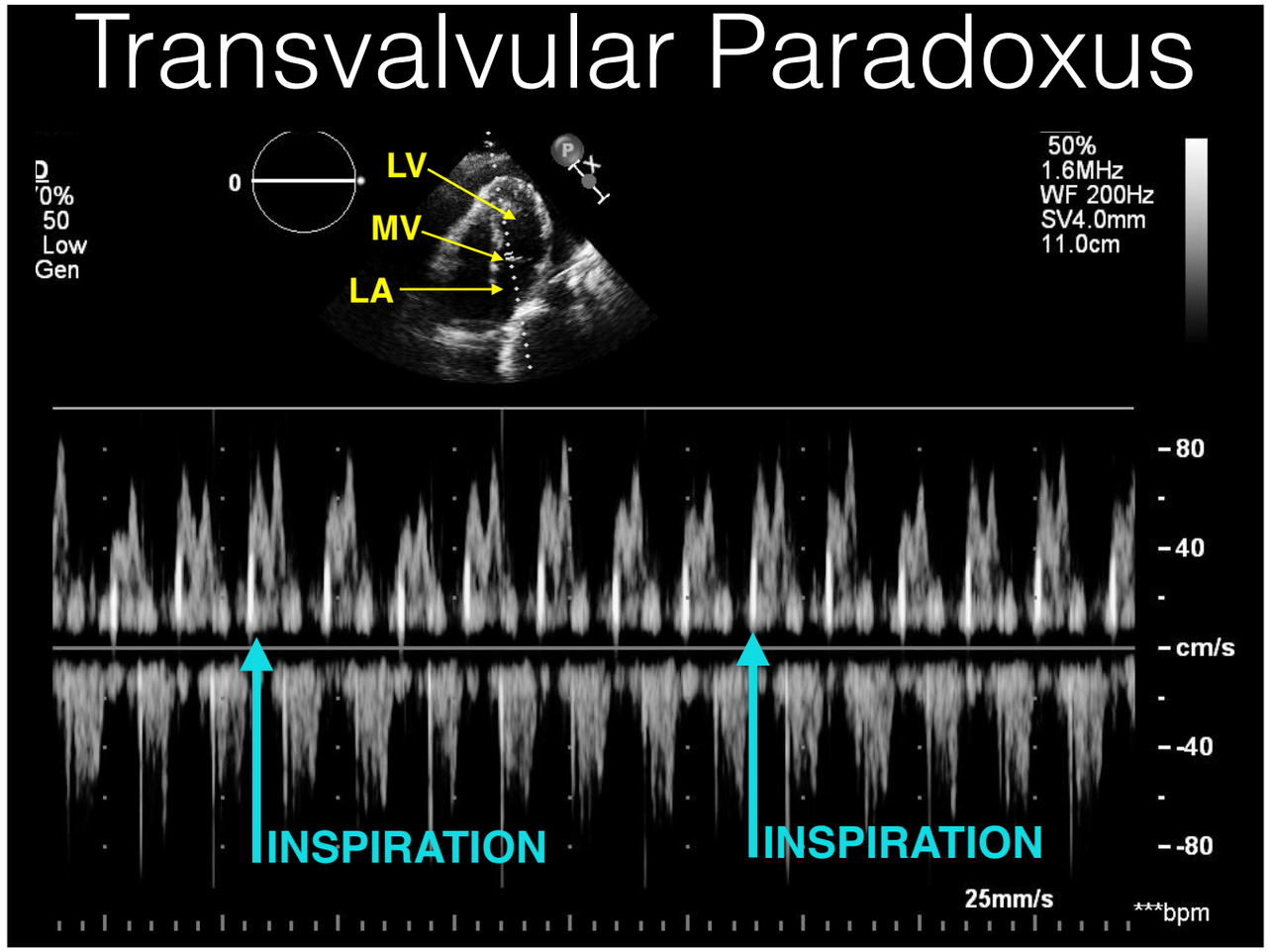


# Transvalvular Paradoxus



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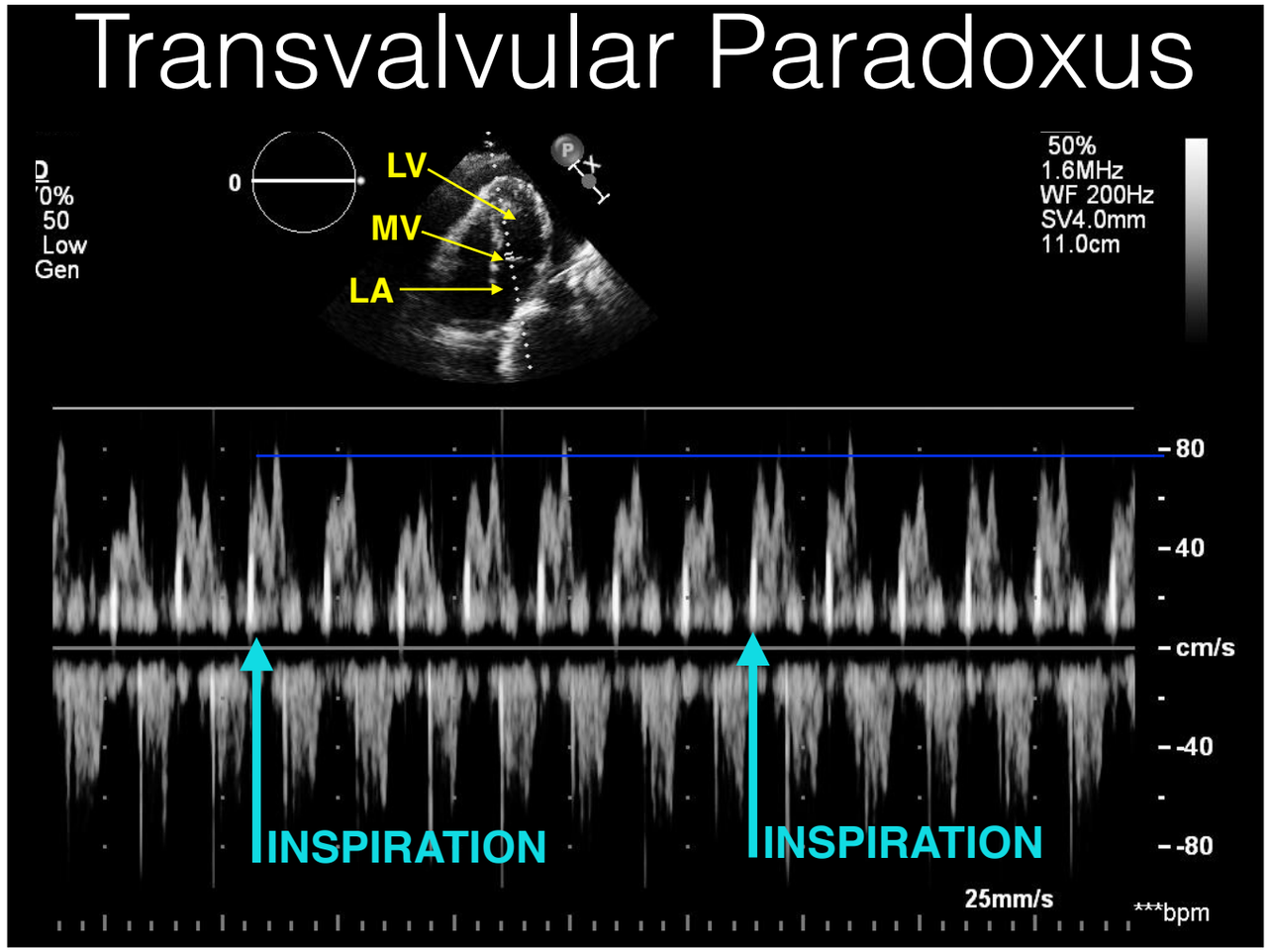
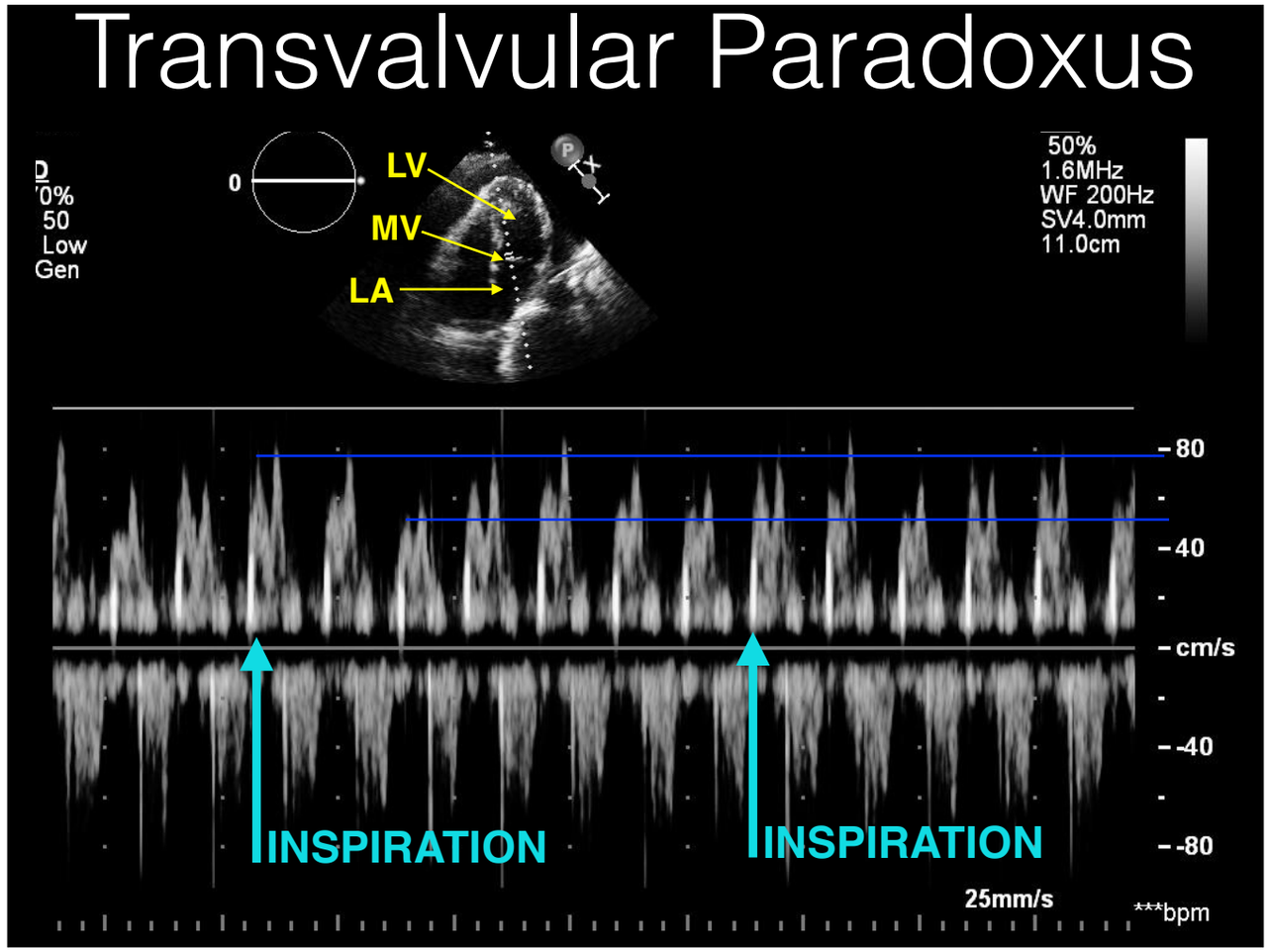
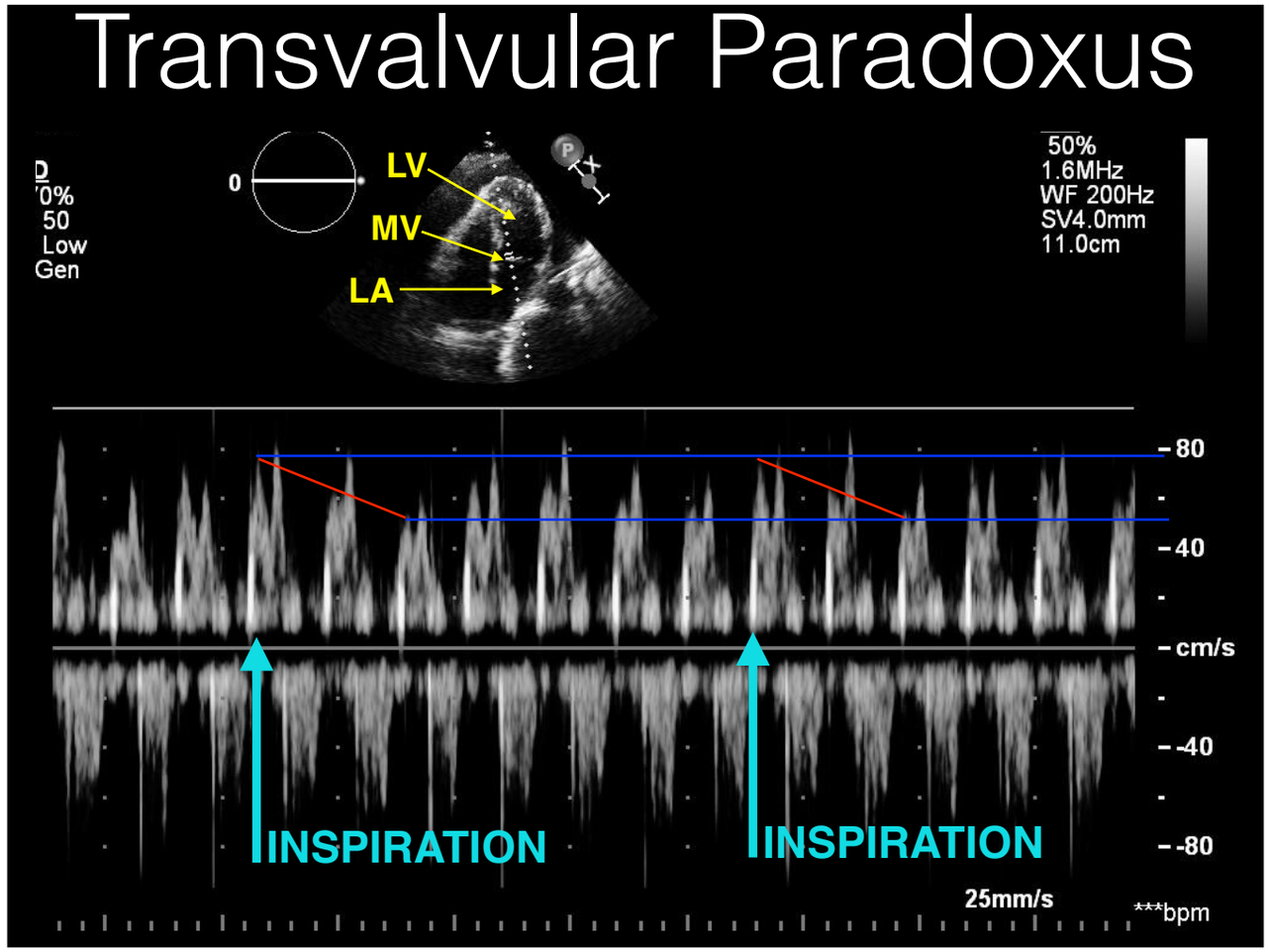


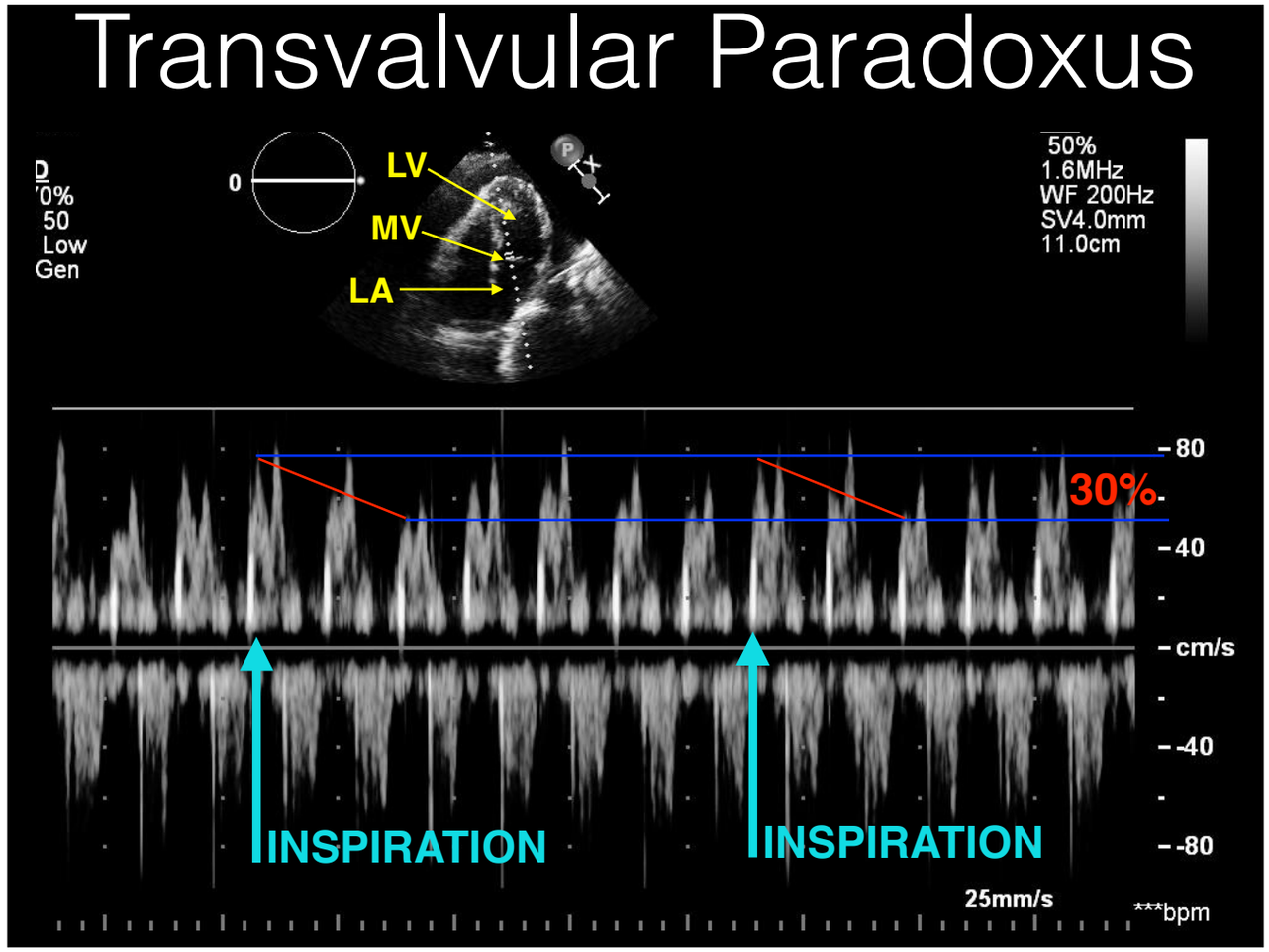
# Transvalvular Paradoxus



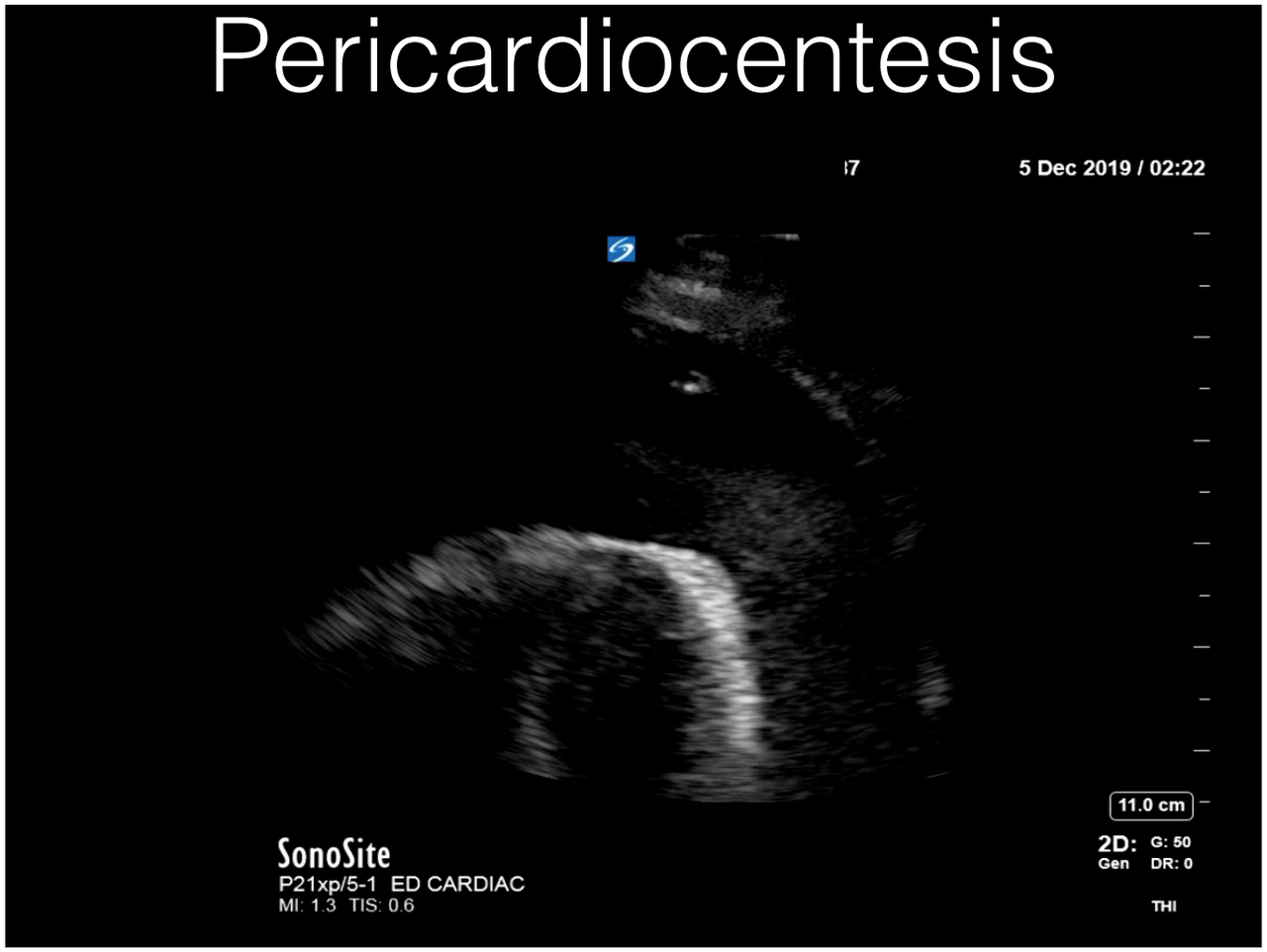
# Transvalvular Paradoxus



# Transvalvular Paradoxus

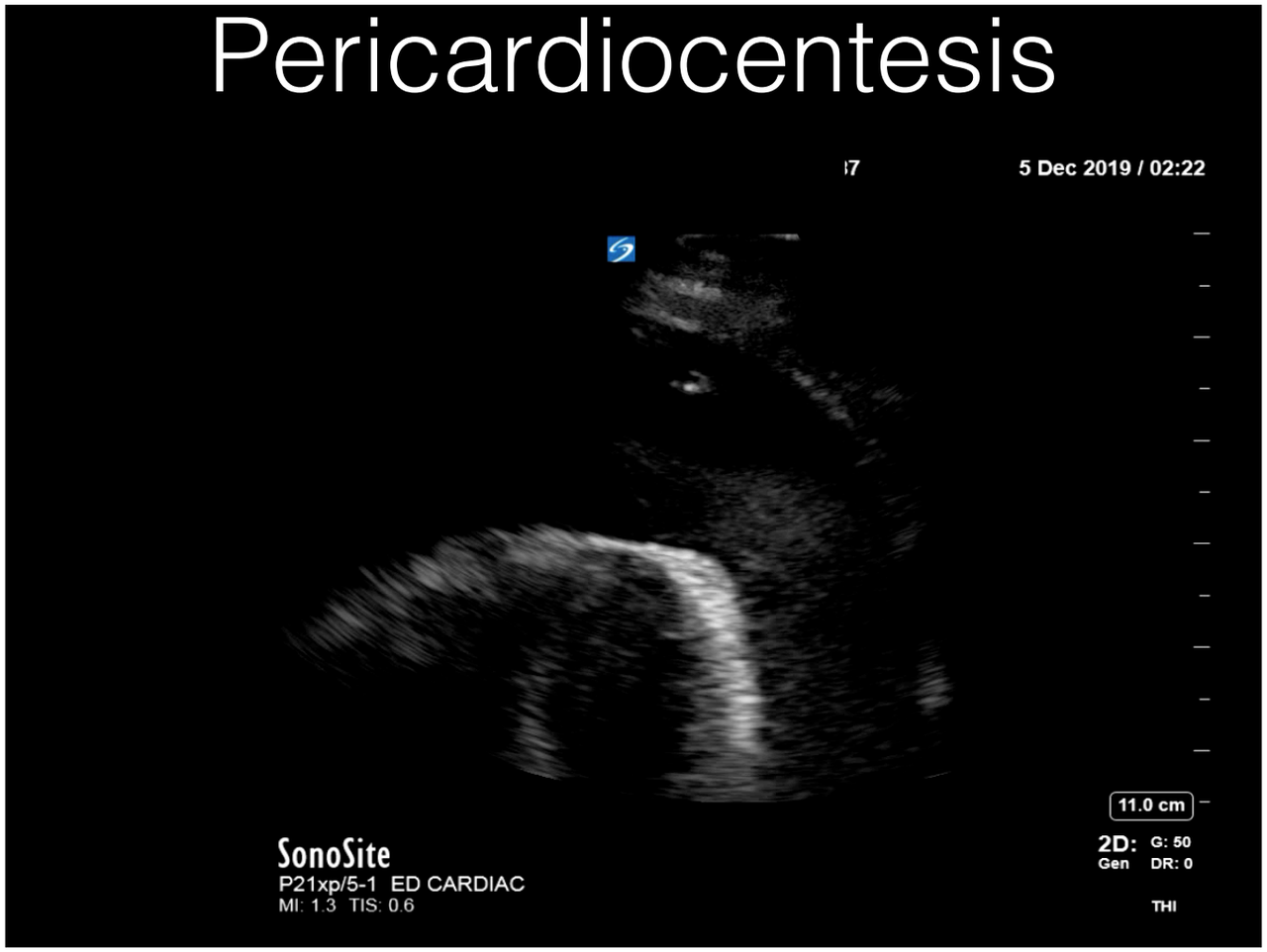


# Pericardiocentesis




Pericardial pressures 30mmHg
610 ml of fluid was drained—->fluid analysis c/w viral pericarditis
No re-accumulation
D/C'd home on HD#4 with anti-inflamm tx (colchicine and NSAIDs)

# Pericardiocentesis



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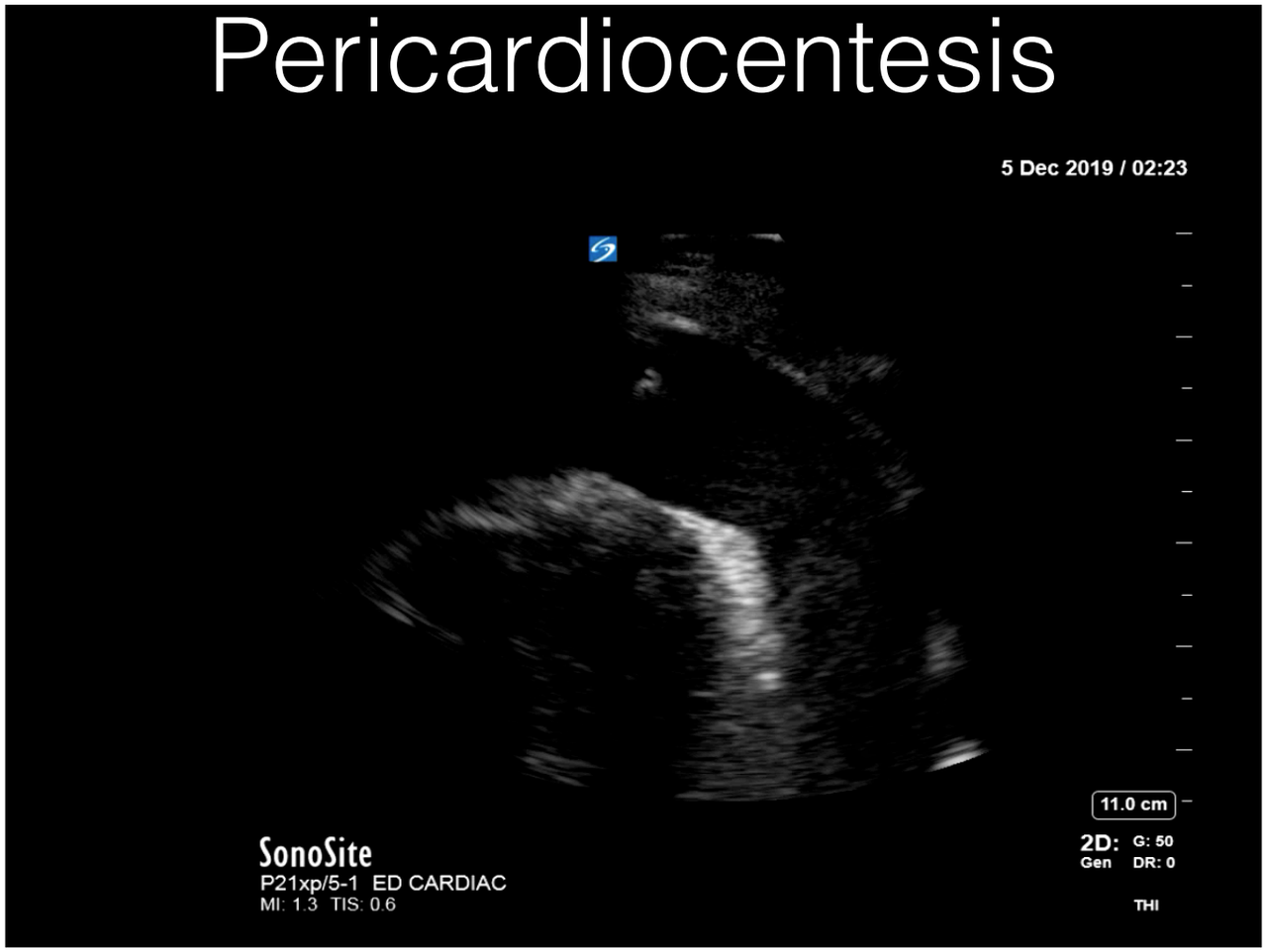

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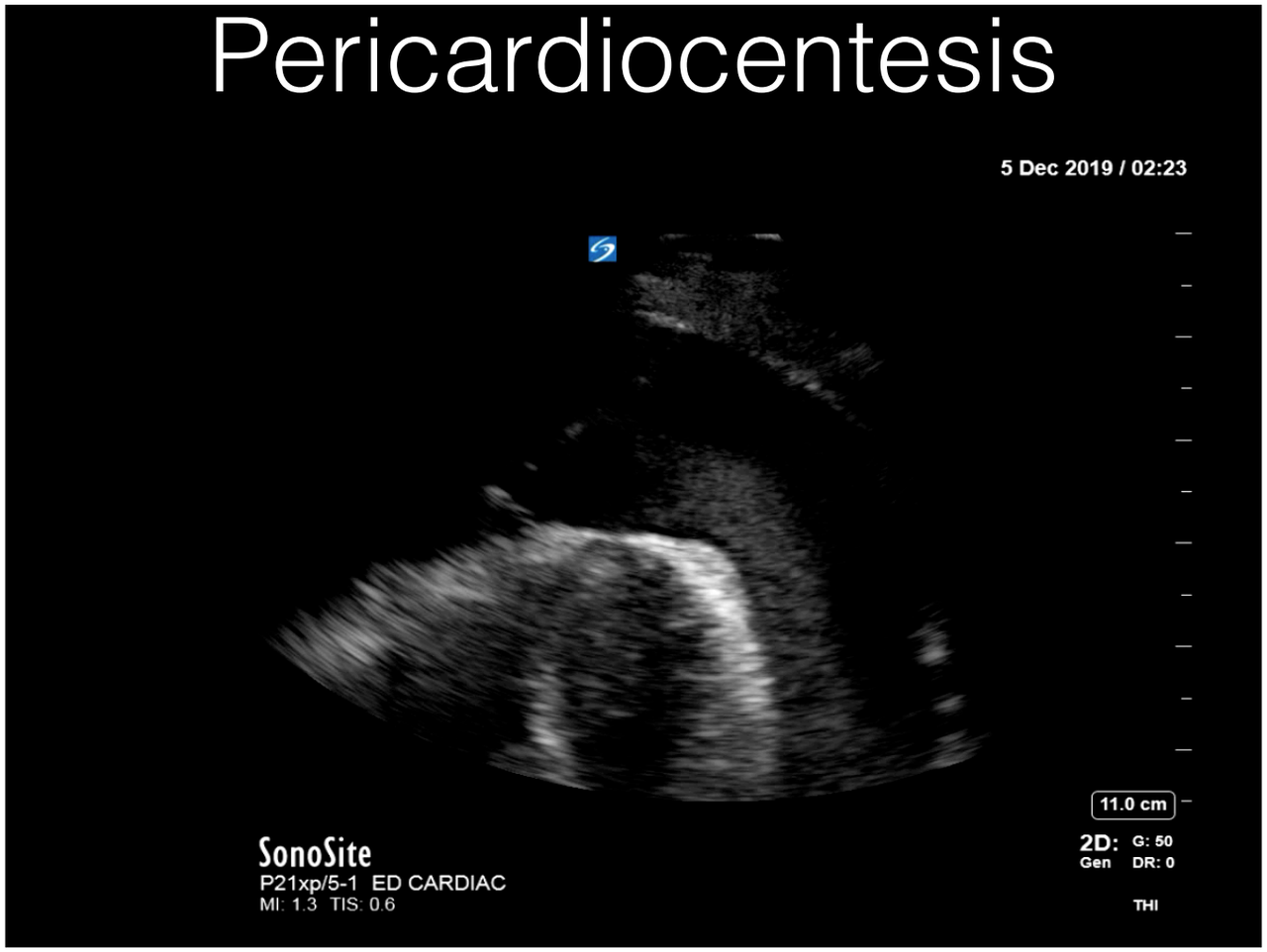
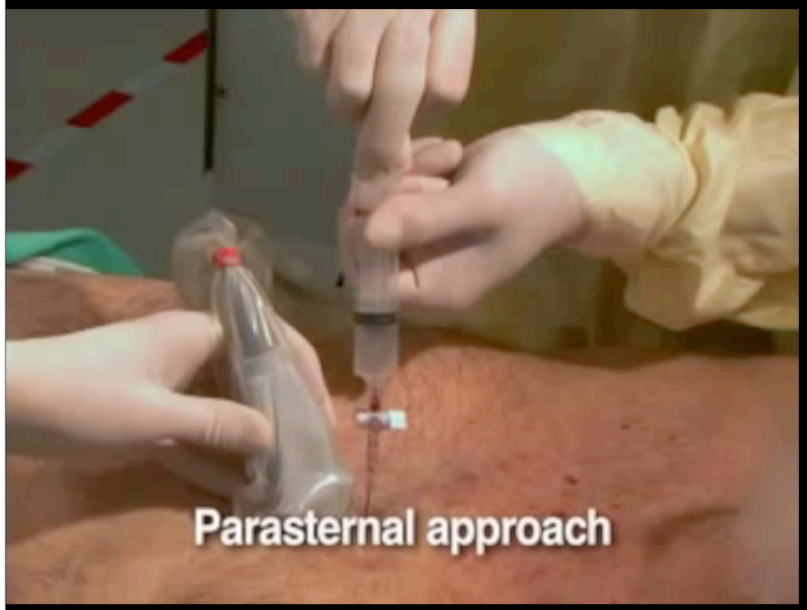
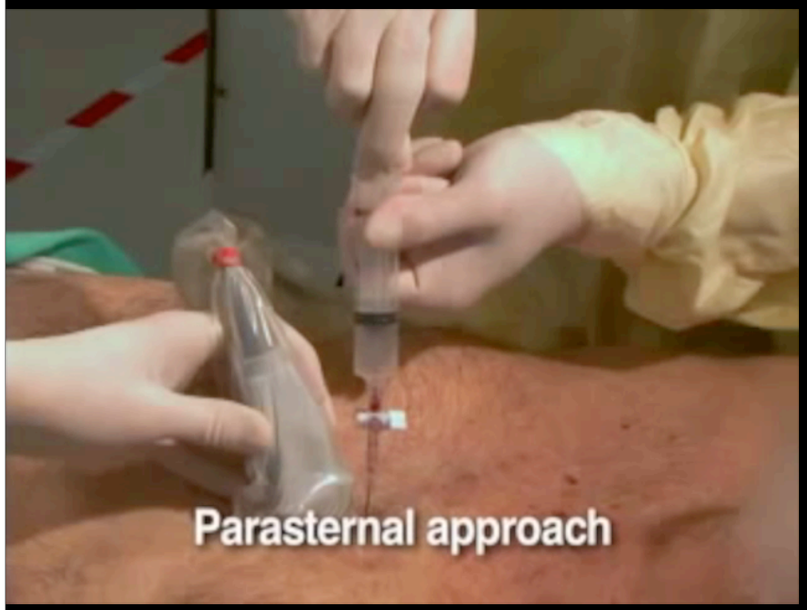


# Parasternal Approach

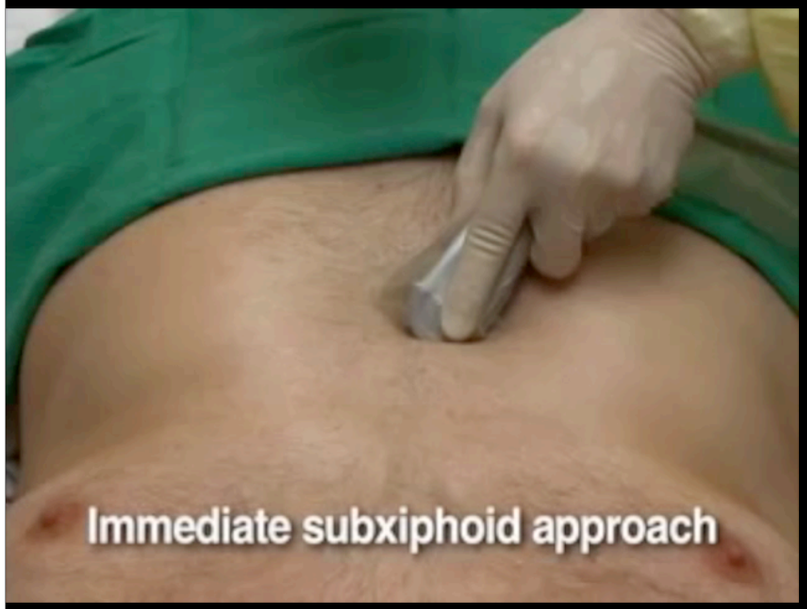


# Parasternal Approach

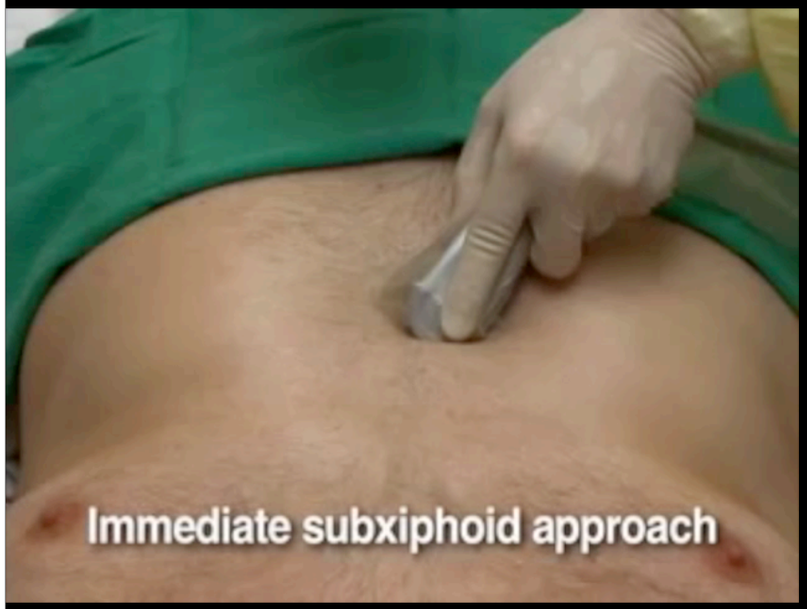


# Parasternal Approach

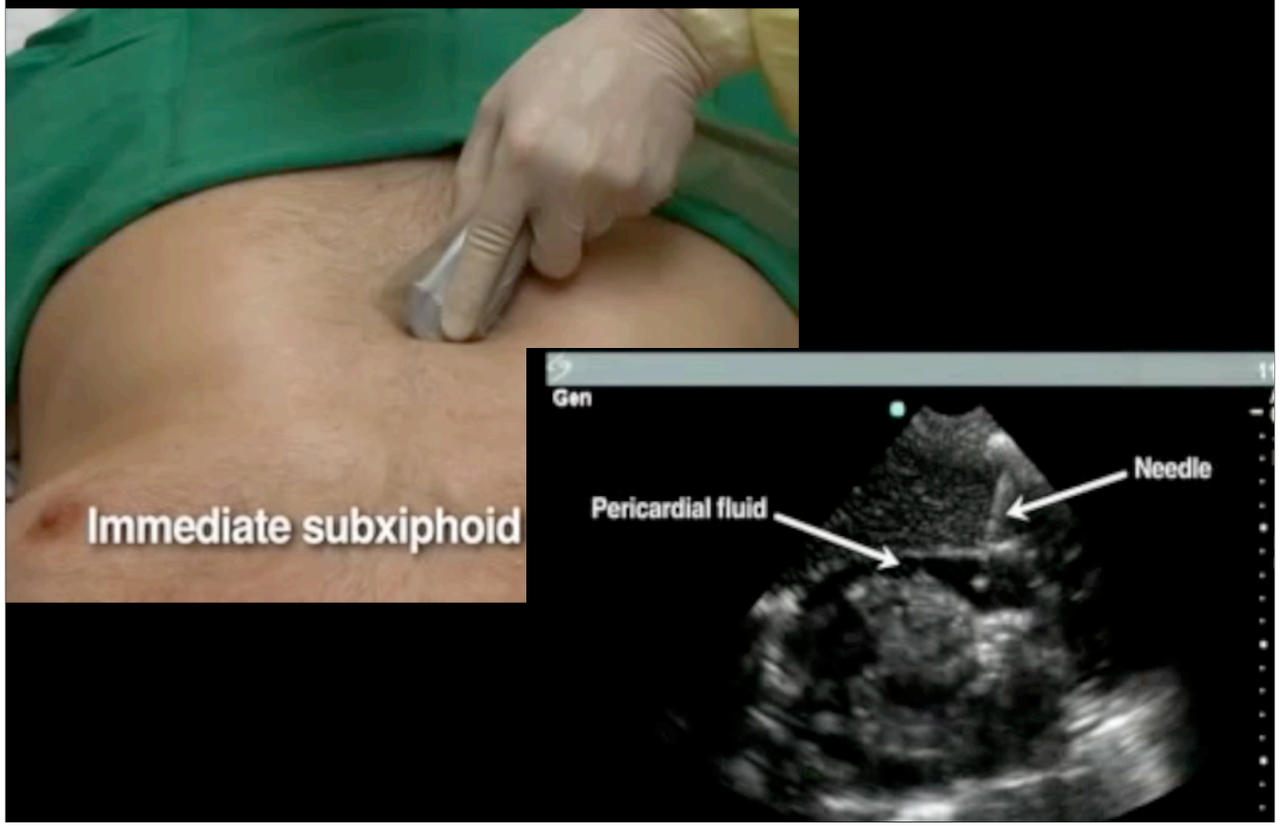
# Subxiphoid Approach



# Subxiphoid Approach



# Subxiphoid Approach



# Cardiac Tamponade

RV- early RA Late

RA will collapse in late diastole initially an can persist until early systole (more prolonged time—> more spec for Tamp) sens 90-100%; spec 60-80%
LA compression is more specific for Tamp
RV collapse very Specific (spec 90-100%; sen 60-80%).. effected by volume depletion and RVH 2/2 pHTN
Compensated Effusion vs Tamponade (SIGNS B4 hemodynamic collapse)
Diastole-->The period b/w Mitral valve opening and closing
Diastole--> Hook up ECG--> may not be practical in critical patients (T wave diastole, PQRS systole)
Diastole--> Advanced ultrasonographers---> elvaluating Mitral Valve and RV with M mode
-time mitral opening with any RV wall indentation posteriorly on Para Long

