Emergency Echocardiography

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Case

Chest Pain

- 13 y/o female with pleuritic CP x2 weeks
- Radiation to back, shoulders. Positional.
- No cough, SOB, leg swelling
- Multiple outside ED visits in last 3 months

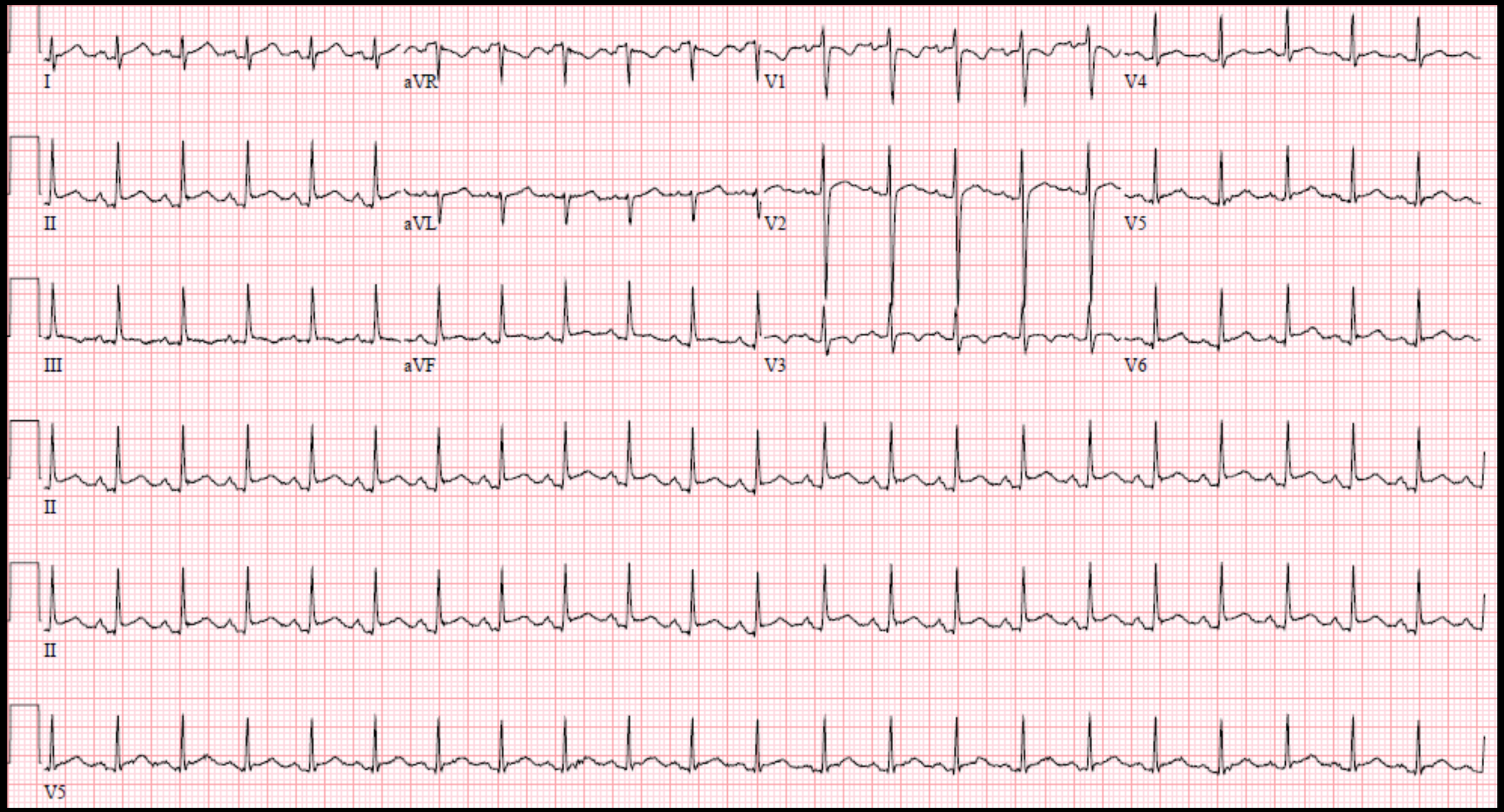
Case

Chest Pain

- T 102, P 140, BP 124/85, 99% RA
- Tachycardic, regular
- Lungs clear
- No peripheral edema