# Cardiac Tamponade

- Right Heart Collapse during diastole

# Cardiac Tamponade

- Right Heart Collapse during diastole
  - RV or RA

# Cardiac Tamponade

- Right Heart Collapse during diastole
  - RV or RA
  - Can be subtle

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- Right Heart Collapse during diastole
  - RV or RA
  - Can be subtle
- Diastole

# Cardiac Tamponade

- Right Heart Collapse during diastole
  - RV or RA
  - Can be subtle
- Diastole
  - Correlate with Mitral Valve Opening

# Cardiac Tamponade

- Right Heart Collapse during diastole
  - RV or RA
  - Can be subtle
- Diastole
  - Correlate with Mitral Valve Opening
- IVC Plethora

# Cardiac Tamponade

- Right Heart Collapse during diastole
  - RV or RA
  - Can be subtle
- Diastole
  - Correlate with Mitral Valve Opening
- IVC Plethora
- MV Inflow respiratory variation

# Clinical Diagnosis

Be mindful of relative hypotension

# Clinical Diagnosis

Hemodynamic Instability

# Clinical Diagnosis

Hemodynamic Instability

+

# Clinical Diagnosis

Hemodynamic Instability

+

Pericardial Effusion

# Clinical Diagnosis

Hemodynamic Instability

+

=

Pericardial Effusion

# Clinical Diagnosis

Hemodynamic Instability

+

Pericardial Effusion

=

Cardiac Tamponade

# Case

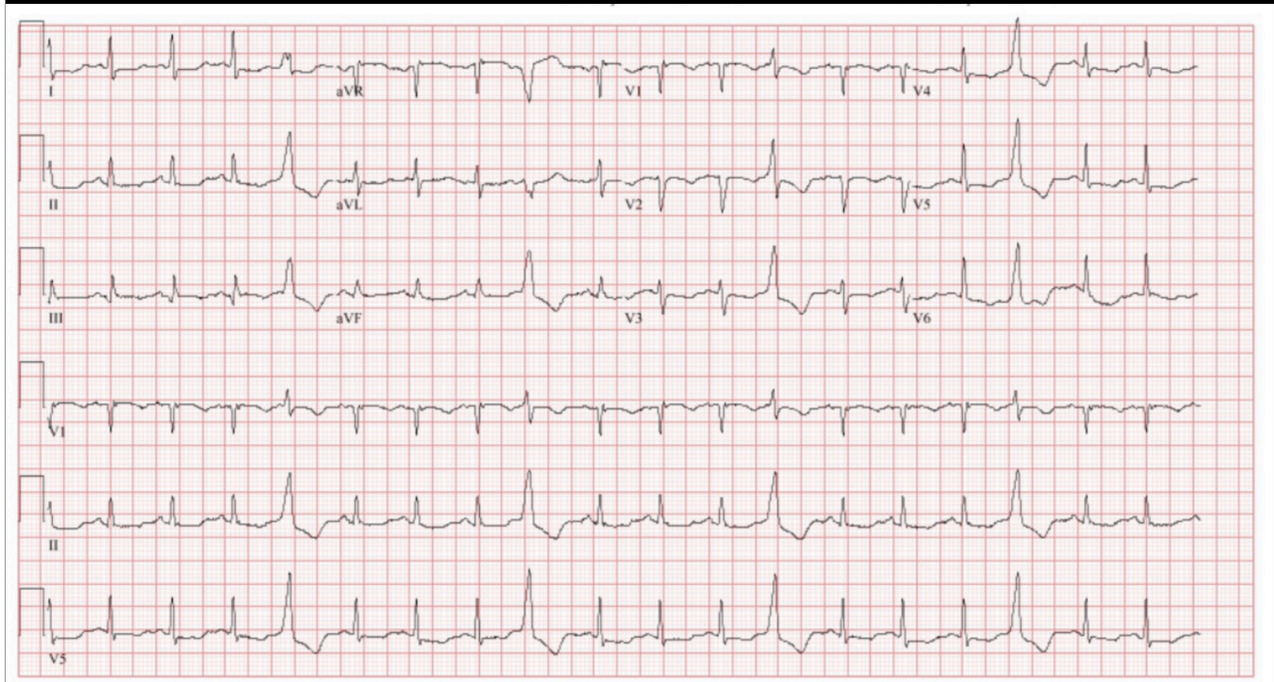
- 84 ♀with AUD, recent fall, c/o lethargy x 2 days

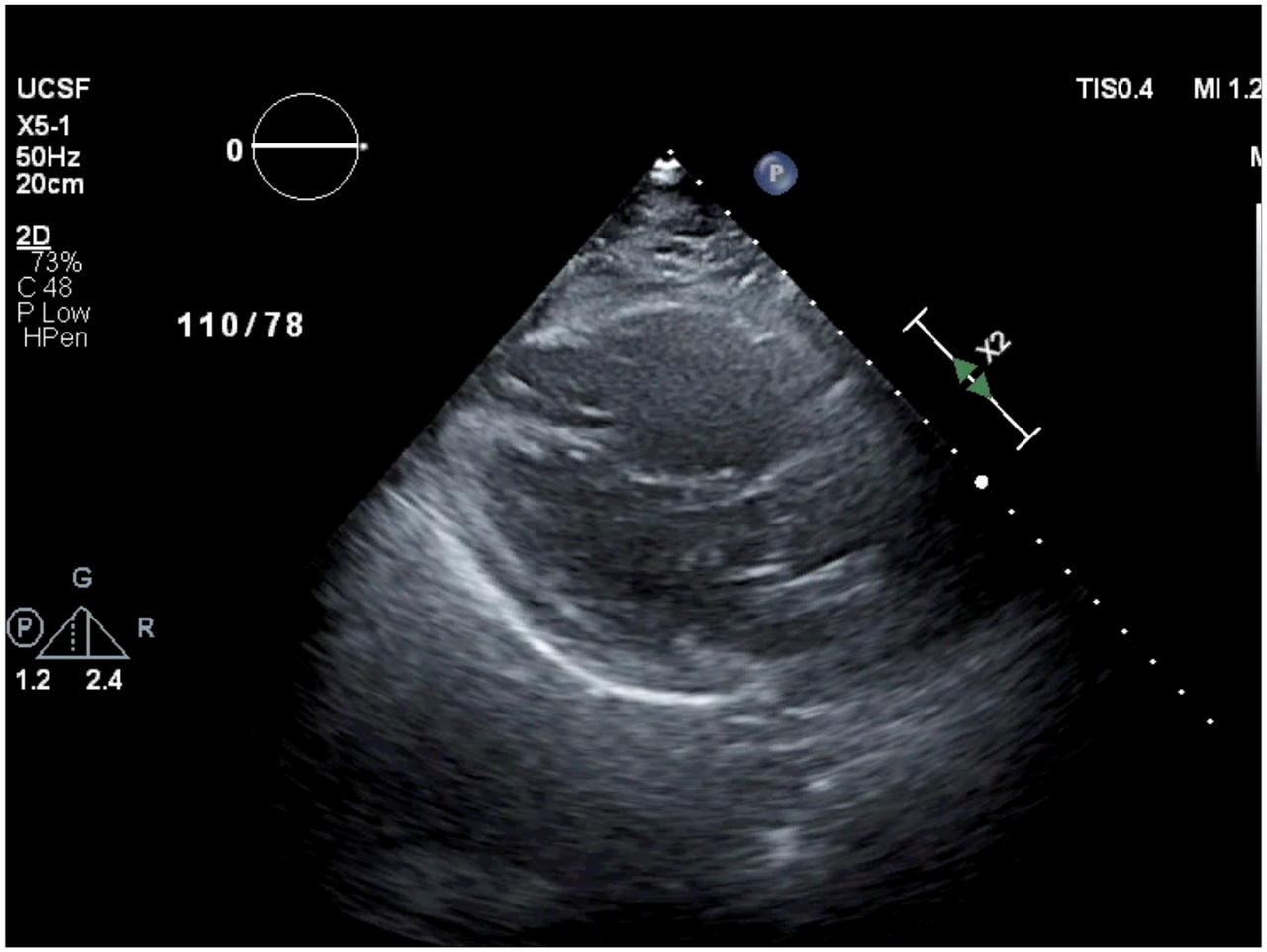
**VS: 36.7 70/30 130 30 92%RA**

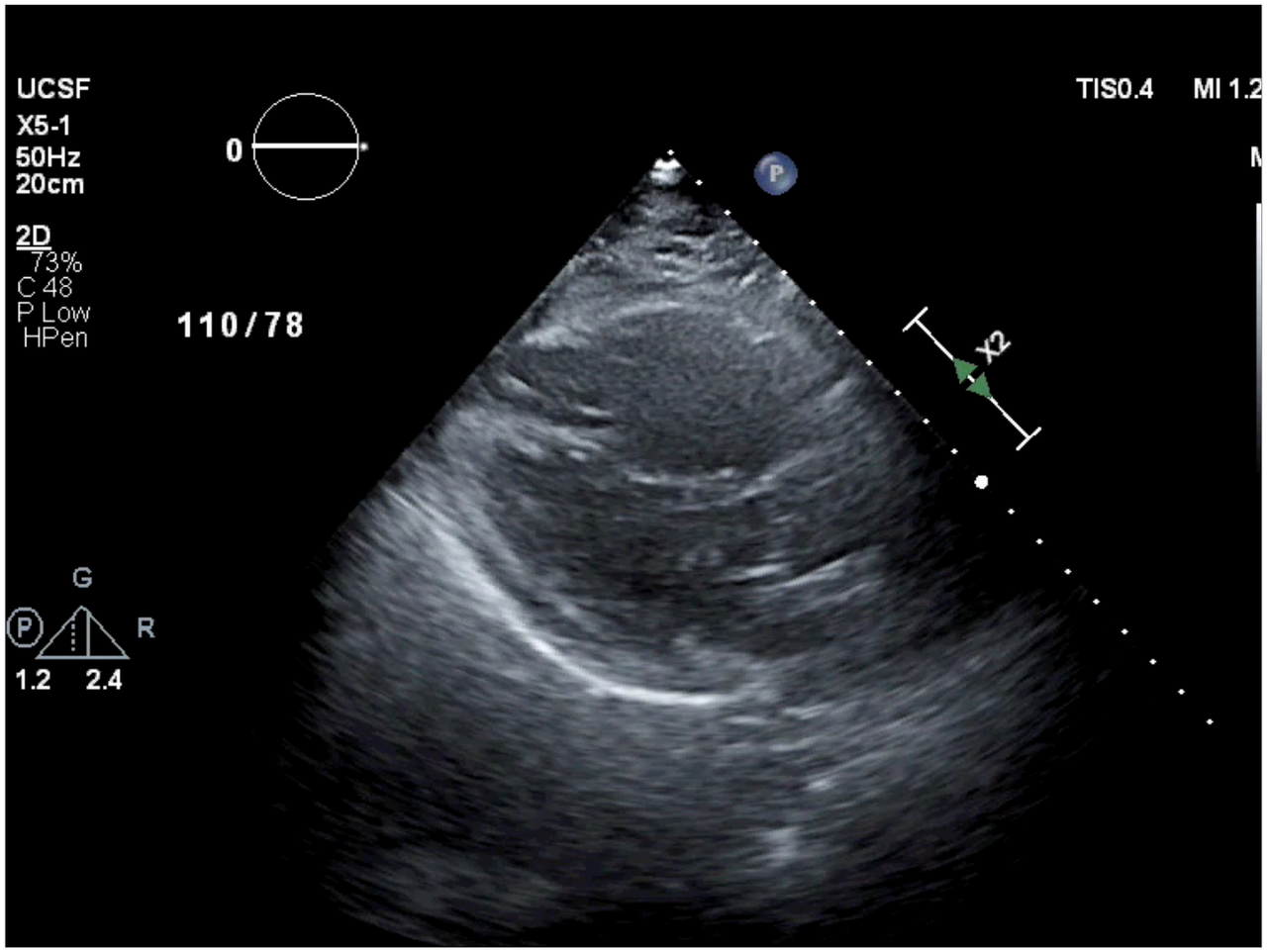
# ECG

Sinus
R Axis Deviation
Mx PVCs

# ECG




UCSF
X5-1
50Hz
20cm
2D
73%
C 48
P Low
HPen
110/78
TIS0.4
MI 1.2
X2
G
P
R
1.2
2.4


UCSF
X5-1
50Hz
20cm
2D
73%
C 48
P Low
HPen
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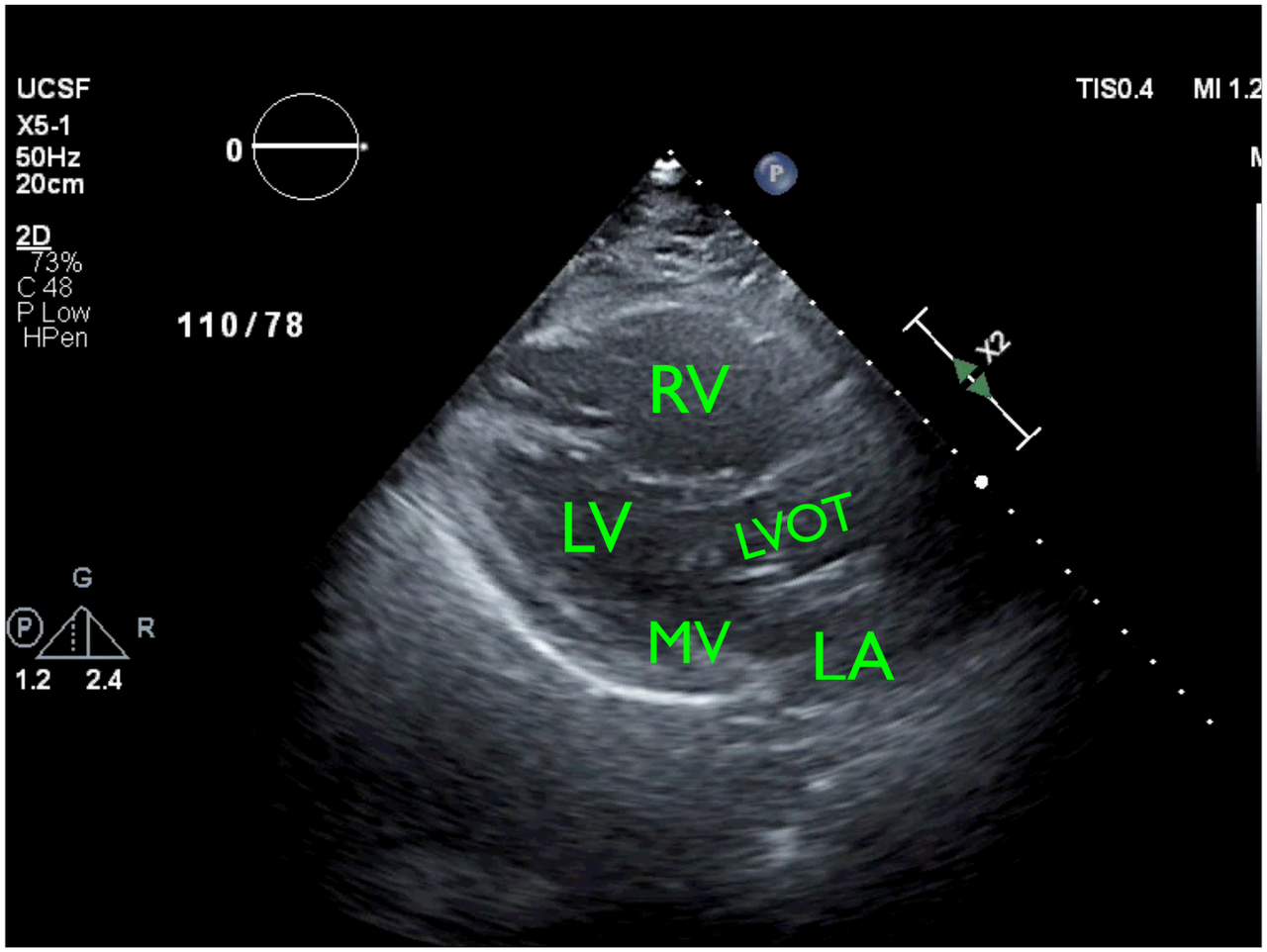
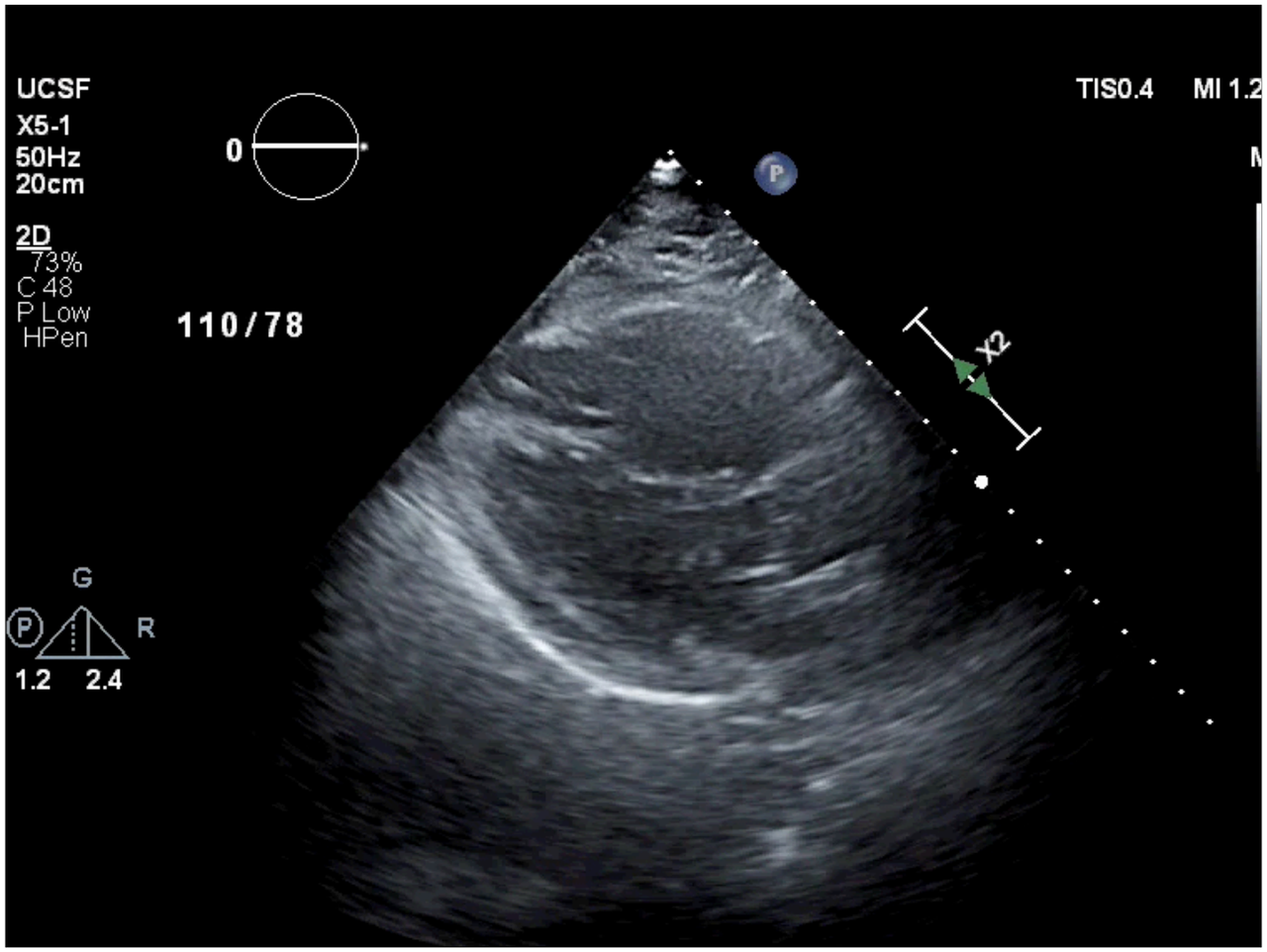
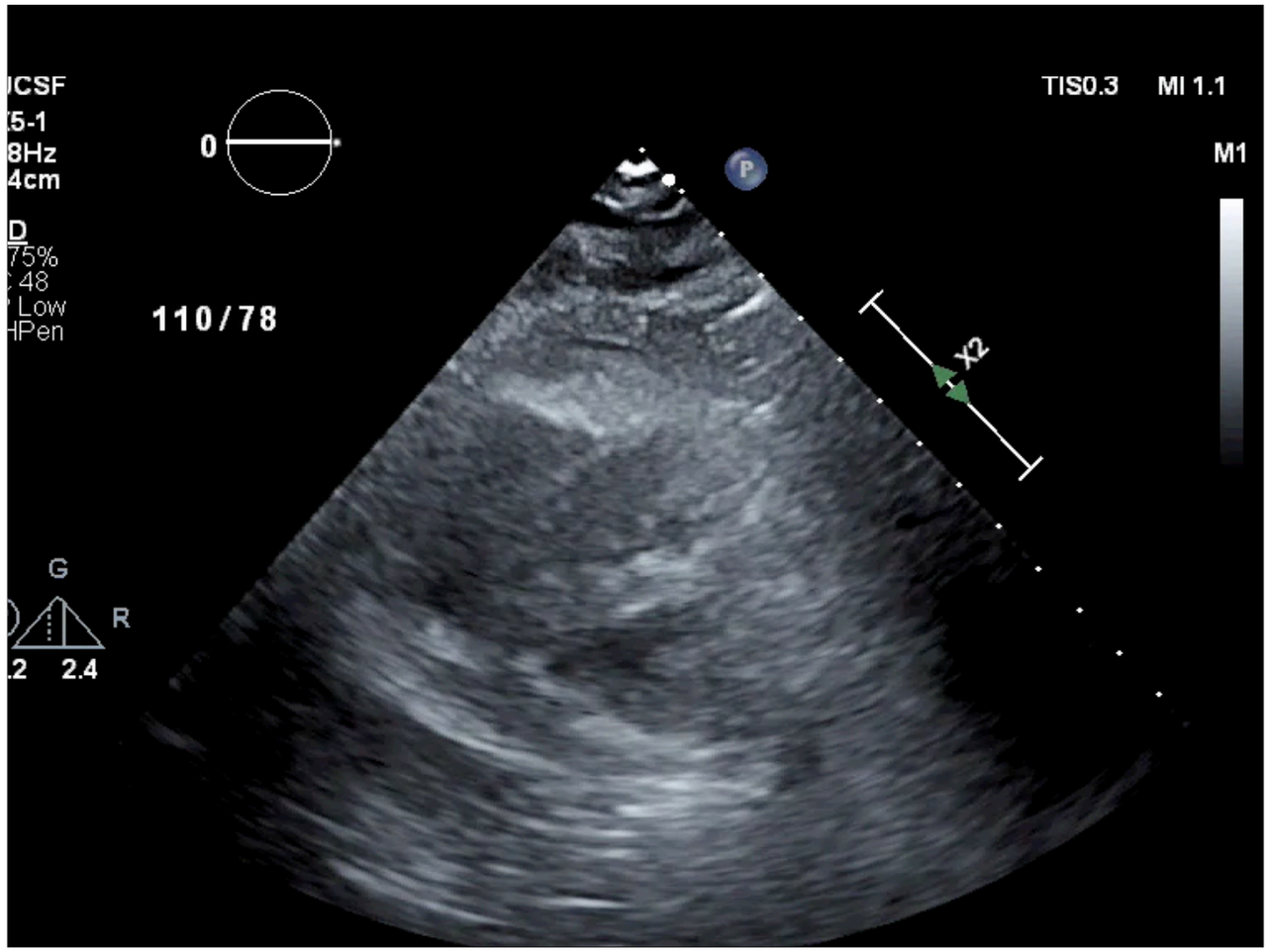
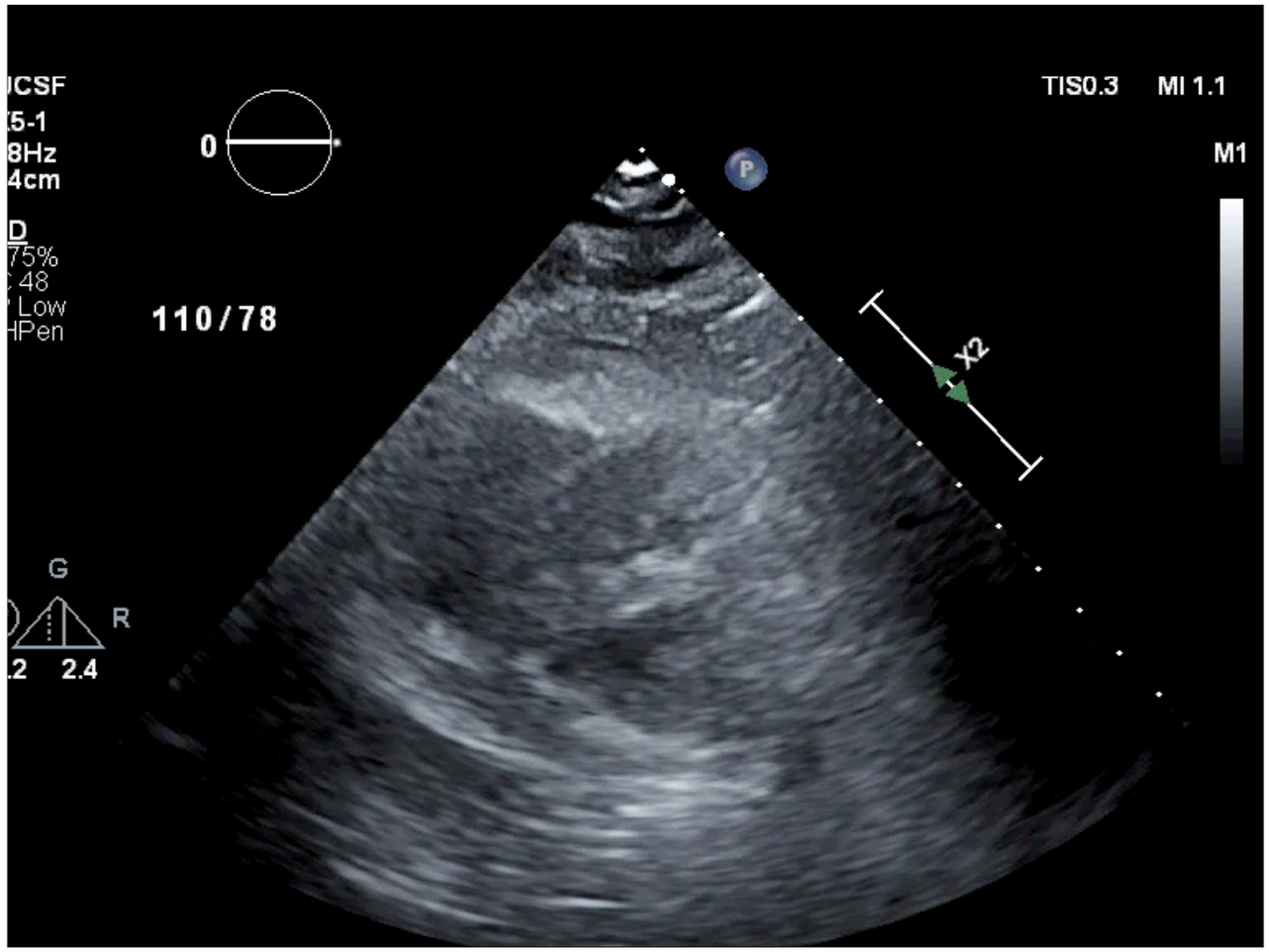
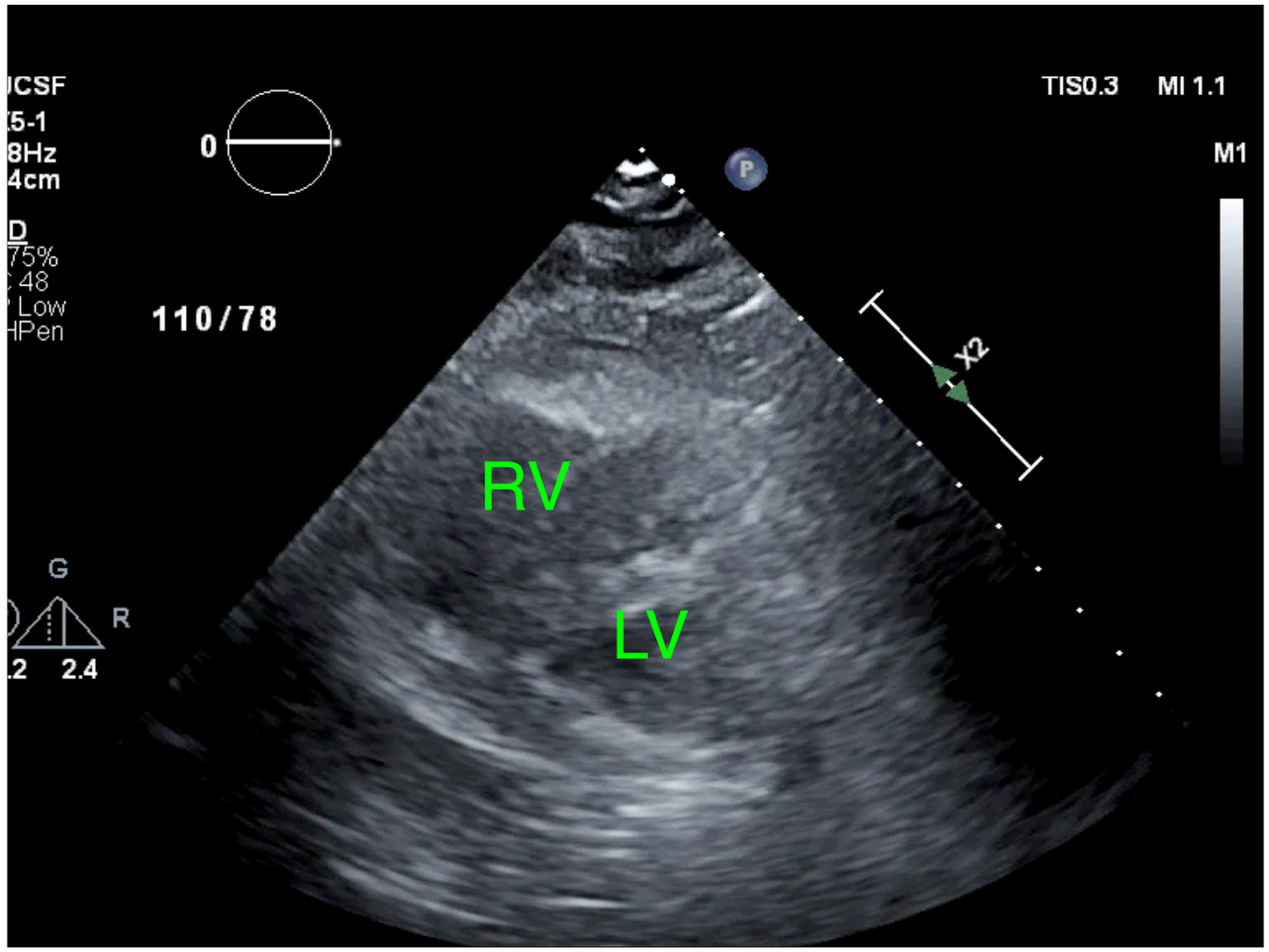
TIS0.4
MI 1.2
X2
G
P
R
1.2
2.4

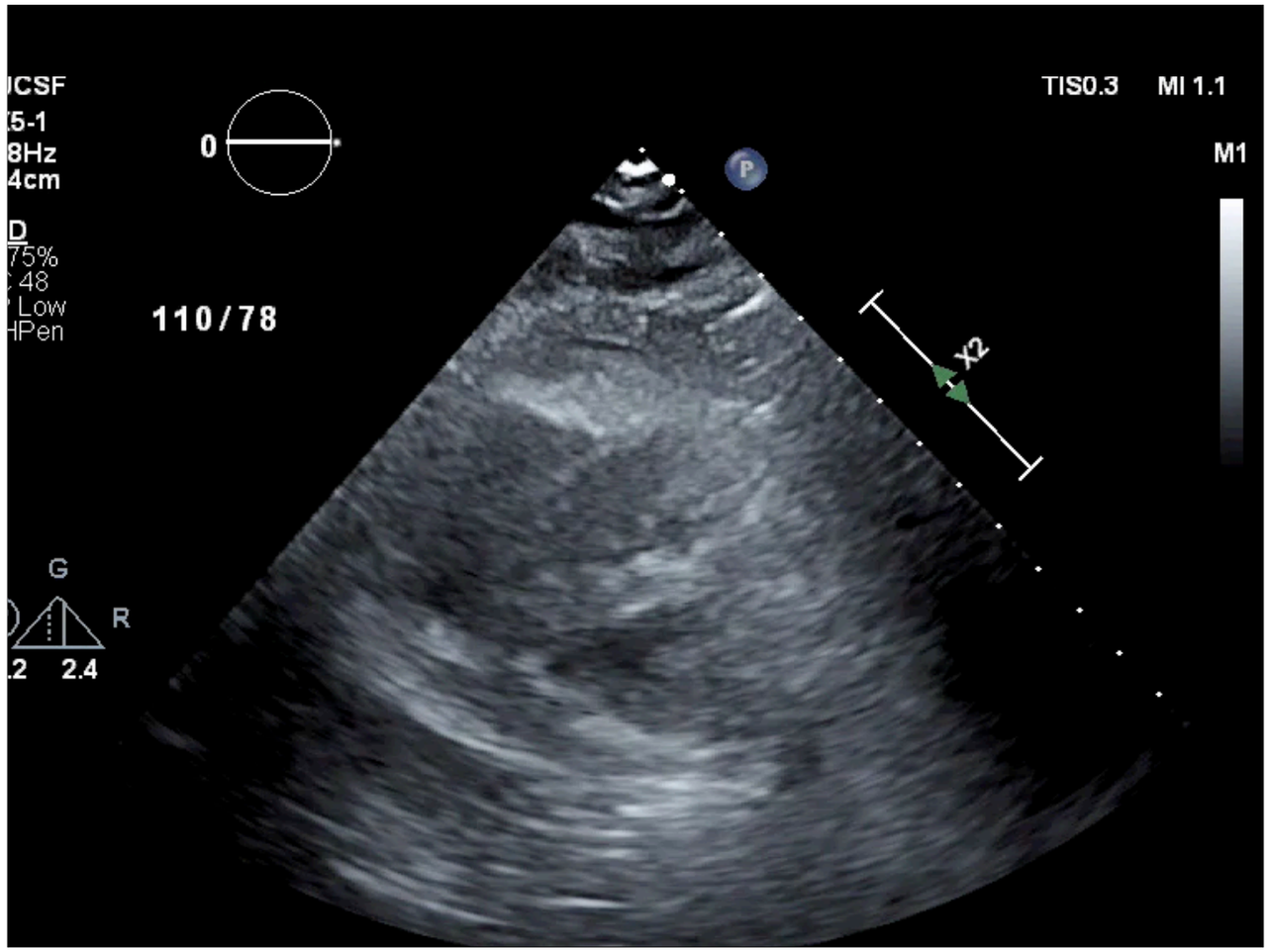

UCSF
X5-1
50Hz
20cm
2D
73%
C 48
P Low
HPen
110/78
TIS0.4
MI 1.2
RV
LV
LVOT
MV
LA
X2
G
P
R
1.2
2.4

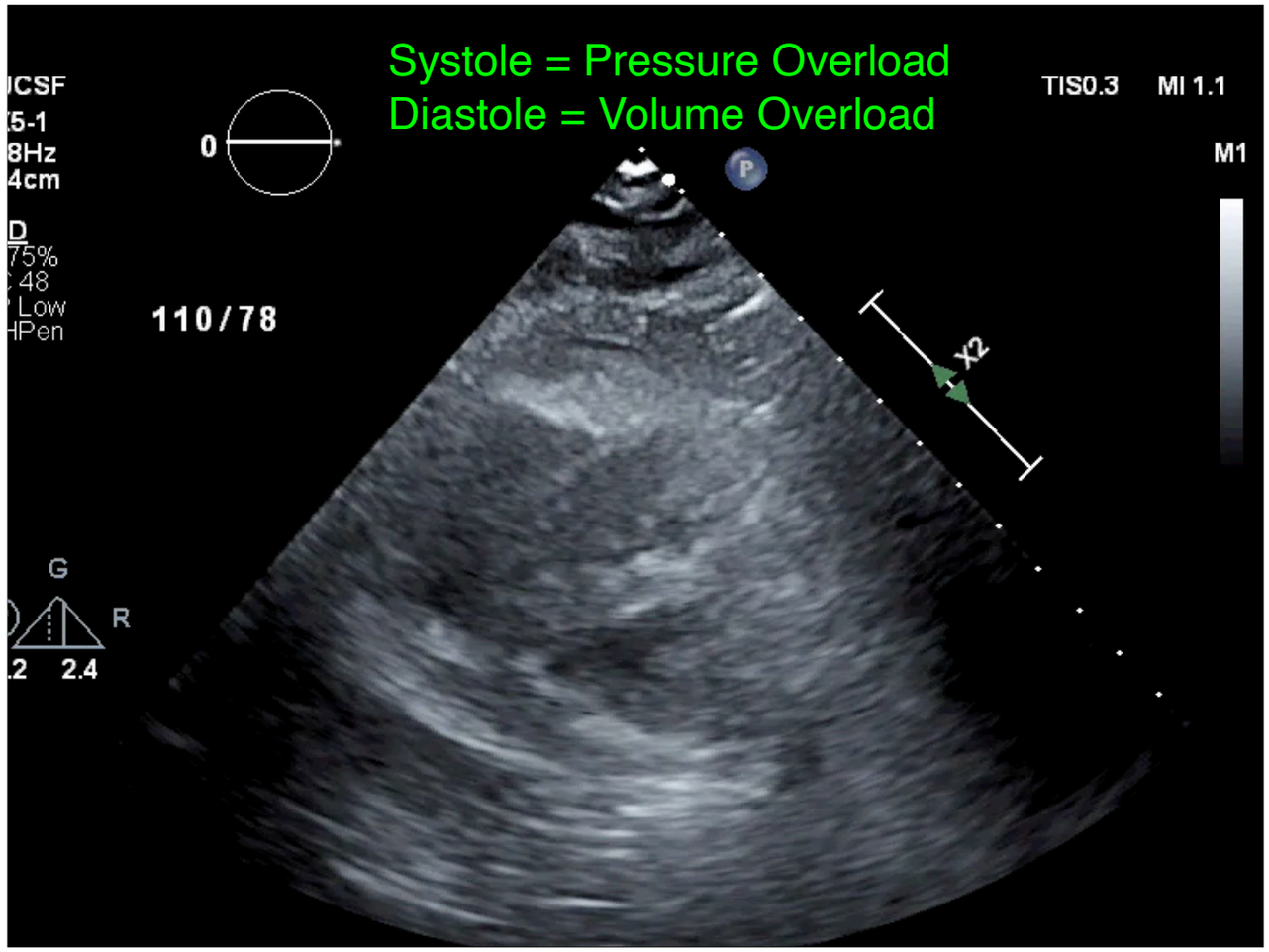

UCSF
X5-1
50Hz
20cm
2D
73%
C 48
P Low
HPen
110/78
TIS0.4
MI 1.2
X2
G
P
R
1.2
2.4

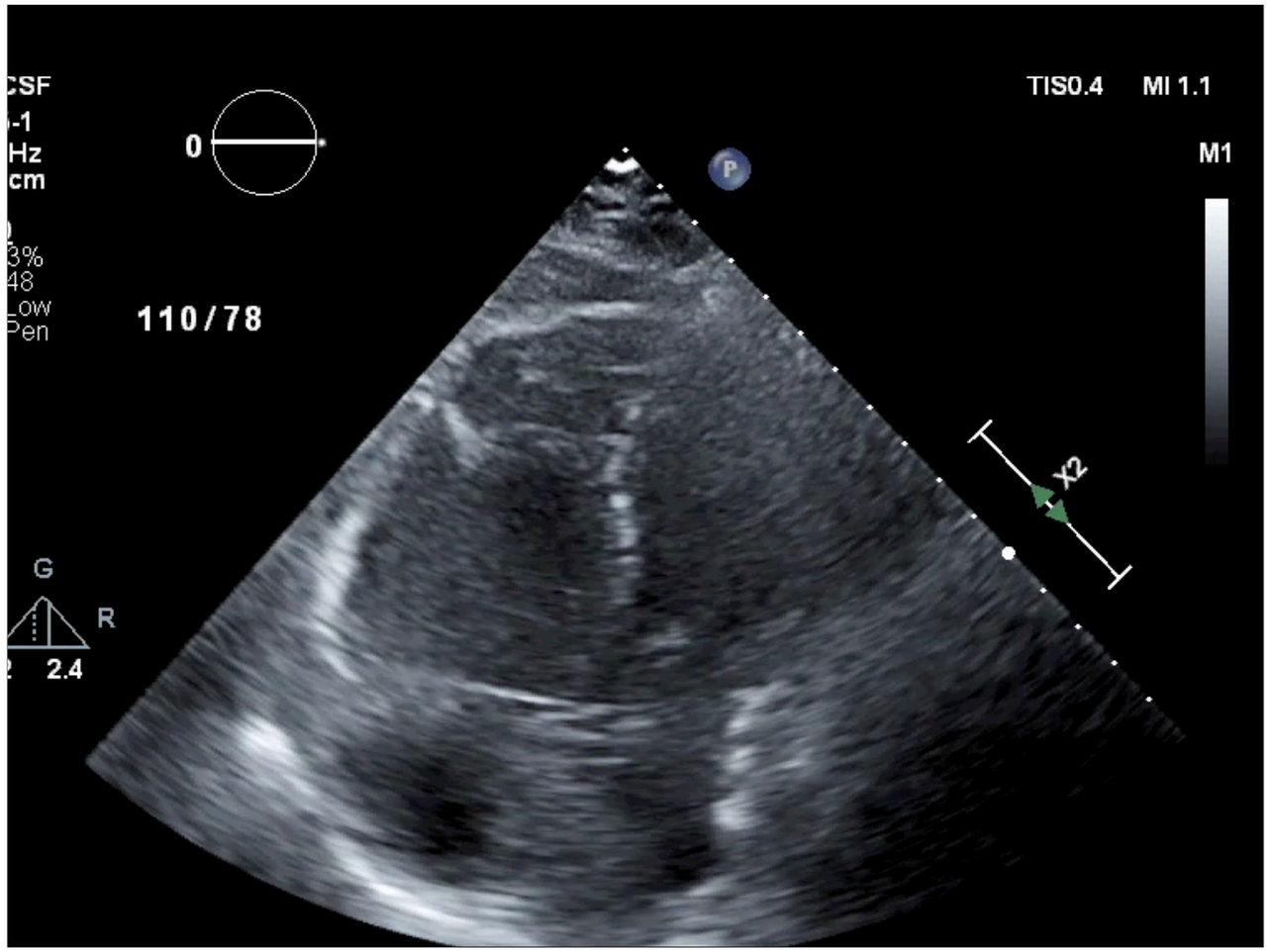

UCSF
5-1
8Hz
4cm
D
75%
48
Low
HPen
0
110/78
TIS0.3 MI 1.1
M1
X2
G
R
.2 2.4


UCSF
5-1
8Hz
4cm
D
75%
48
Low
HPen
0
110/78
TIS0.3 MI 1.1
M1
X2
G
R
.2 2.4

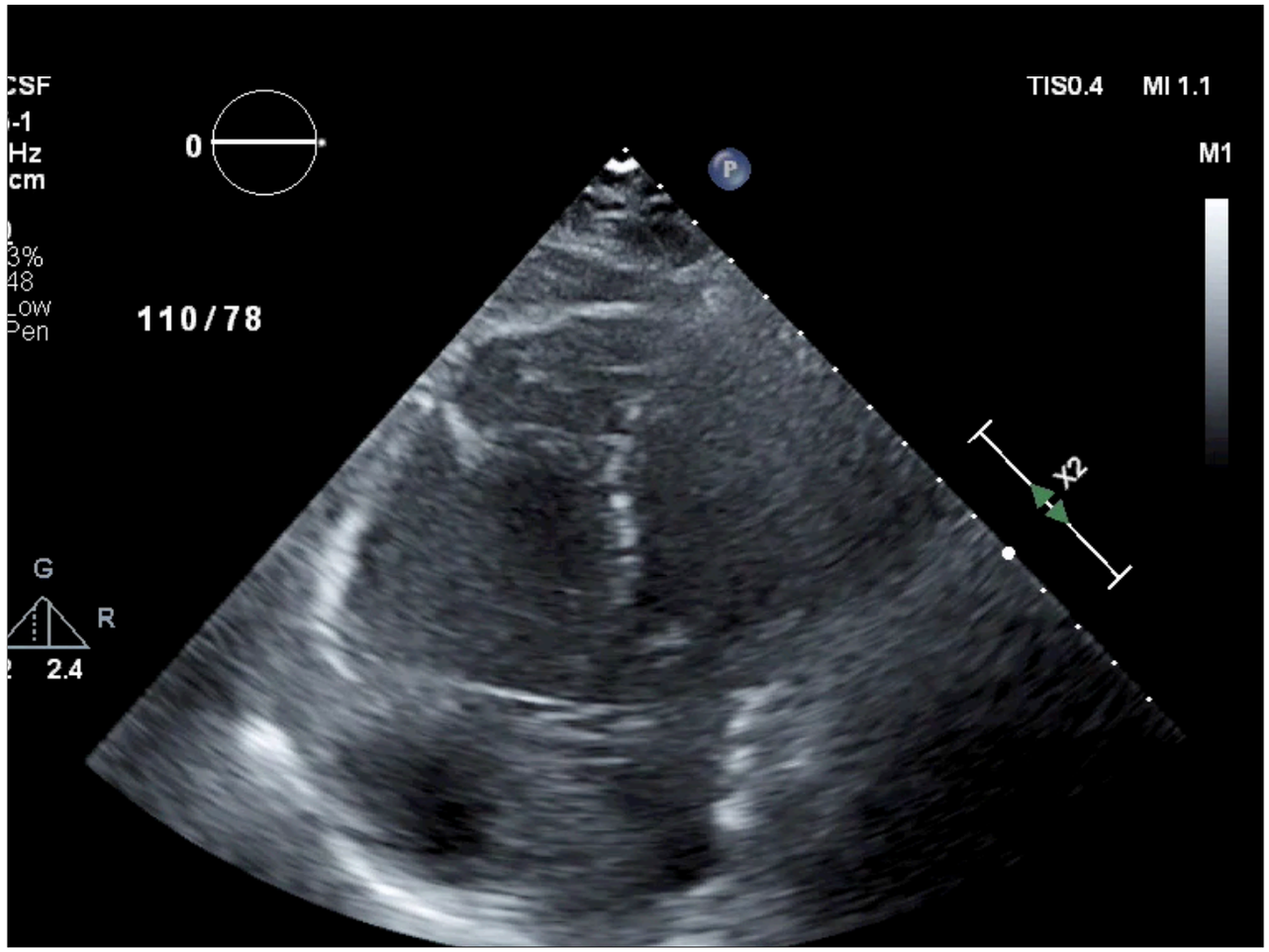

UCSF
5-1
8Hz
4cm
D
75%
48
Low
HPen
0
110/78
TIS0.3
MI 1.1
M1
P
x2
RV
LV
G
R
.2
2.4

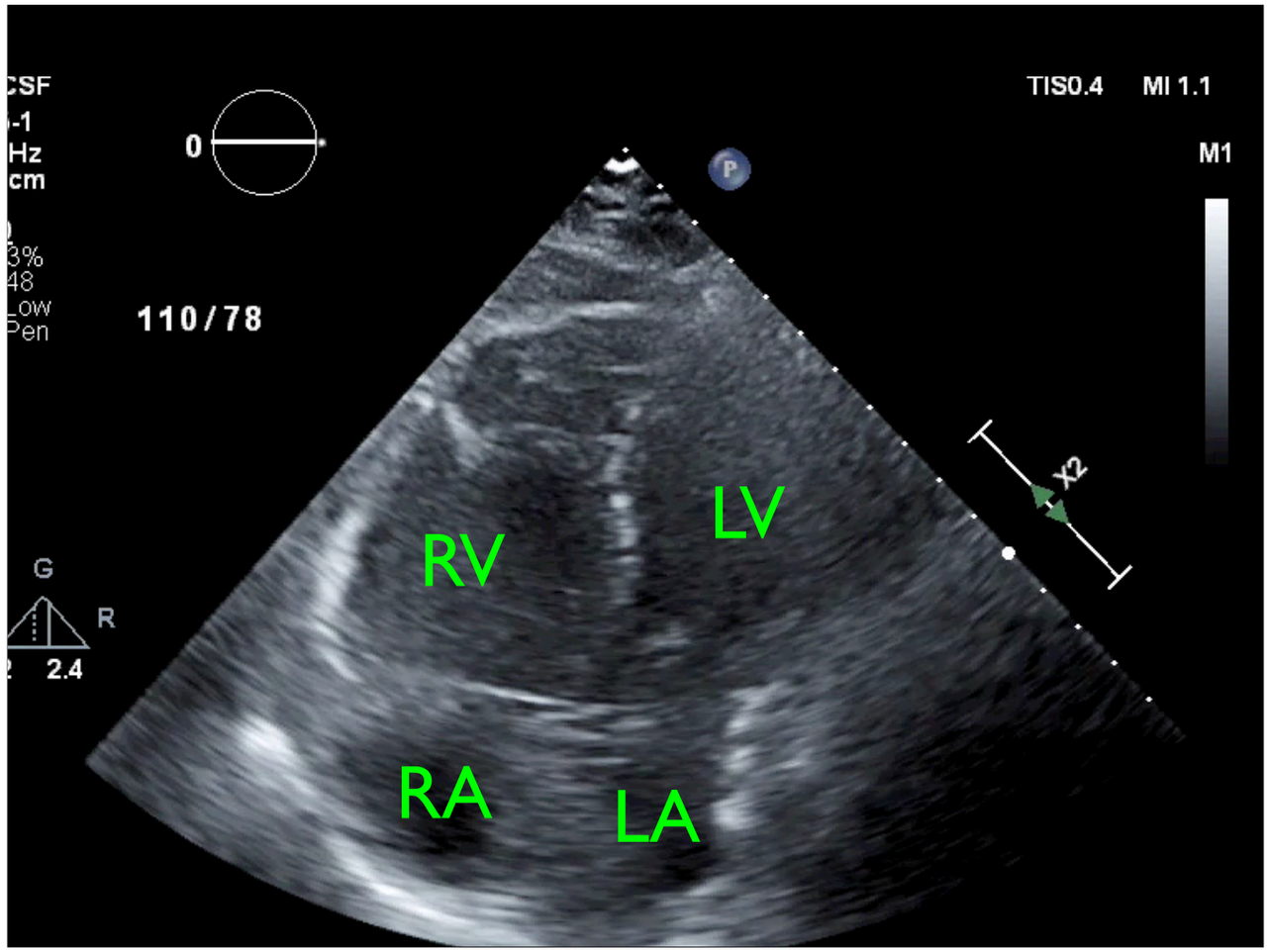

UCSF
5-1
8Hz
4cm
D
75%
48
Low
HPen
0
110/78
TIS0.3 MI 1.1
M1
X2
G
R
.2 2.4

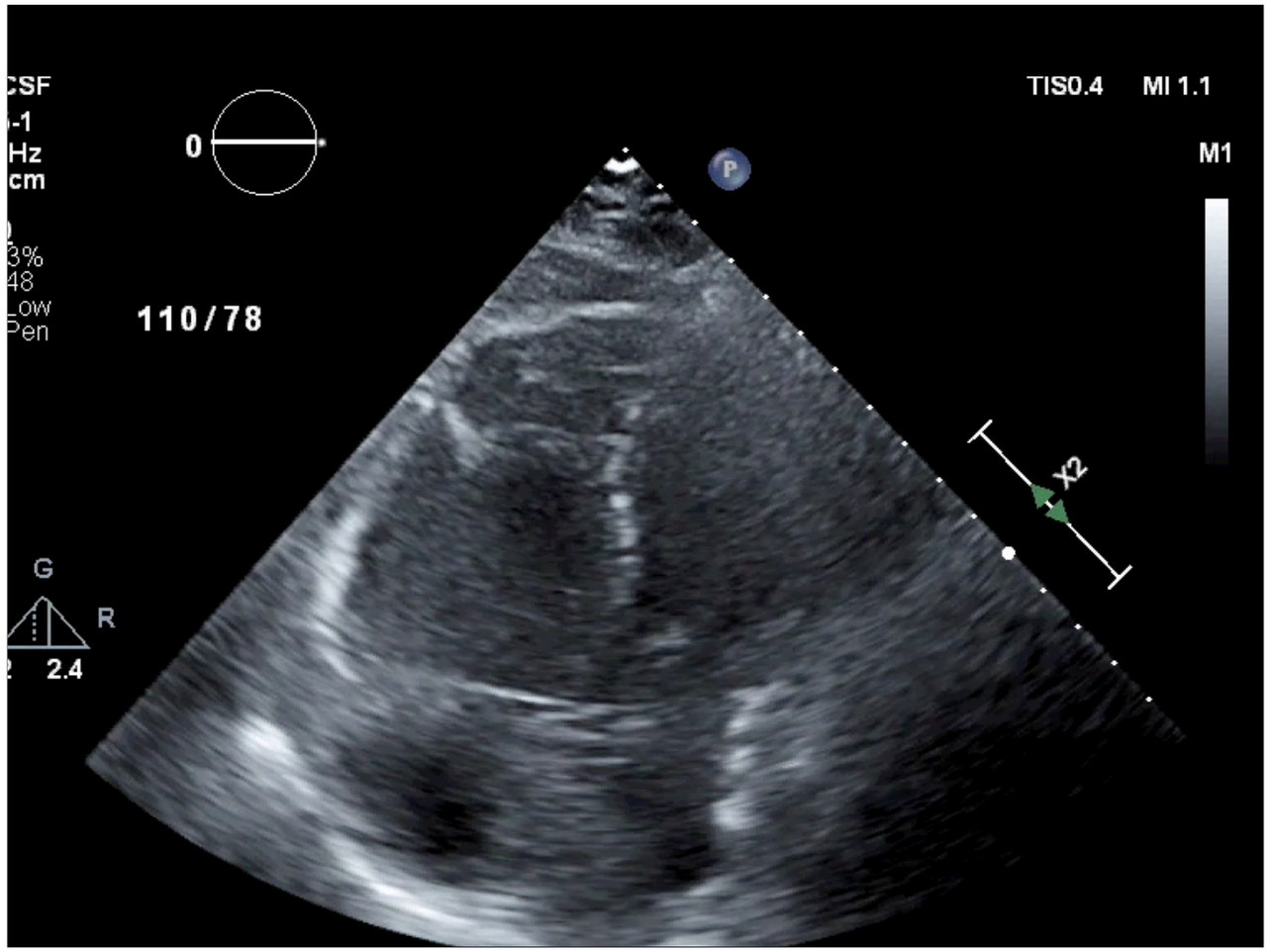

Systole = Pressure Overload
Diastole = Volume Overload
UCSF
5-1
8Hz
4cm
D
75%
48
Low
HPen
0
110/78
TIS0.3
MI 1.1
M1
P
x2
G
R
.2
2.4




RV apical WM preserved

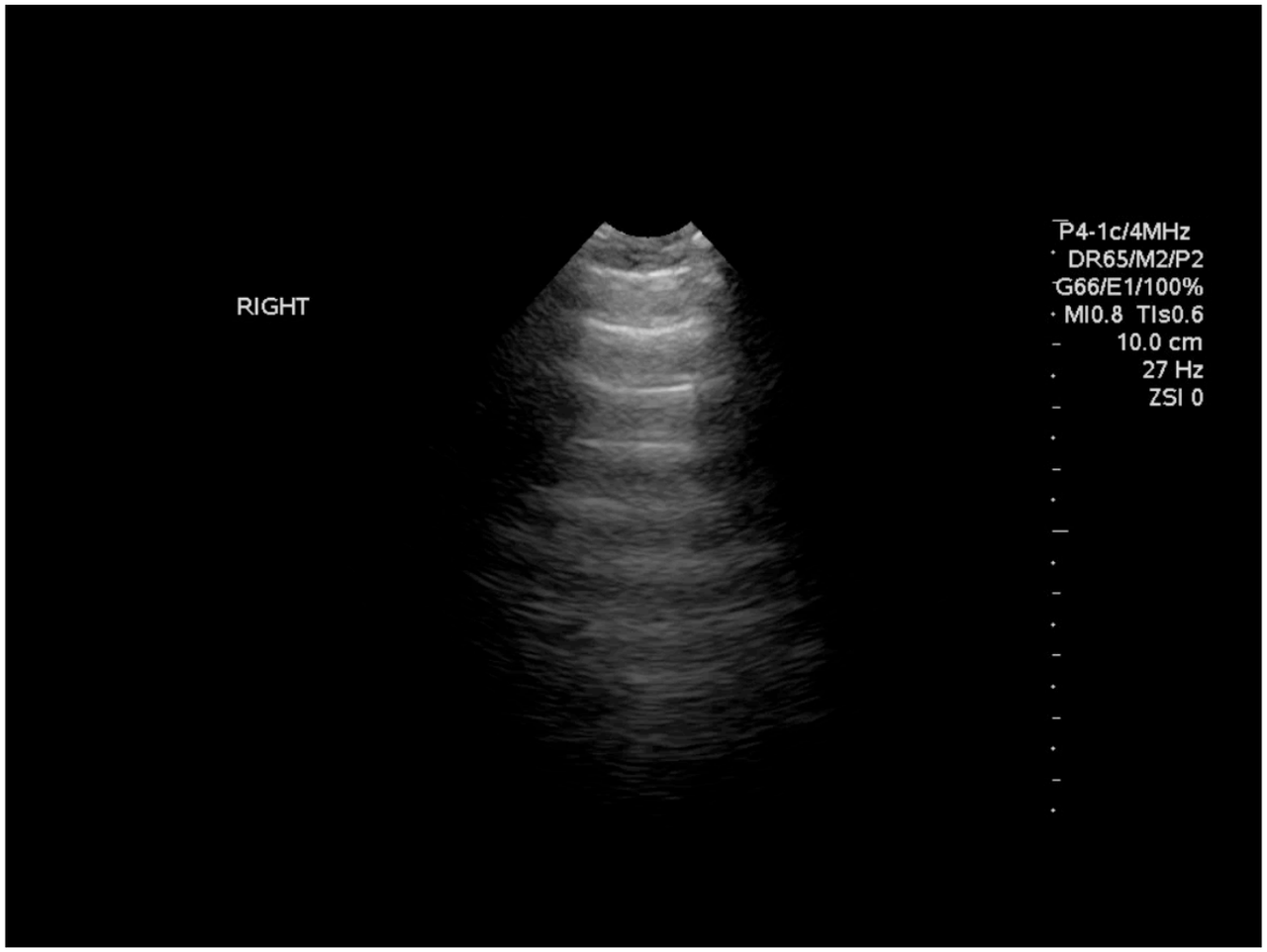

CSF
-1
Hz
cm
3%
48
ow
Pen
0
110/78
TIS0.4
MI 1.1
M1
X2
G
R
2.4

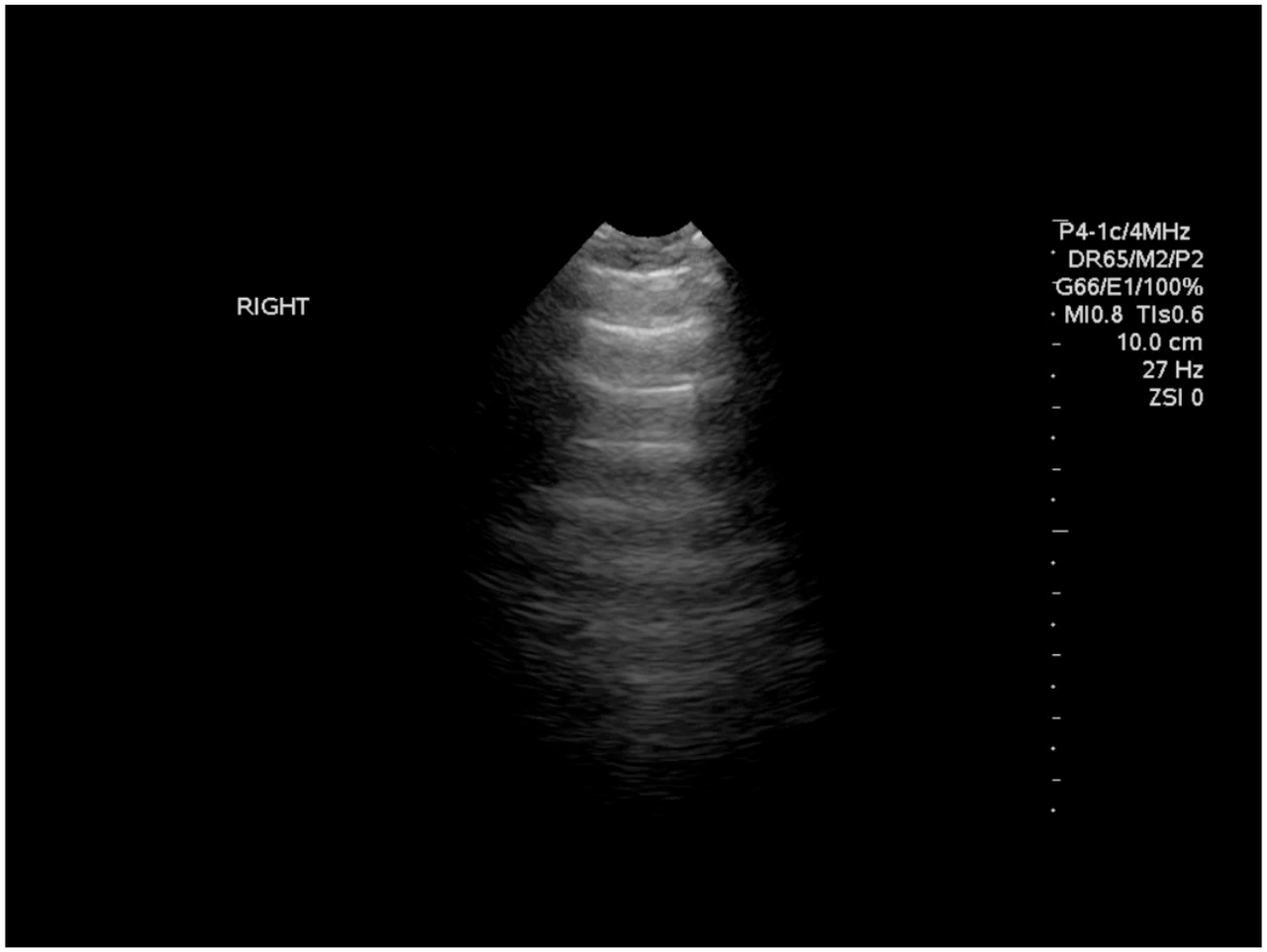

TIS0.4 MI 1.1
M1
110/78
RV
LV
RA
LA
X2
G
R
2.4

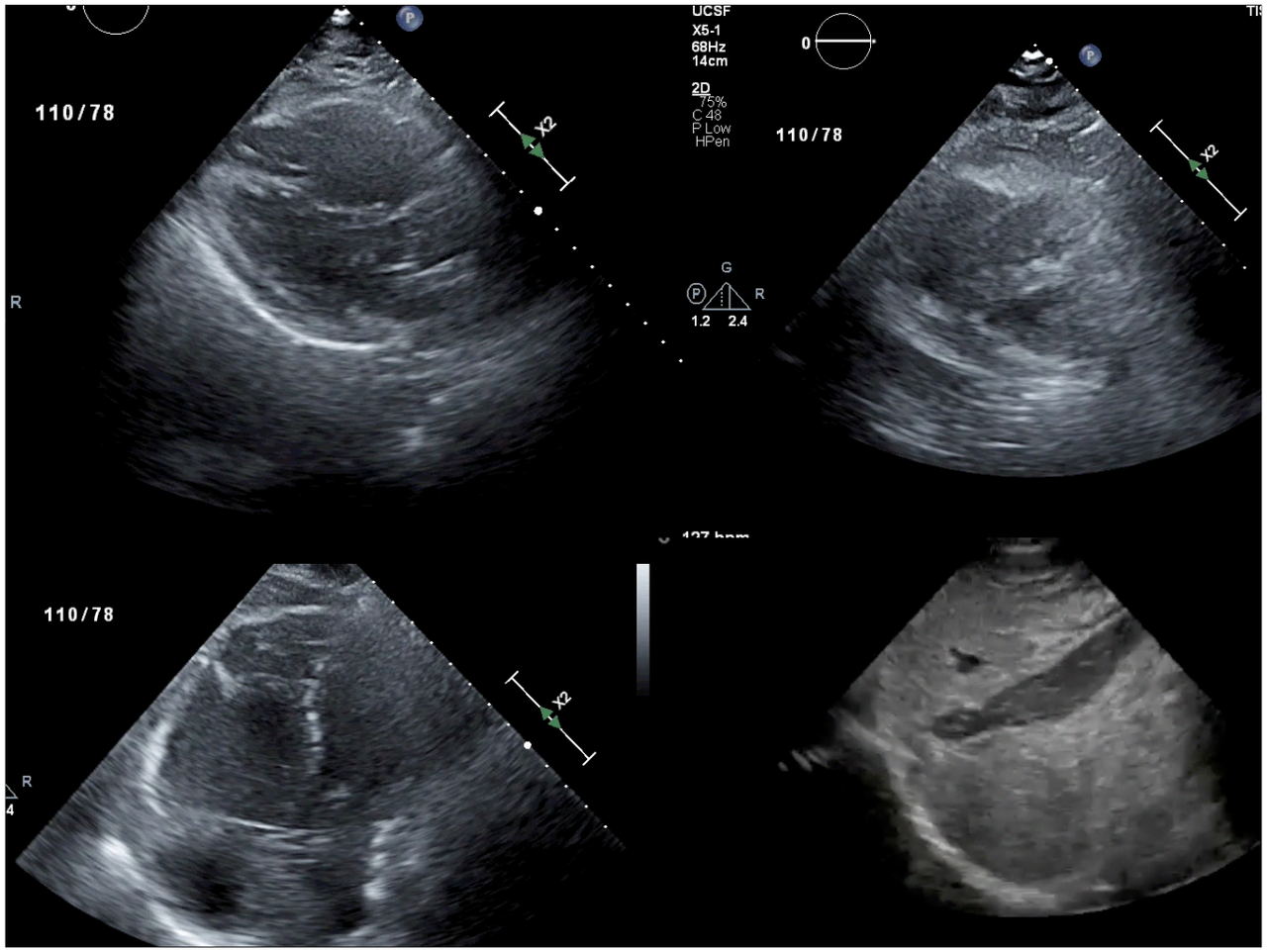

CSF
-1
Hz
cm
3%
48
ow
Pen
0
110/78
TIS0.4
MI 1.1
M1
X2
G
R
2.4

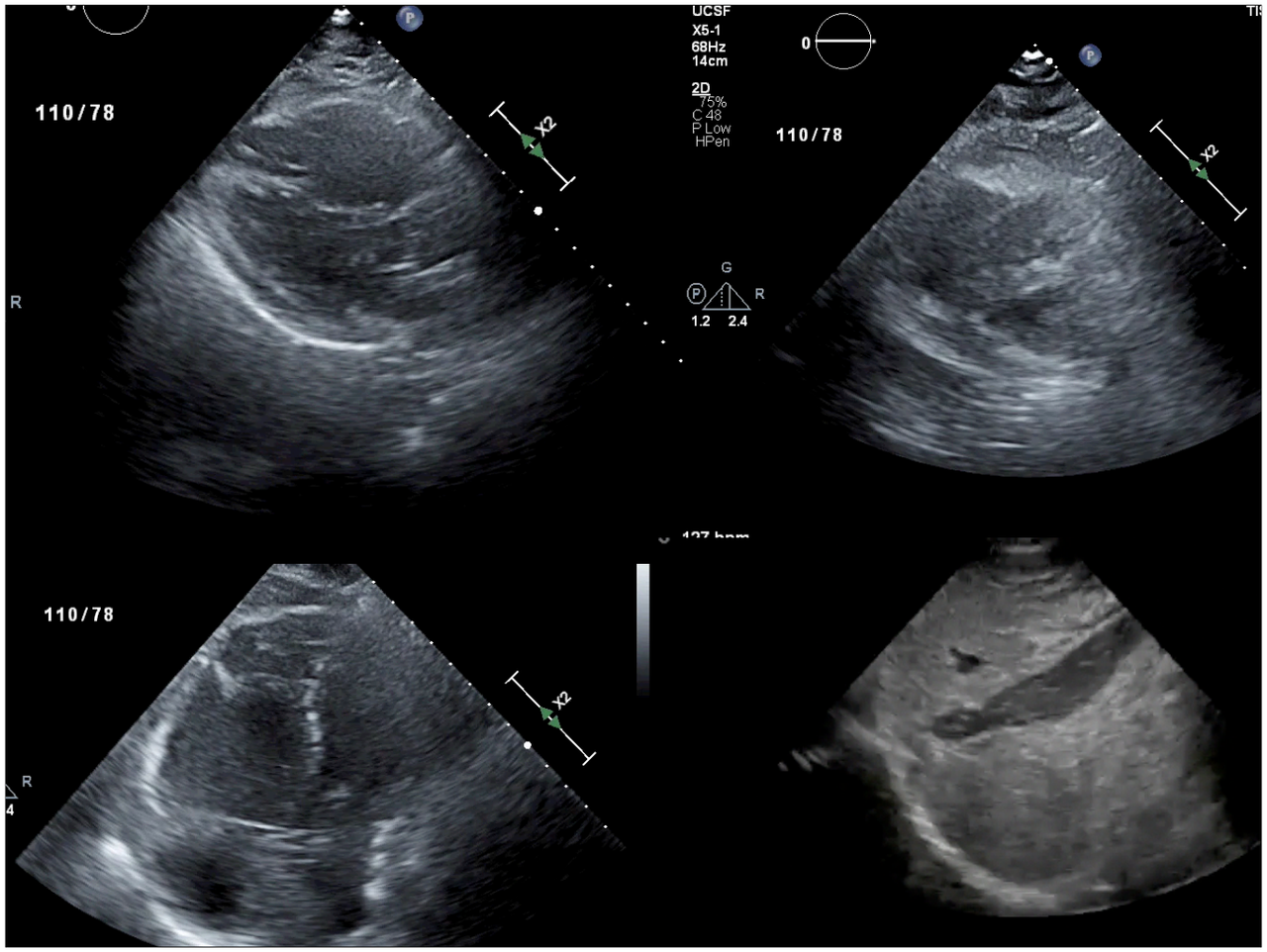

96%
MI
0.8
TIS
0.7
A
B
DVD
16

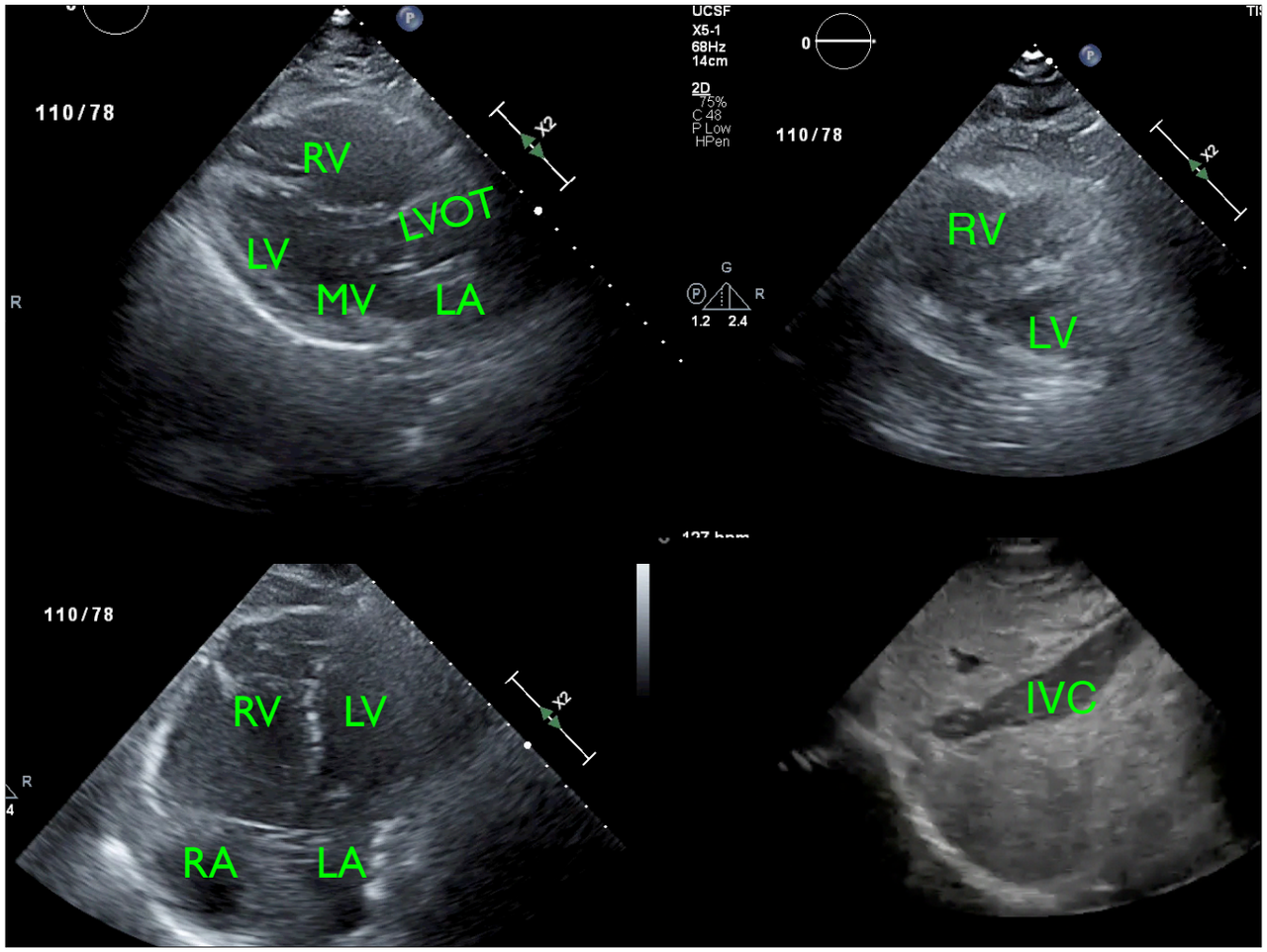

96%
MI
0.8
TIS
0.7
A
B
DVD
16


RIGHT
P4-1c/4MHz
DR65/M2/P2
G66/E1/100%
MI0.8 TIs0.6
10.0 cm
27 Hz
ZSI 0


RIGHT
P4-1c/4MHz
DR65/M2/P2
G66/E1/100%
MI0.8 TIs0.6
10.0 cm
27 Hz
ZSI 0


UCSF
X5-1
68Hz
14cm
2D
75%
C 48
P Low
HPen
110/78
X2
G
1.2 2.4
R


UCSF
X5-1
68Hz
14cm
2D
75%
C 48
P Low
HPen
110/78
X2
G
1.2 2.4
R


110/78
RV
LVOT
LV
MV
LA
UCSF
X5-1
68Hz
14cm
2D
75%
C 48
P Low
HPen
110/78
RV
LV
110/78
RV
LV
RA
LA
IVC

D shaped-
McConnell's--> RV Dysfxn-- mid-wall hypokinesis/akenisis w/ nml apical wall motion==> 4chamber
--"Regional RV Dysfxn)--> Sensitivity 77%, Spec 94% (Higher spec b/c this is unique to RV dyxfn from PE vs COPD/pHTN/RCA MI

# Regional Right Ventricular Dysfunction Detected by Echocardiography in Acute Pulmonary Embolism

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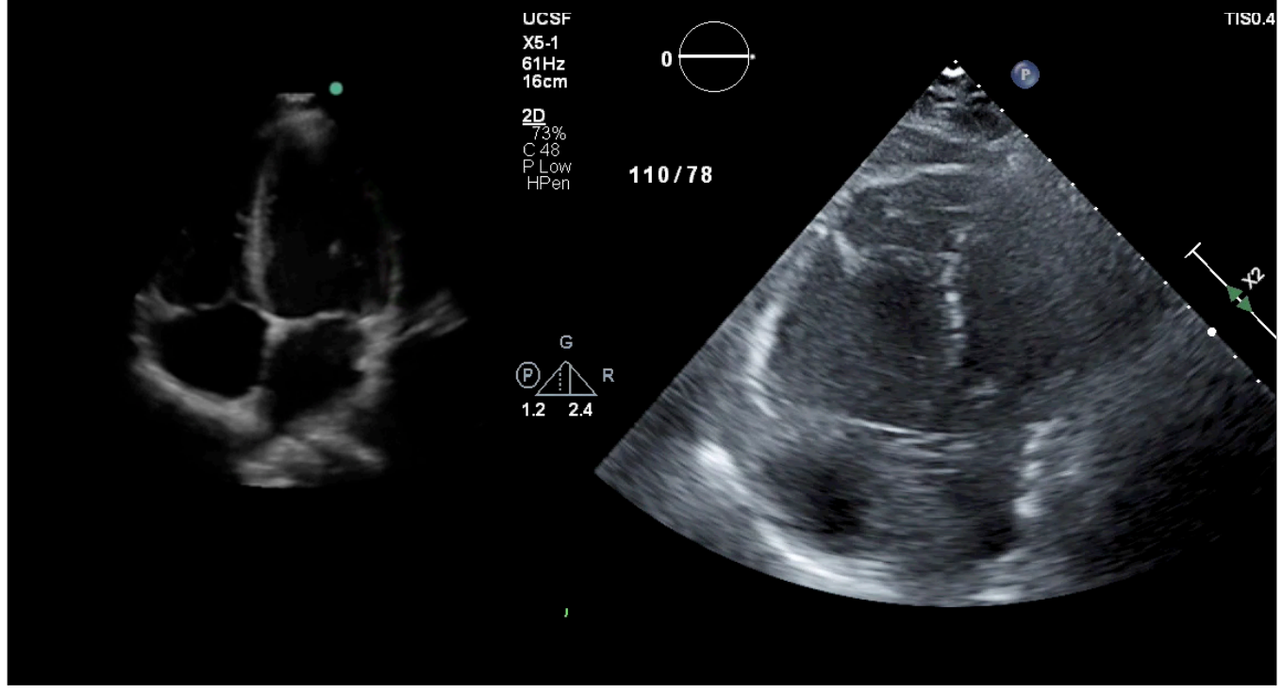
- McConnell's Sign
- RV Hypokenesis w/ preserved apical WM
- Sensitivity 77%; Specificity 94%

# RV Function

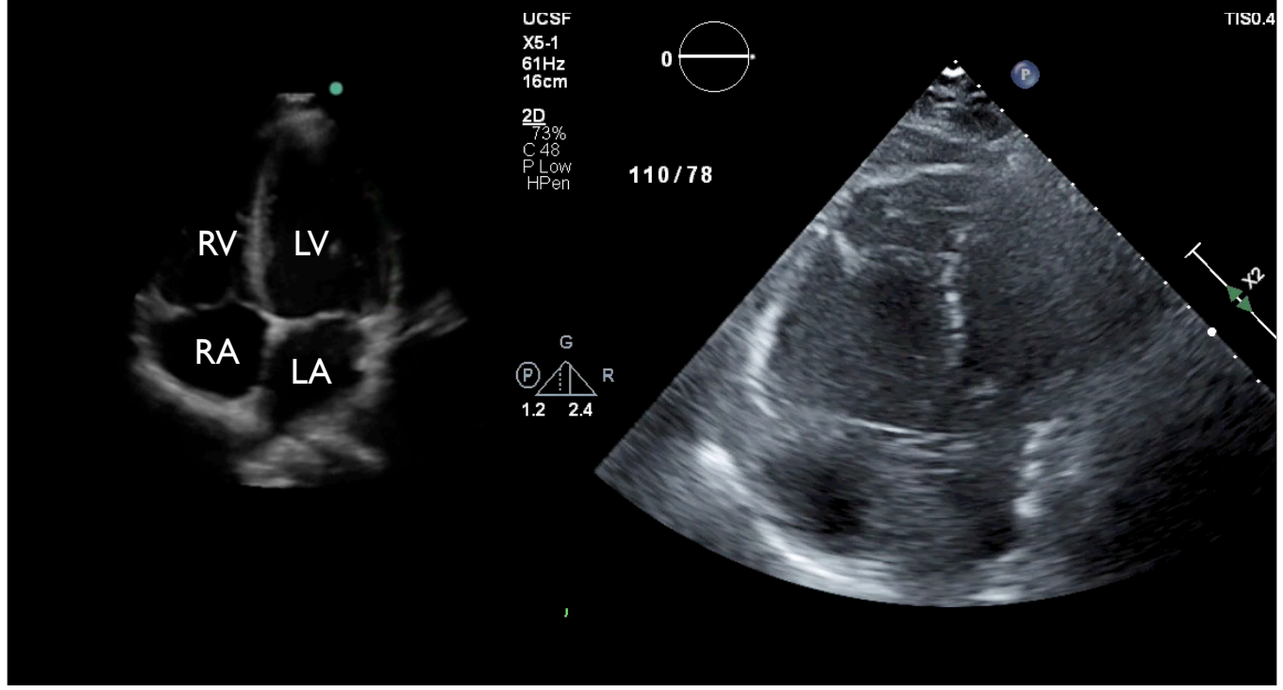
# Tricuspid Annular  Plane Systolic Excursion (TAPSE)