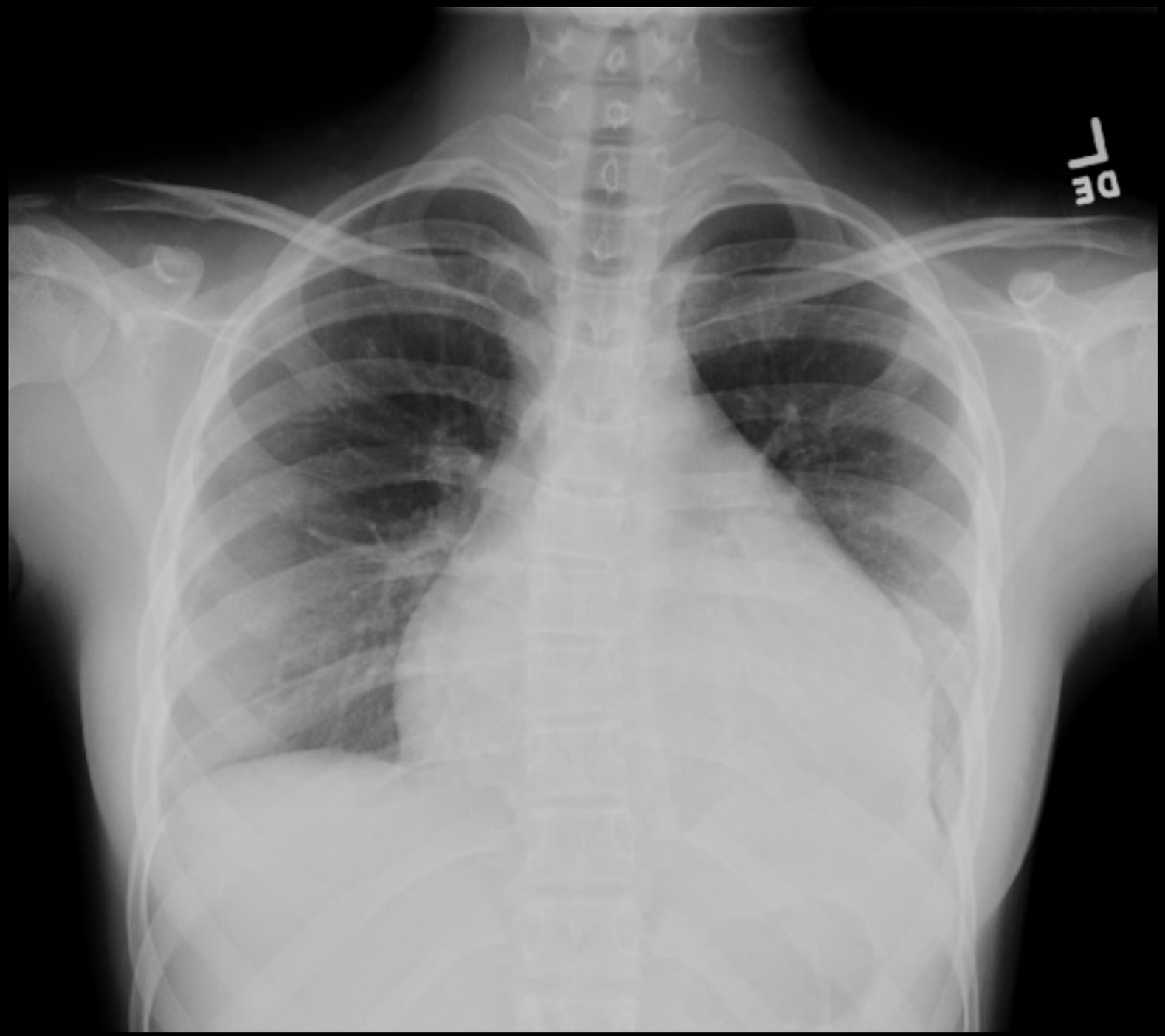
Case

Chest Pain



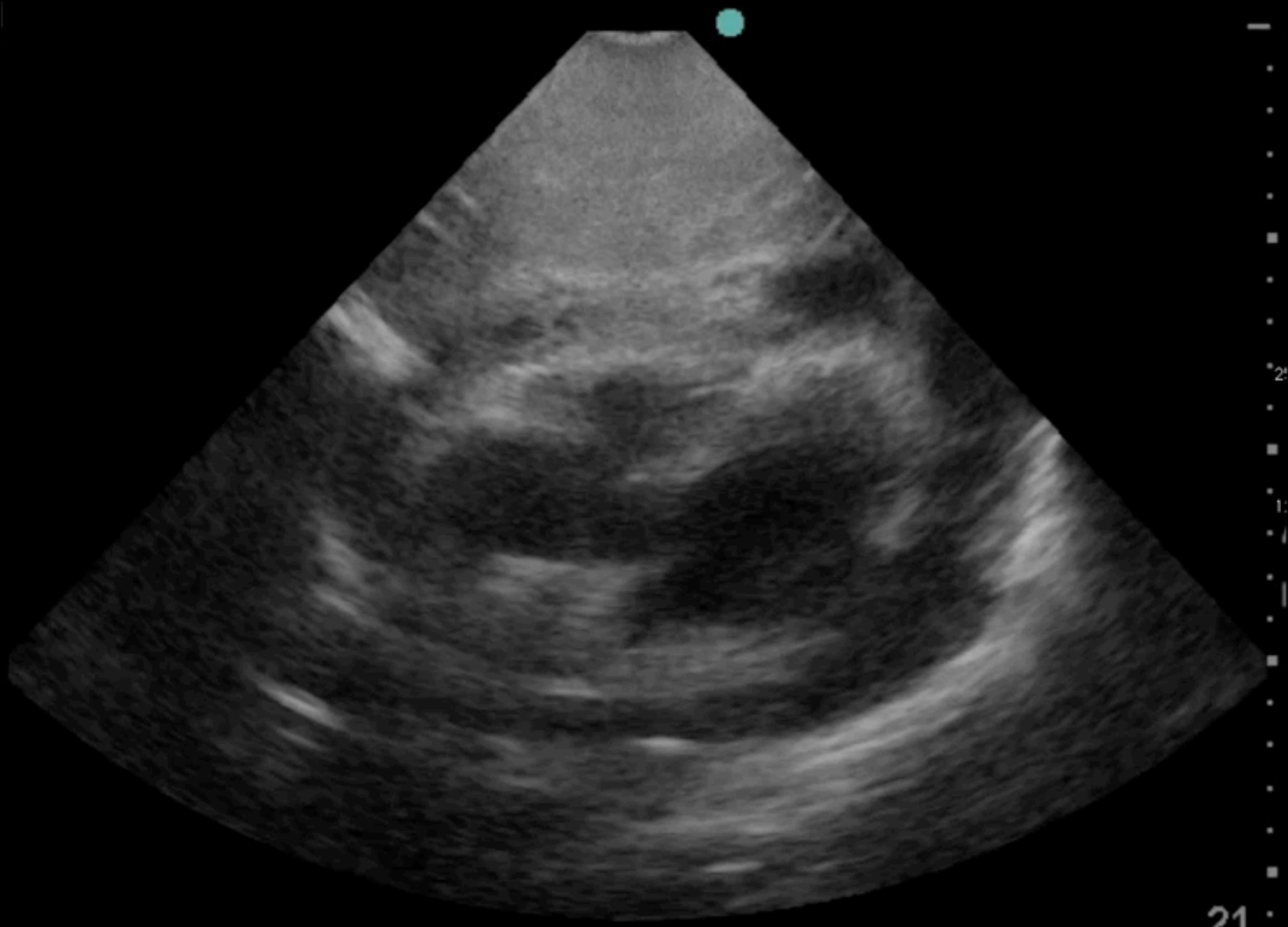
Case

Chest Pain



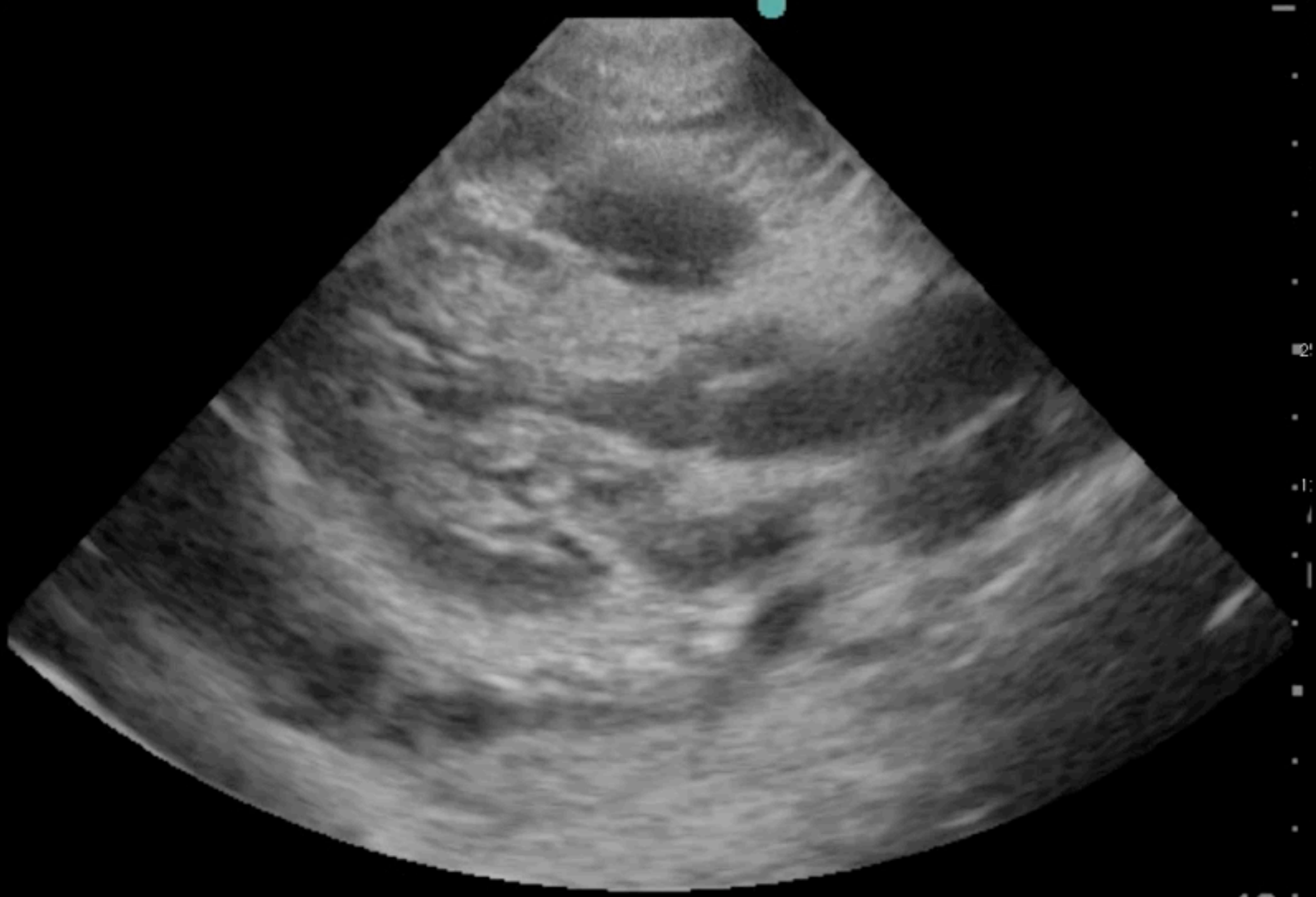
Case

Chest Pain



Case

Chest Pain



Case

Chest Pain

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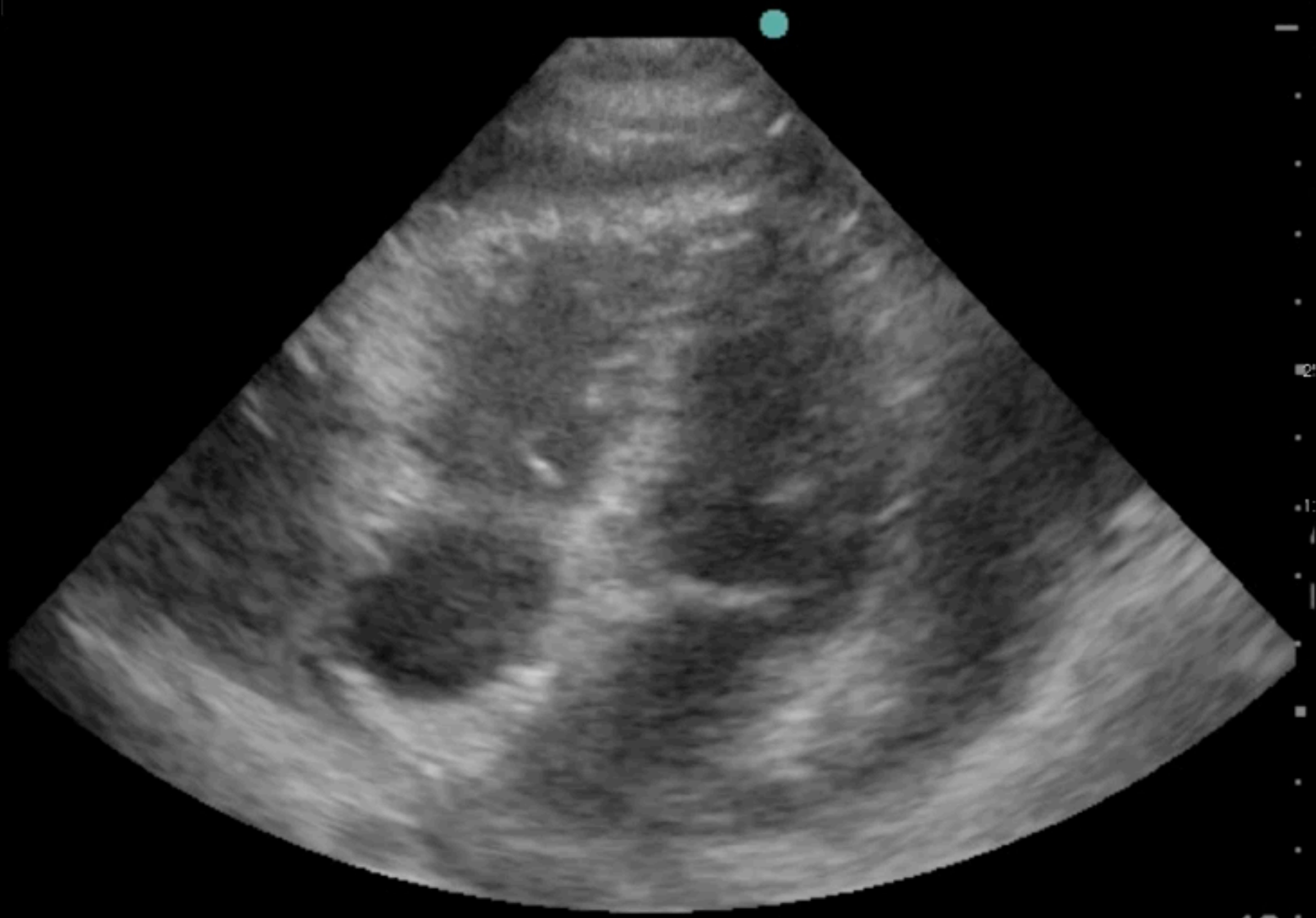
Chest Pain