# Tricuspid Annular  Plane Systolic Excursion (TAPSE)

# Tricuspid Annular Plane Systolic Excursion (TAPSE)



# Tricuspid Annular Plane Systolic Excursion (TAPSE)



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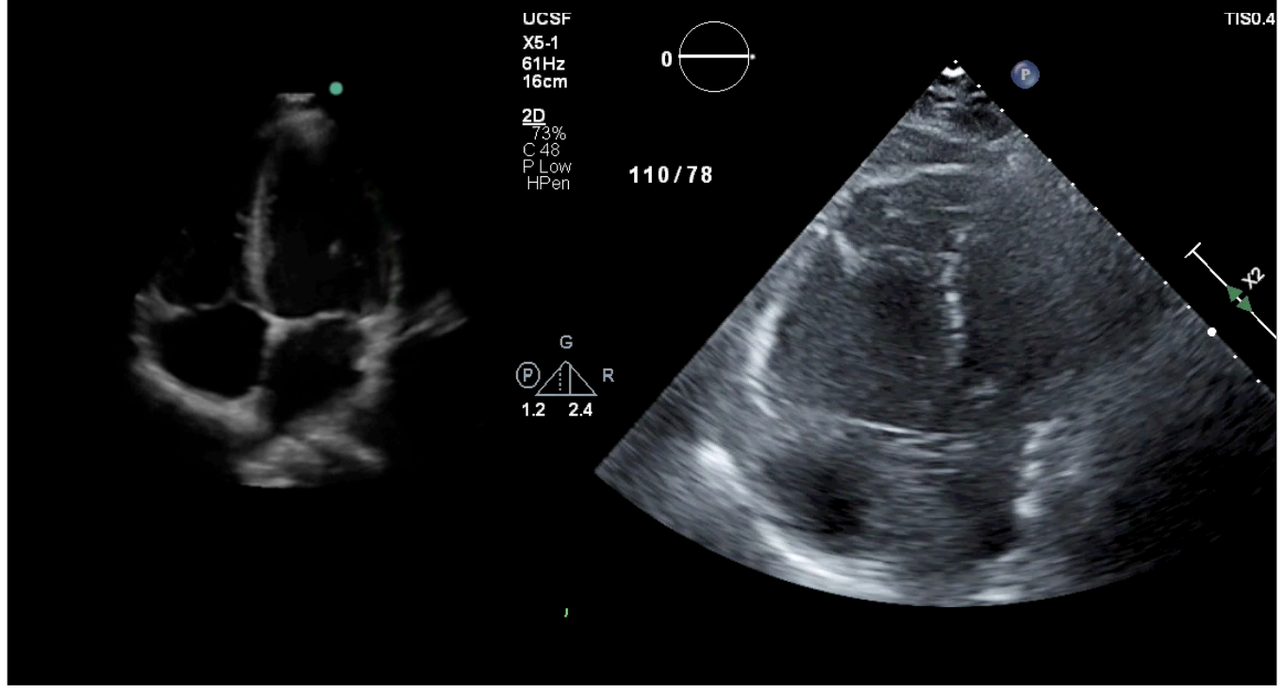

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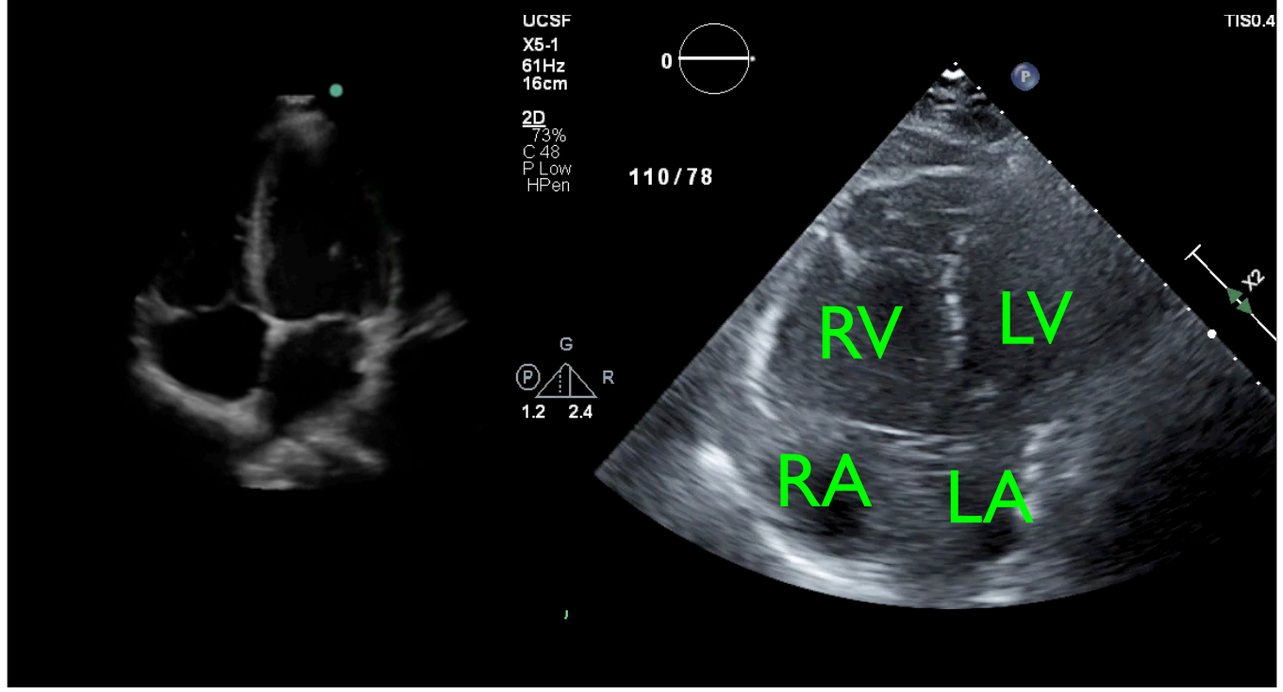

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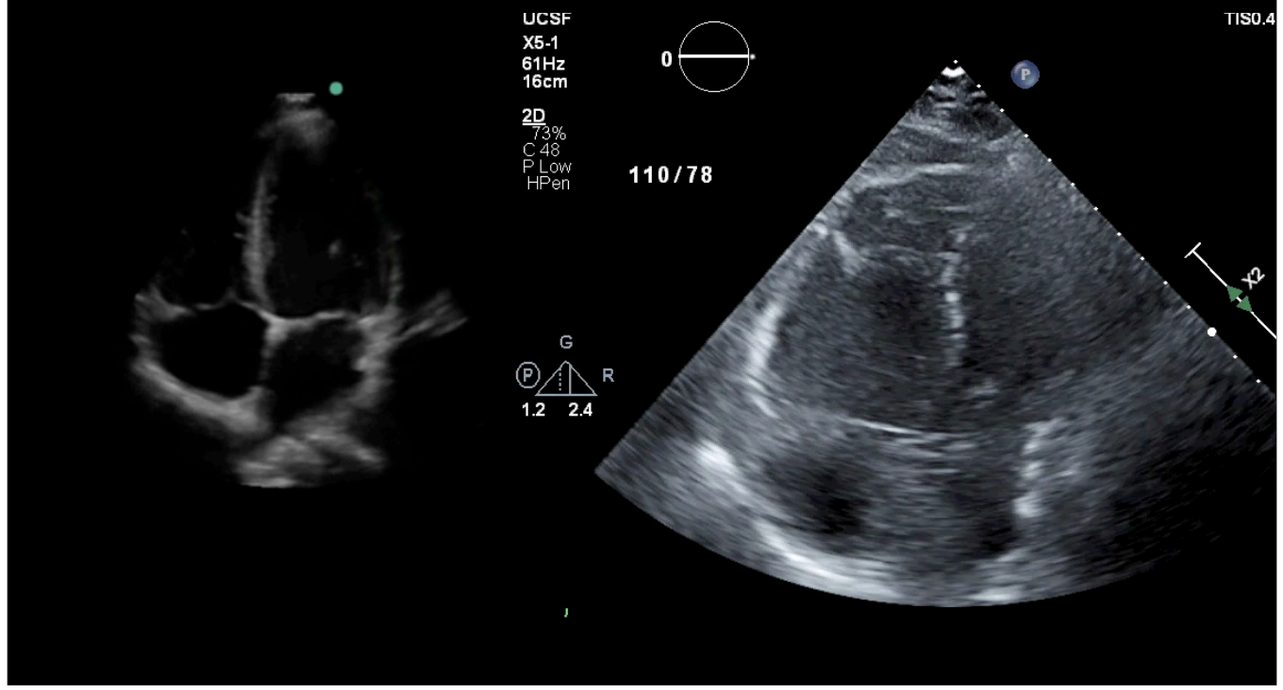

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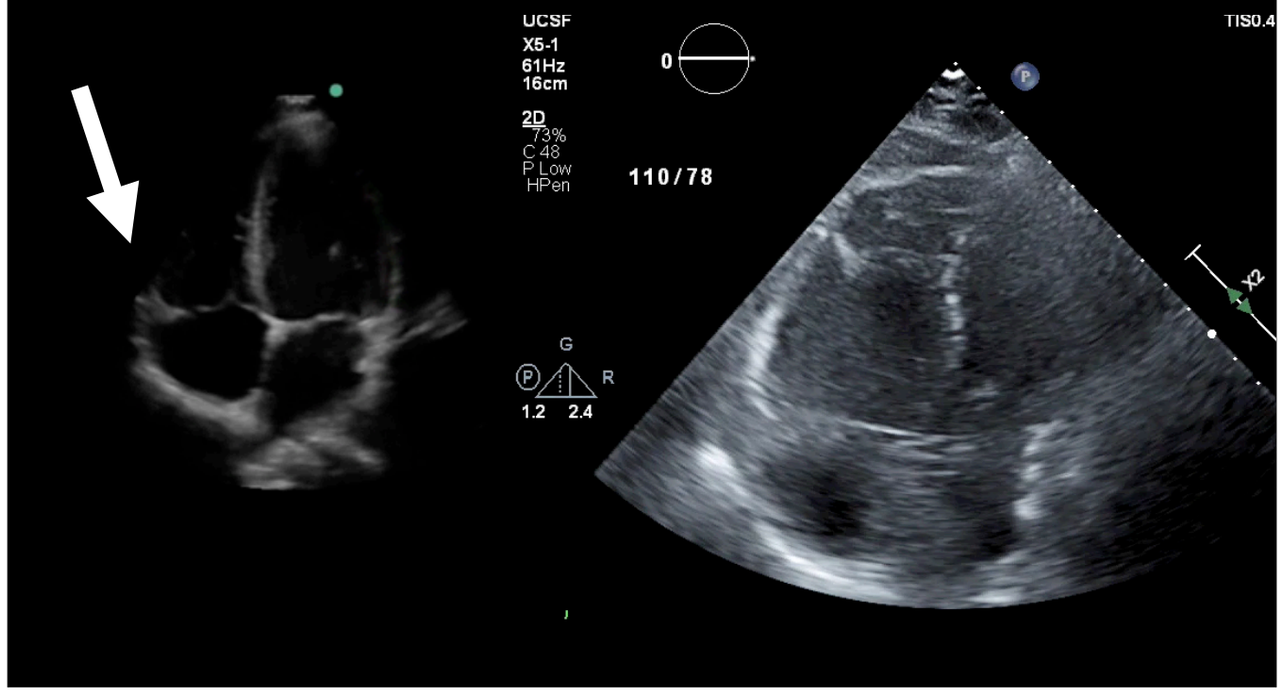

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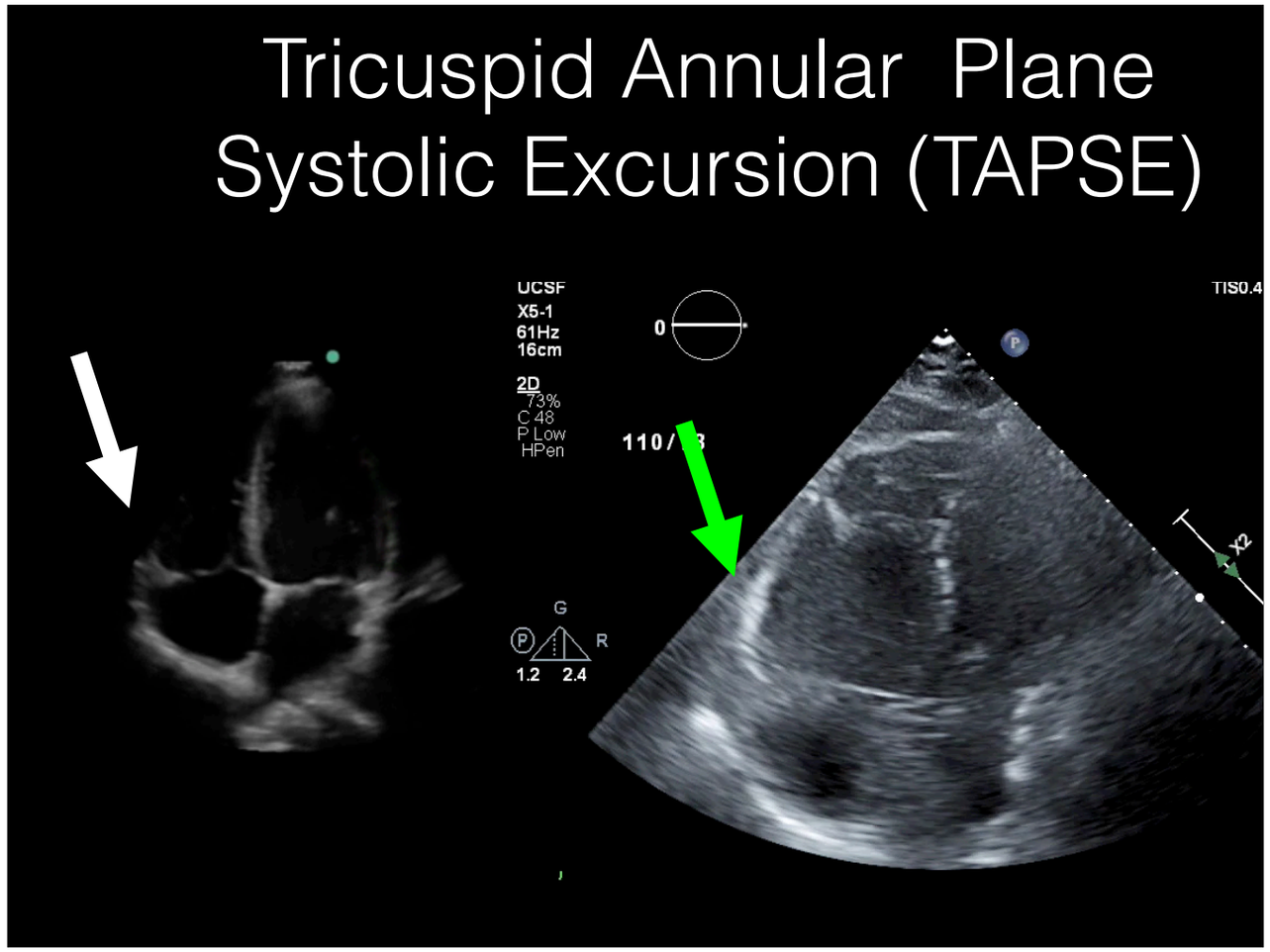

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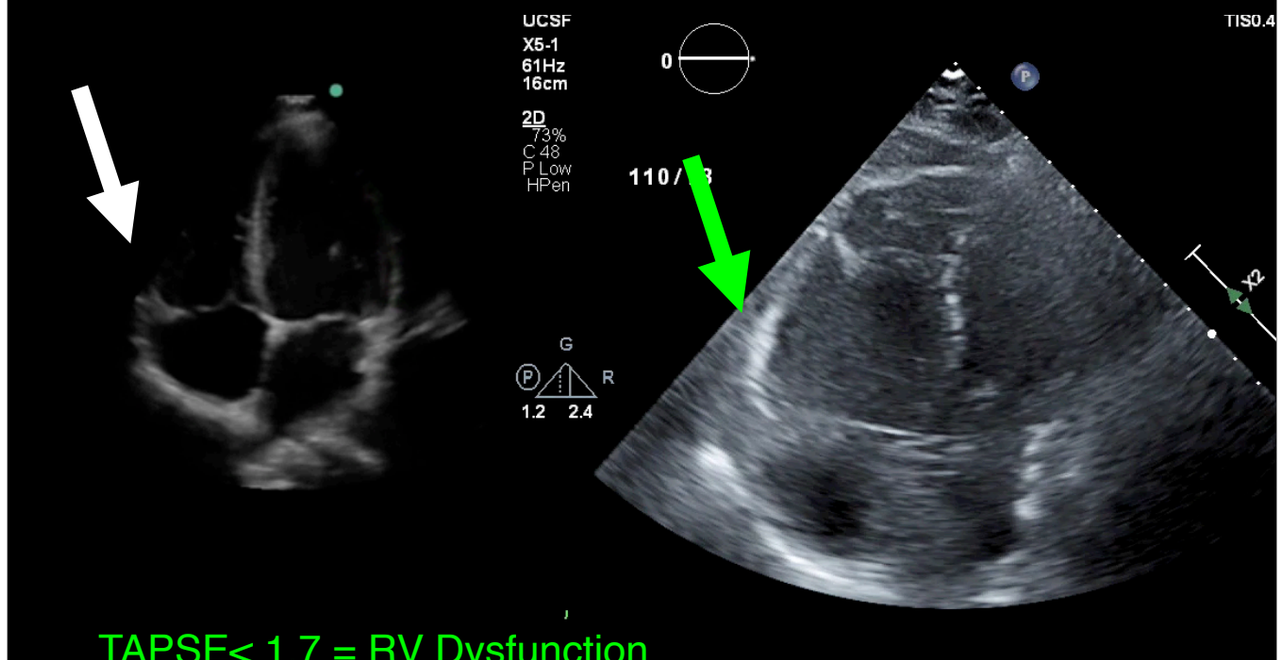
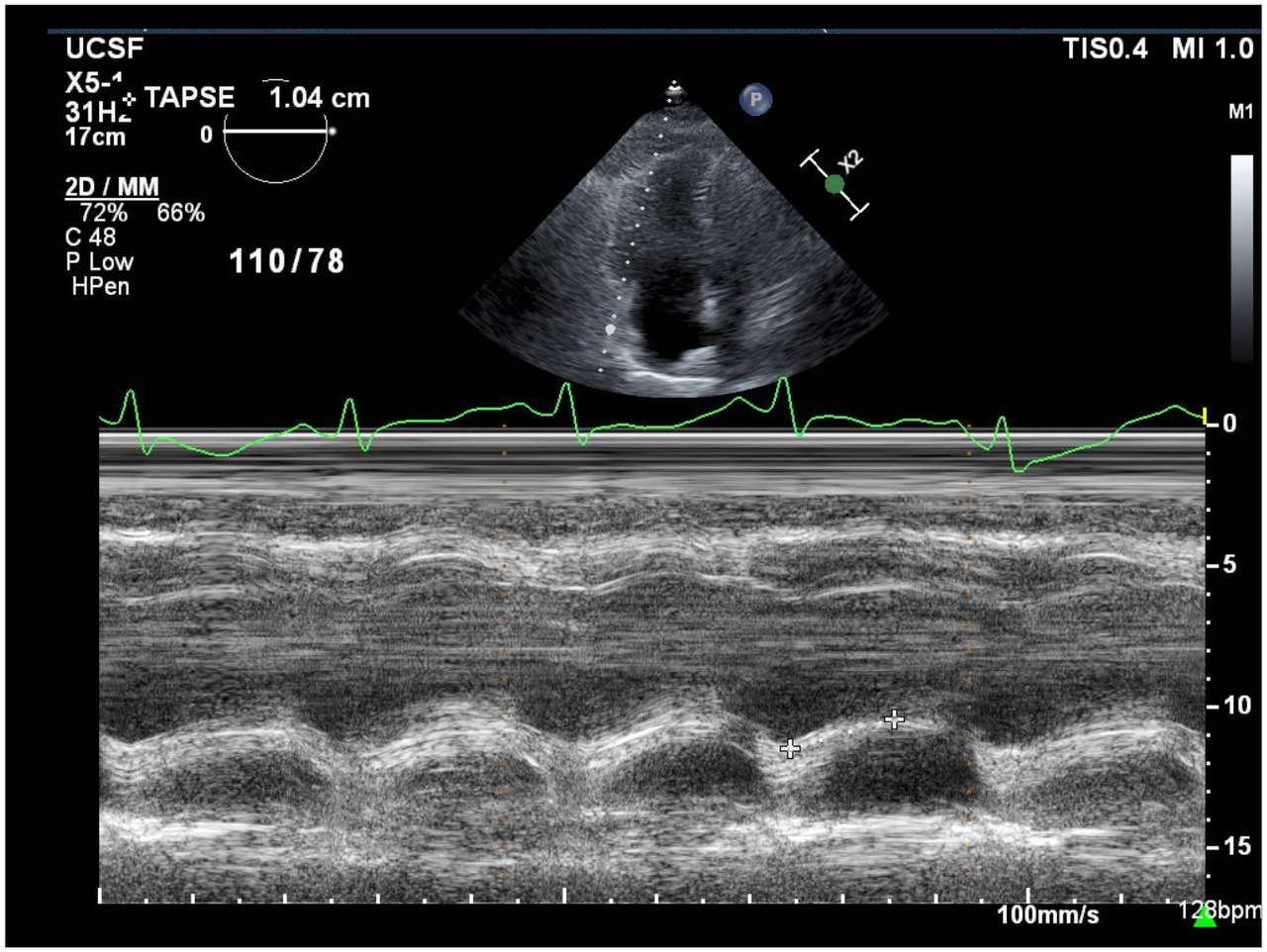
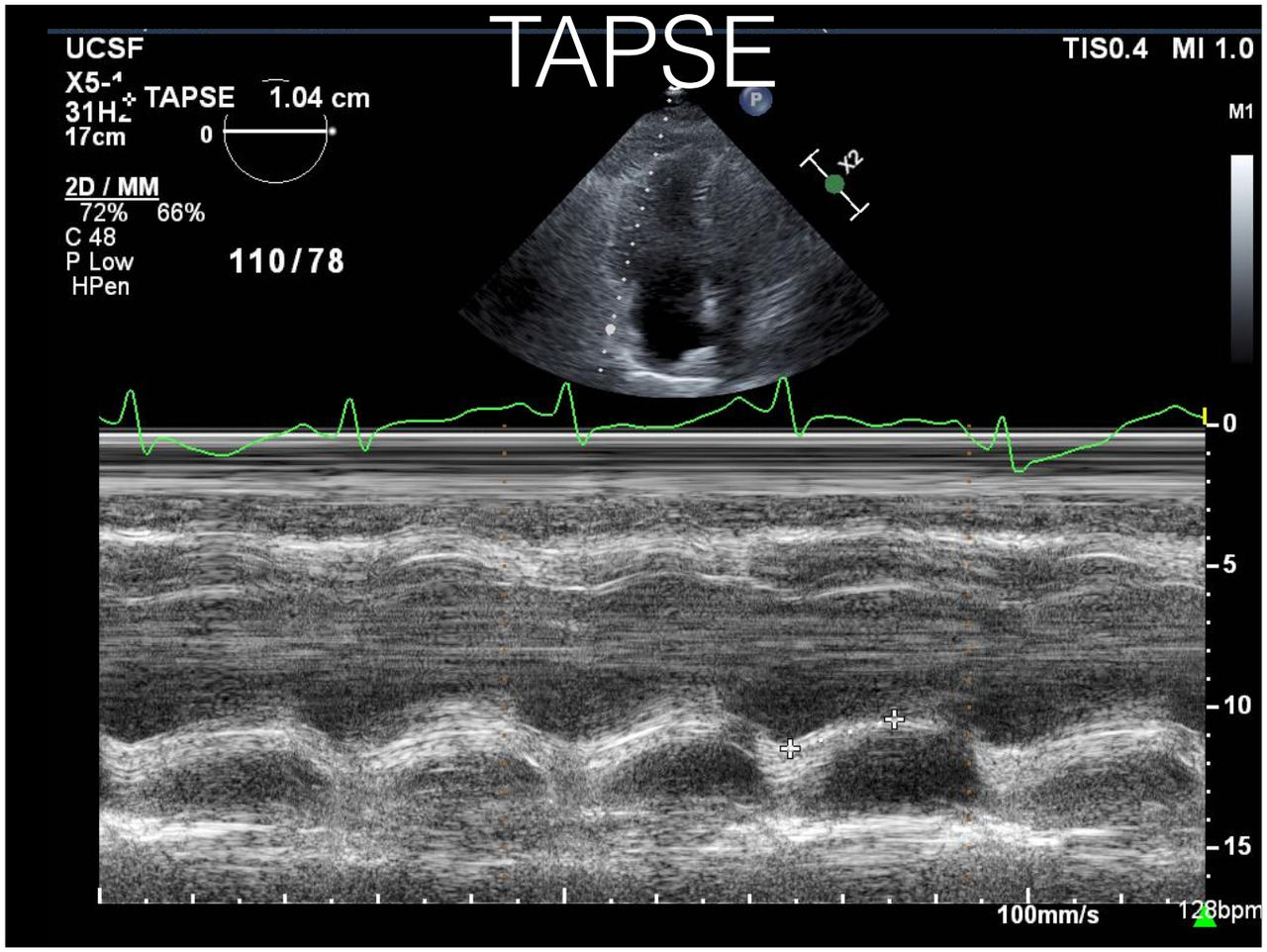
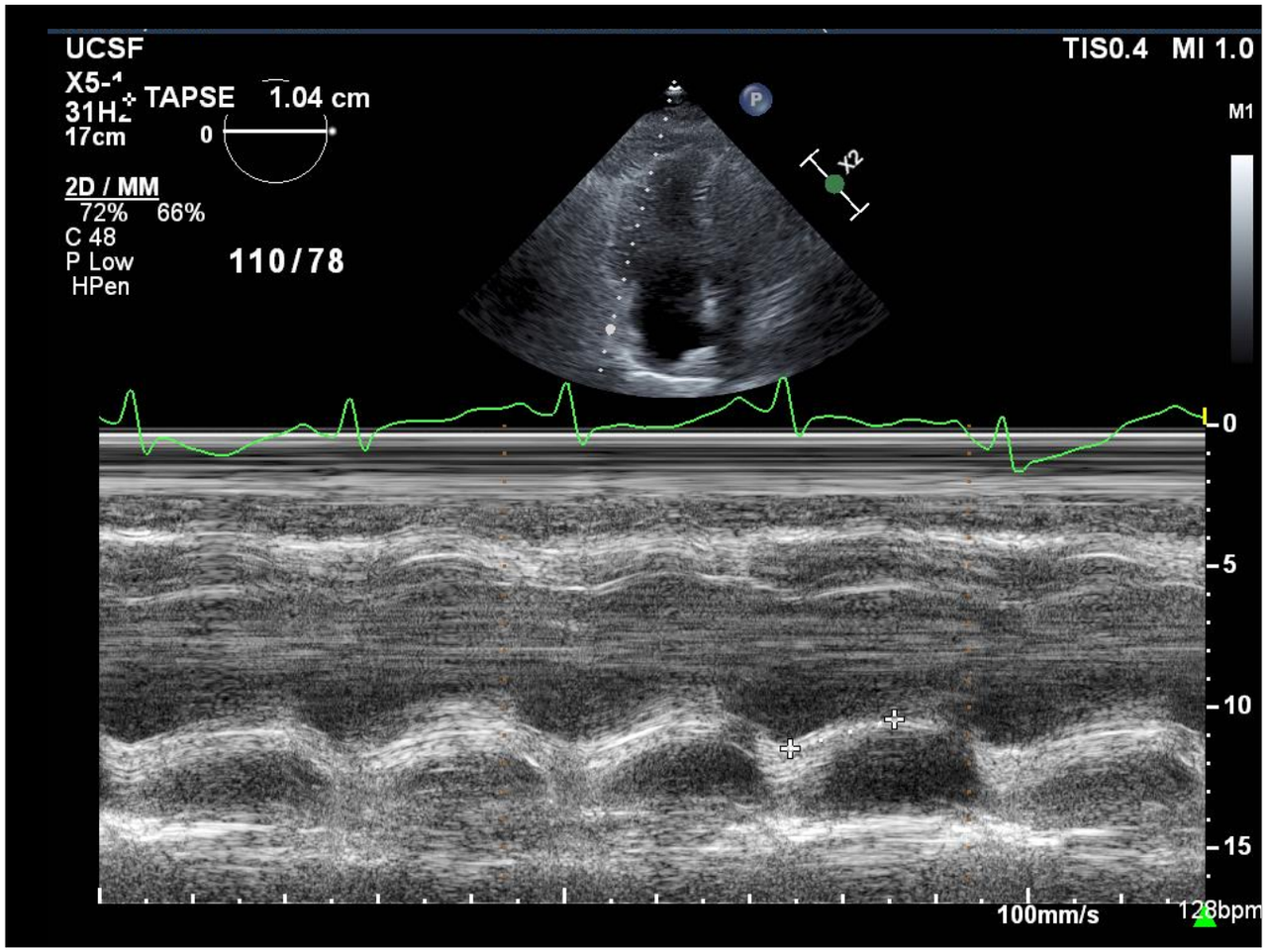



TAPSE< 1.7 = RV Dysfunction




TAPSE- 1.04 on Formal TTE


TAPSE
UCSF
TAPSE 1.04 cm
2D / MM
72% 66%
C 48
P Low
HPen
110/78
TIS0.4 MI 1.0
M1
0
5
10
15
100mm/s
128bpm


UCSF
TIS0.4 MI 1.0
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2D / MM
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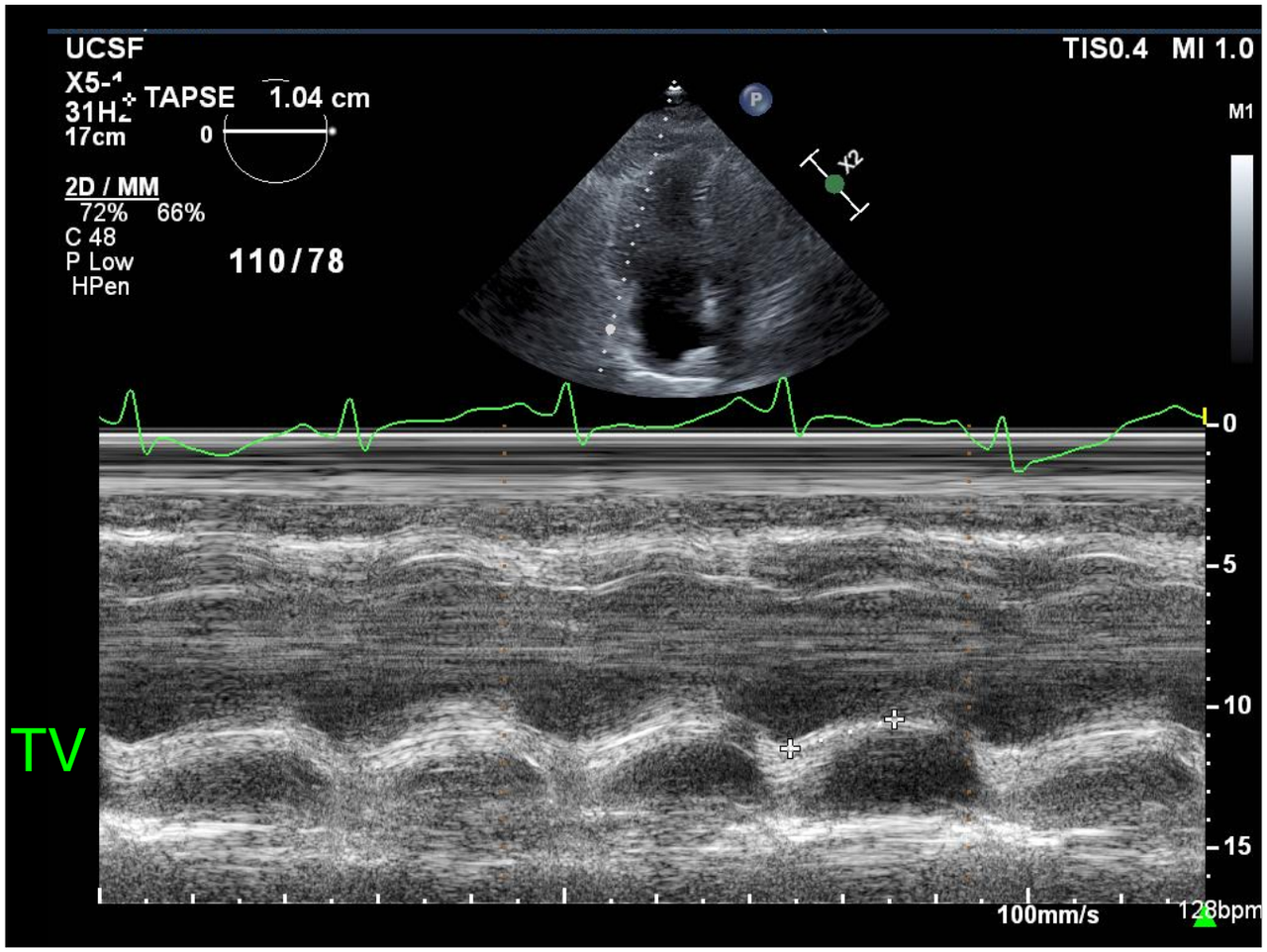
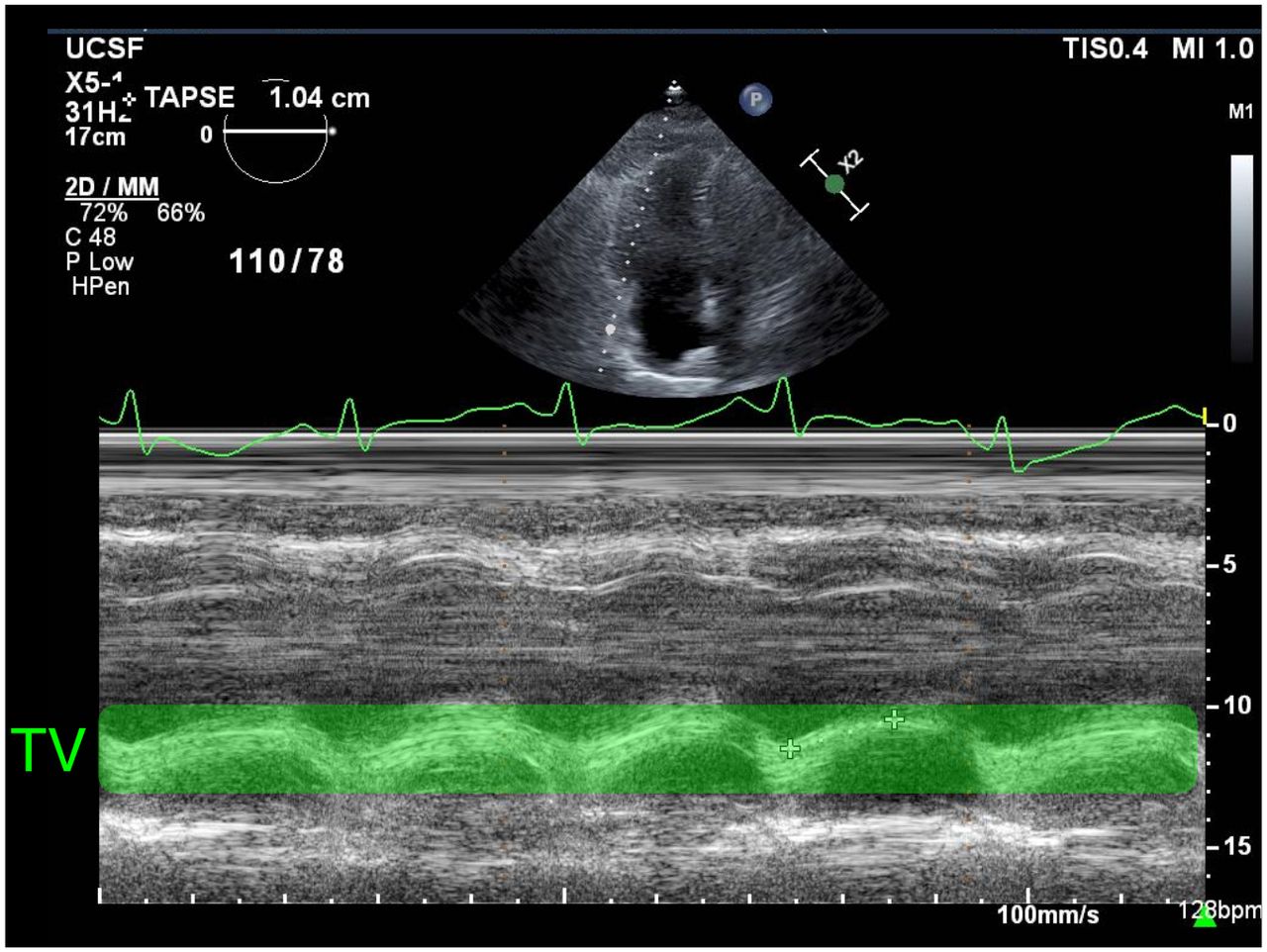
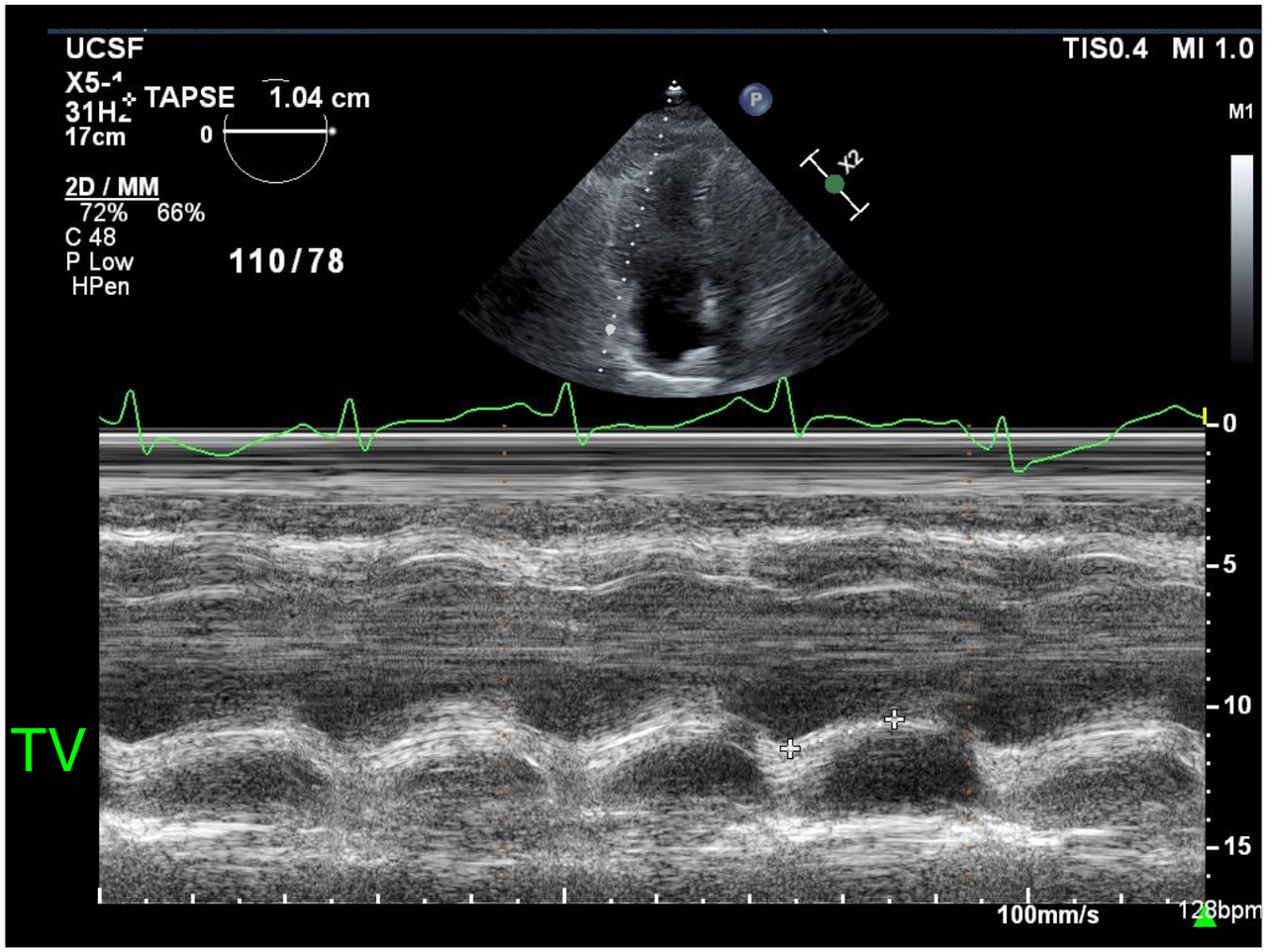
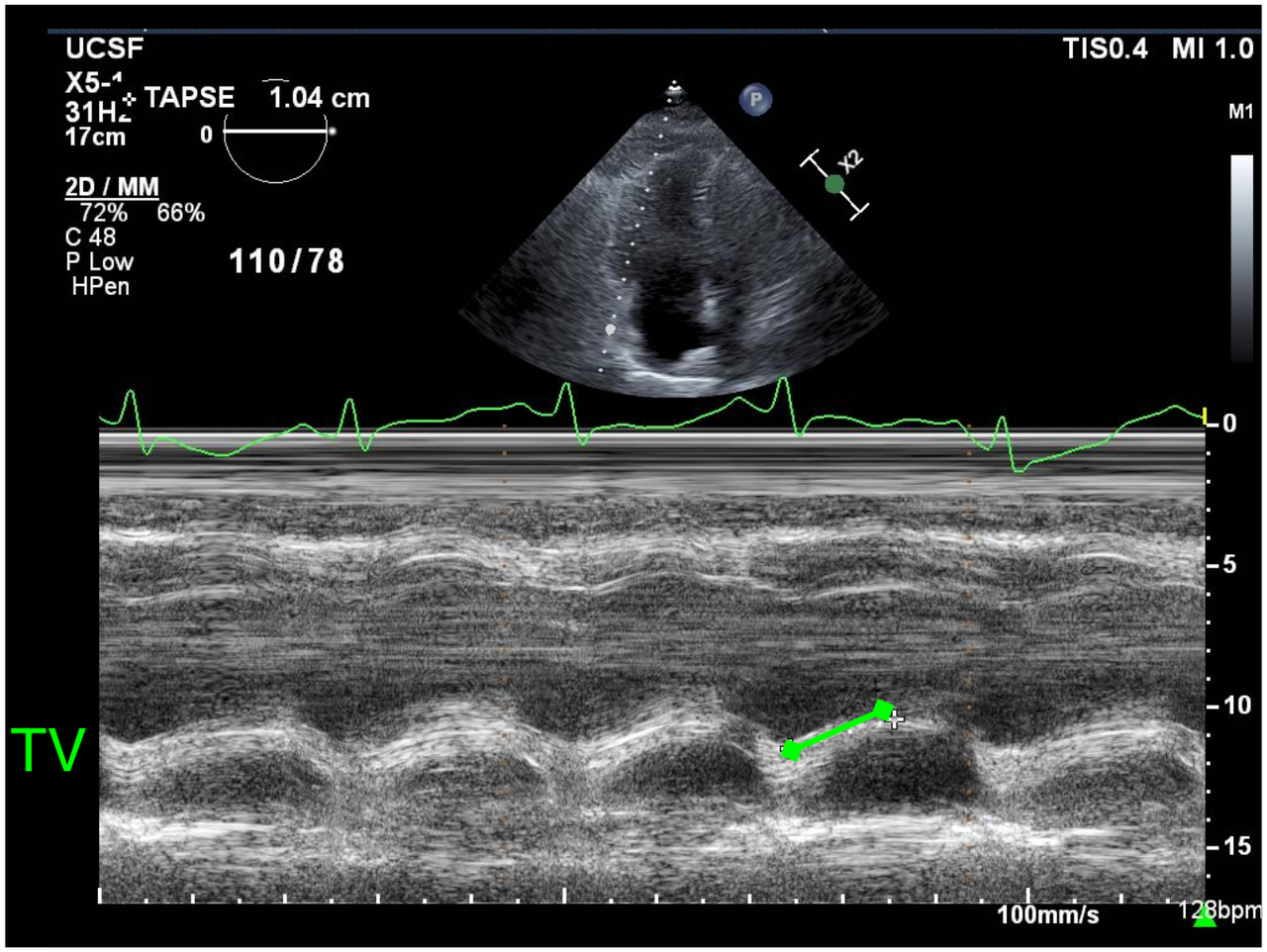