Indications

- Possible effusion/tamponade
- Chest trauma
- Acute chest pain
- Cardiac arrest or PEA
- Unexplained hypotension
- Respiratory distress

Indications

- Ability to detect cardiac disease in 61 patients: medical student with 18 hours echo training vs board certified cardiologists with physical exam
- students identified 75% pathologies, cardiologists 49%

Kobal et al. Comparison of effectiveness of hand-carried ultrasound to bedside cardiovascular physical exam. *Am J Cardiology* 2005; 96:1002-6

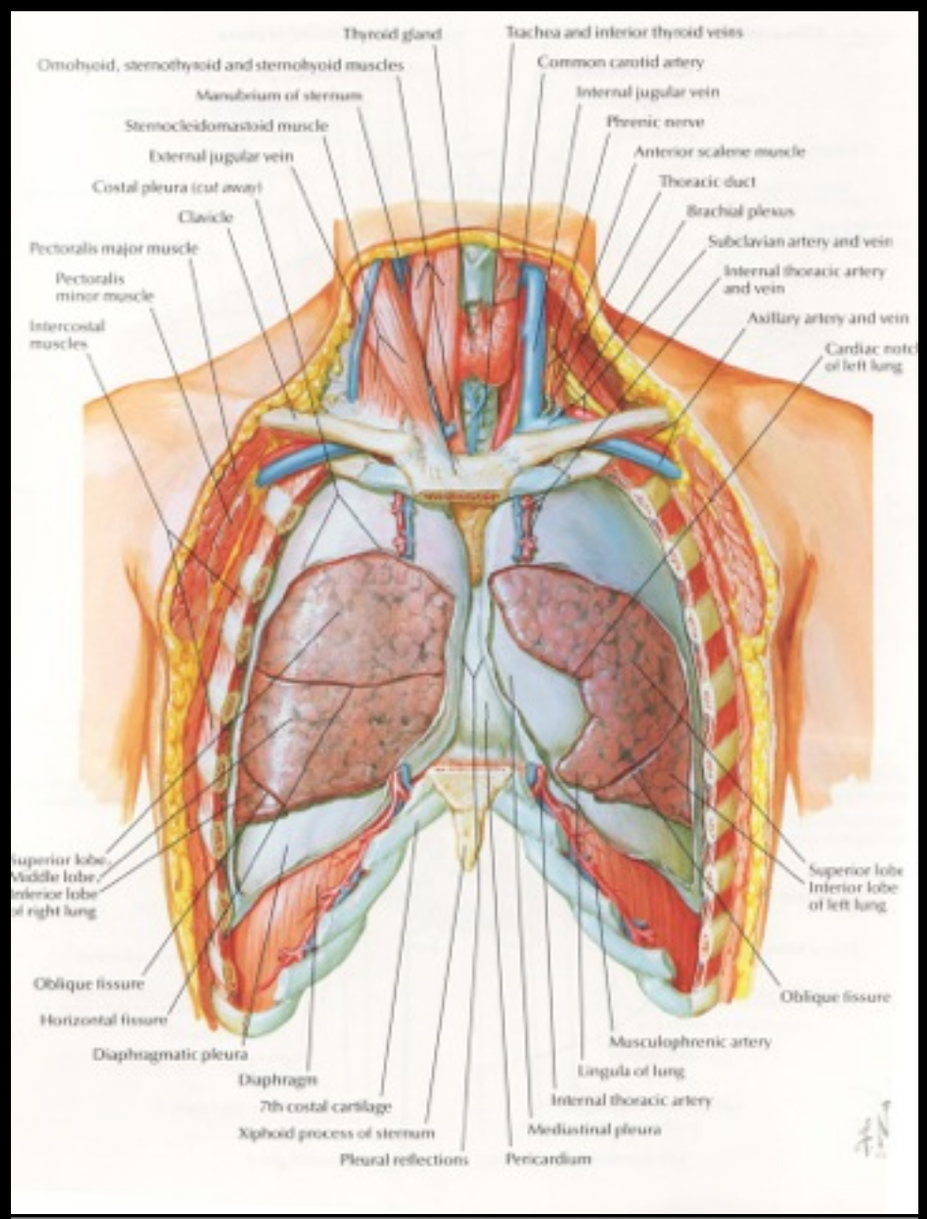
Goals

- pericardial effusion
- LV function (how good is the squeeze?)
- RV function (PE?)
- ascending aortic aneurysm/dissection

Comparison to Physical Exam

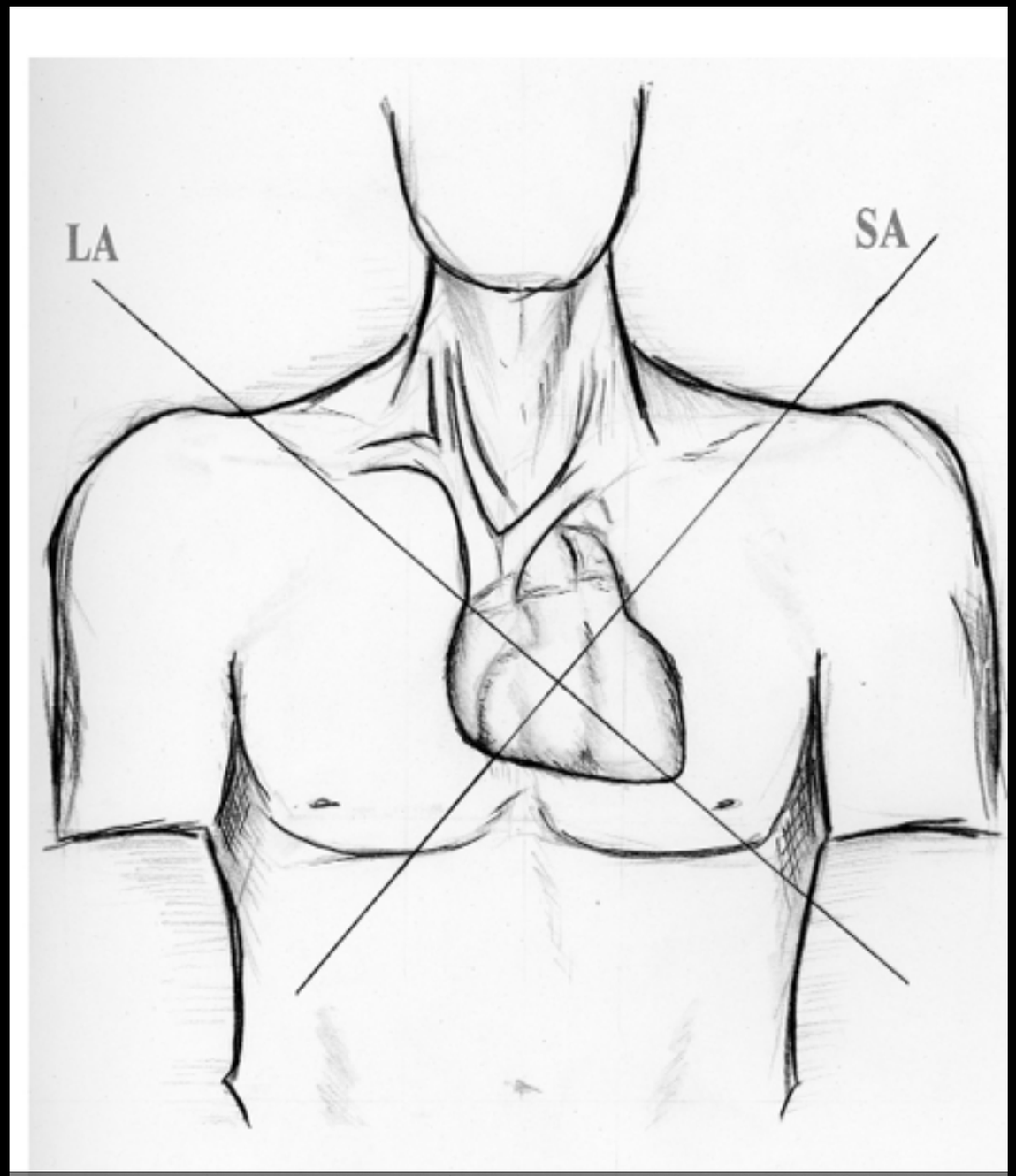
Clinical Sign	Incidence
Pulsus paradoxus	36%
Muffled heart tones	24%
S4	42-70%
S3	10-30%
Widened pulse pressure	5%