UCSF
TIS0.4 MI 1.0
TAPSE 1.04 cm
2D / MM
72% 66%
C 48
P Low
HPen
110/78
M1
TV
0
5
10
15
100mm/s
128bpm


UCSF
TIS0.4 MI 1.0
TAPSE 1.04 cm
17cm
2D / MM
72% 66%
C 48
P Low
HPen
110/78
M1
X2
TV
0
5
10
15
100mm/s
128bpm


UCSF
TIS0.4 MI 1.0
TAPSE 1.04 cm
2D / MM
72% 66%
C 48
P Low
HPen
110/78
M1
TV
0
5
10
15
100mm/s
128bpm


UCSF
TIS0.4 MI 1.0
TAPSE 1.04 cm
17cm
2D / MM
72% 66%
C 48
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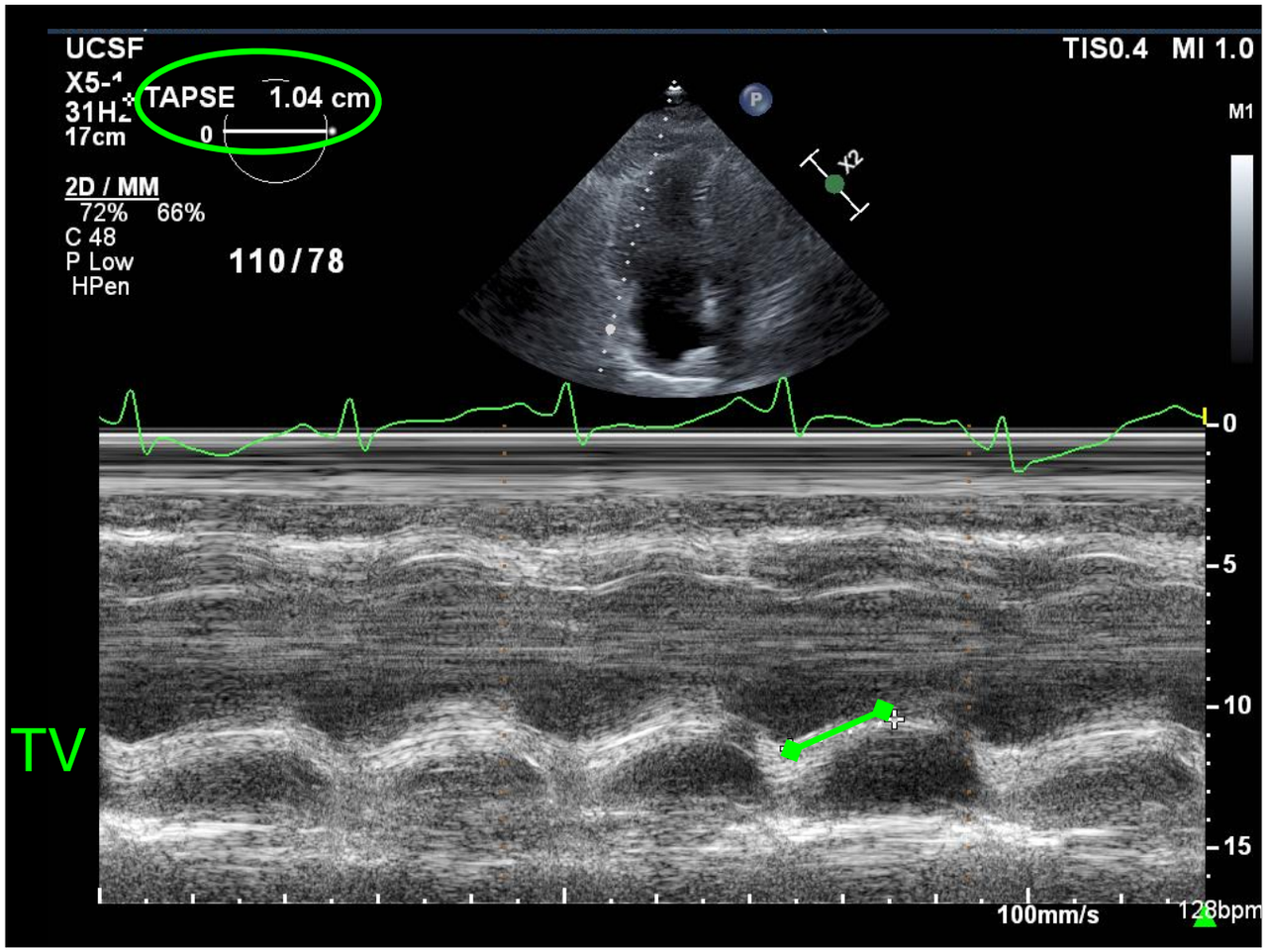
UCSF
TAPSE 1.04 cm
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10
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100mm/s
128bpm

ORIGINAL INVESTIGATION

# Prognostic Value of Echocardiographically Assessed Right Ventricular Dysfunction in Patients With Pulmonary Embolism

*Marije ten Wolde, MD; Maaike Söhne, MD; Elske Quak, MD; Melvin R. Mac Gillavry, MD; Harry R. Büller, MD*

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ORIGINAL ARTICLE

# Prognostic significance of tricuspid annular displacement in normotensive patients with acute symptomatic pulmonary embolism

J. L. LOBO,* A. HOLLEY,† V. TAPSON,‡ L. MOORES,§ M. ORIBE,¶ M. BARRÓN,** R. OTERO,†† D. NAUFFAL,‡‡ R. VALLE,§§ M. MONREAL,¶¶ R. D. YUSEN*** and D. JIMÉNEZ,††† FOR THE PROTECT AND THE RIETE INVESTIGATORS

ORIGINAL INVESTIGATION

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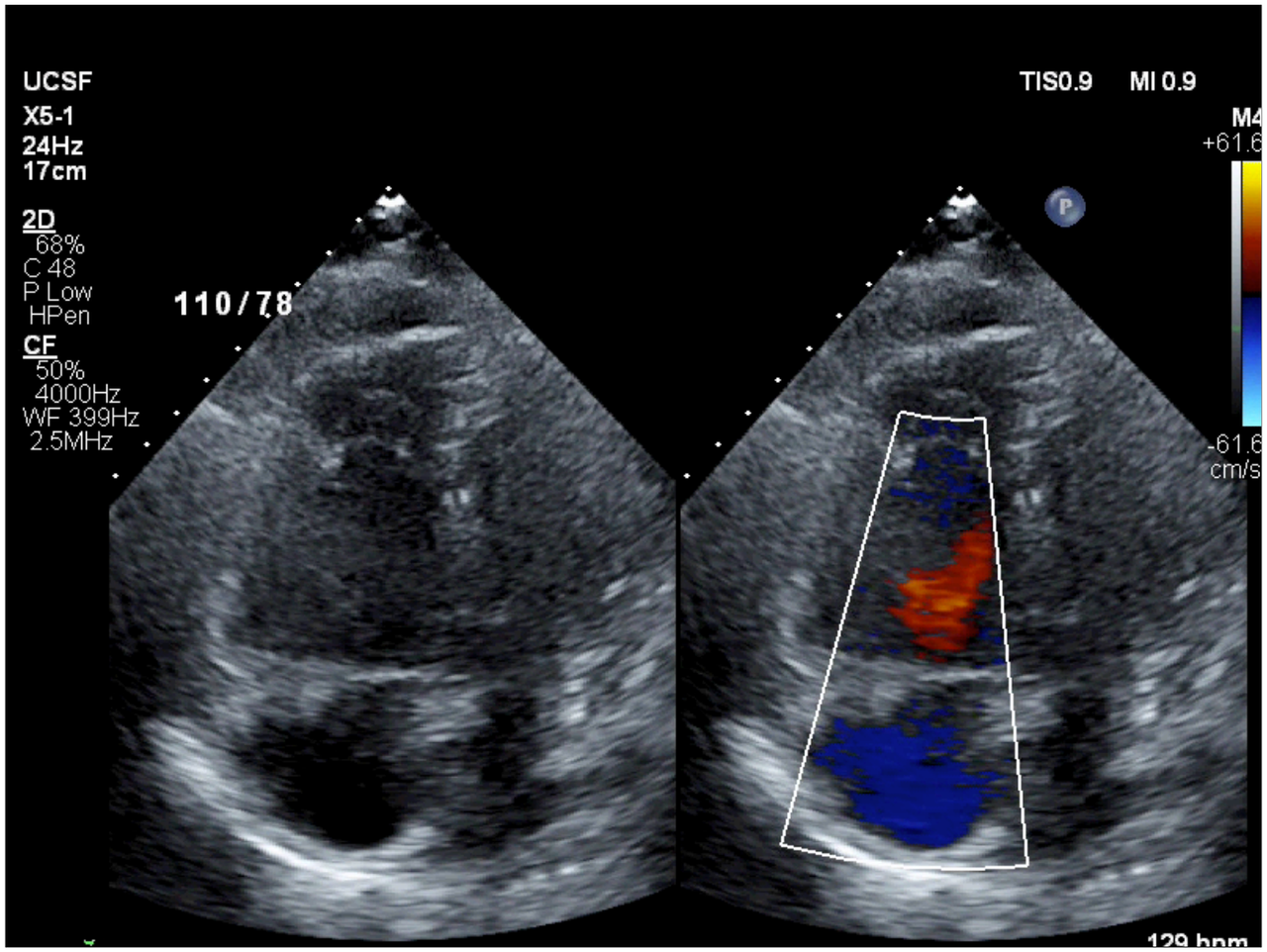
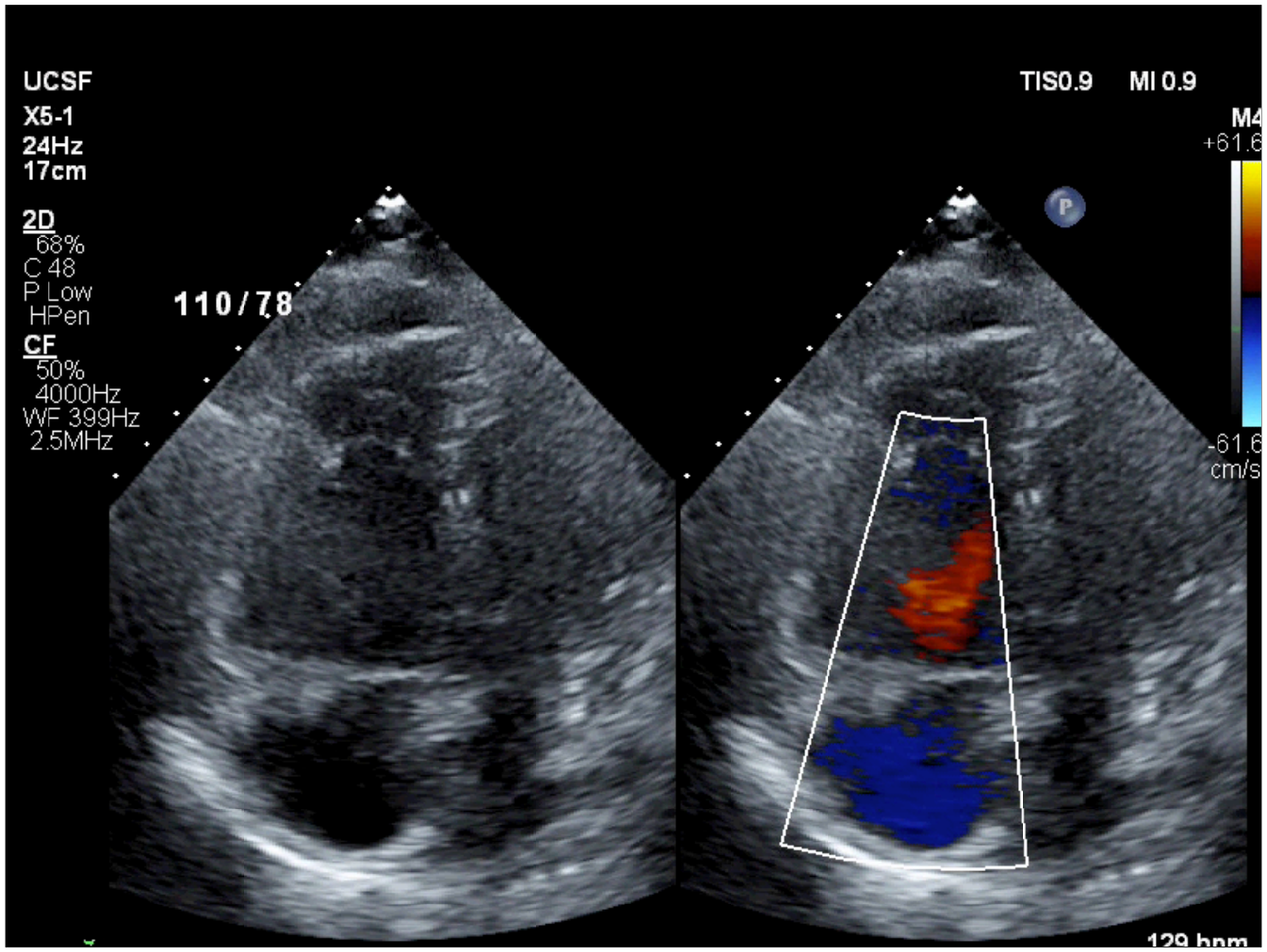
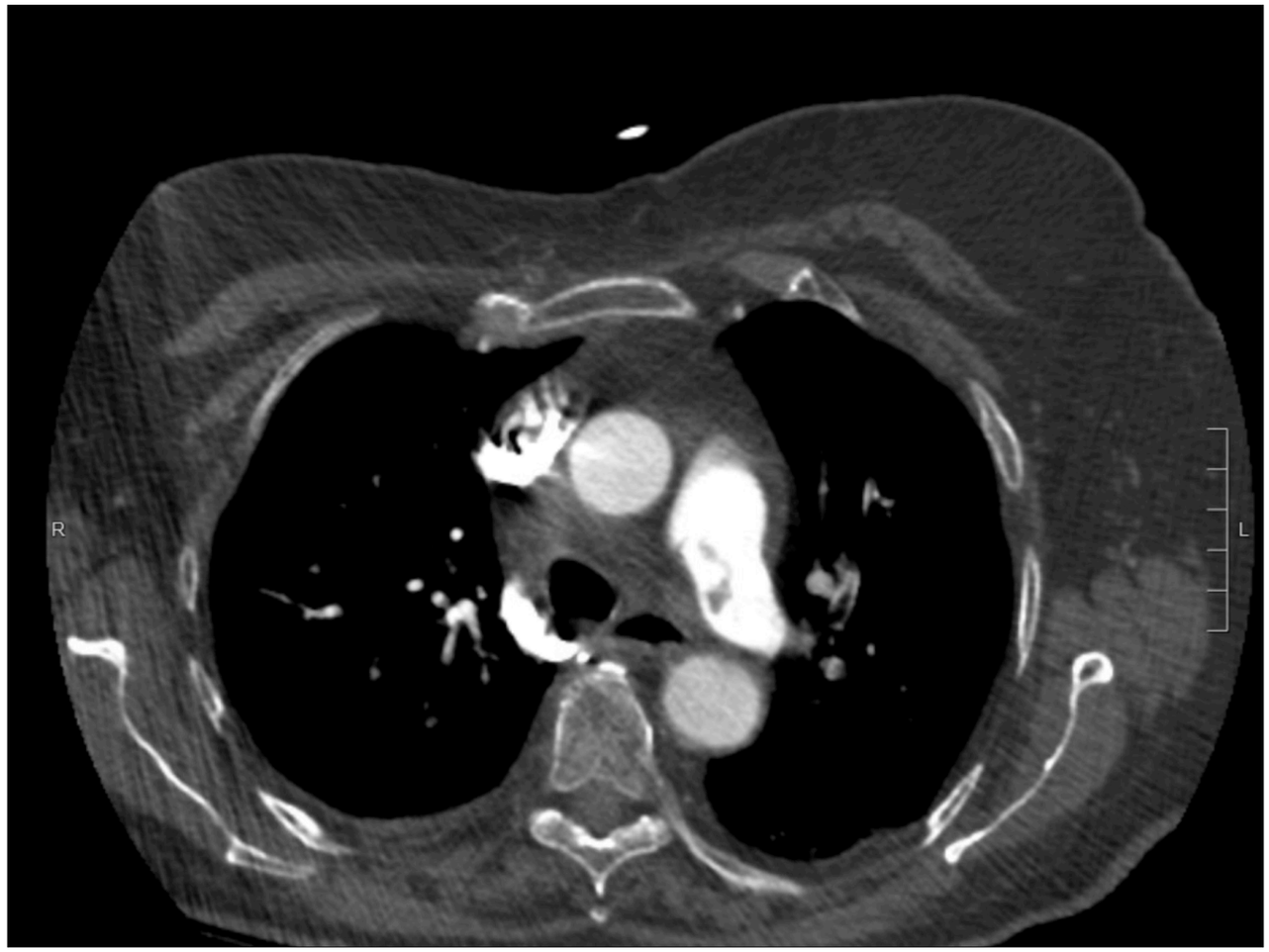
# Tricuspid Annular Plane of Systolic Excursion to Prognosticate Acute Pulmonary Symptomatic Embolism (TAPSEPAPSE Study)

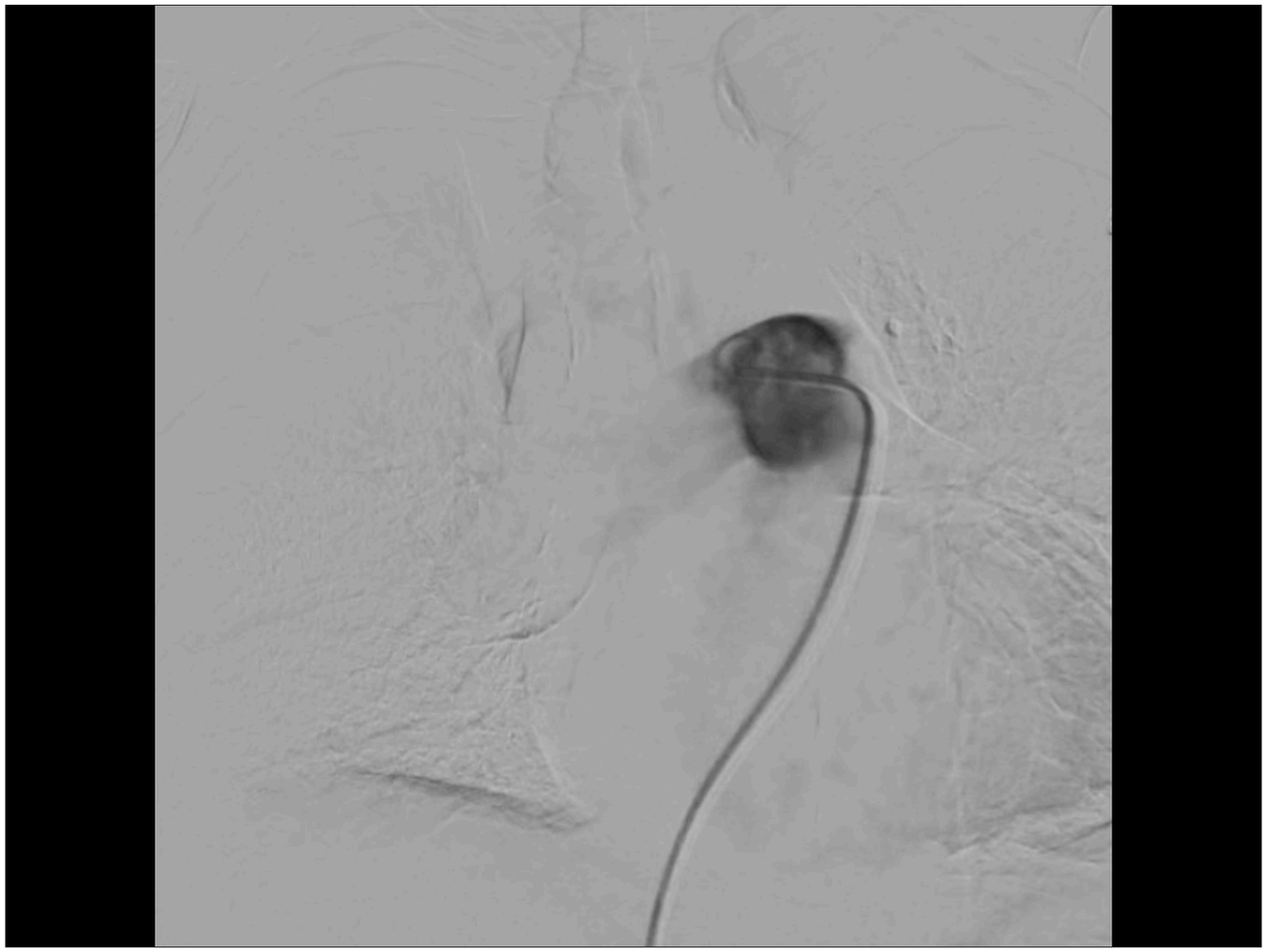
***Shadi Lahham, MD, MS, John C. Fox, MD, Maxwell Thompson, MD, Tanyaporn Nakornchai, MD, Badriah Alruwaili, MBBS, Ghadeer Doman, MBBS, Shannon May Lee, BS, Amal Shafi, BS, Inna Shniter, MD, Victoria Valdes, BS, Lishi Zhang, MS***



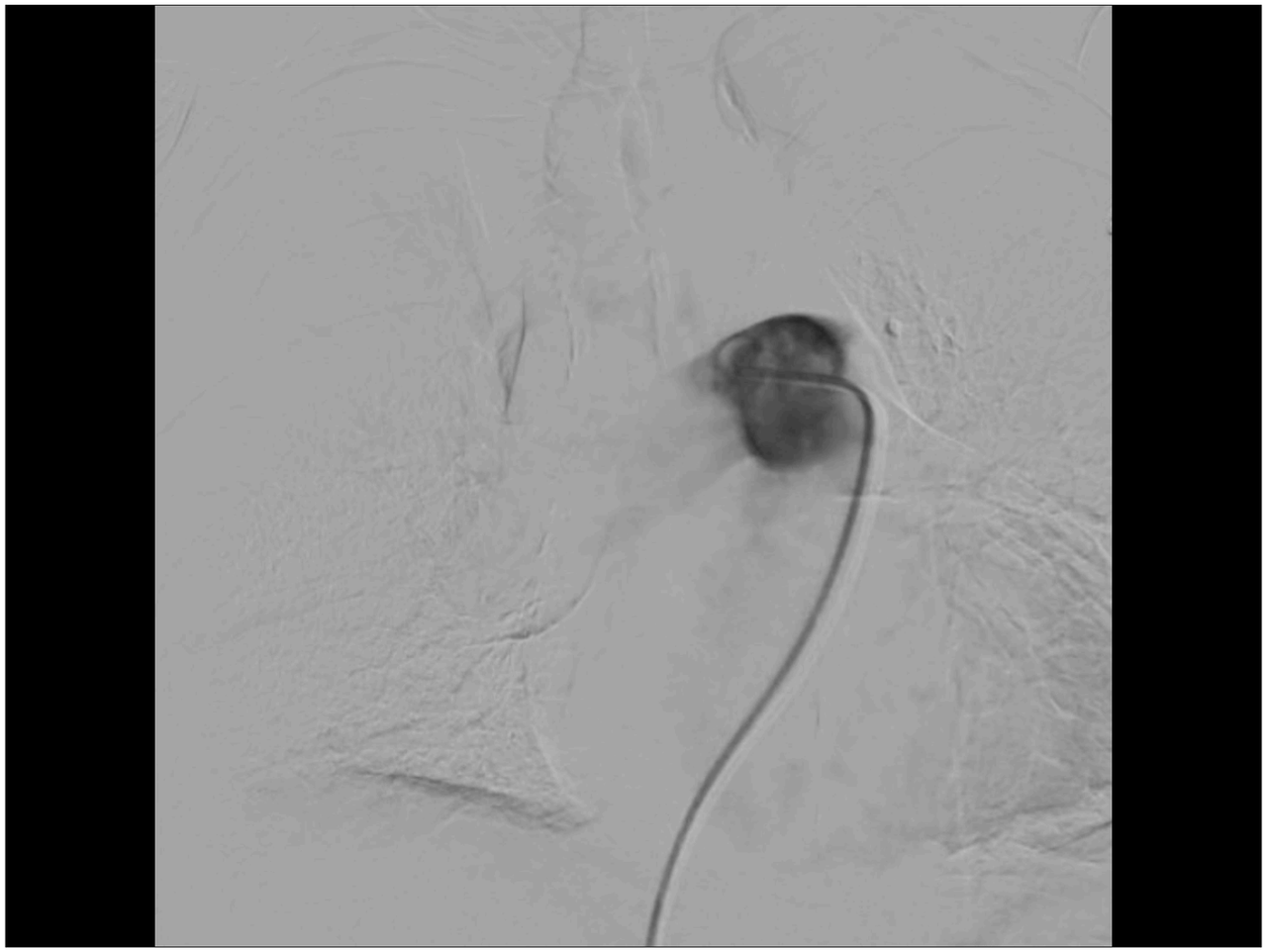

TR
BART
Blood regurgitating back into RA


UCSF
X5-1
24Hz
17cm
2D
68%
C 48
P Low
HPen
CF
50%
4000Hz
WF 399Hz
2.5MHz
110/78
TIS0.9
MI 0.9
M4
+61.6
-61.6
cm/s
129 bpm

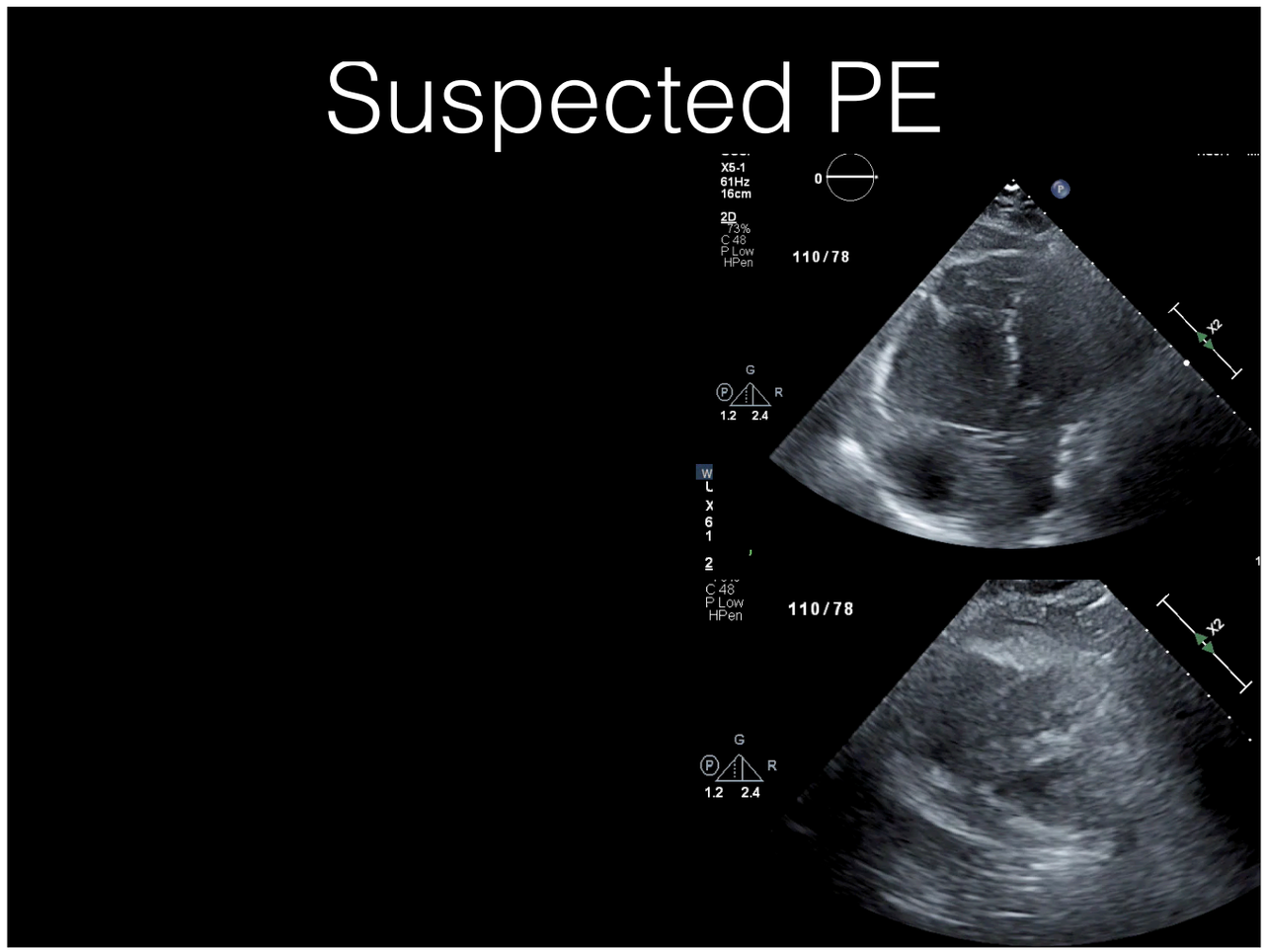

R
L



No improvement on Heparin gtt
Pulm Catheterization
Embolectomy



# Suspected PE



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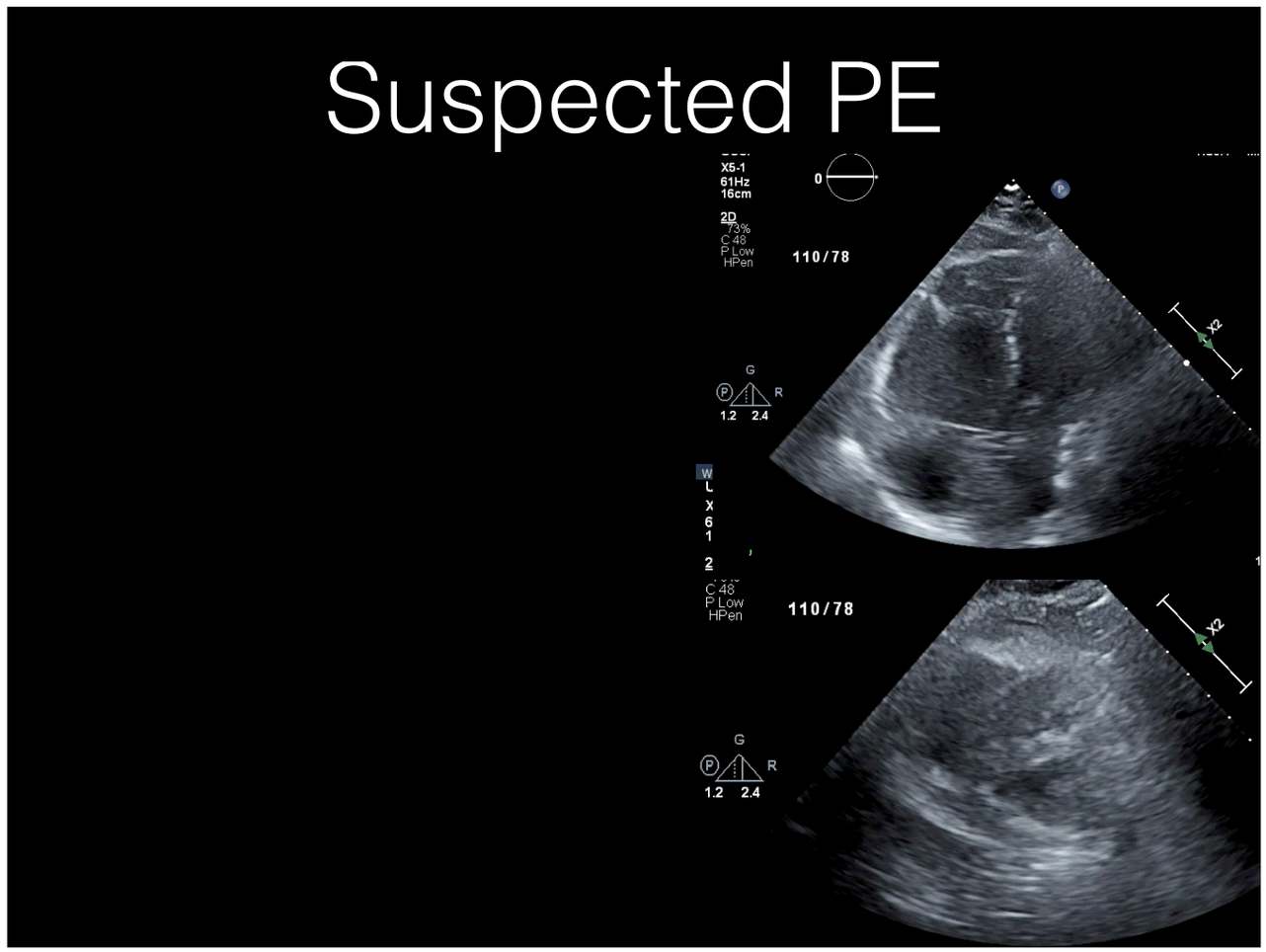
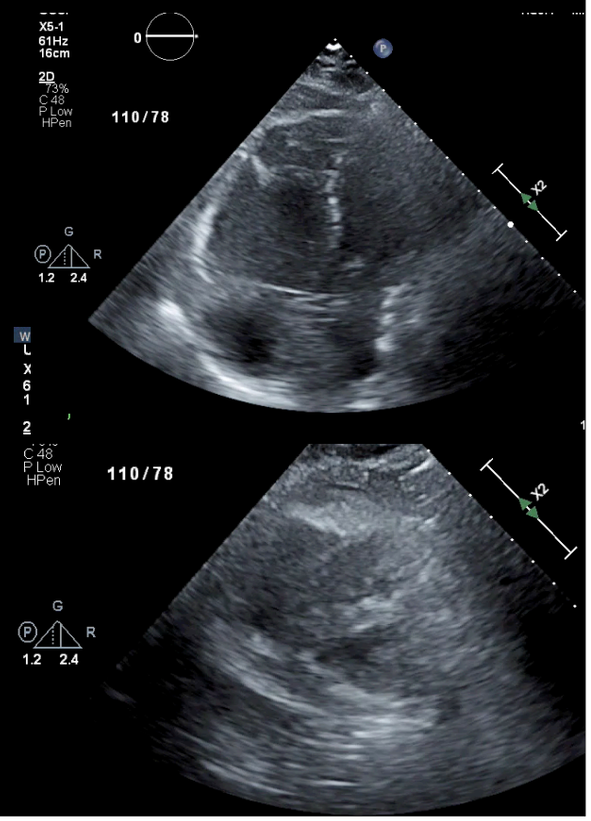


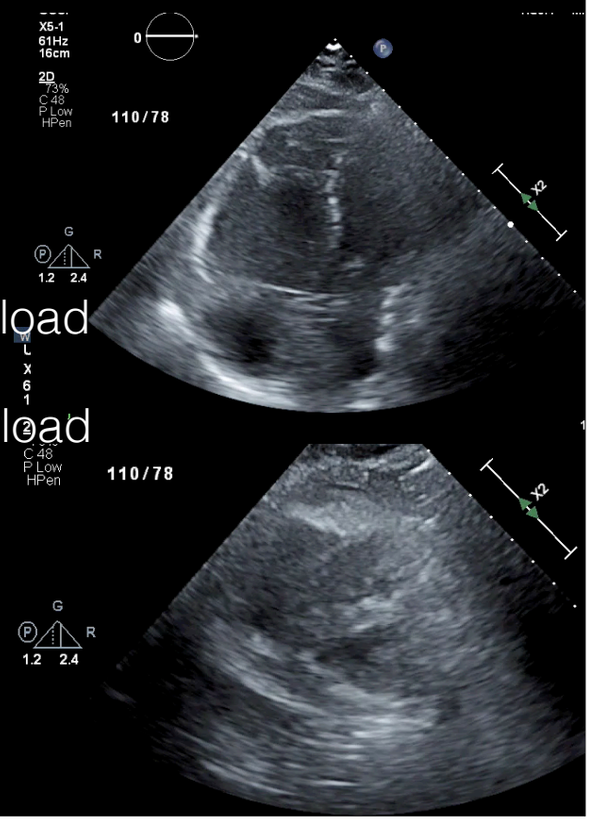
# Suspected PE

- RV enlargement



# Suspected PE

- RV enlargement
- D-shaped Septum
  - Systole= Pressure Overload
  - Diastole = Volume Overload



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- D-shaped Septum
  - Systole= Pressure Overload
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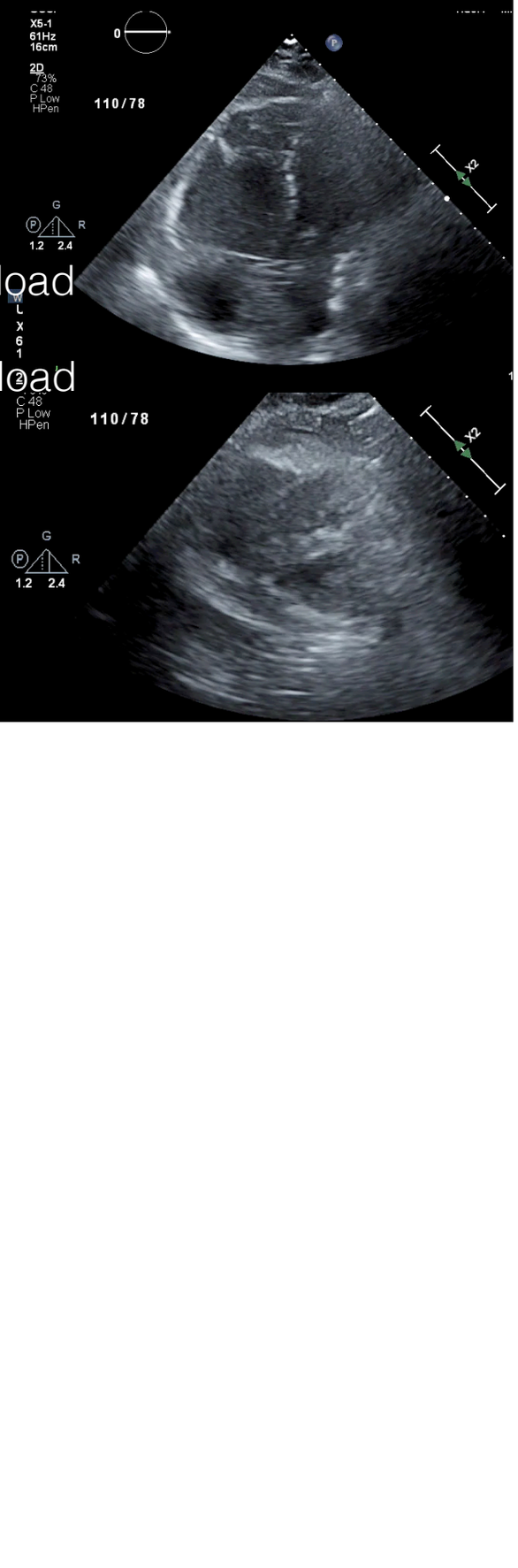
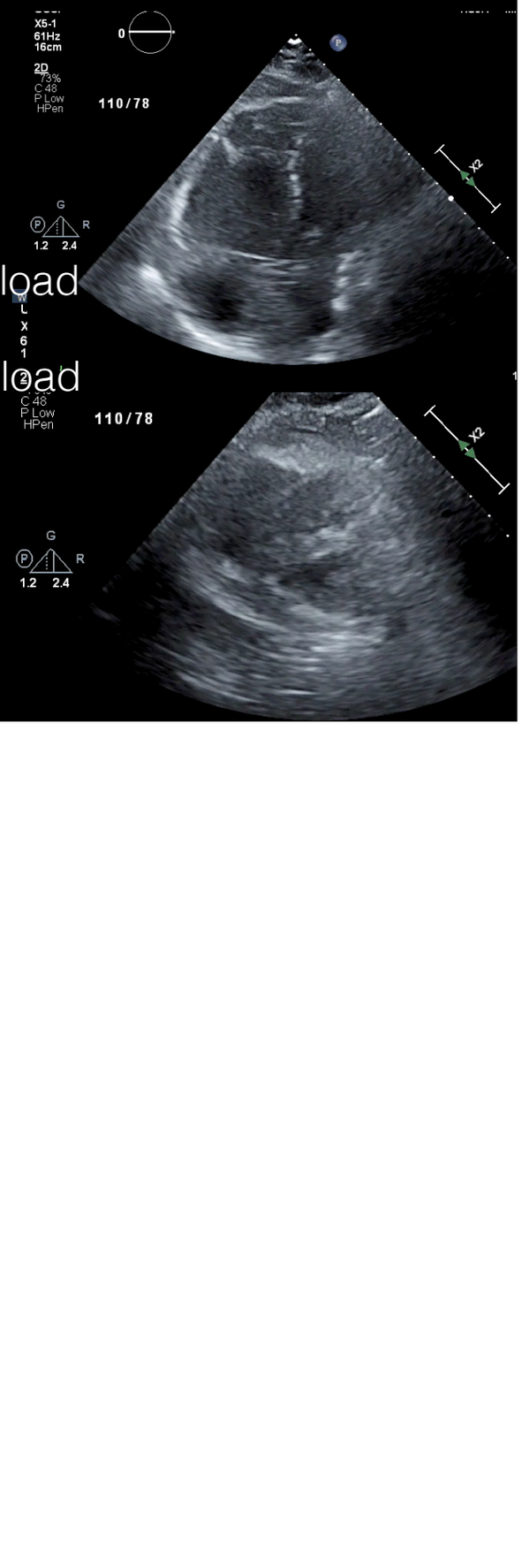
- RV Dysfunction (TAPSE)



# Suspected PE

- RV enlargement
- D-shaped Septum
  - Systole= Pressure Overload
  - Diastole = Volume Overload
- McConnell's Sign
- RV Dysfunction (TAPSE)
- Tricupsid Regurgitation



# Case

- 65 y/o ♂ h/o cerebral aneurysm BIBA with jaw pain radiating to chest. EMS noted Slurred speech and RLE weakness.

VS: 36.6 99/50 80 20 100%RA

Extr: RLE with non-palpable DP pulse

Neuro: RLE with flaccid paralysis and ↓ sensation.

What is the POCUS dissection evaluation protocol?

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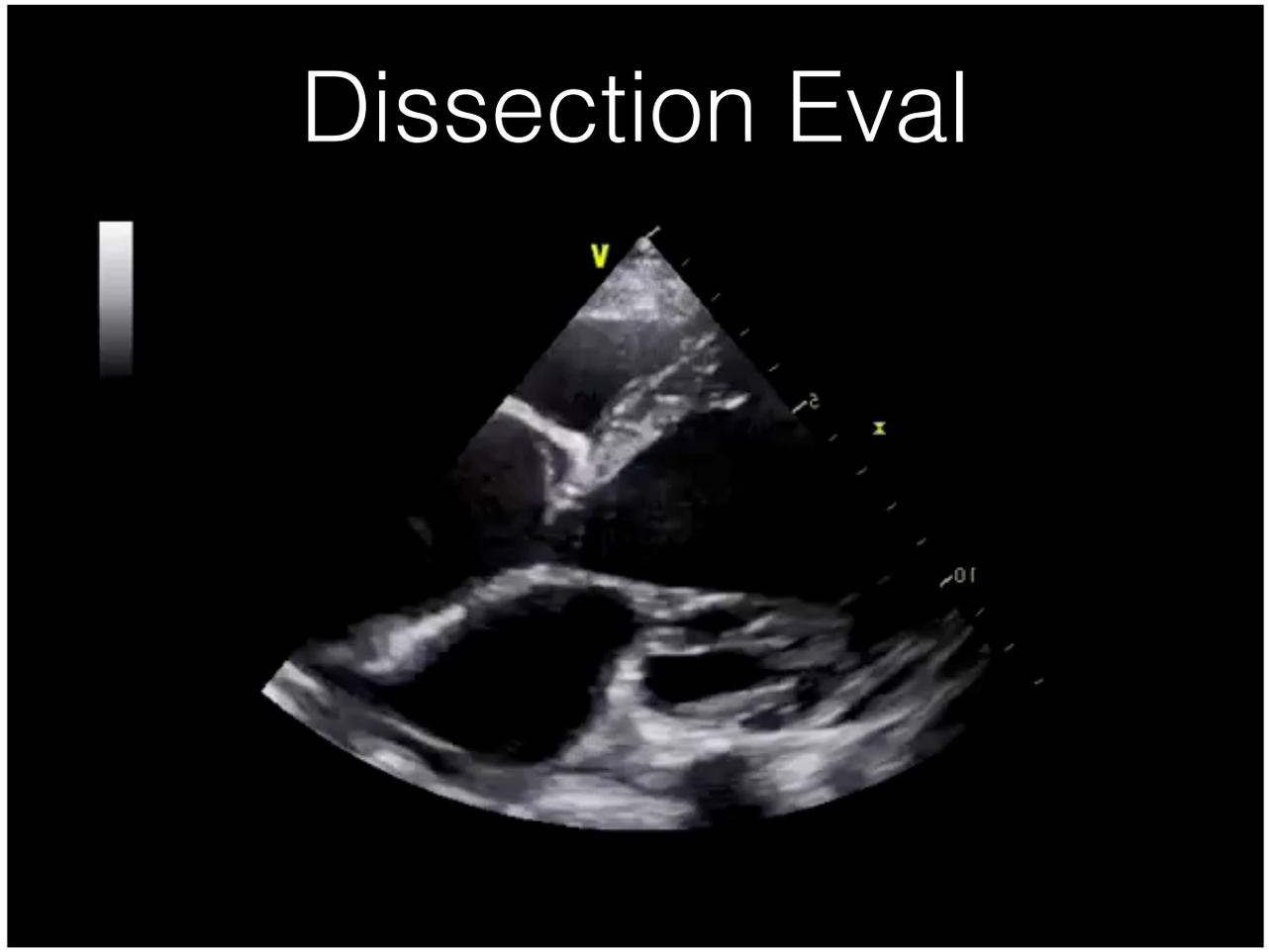
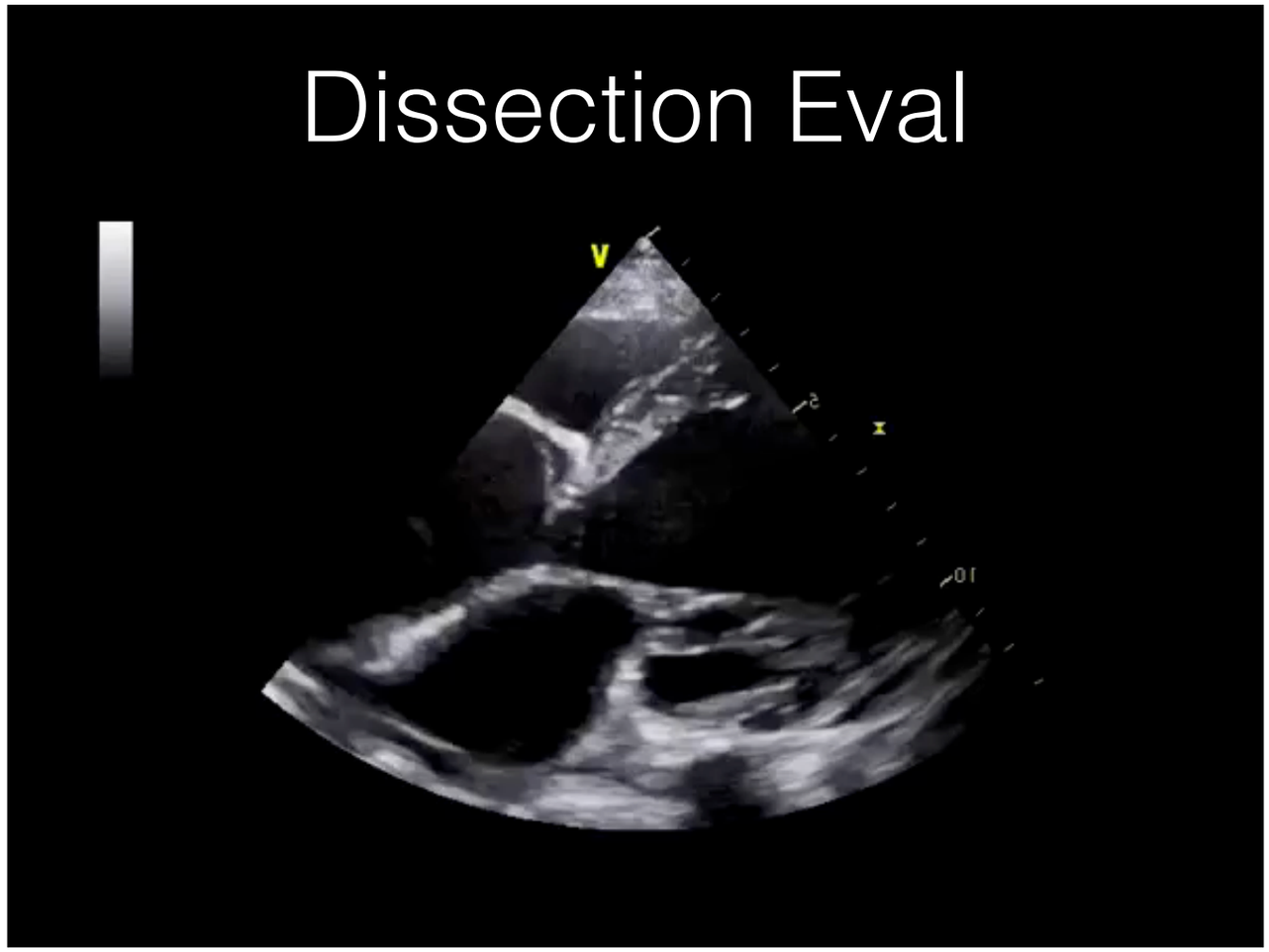
- ***Parasternal Long Cardiac View***
- ***Suprasternal Notch View***
- ***Abdominal Aorta Evaluation***

# Dissection Eval



# Dissection Eval



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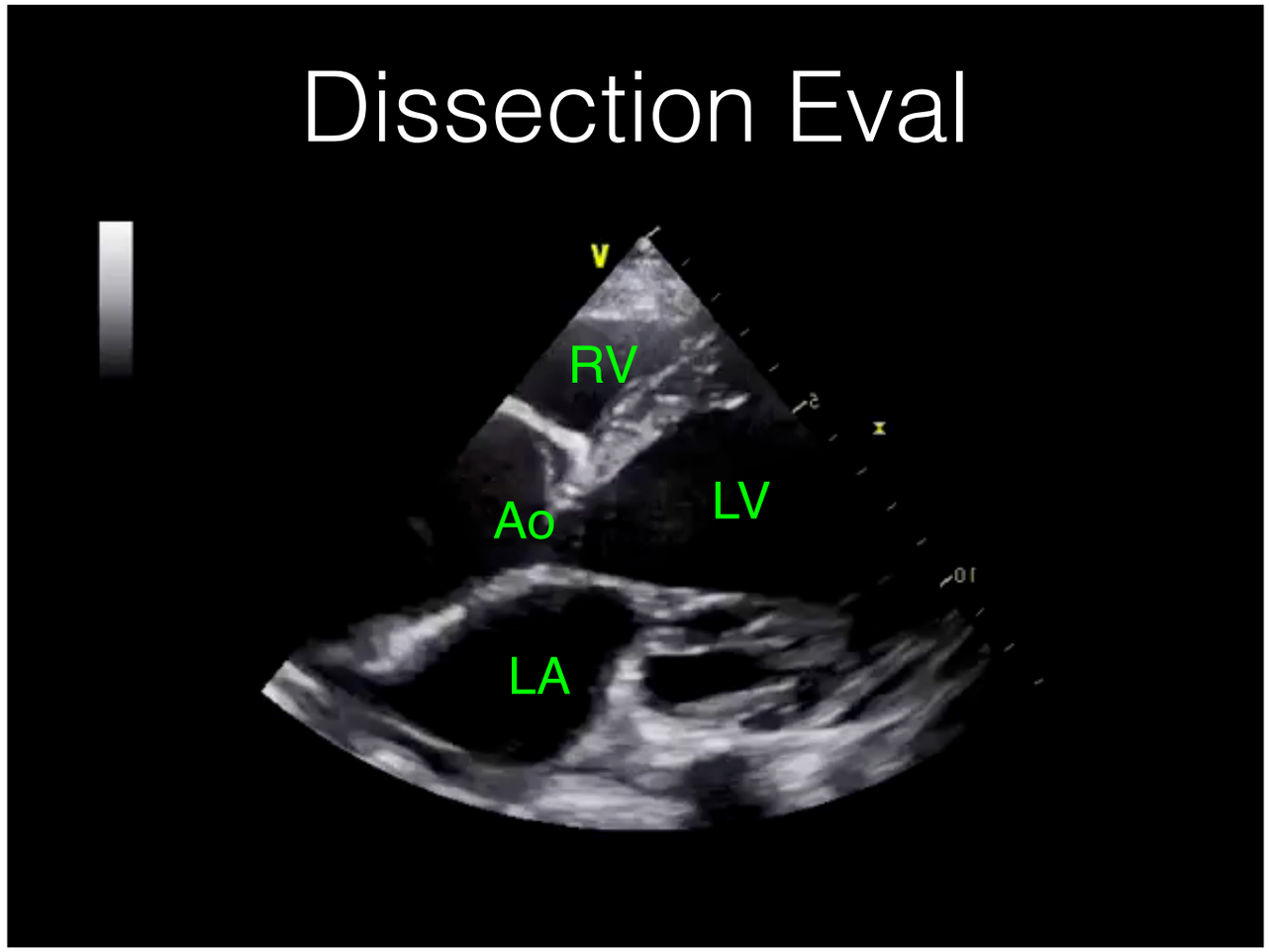

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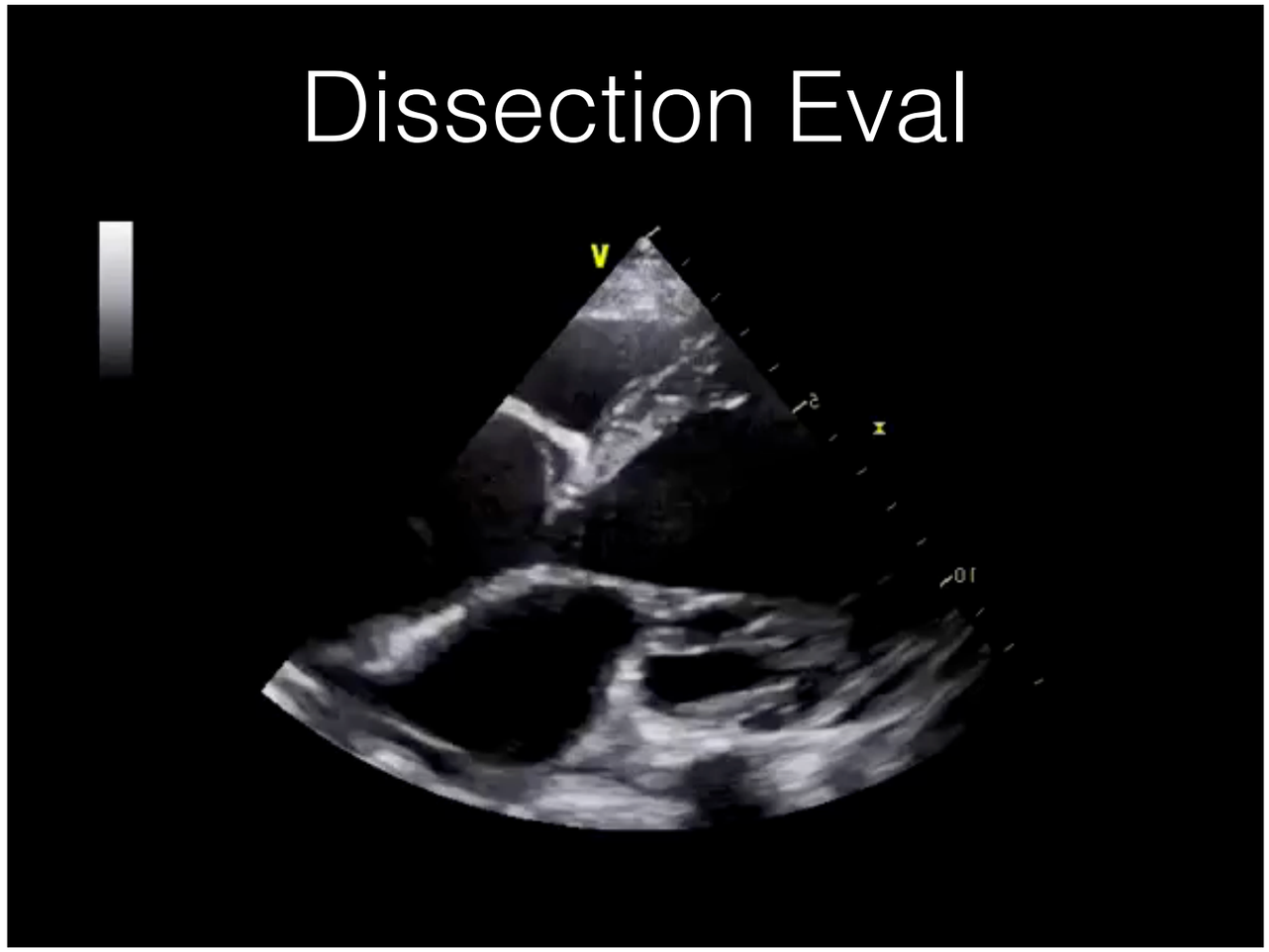

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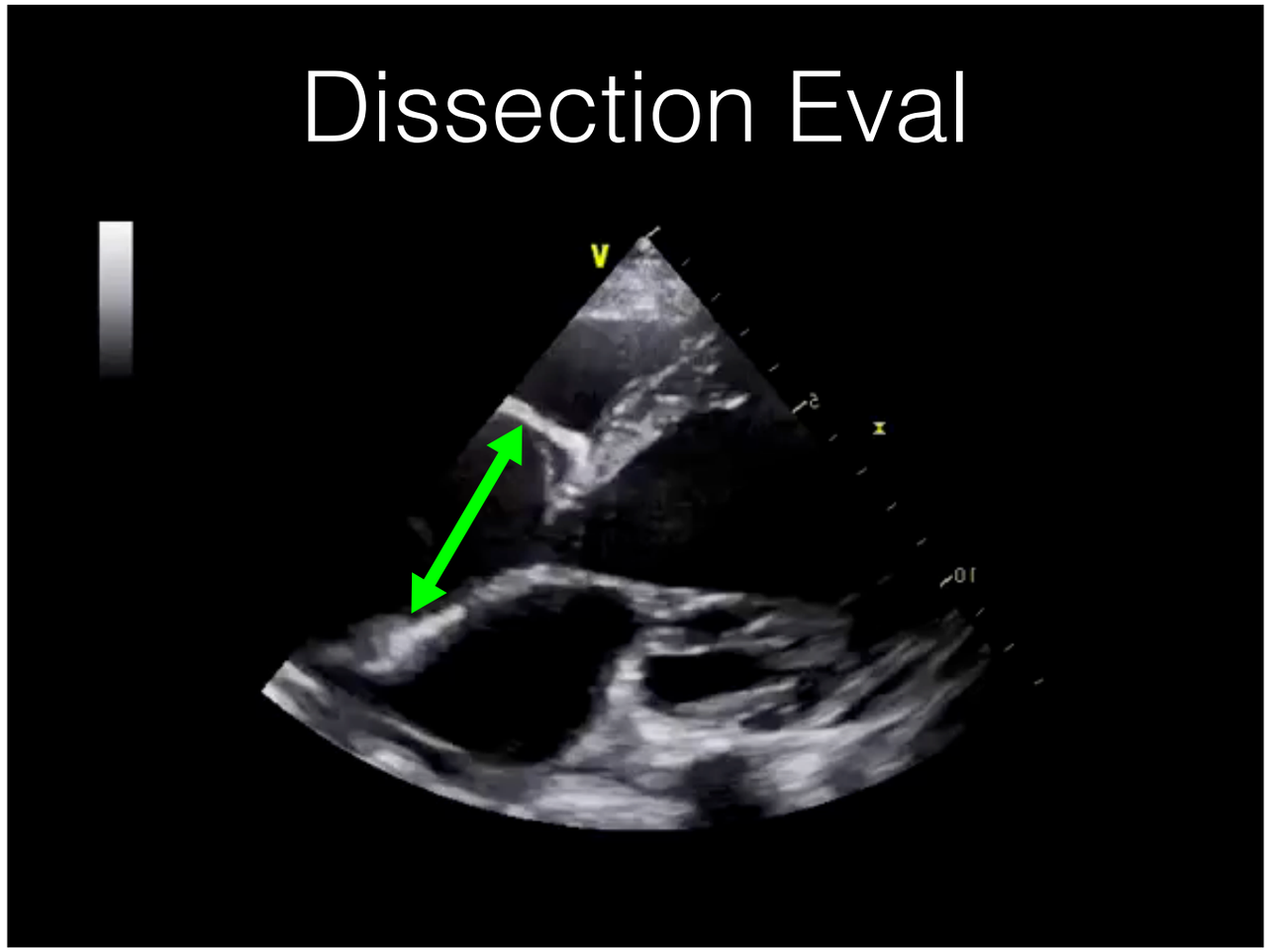

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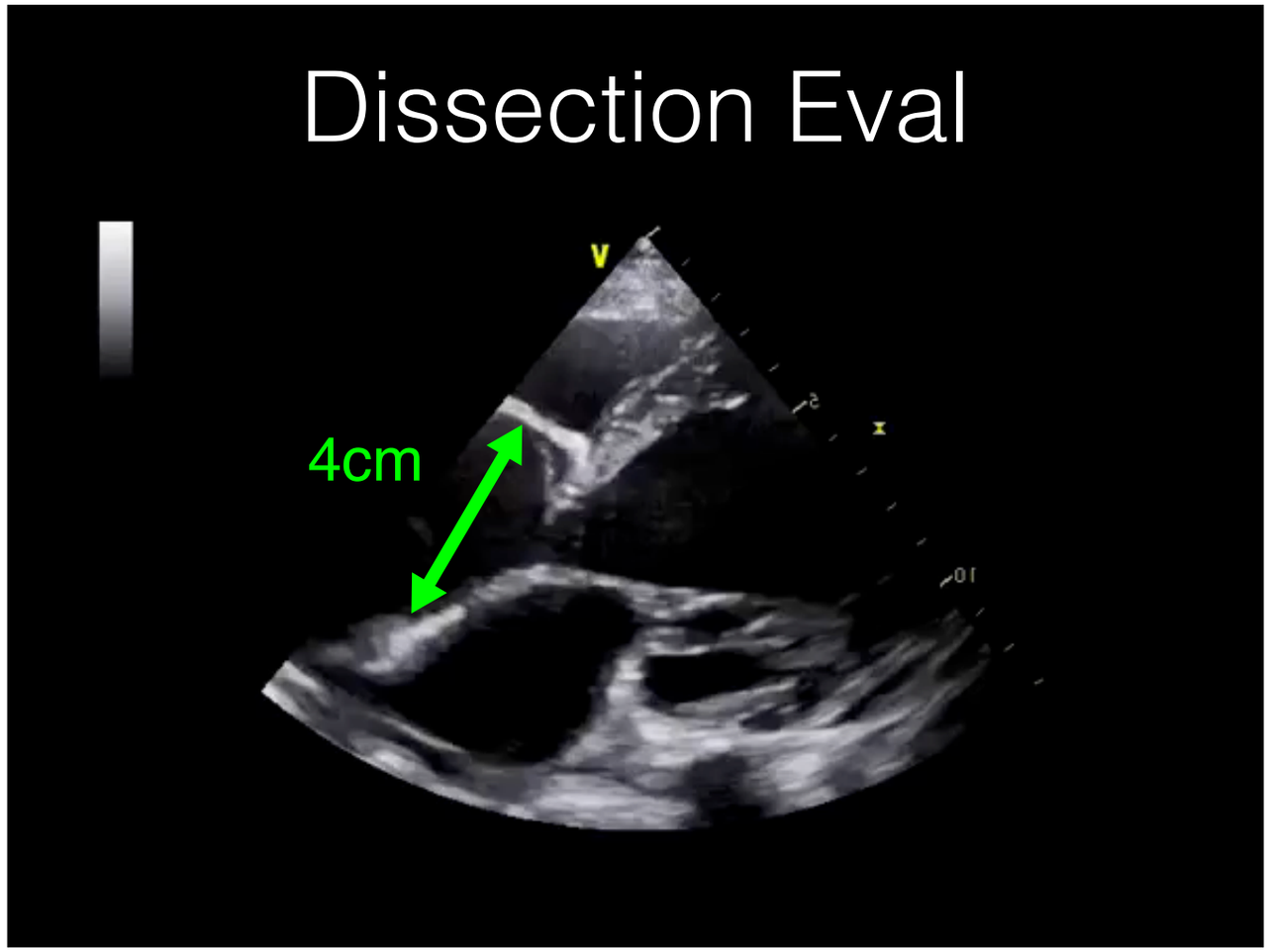

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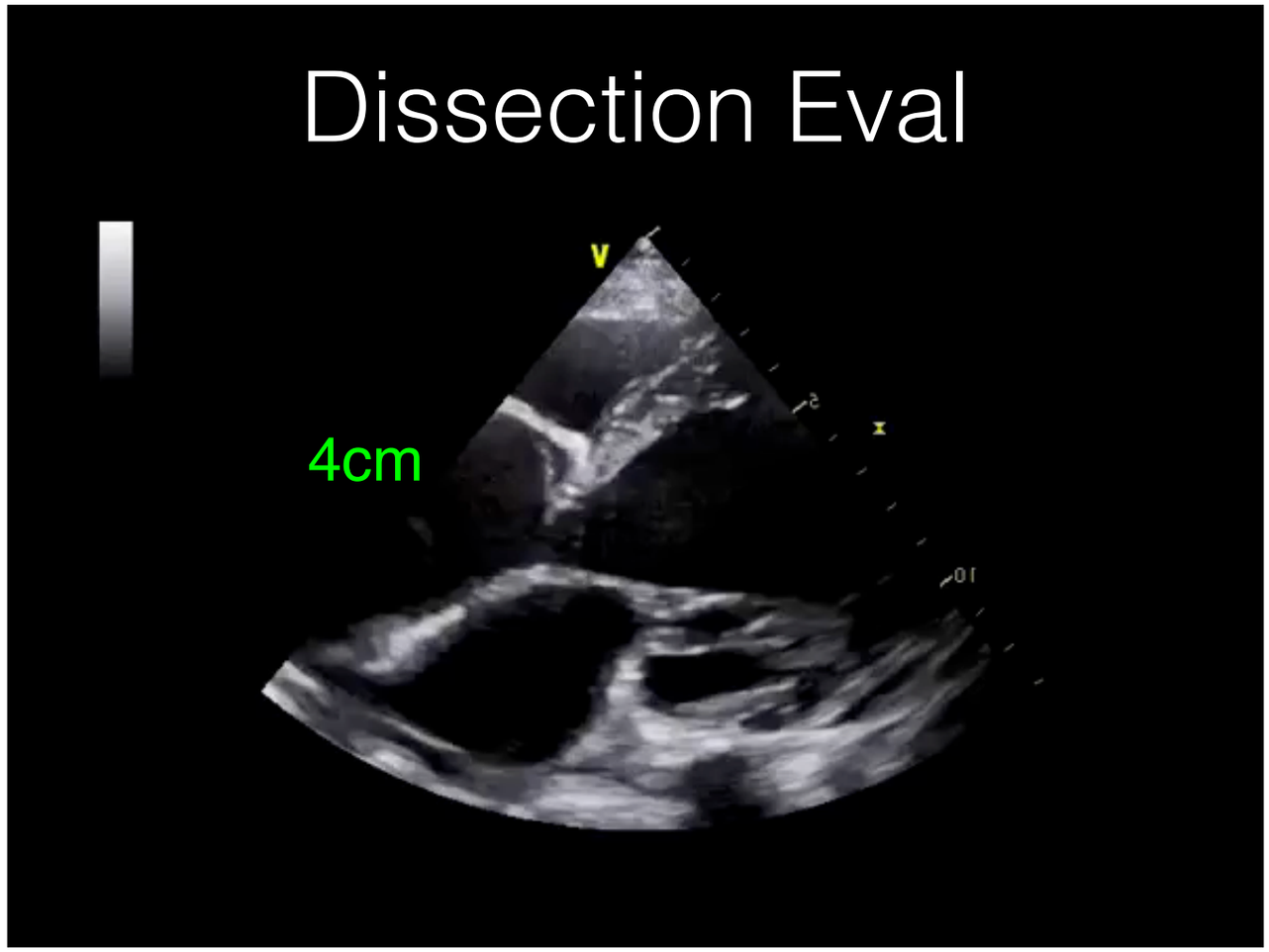

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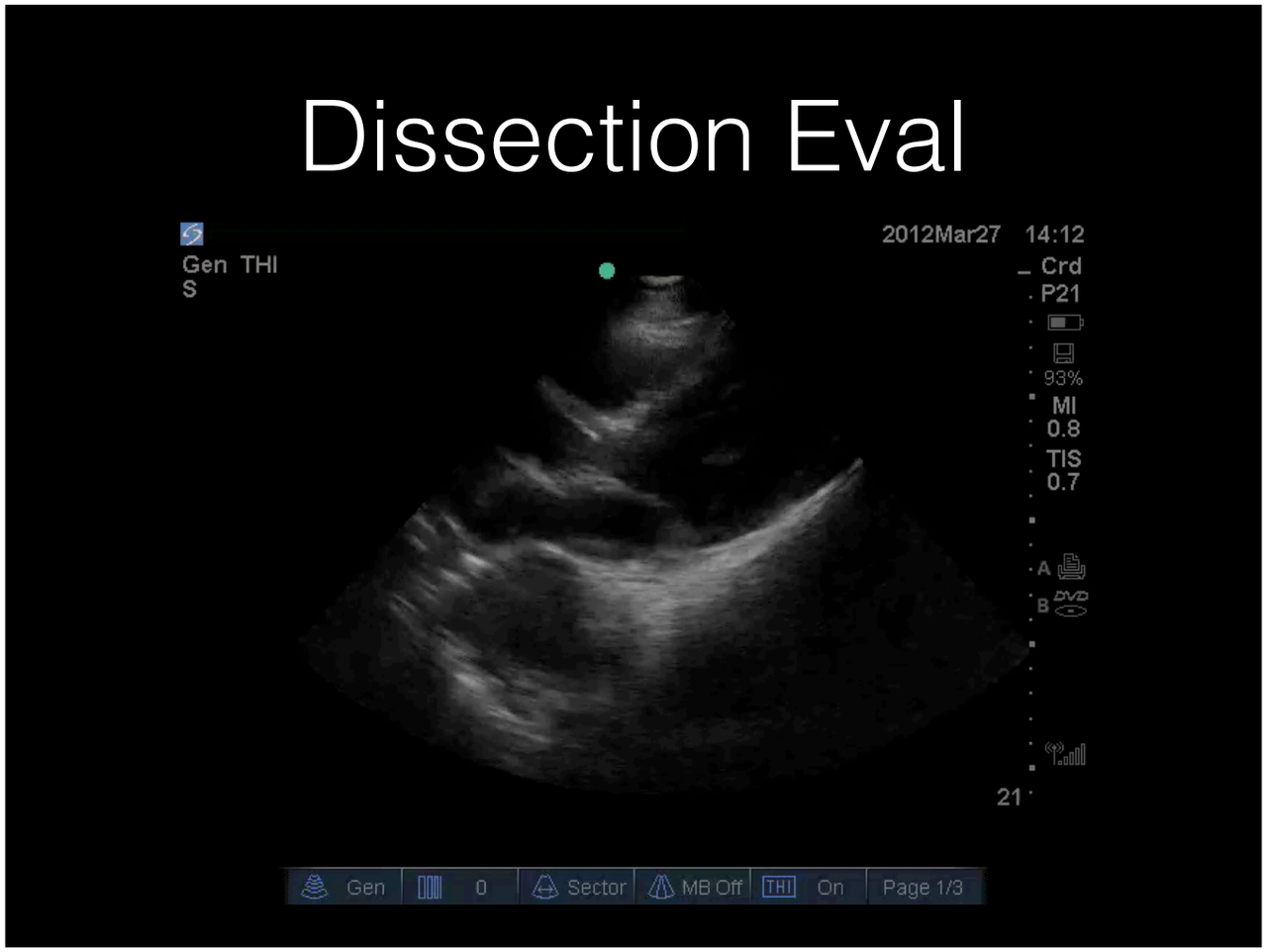

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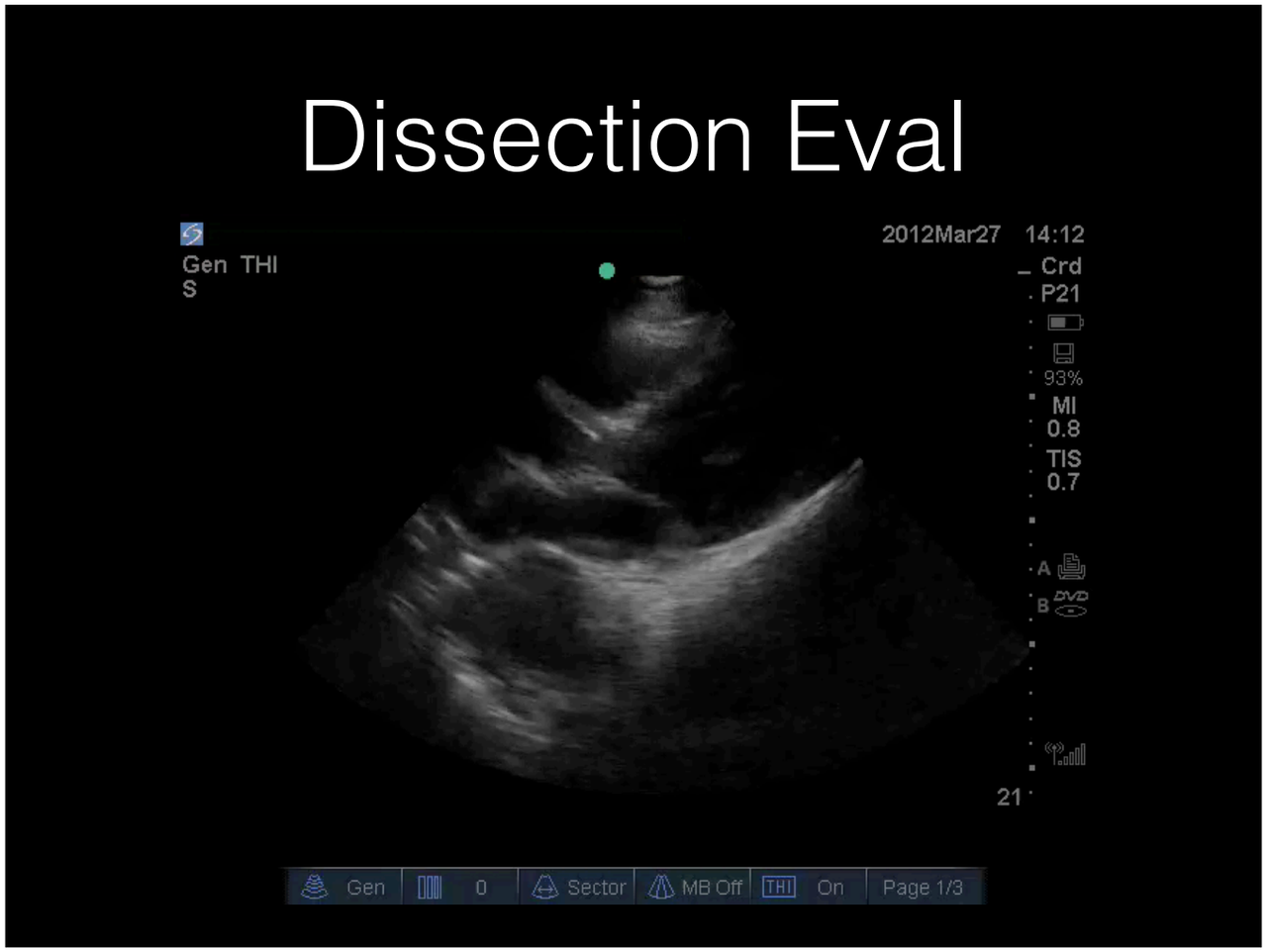

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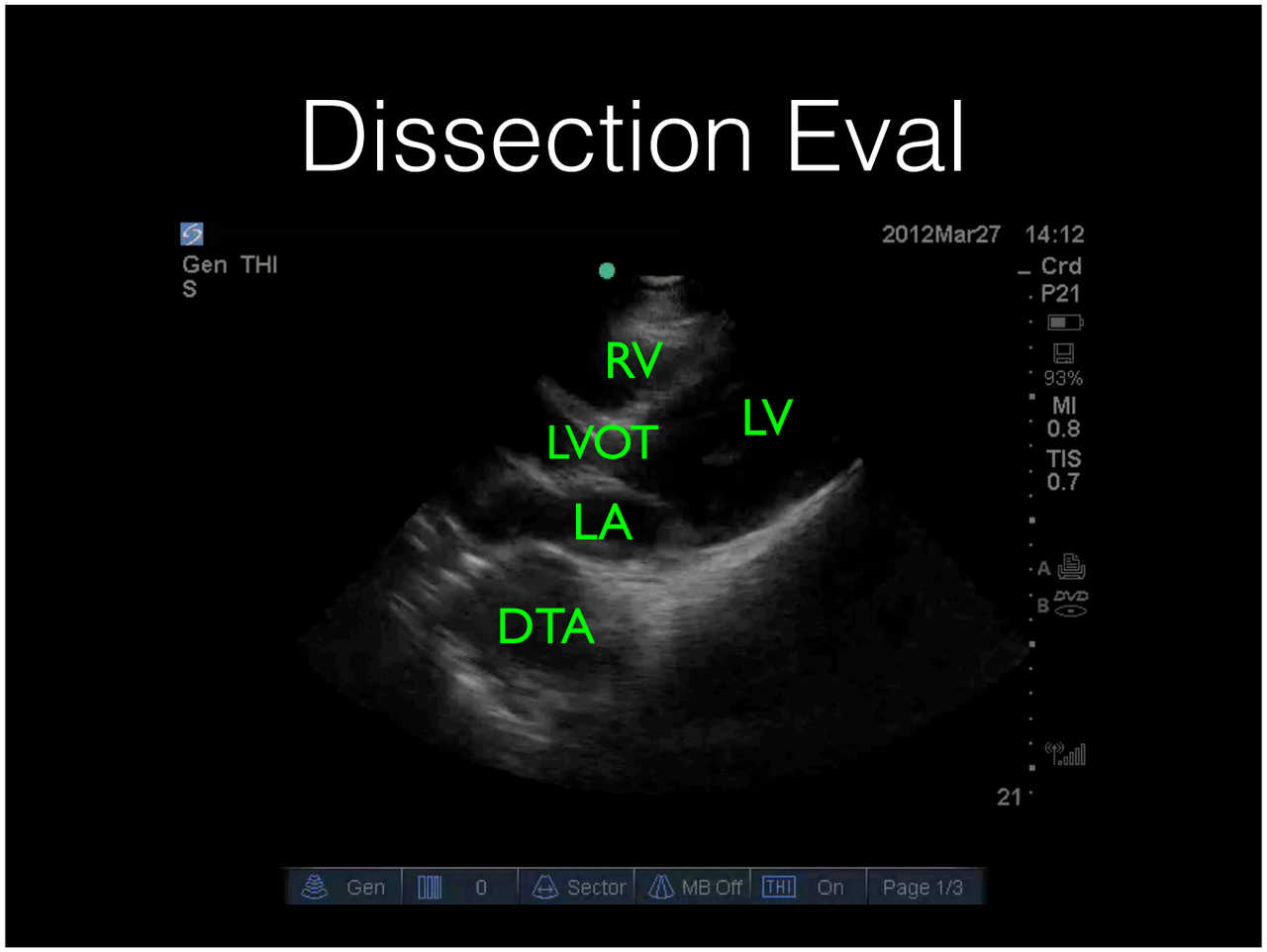

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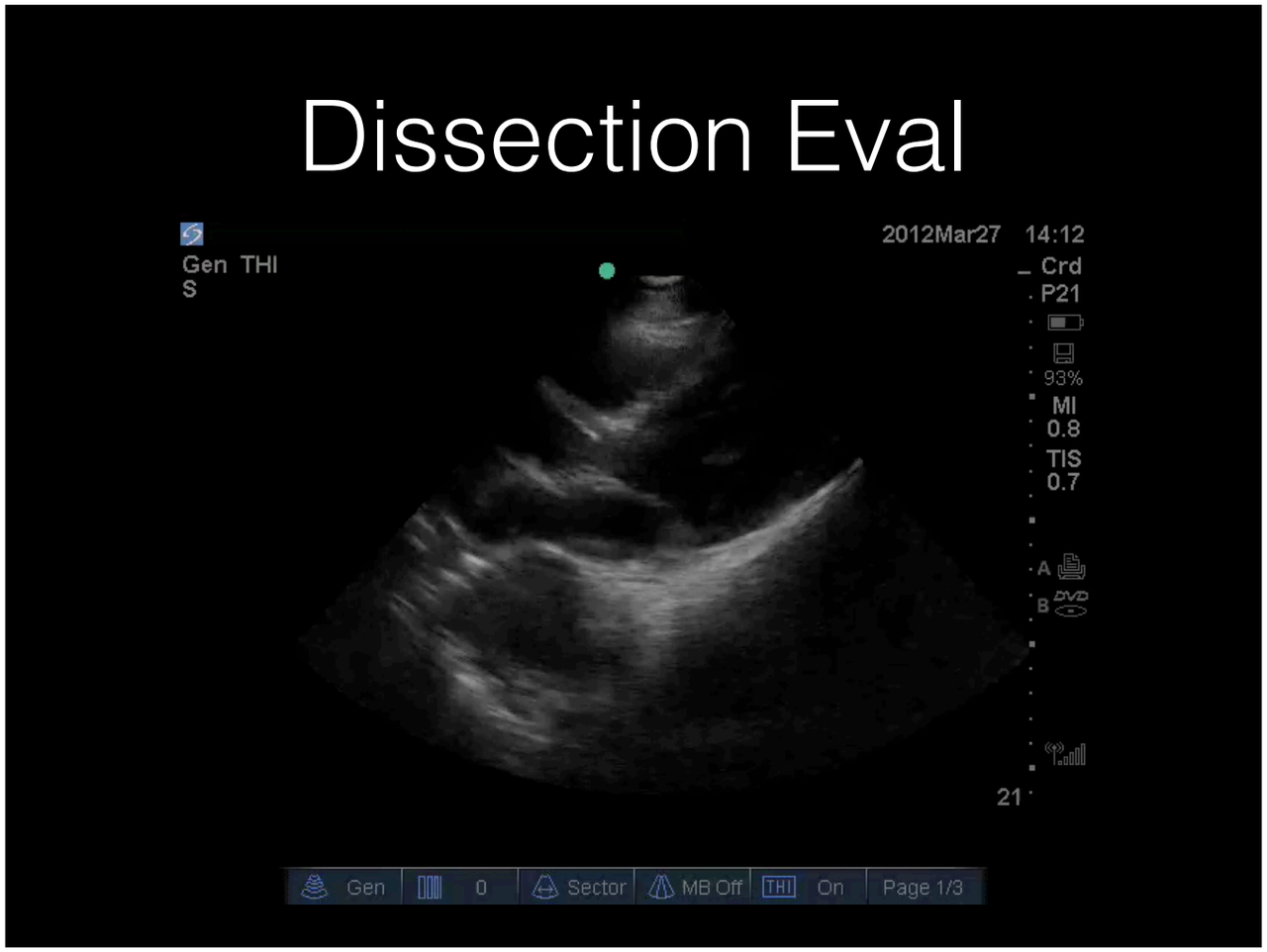