Anatomy



- Chest is difficult to ultrasound
  - ribs
  - lungs

Anatomy



Technical Considerations

Phased Array Probe

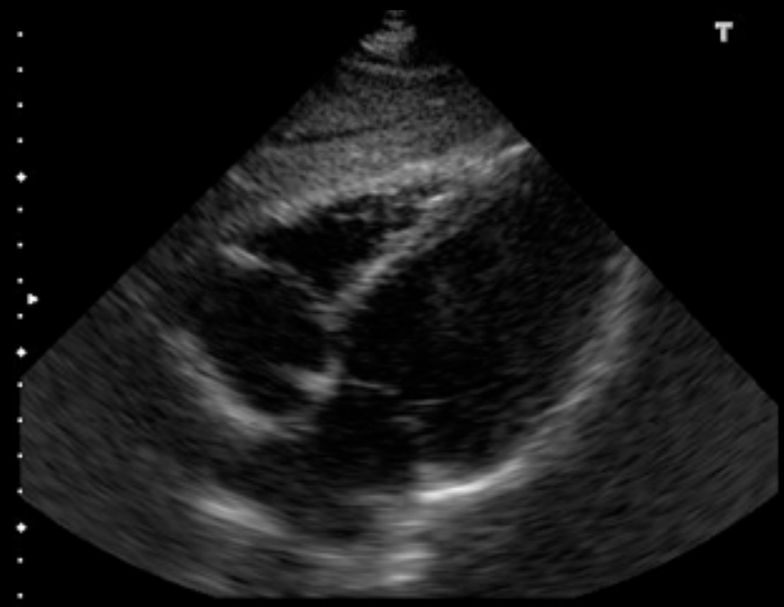
- small footprint
- deep penetration
- 2-4 MHz

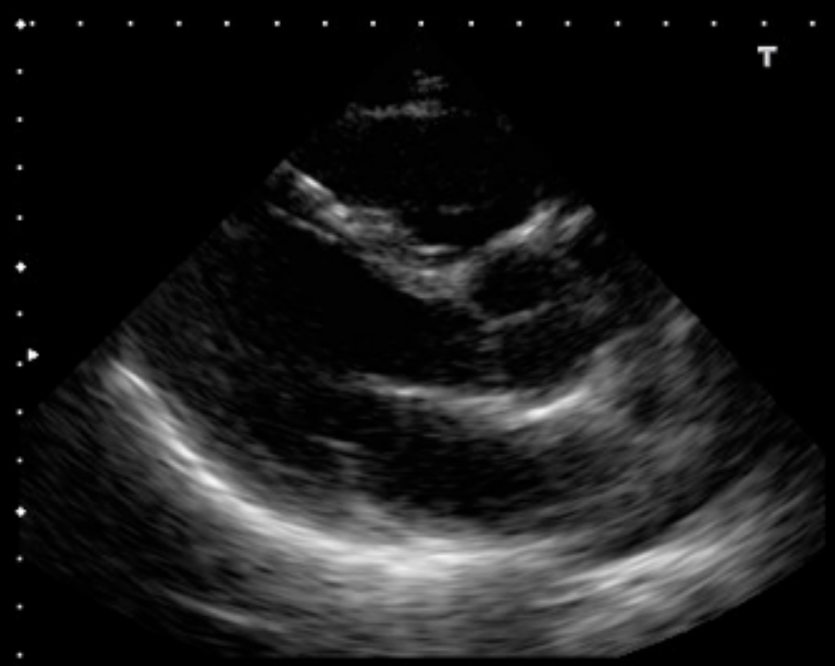
Technical Considerations

Machine Settings

make sure to use the cardiac preset

Orientation





“Standard” Echo Images

- Start with the basic exam
- Try to reproduce standard views
- Pattern recognition
- Important to learn all four views

Patient Positioning

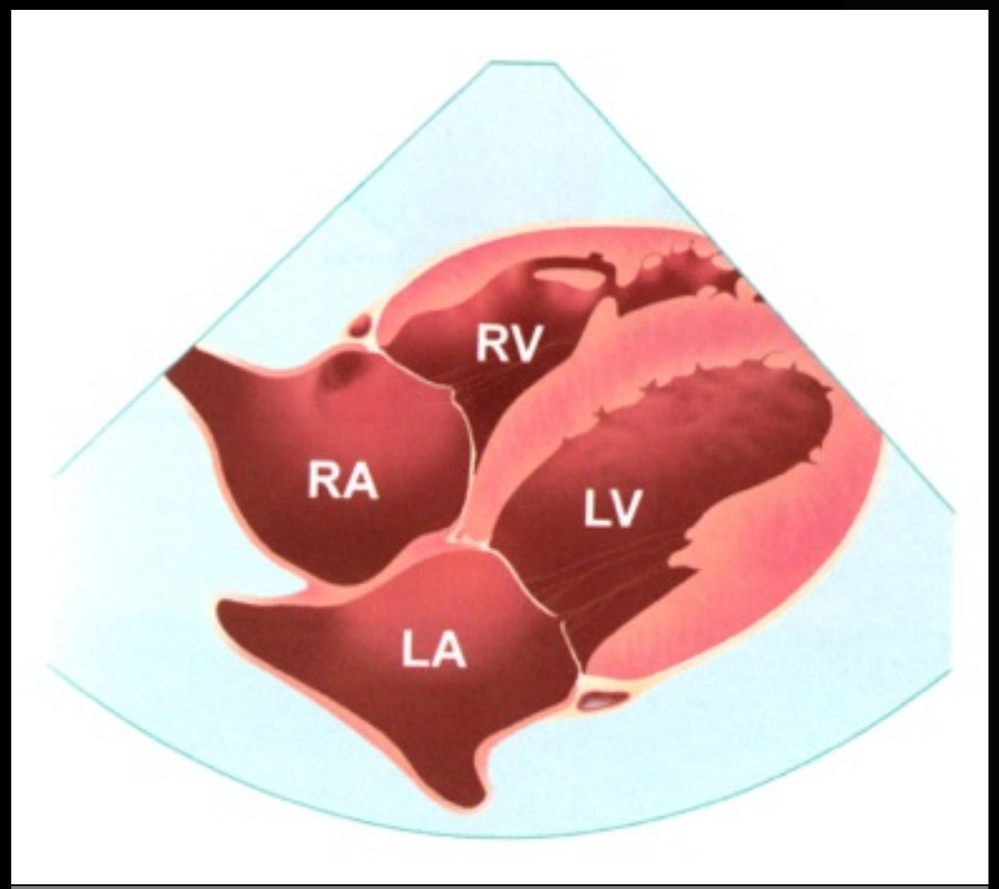
- left lateral decubitus
- left arm raised