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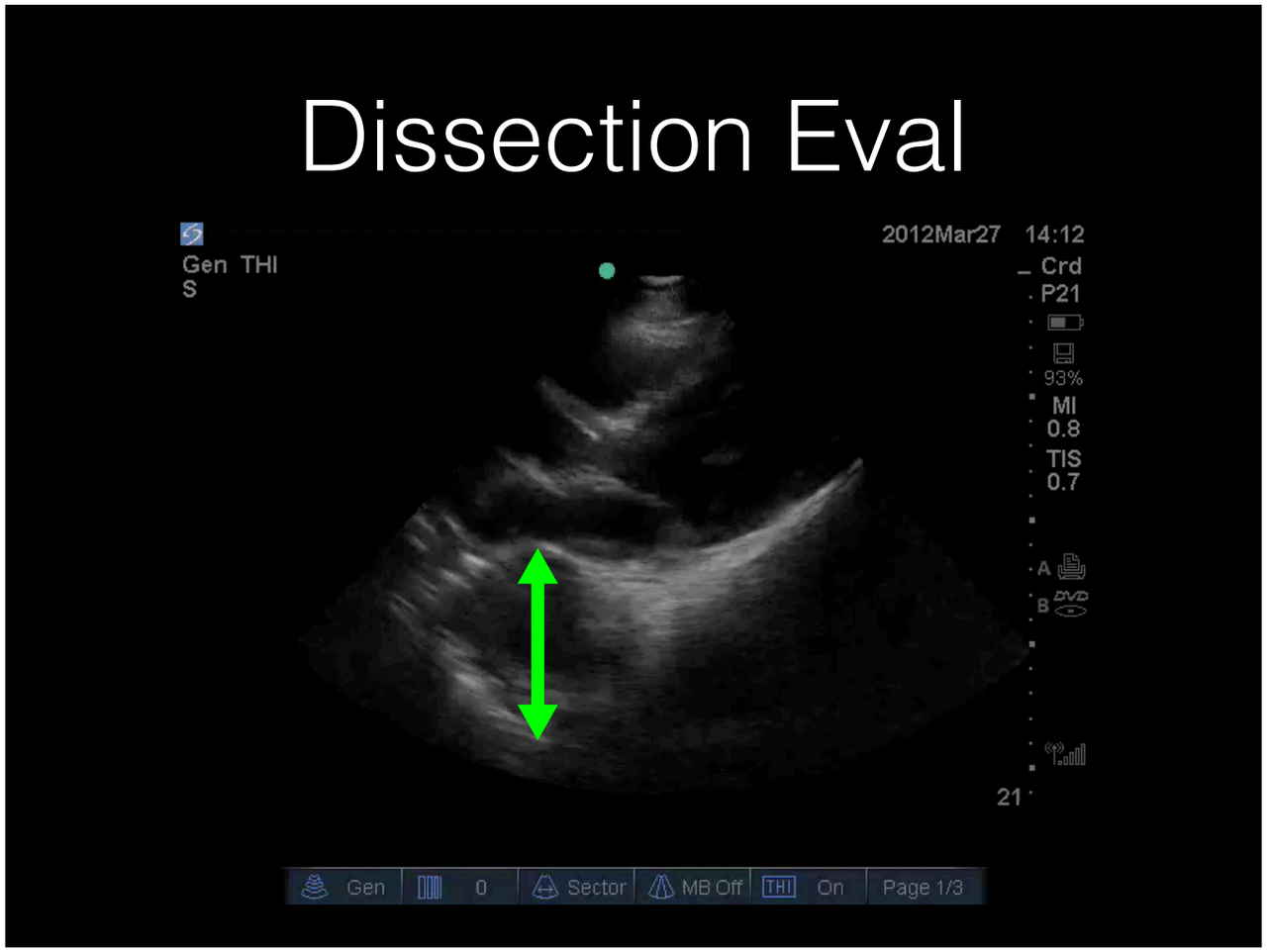

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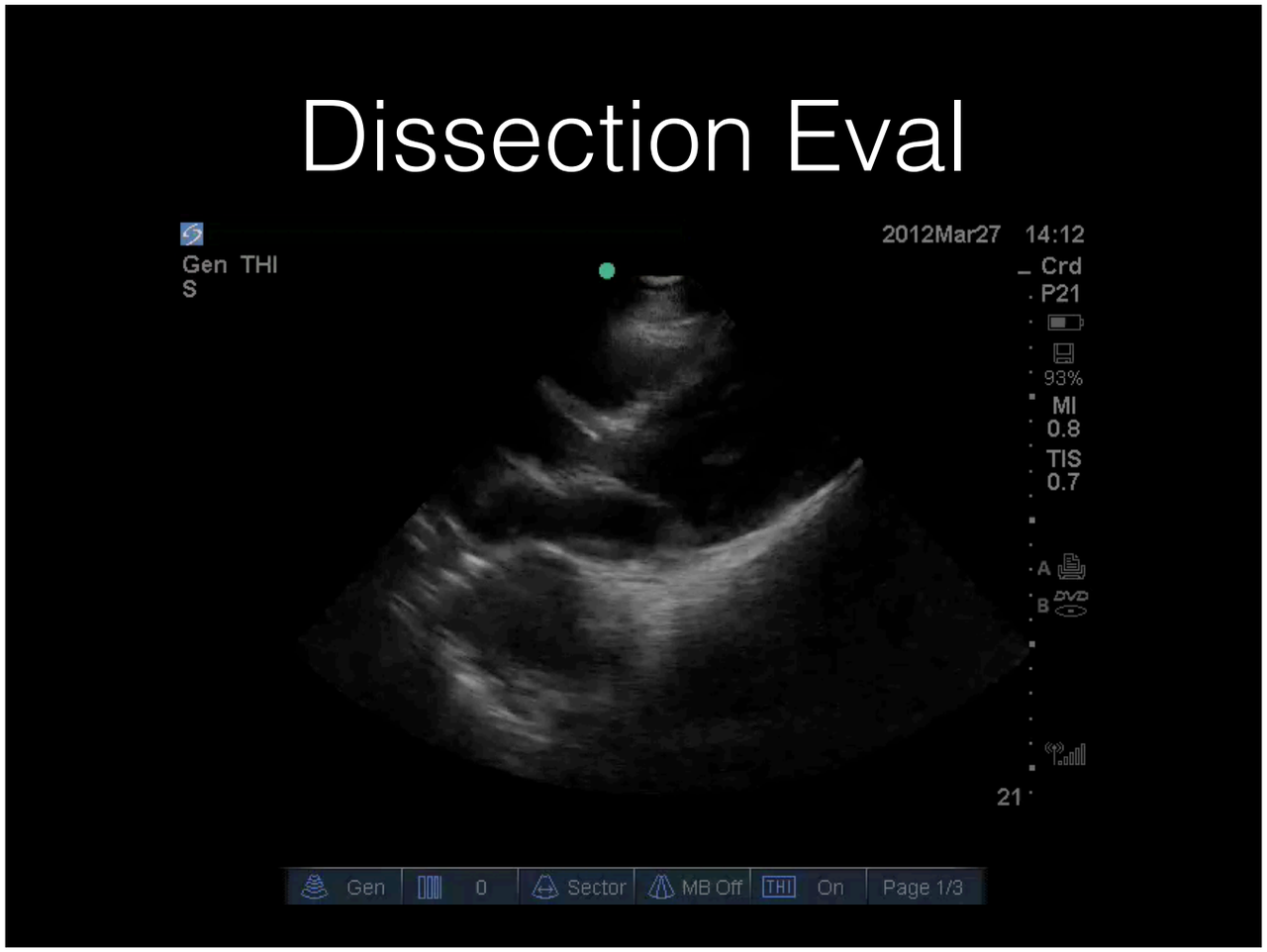

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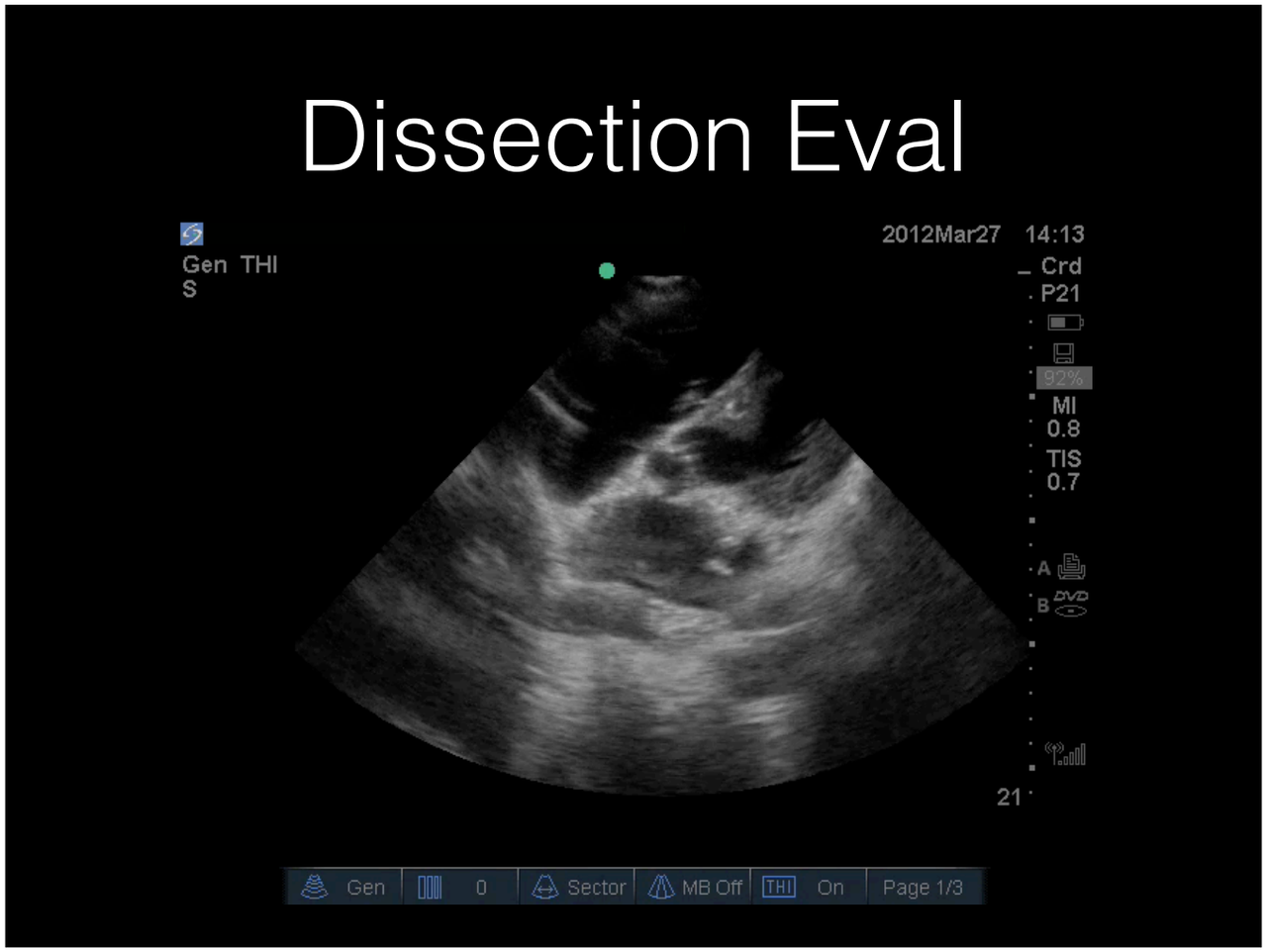


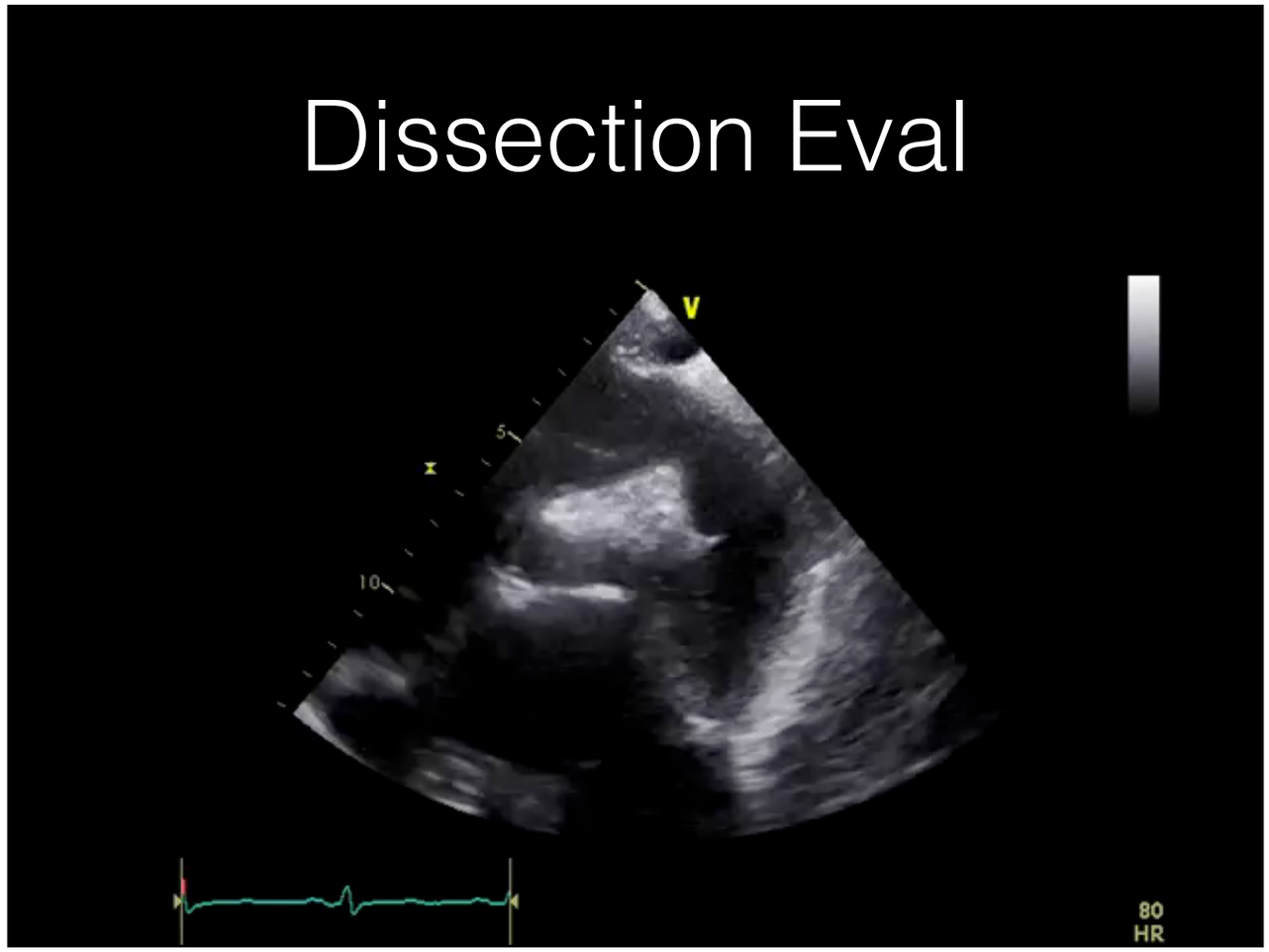
# Suprasternal Notch

# Suprasternal Notch

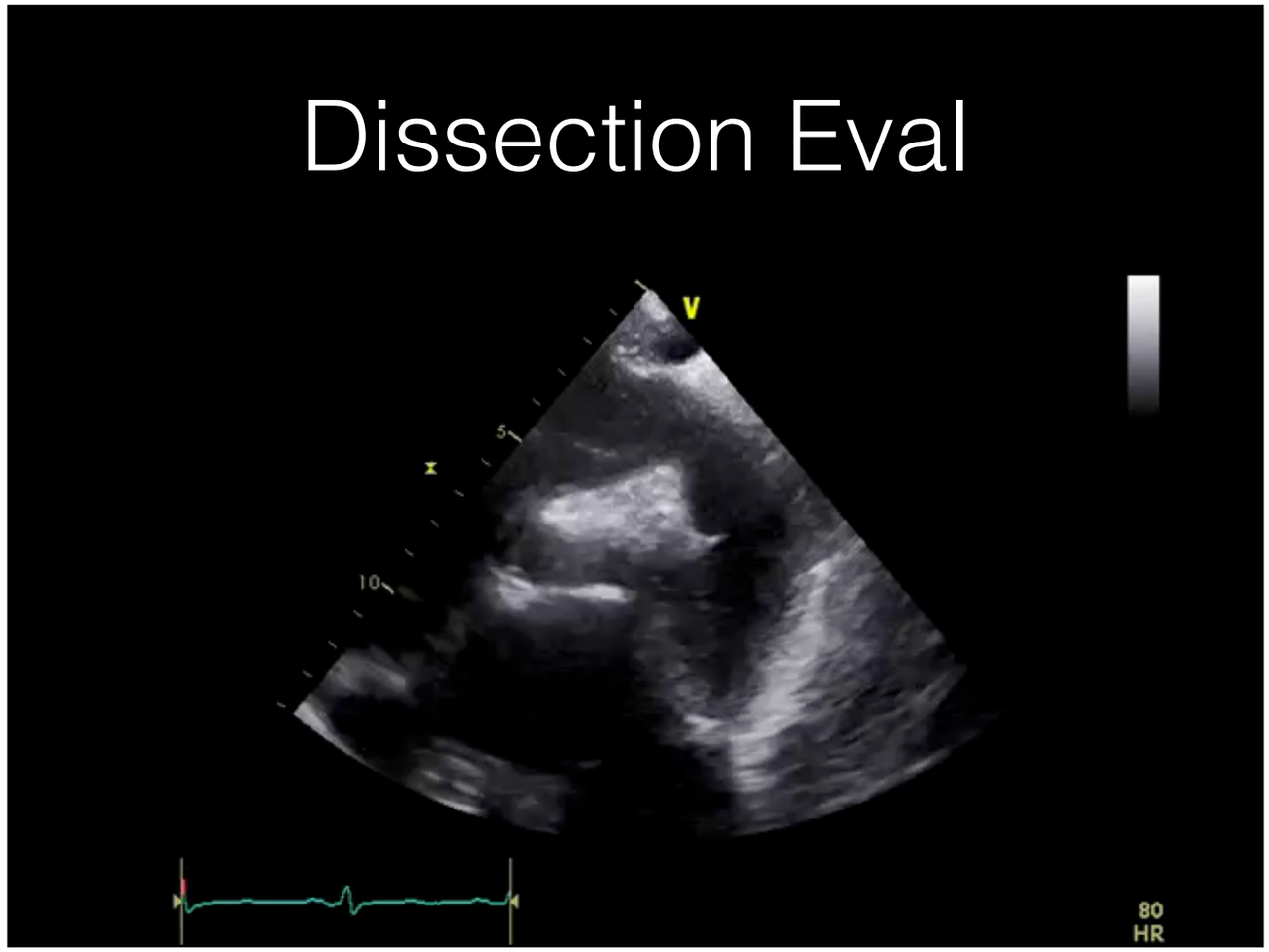
# Suprasternal Notch


# Suprasternal Notch


# Dissection Eval



# Dissection Eval



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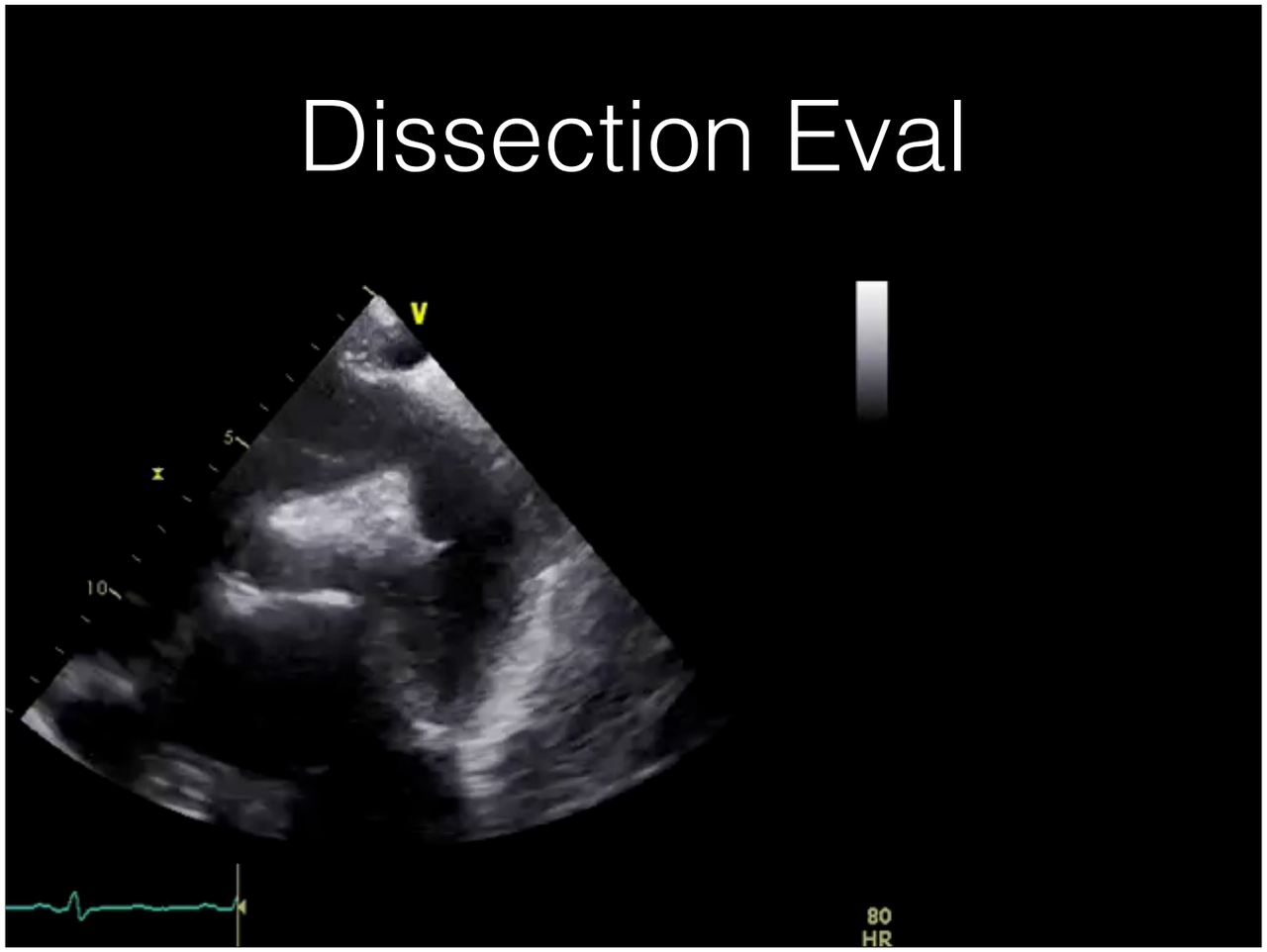

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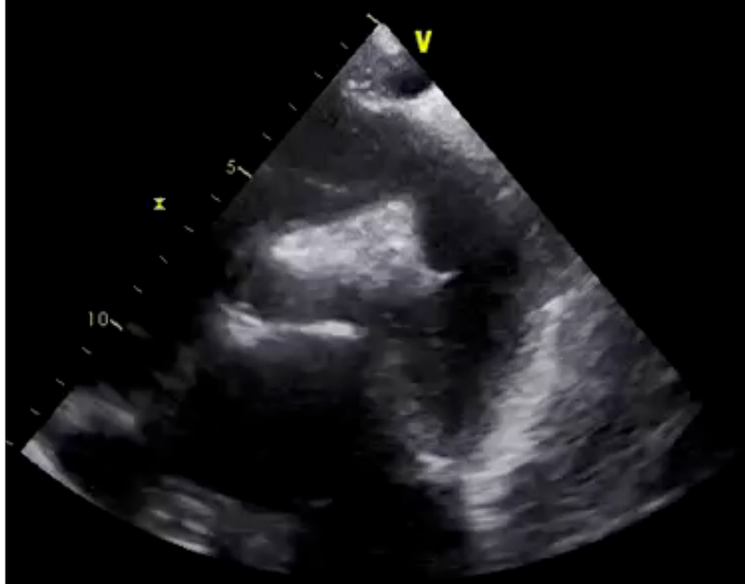


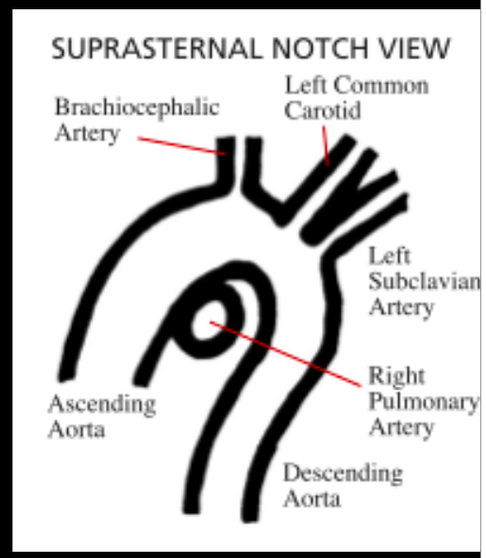

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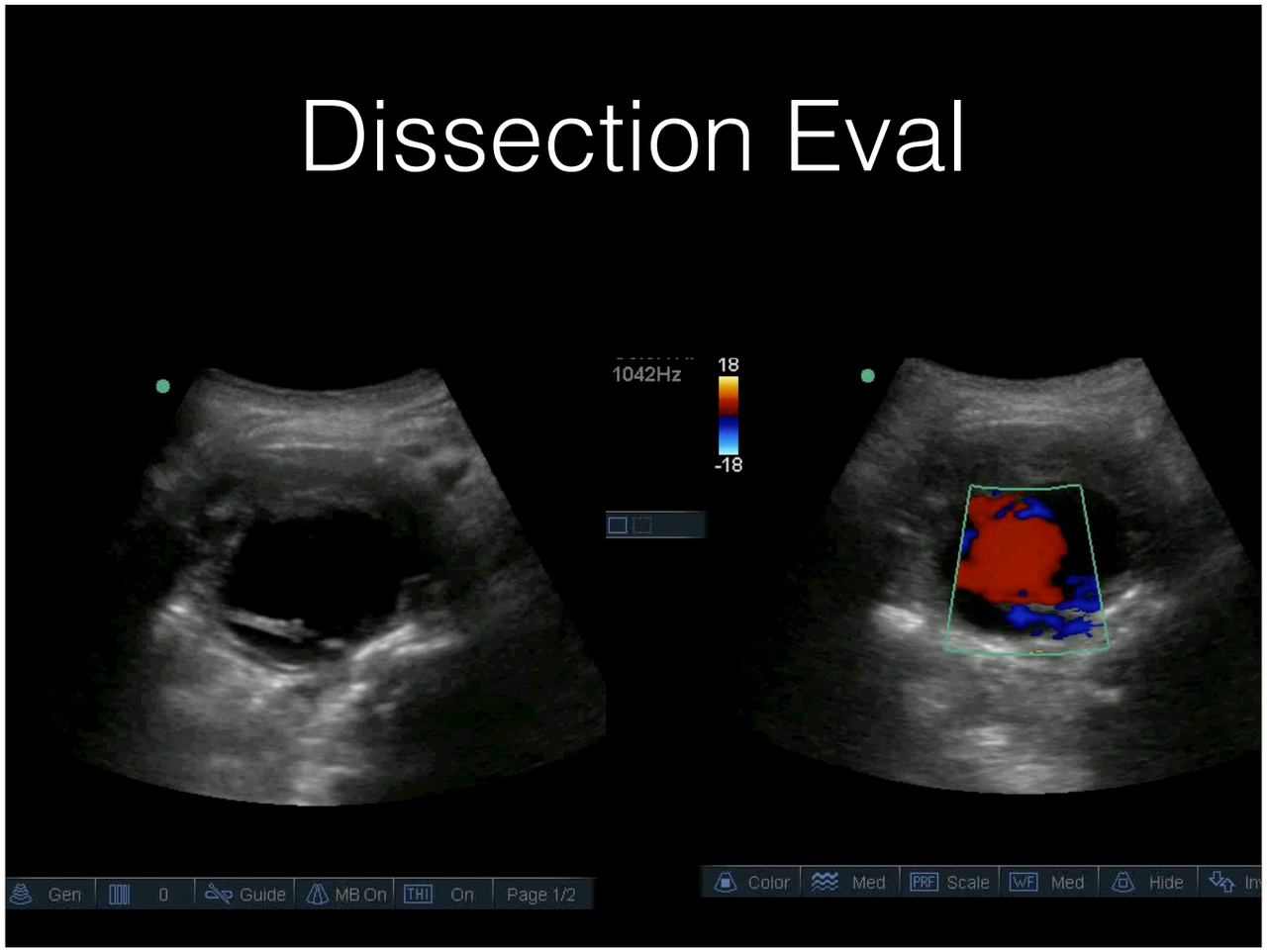
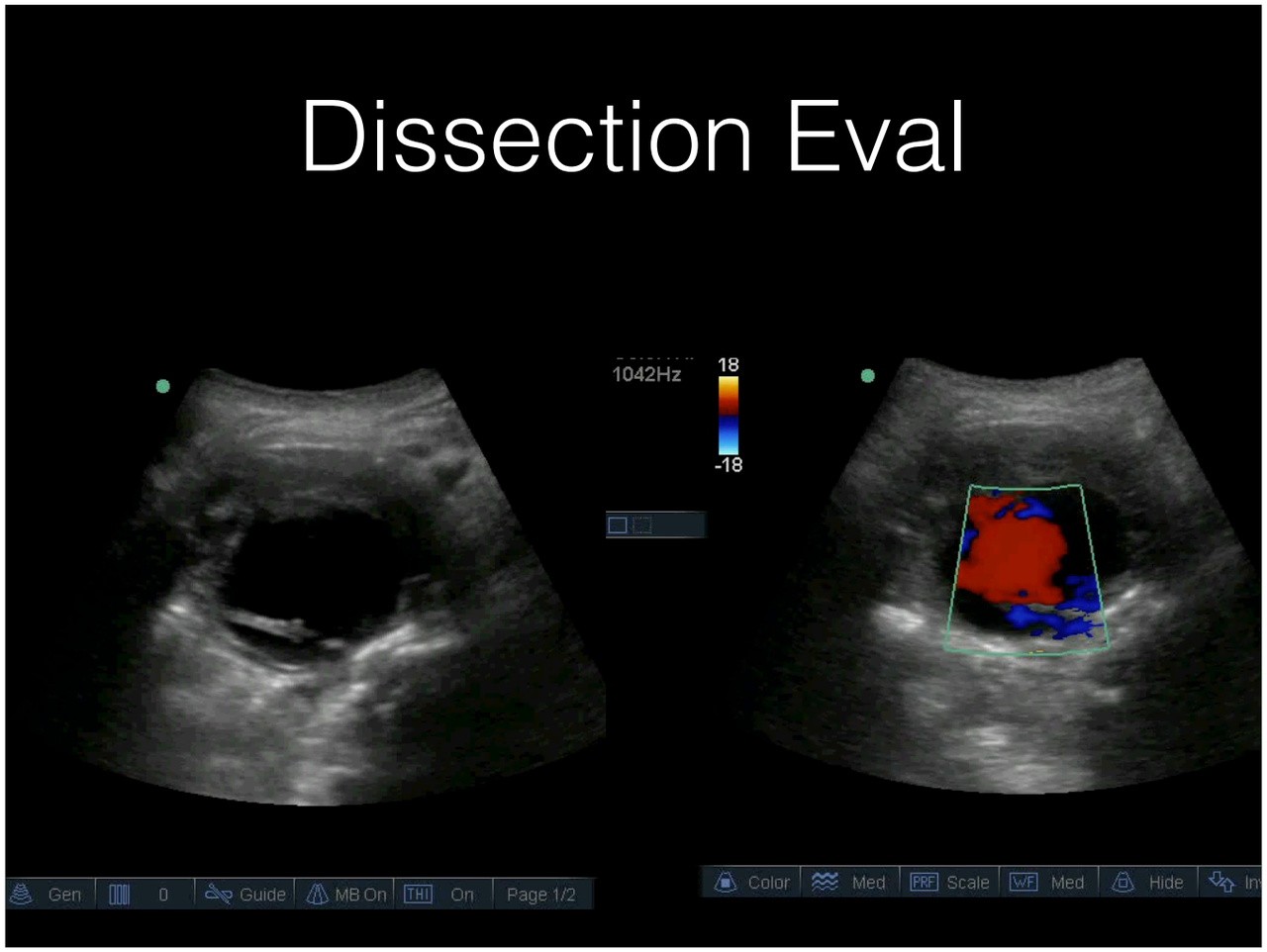
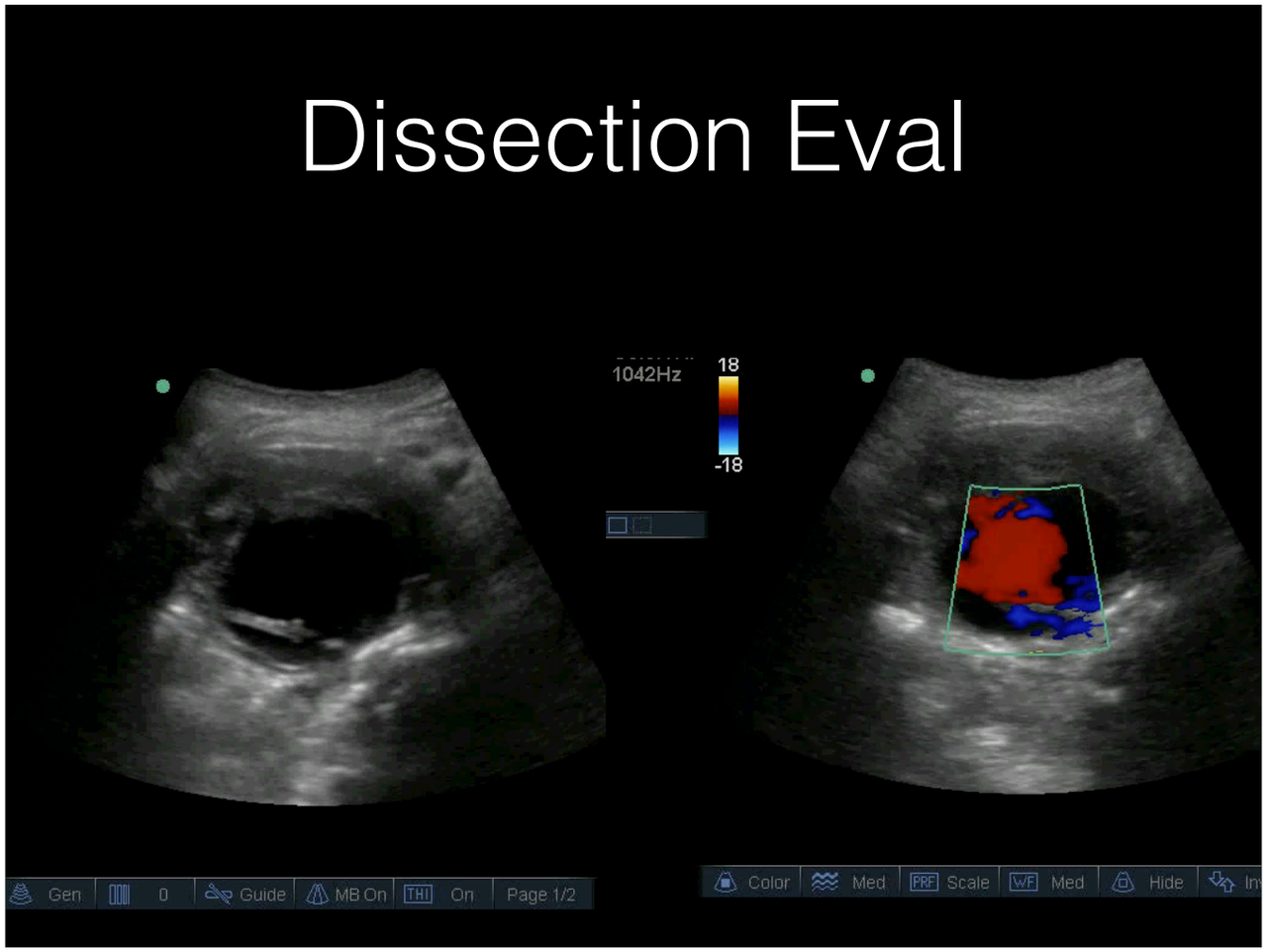


# Dissection Eval

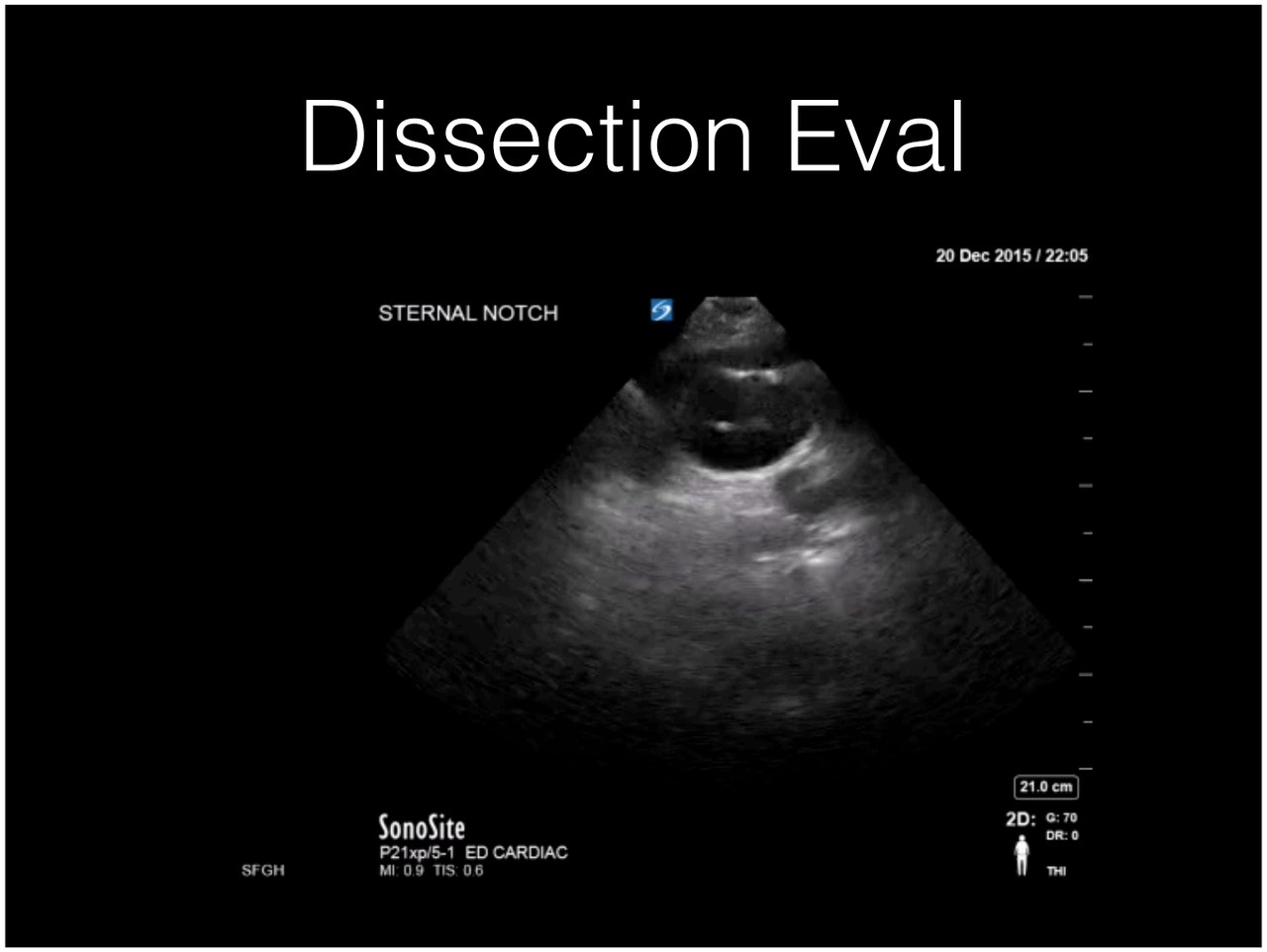


# Dissection Eval

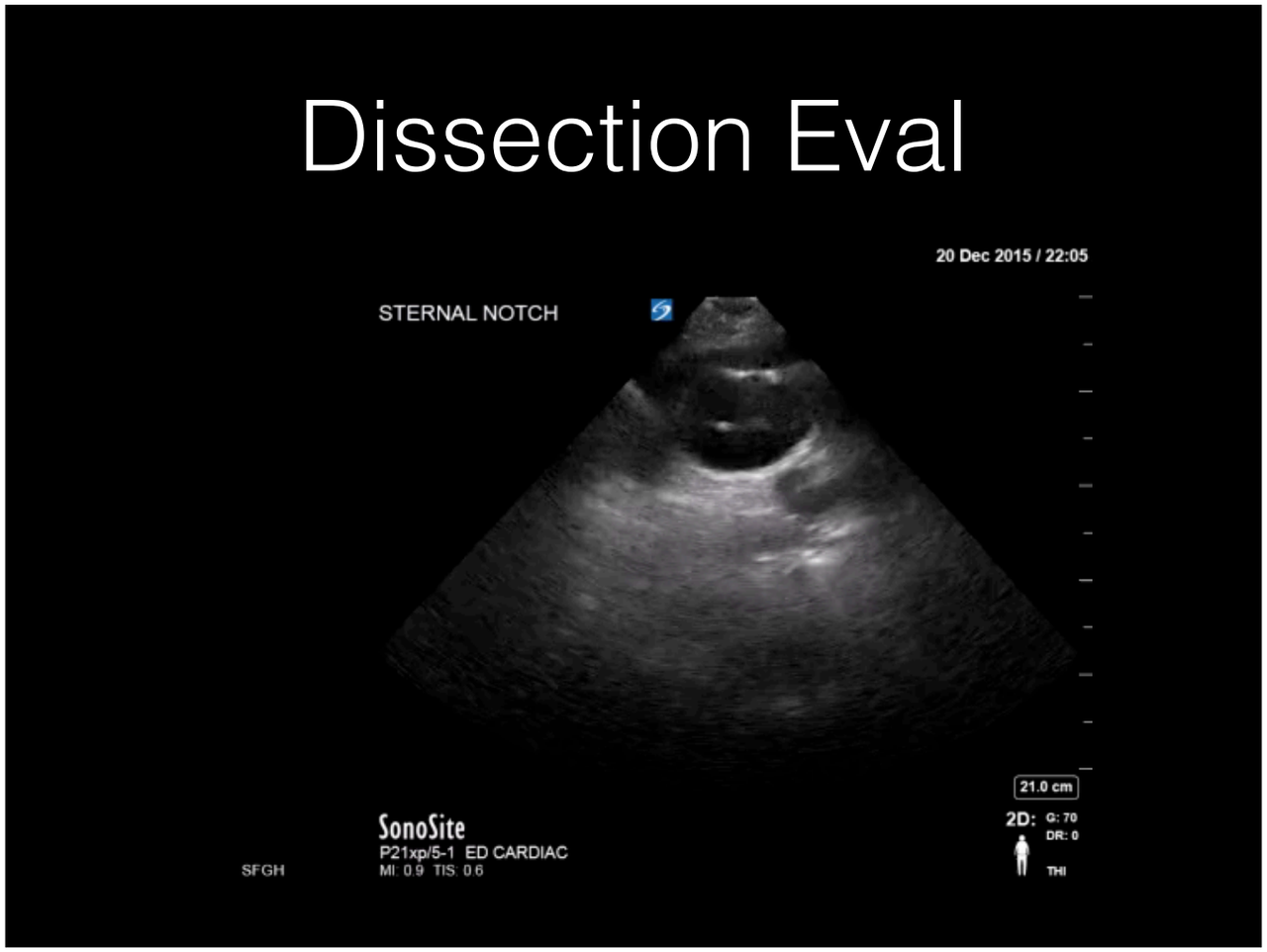


# Back to Our Patient

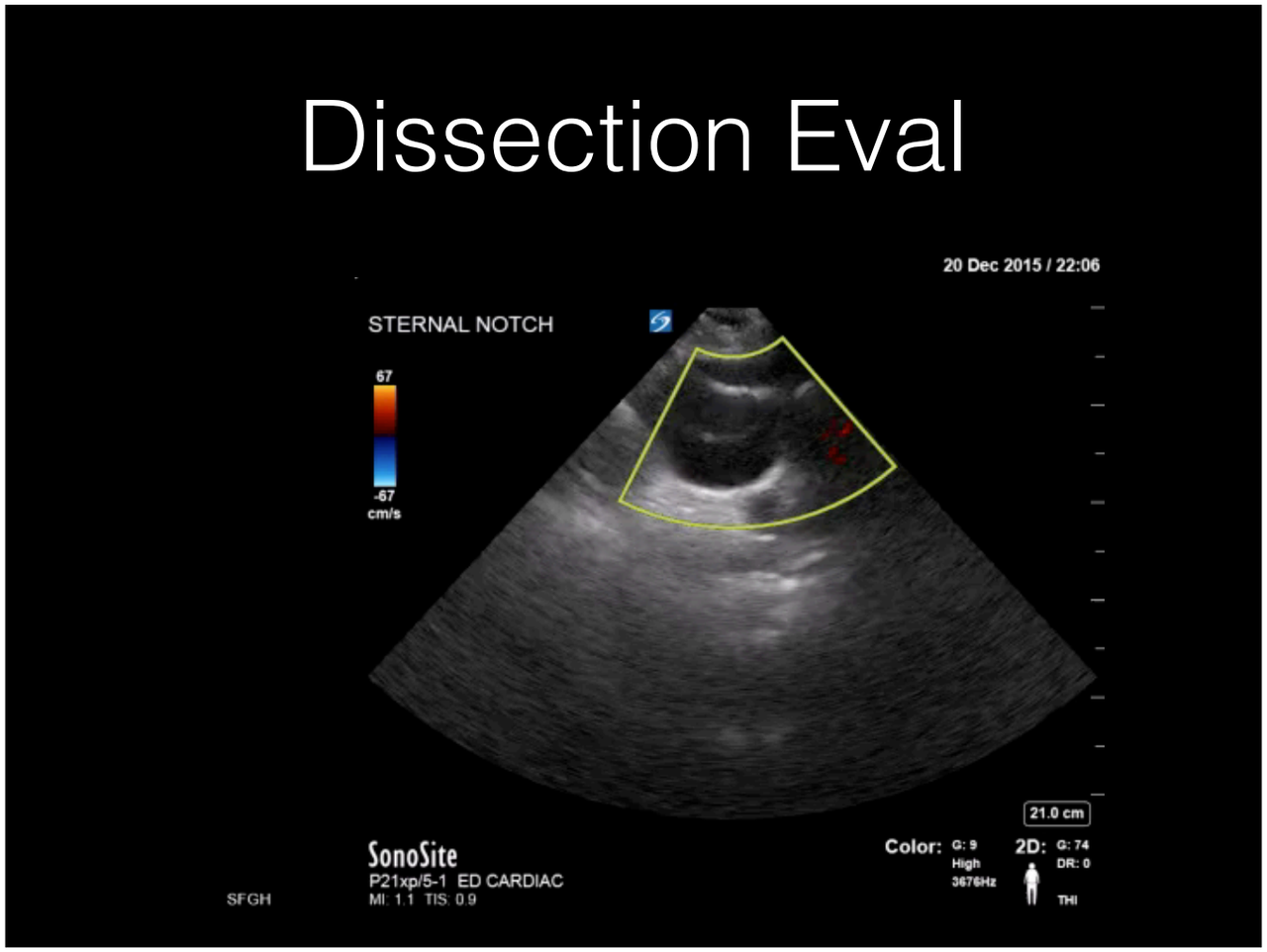
# Dissection Eval



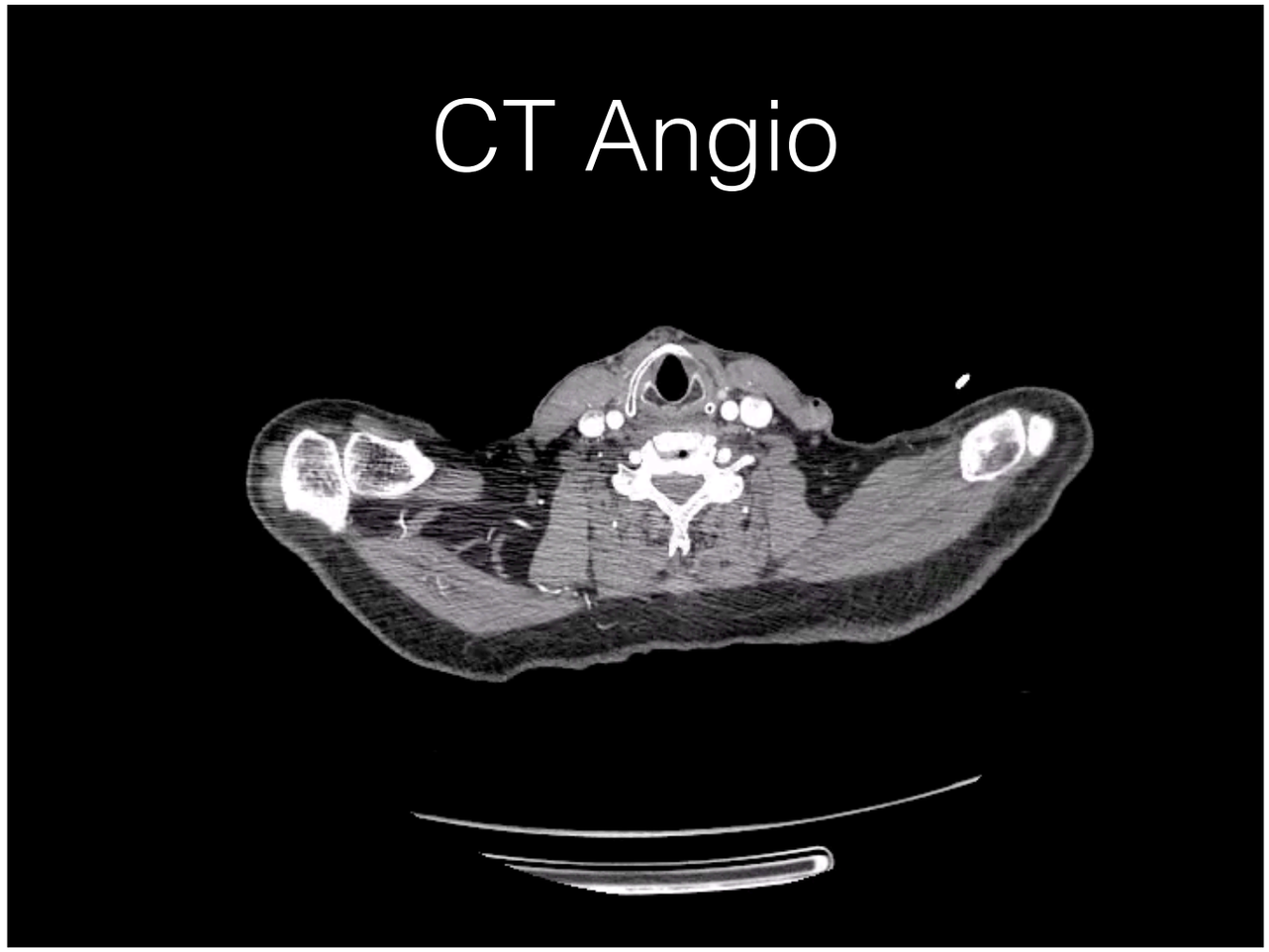
# Dissection Eval



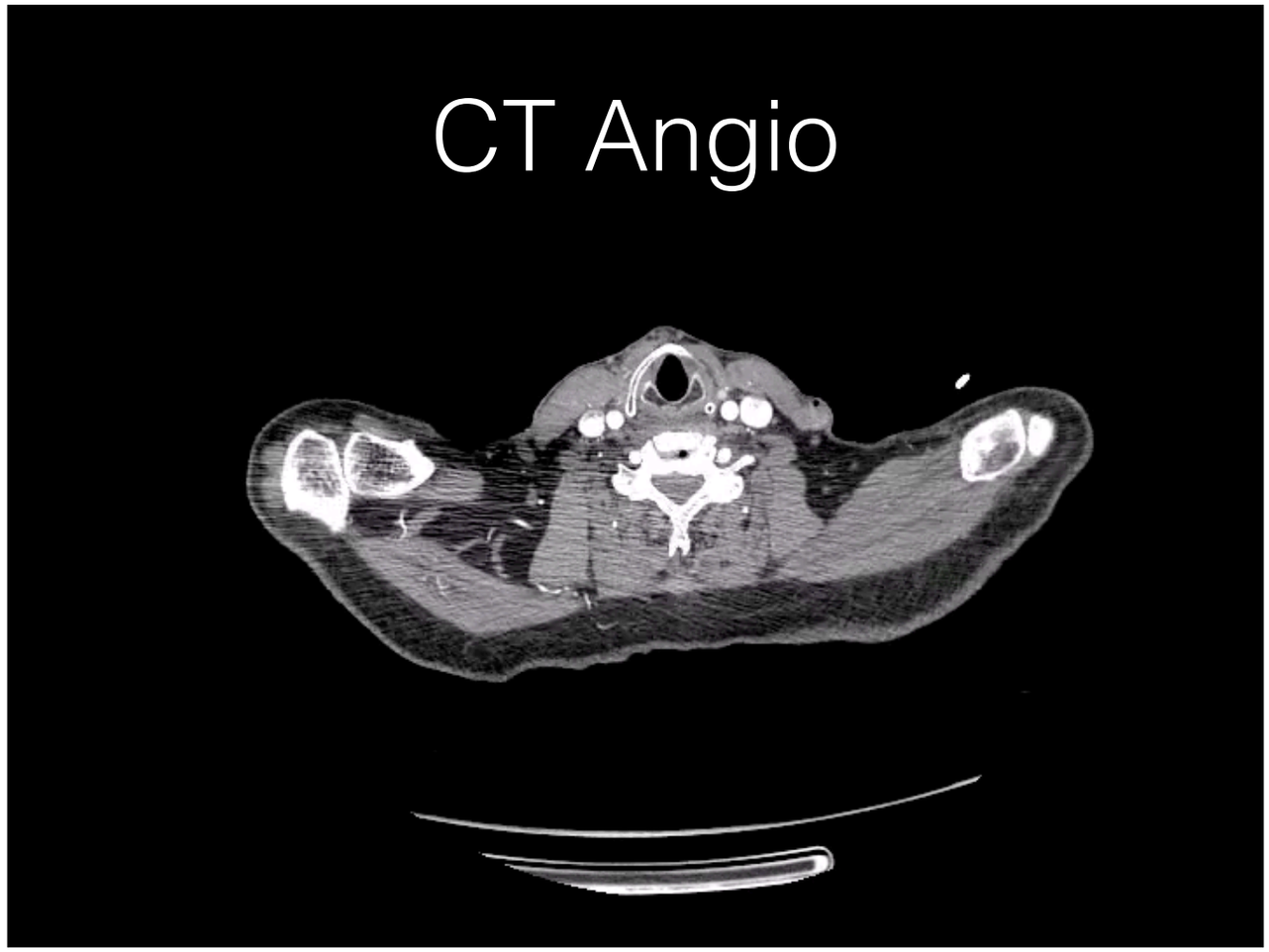
# Dissection Eval

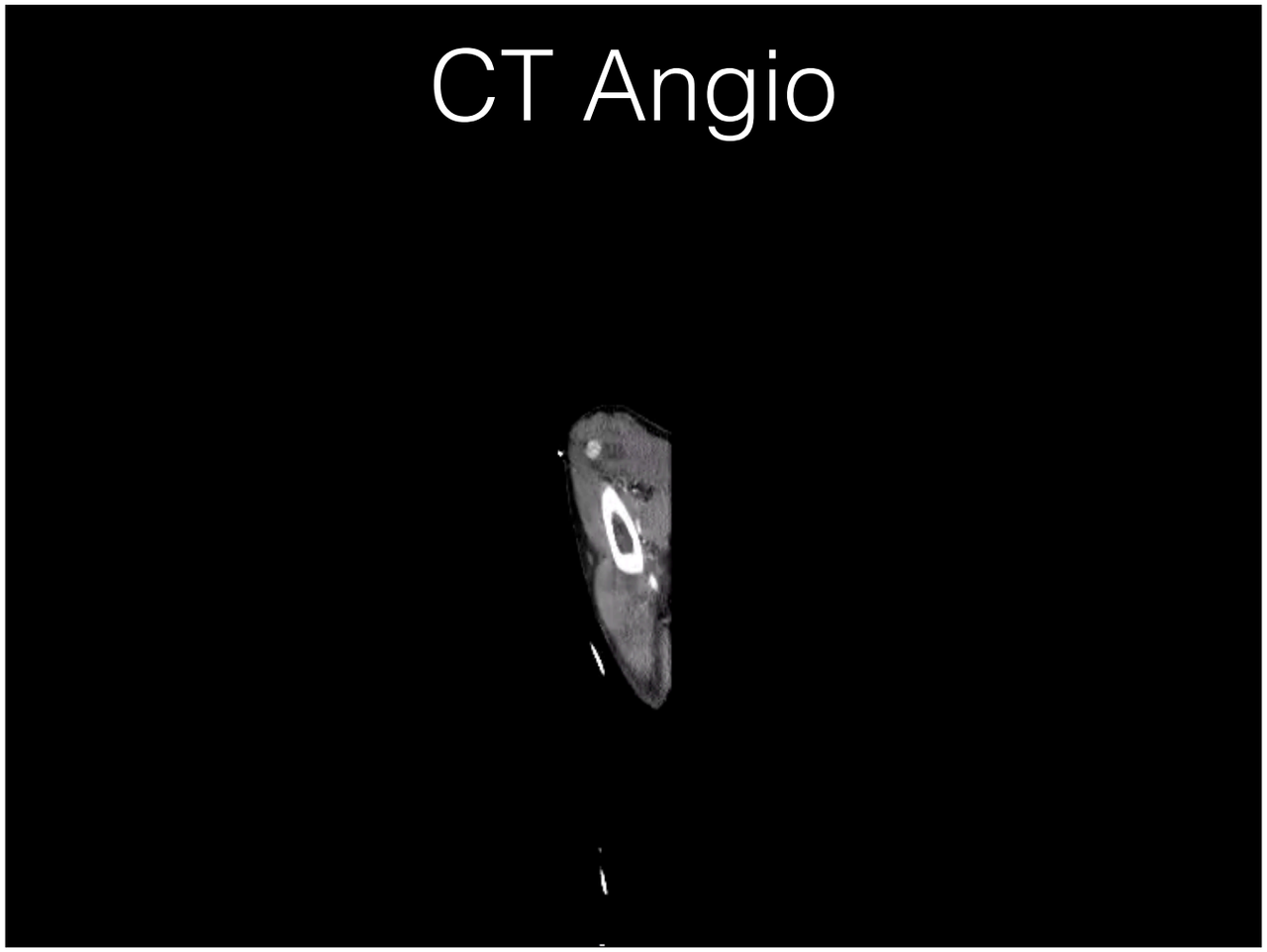


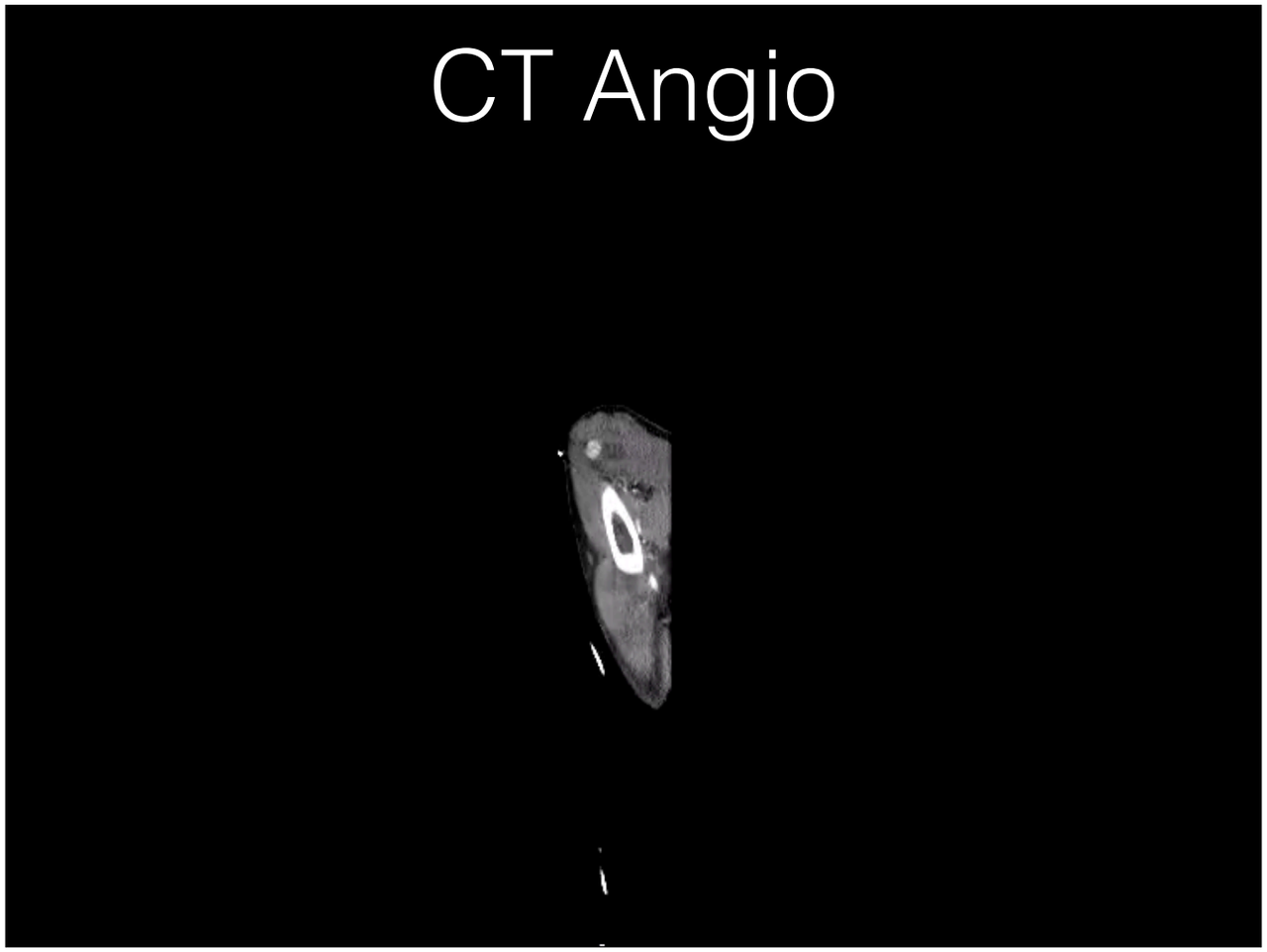
# CT Angio



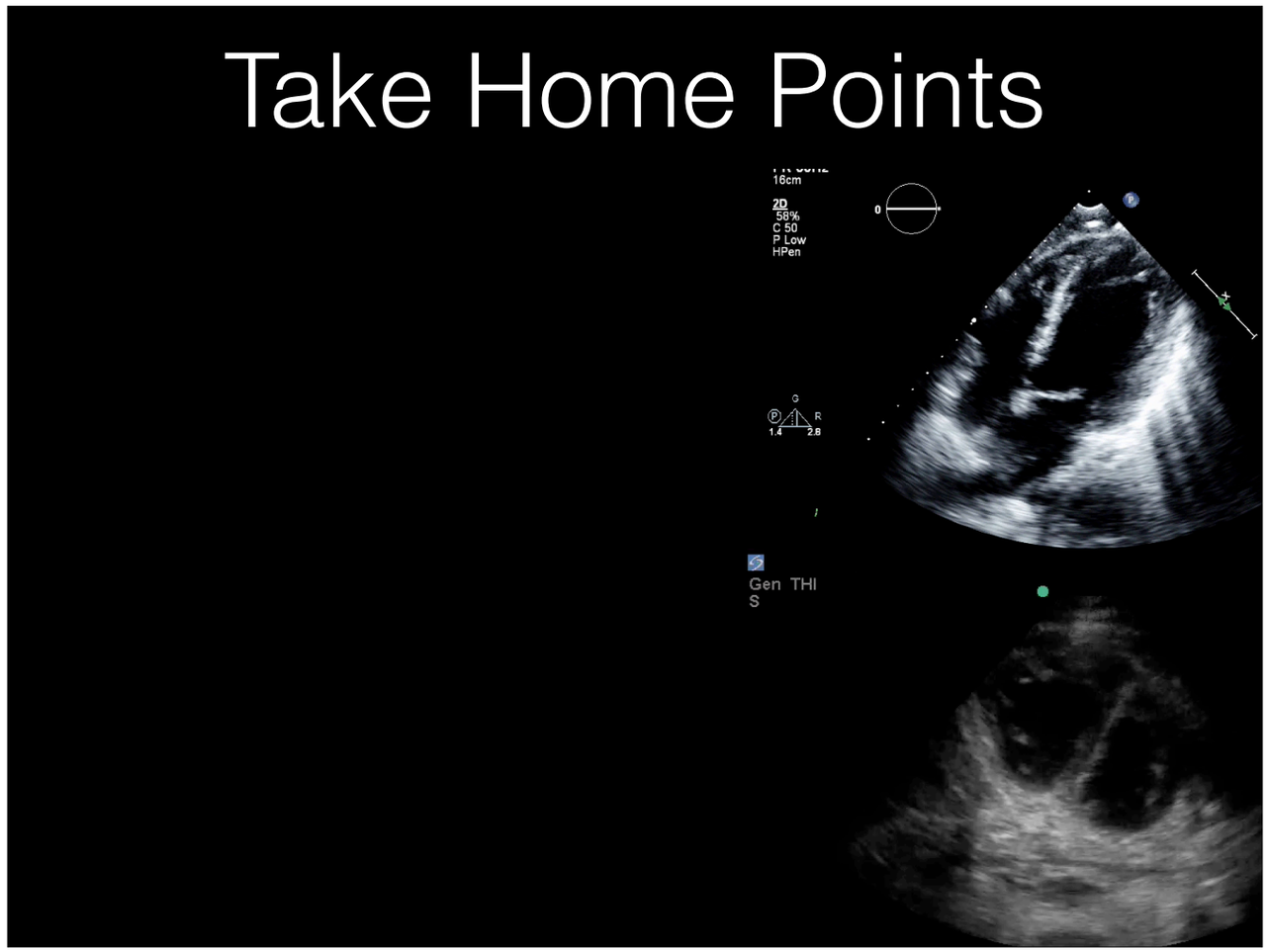
# CT Angio




CT Angio

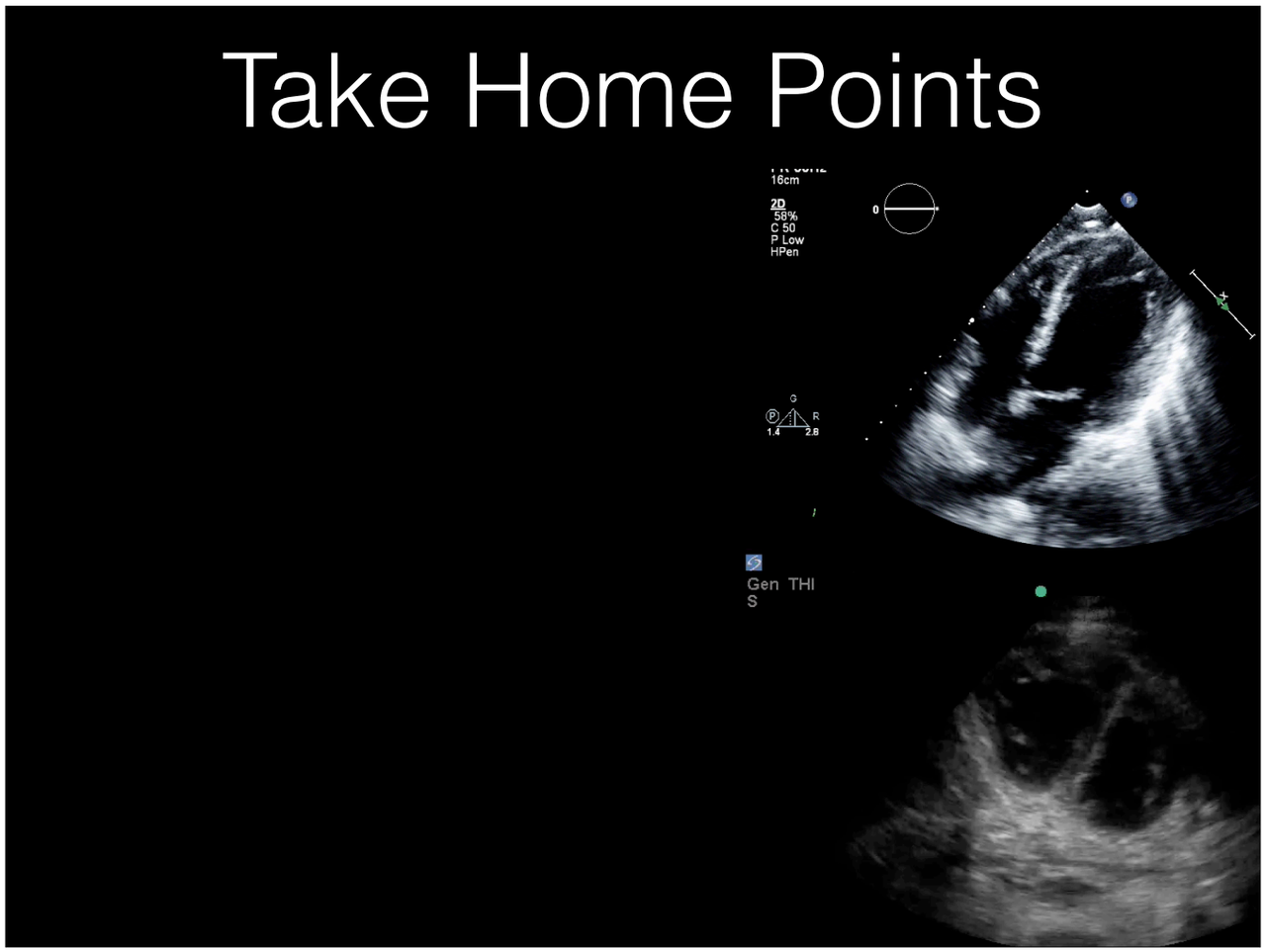

CT Angio

# Take Home Points



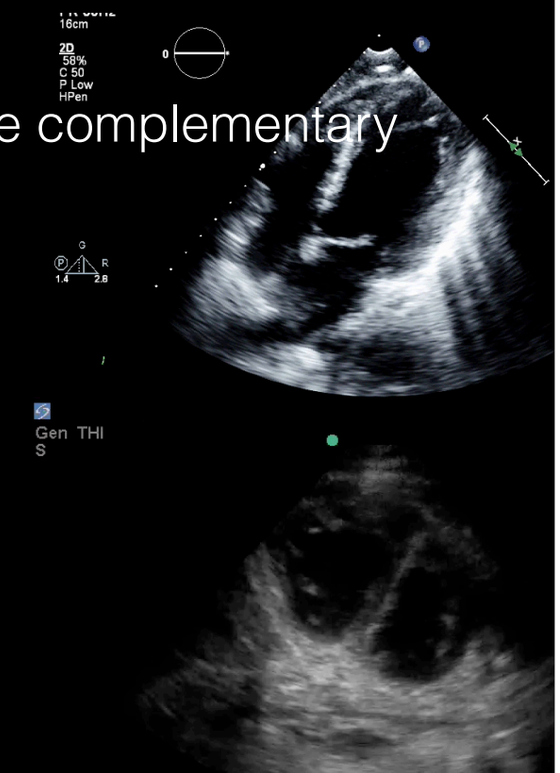

+Look for regional wall abnml with acute ECG changes
If pattern doesn't fit vessels distribution—> consider Takotsobu
+We discussed Transvalvular Paradoxus; M-Mode to evaluate for RV collapse
+Evaluate RV fxn in cases of Suspected PE or new dx PE—> Pre-test prob; prognostic implications

# Take Home Points



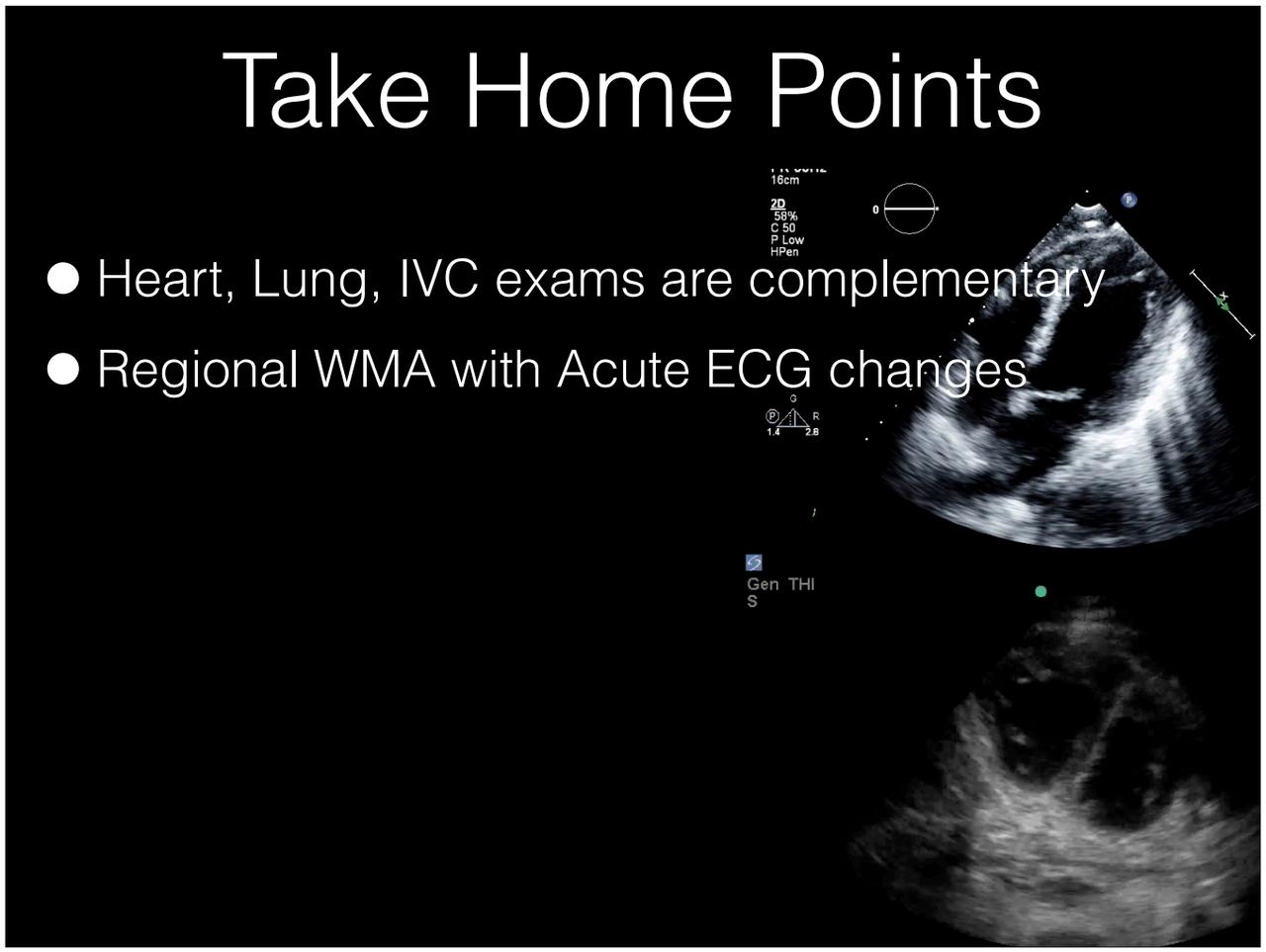
# Take Home Points

- Heart, Lung, IVC exams are complementary



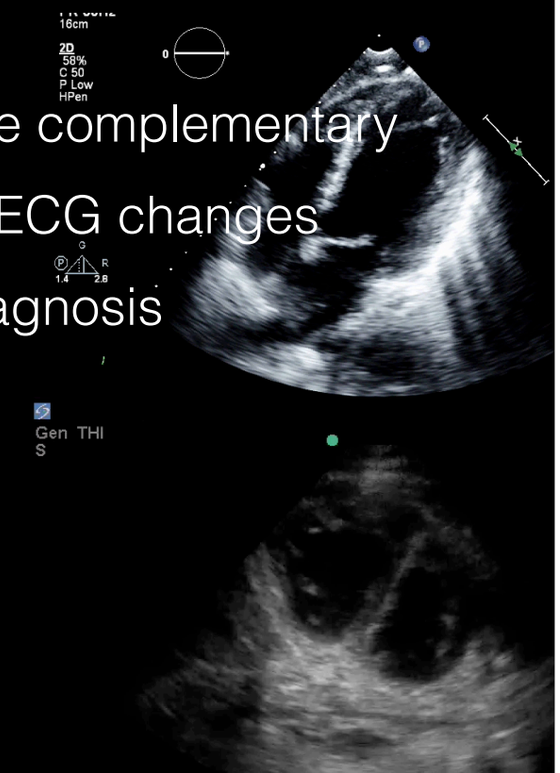
# Take Home Points

- Heart, Lung, IVC exams are complementary
- Regional WMA with Acute ECG changes



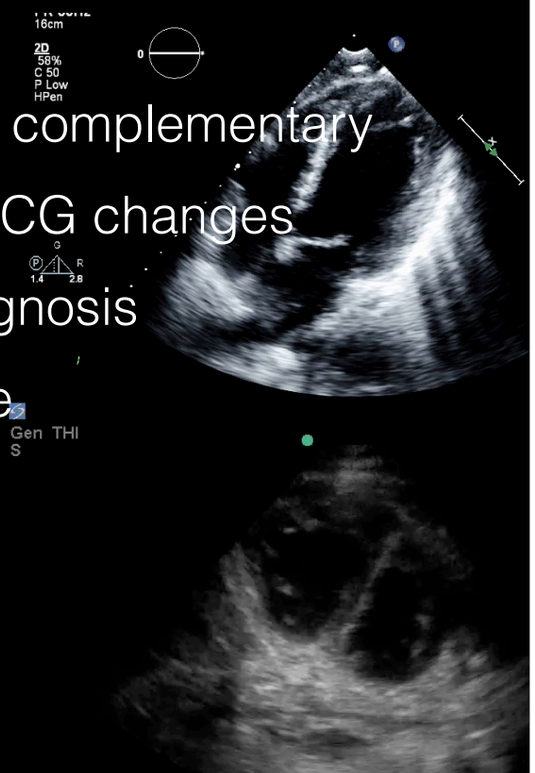
# Take Home Points

- Heart, Lung, IVC exams are complementary
- Regional WMA with Acute ECG changes
- Tamponade is a clinical diagnosis



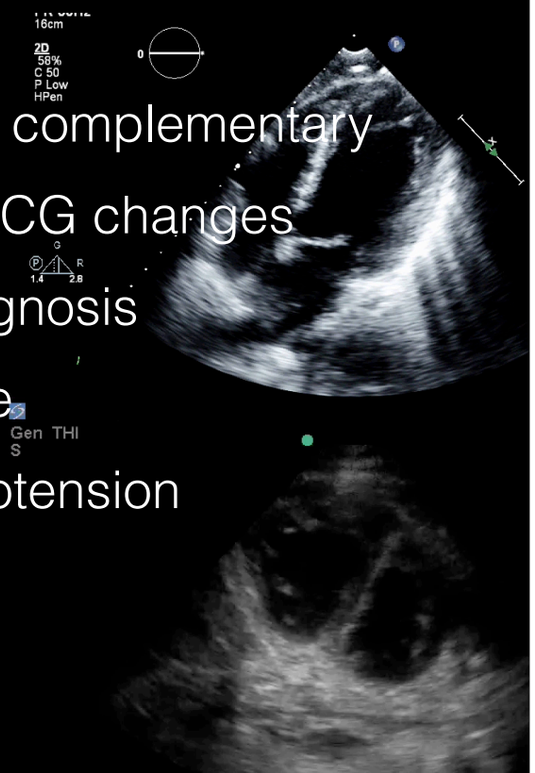
# Take Home Points

- Heart, Lung, IVC exams are complementary
- Regional WMA with Acute ECG changes
- Tamponade is a clinical diagnosis
  - RV & RA diastolic collapse



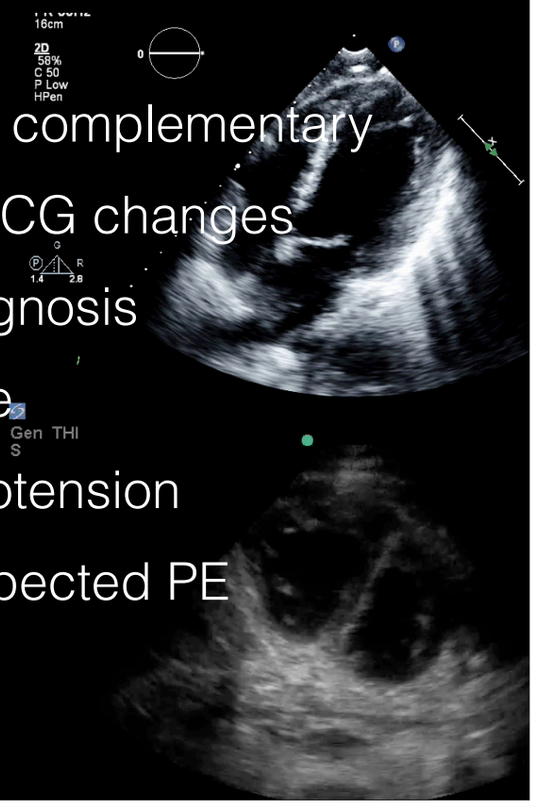
# Take Home Points

- Heart, Lung, IVC exams are complementary
- Regional WMA with Acute ECG changes
- Tamponade is a clinical diagnosis
  - RV & RA diastolic collapse
  - Be mindful of relative hypotension



# Take Home Points

- Heart, Lung, IVC exams are complementary
- Regional WMA with Acute ECG changes
- Tamponade is a clinical diagnosis
  - RV & RA diastolic collapse
  - Be mindful of relative hypotension
- RV Function for New or Suspected PE



# Take Home Points


- Heart, Lung, IVC exams are complementary
- Regional WMA with Acute ECG changes
- Tamponade is a clinical diagnosis
  - RV & RA diastolic collapse
  - Be mindful of relative hypotension
- RV Function for New or Suspected PE
- POCUS eval for suspected Dissection

# Thank You