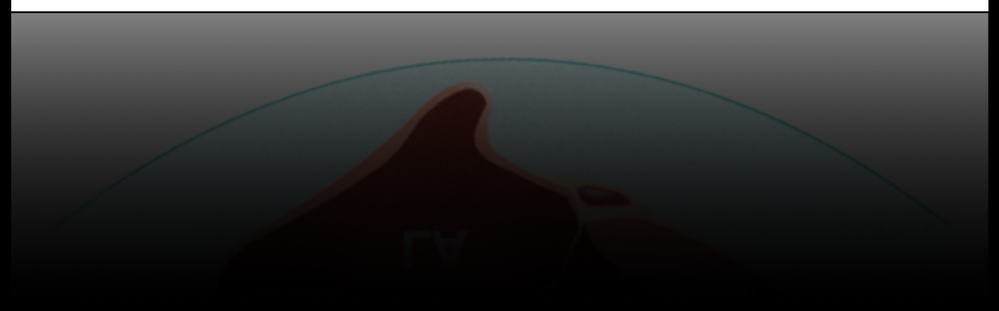
Normal Sonographic Findings

Subcostal Four-Chamber

Normal Sonographic Findings

Subcostal Four-Chamber



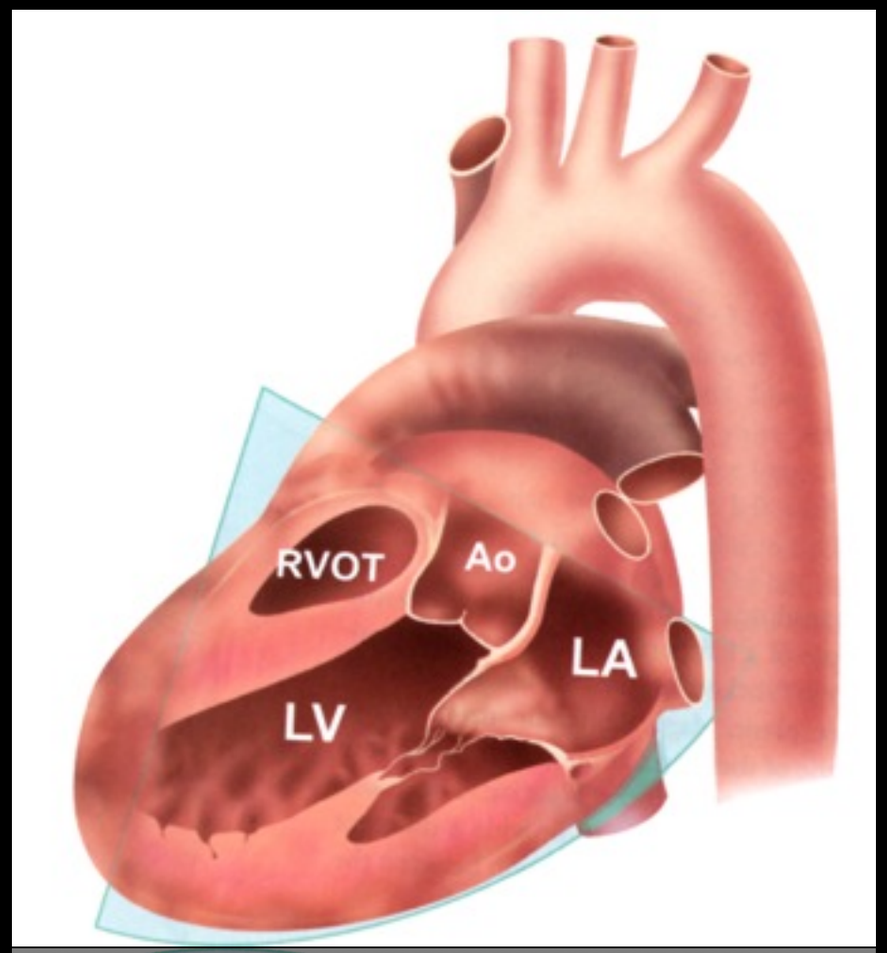


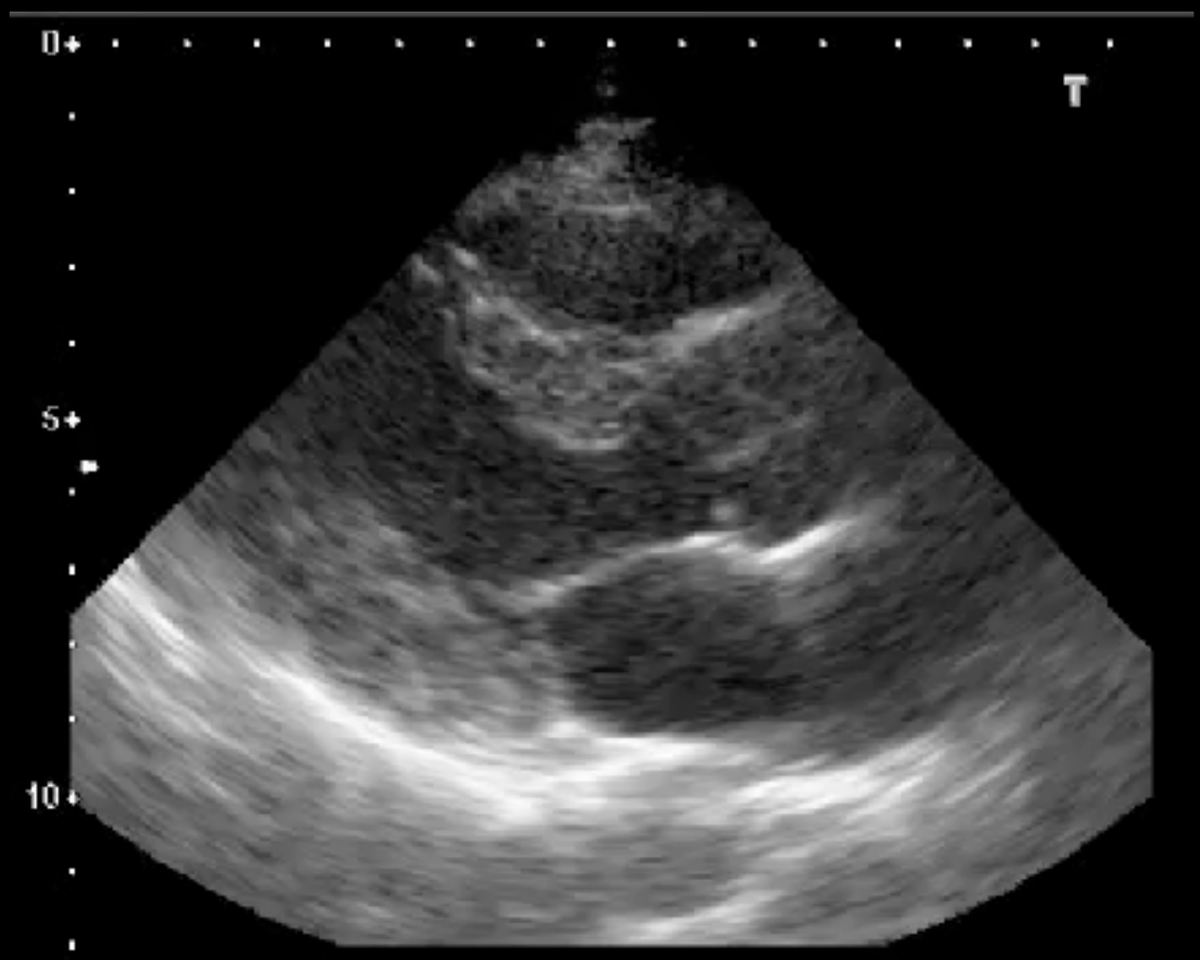
Normal Sonographic Findings

Parasternal Long-Axis

Normal Sonographic Findings

Parasternal Long-Axis



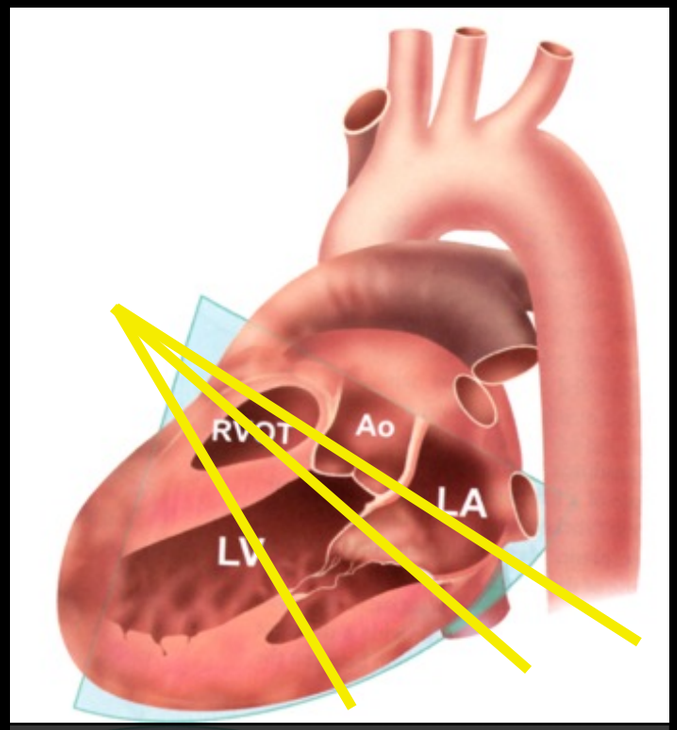


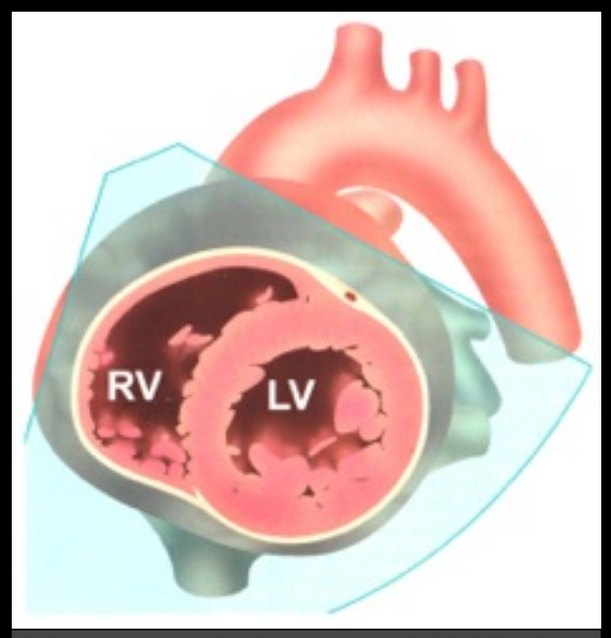
Normal Sonographic Findings

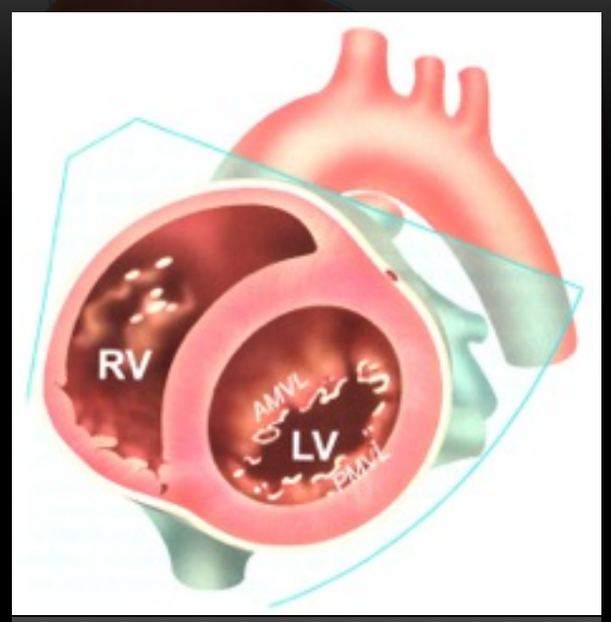
Parasternal Short-Axis

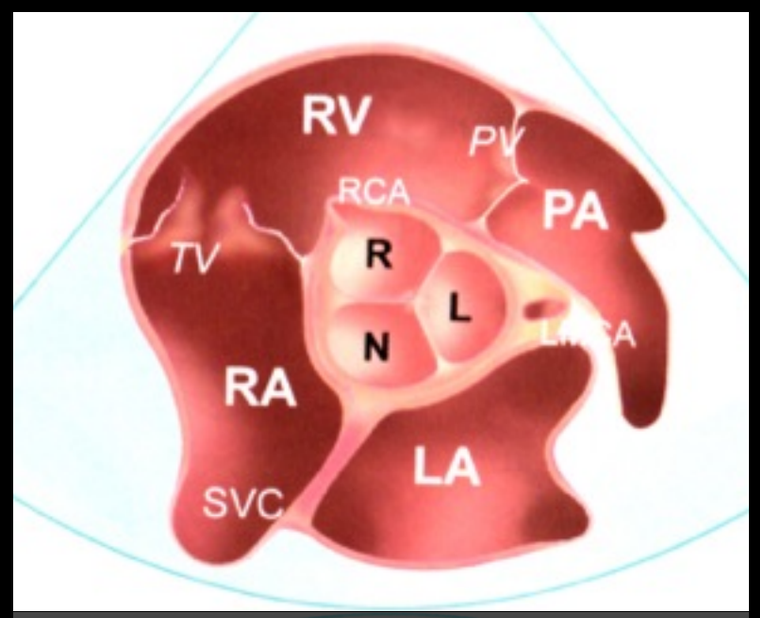
Normal Sonographic Findings

Parasternal Short-Axis









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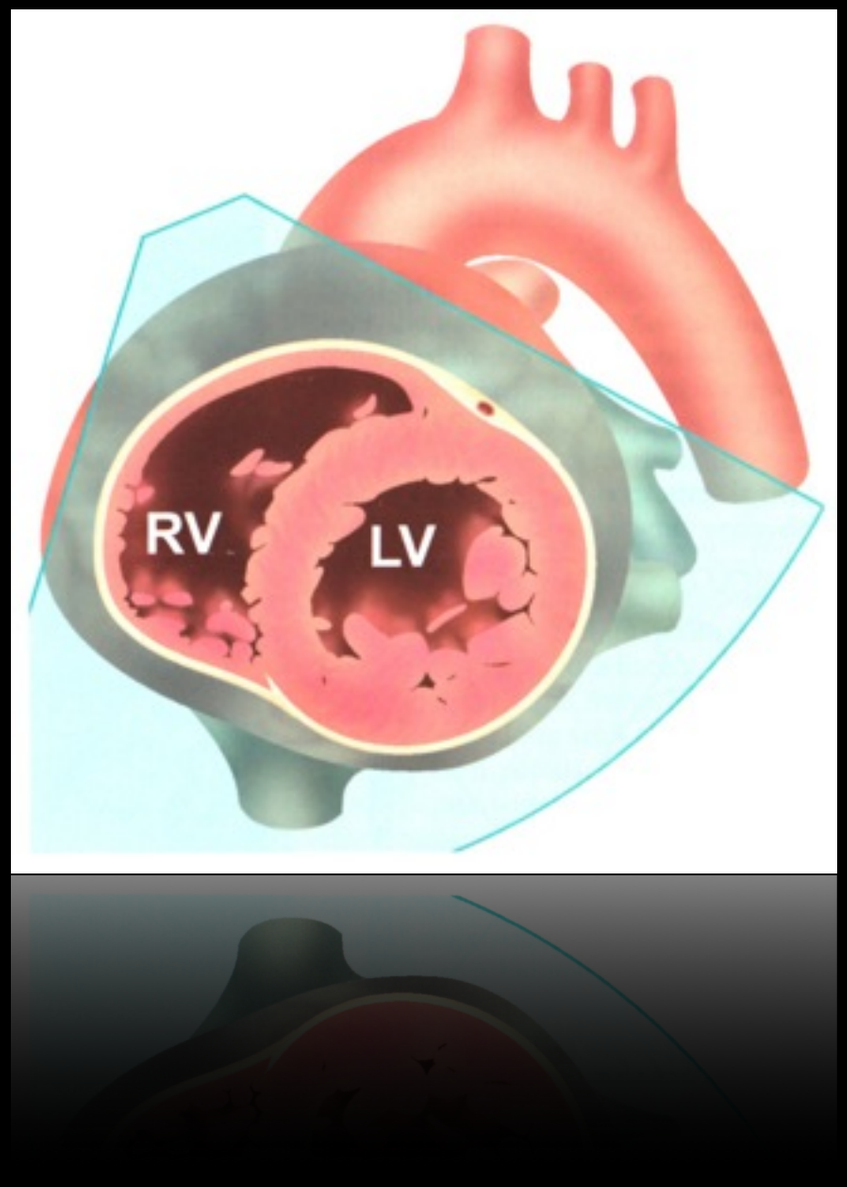

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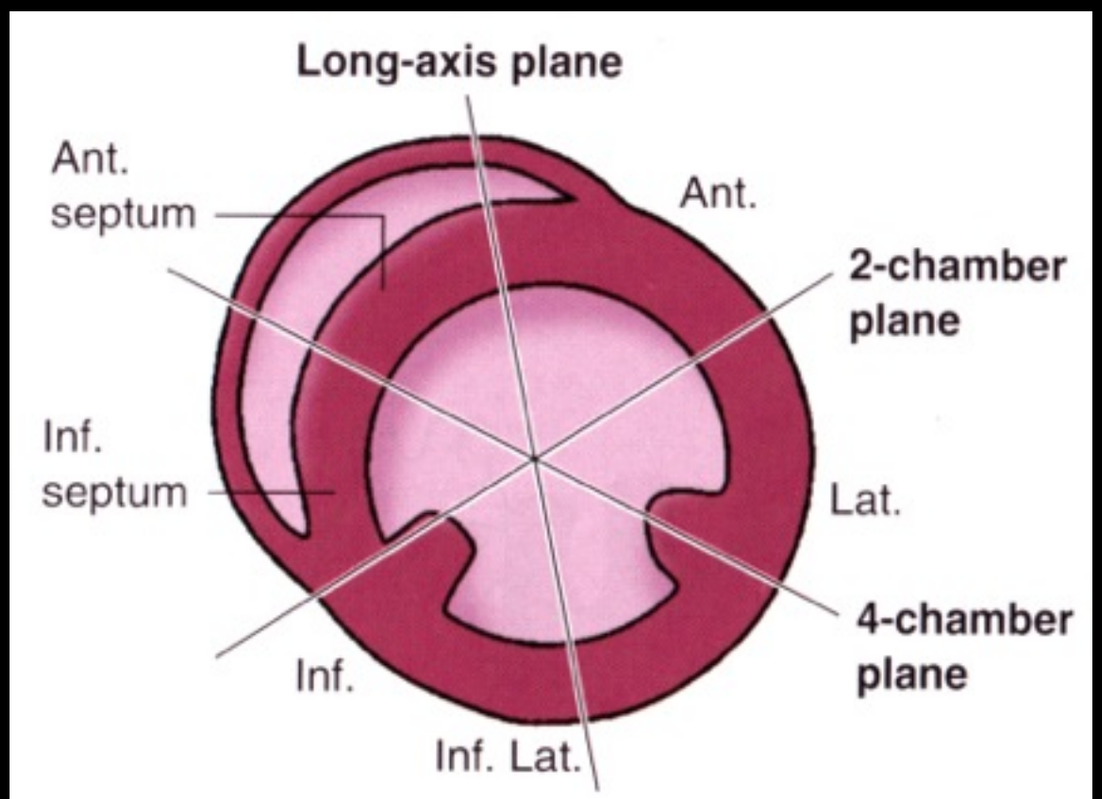

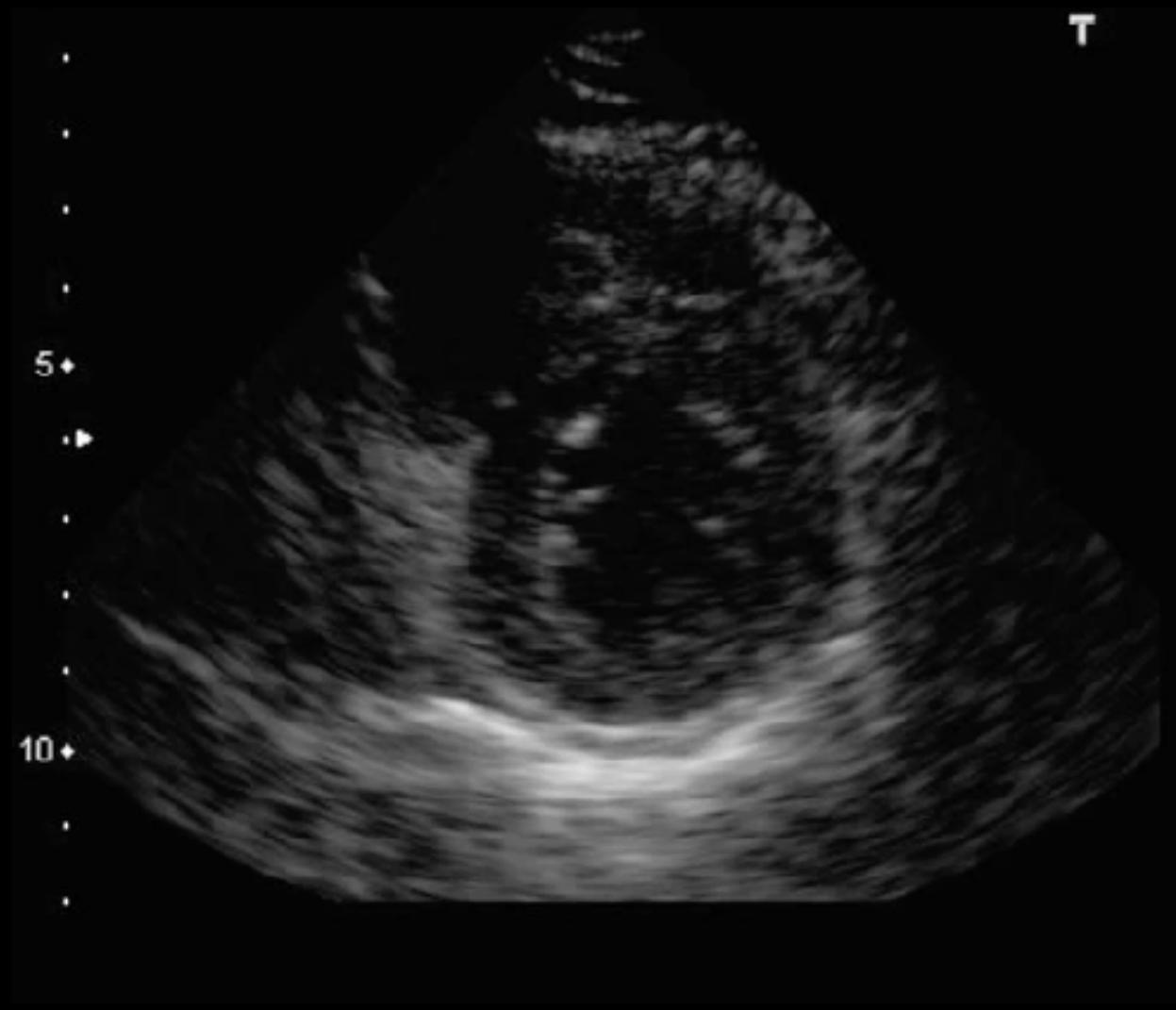

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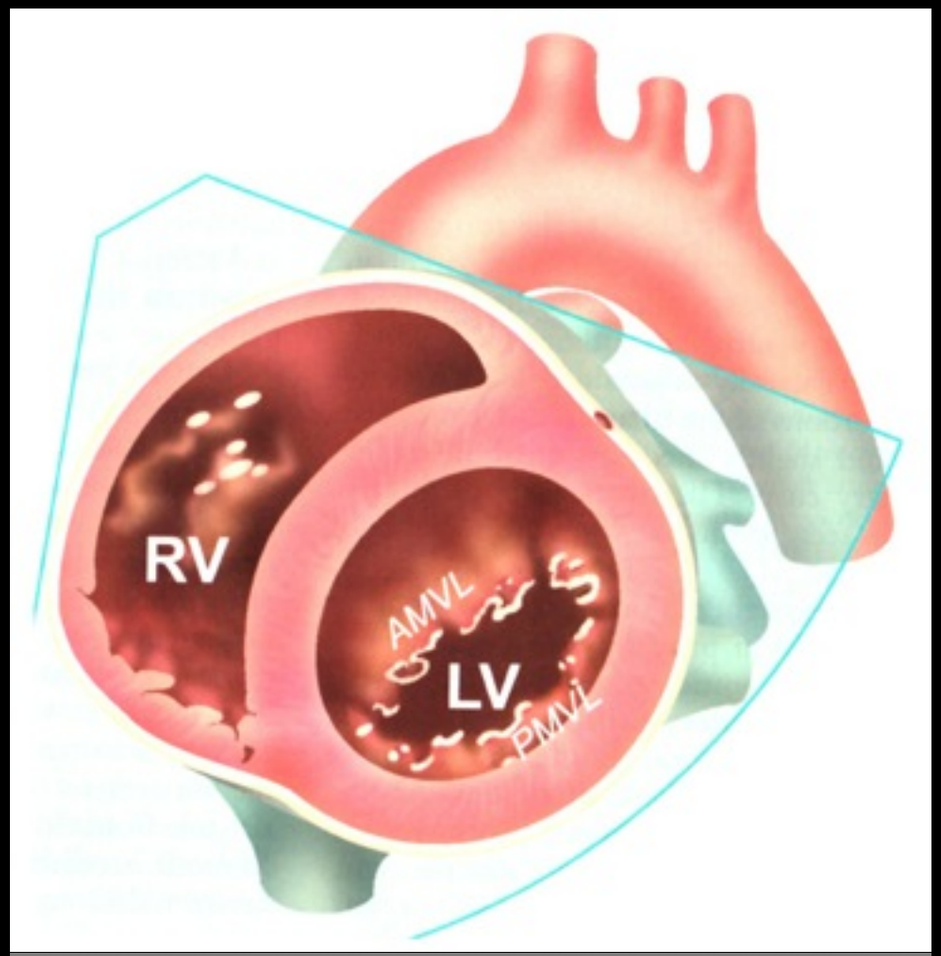
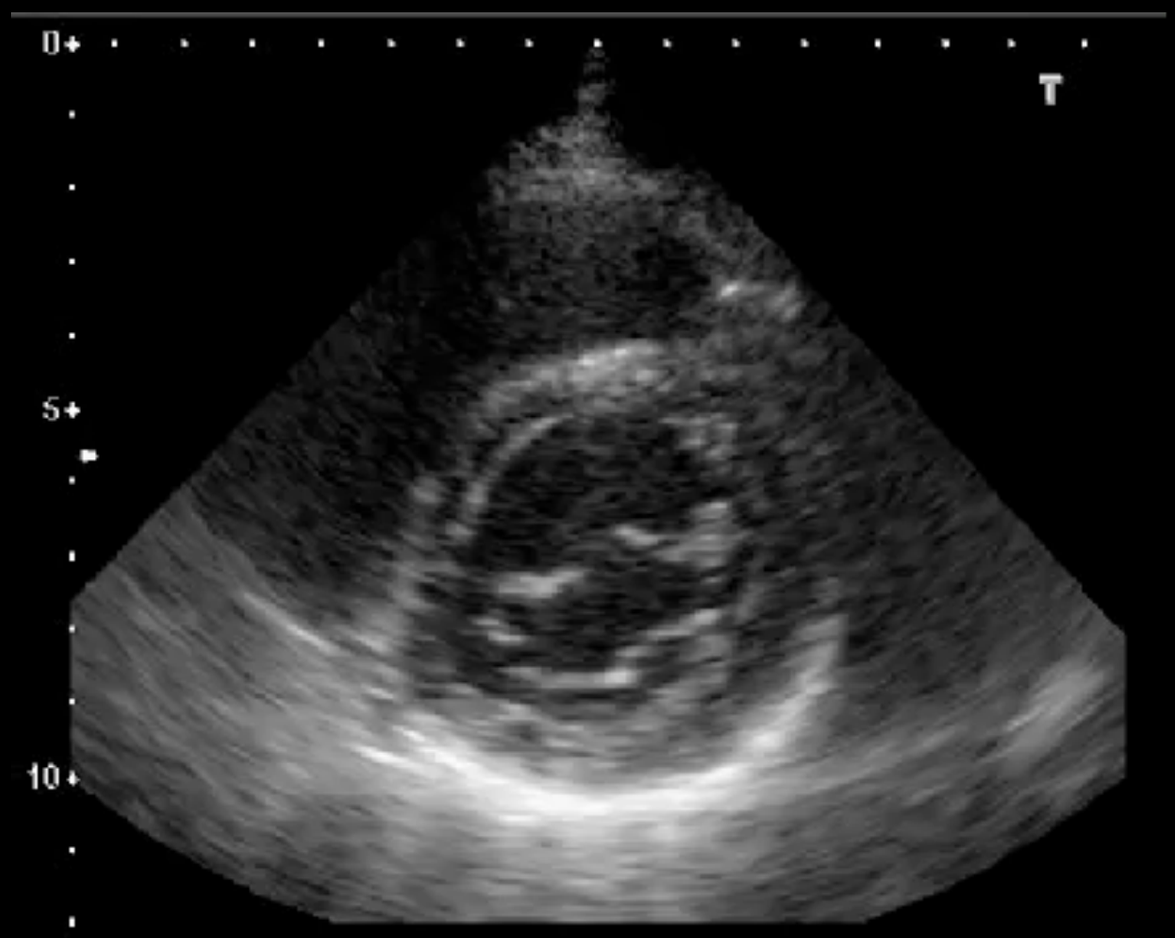
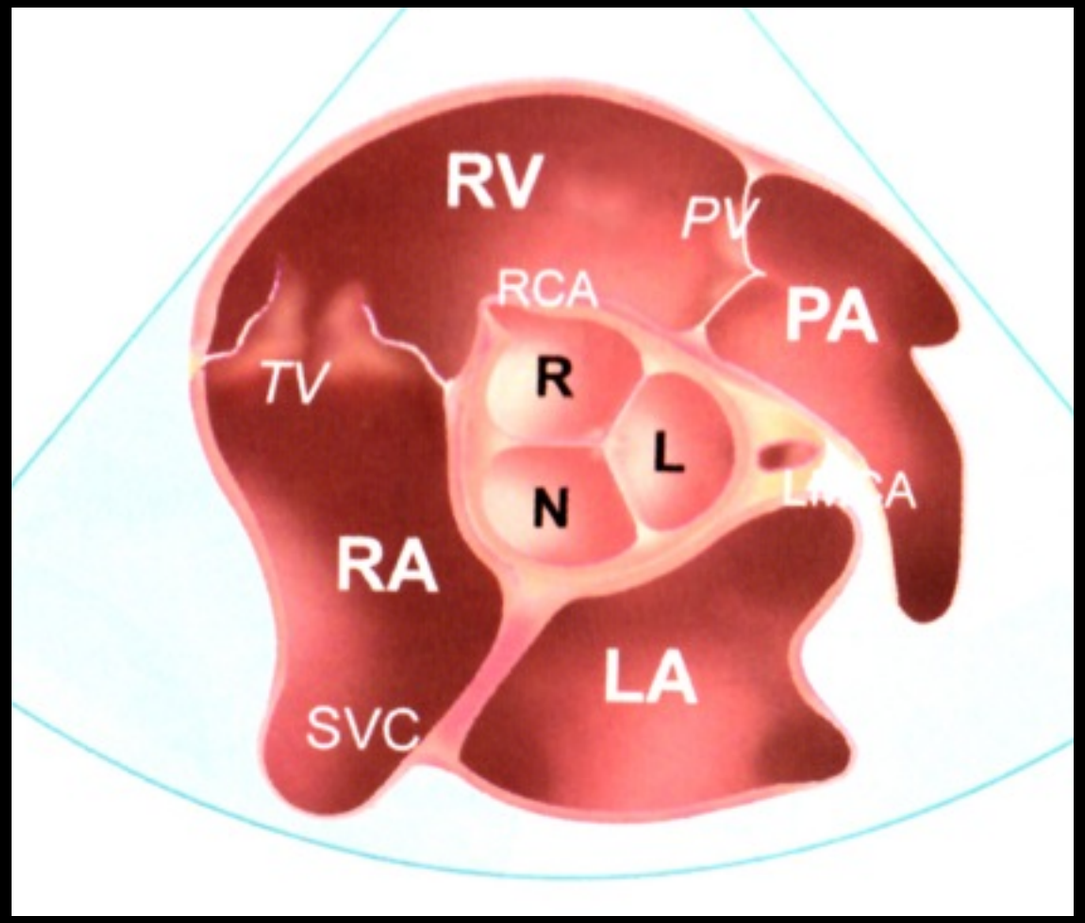




Normal Sonographic Findings

Parasternal Short-Axis

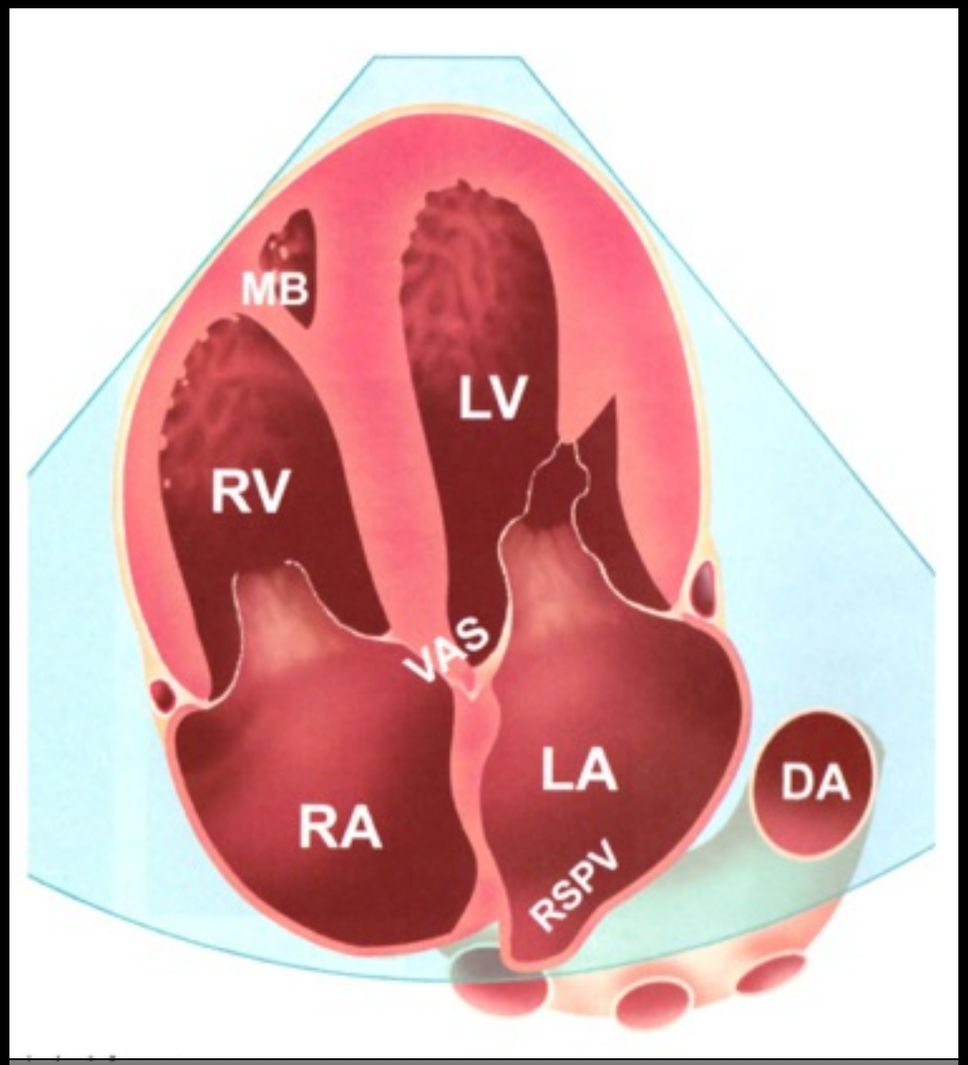


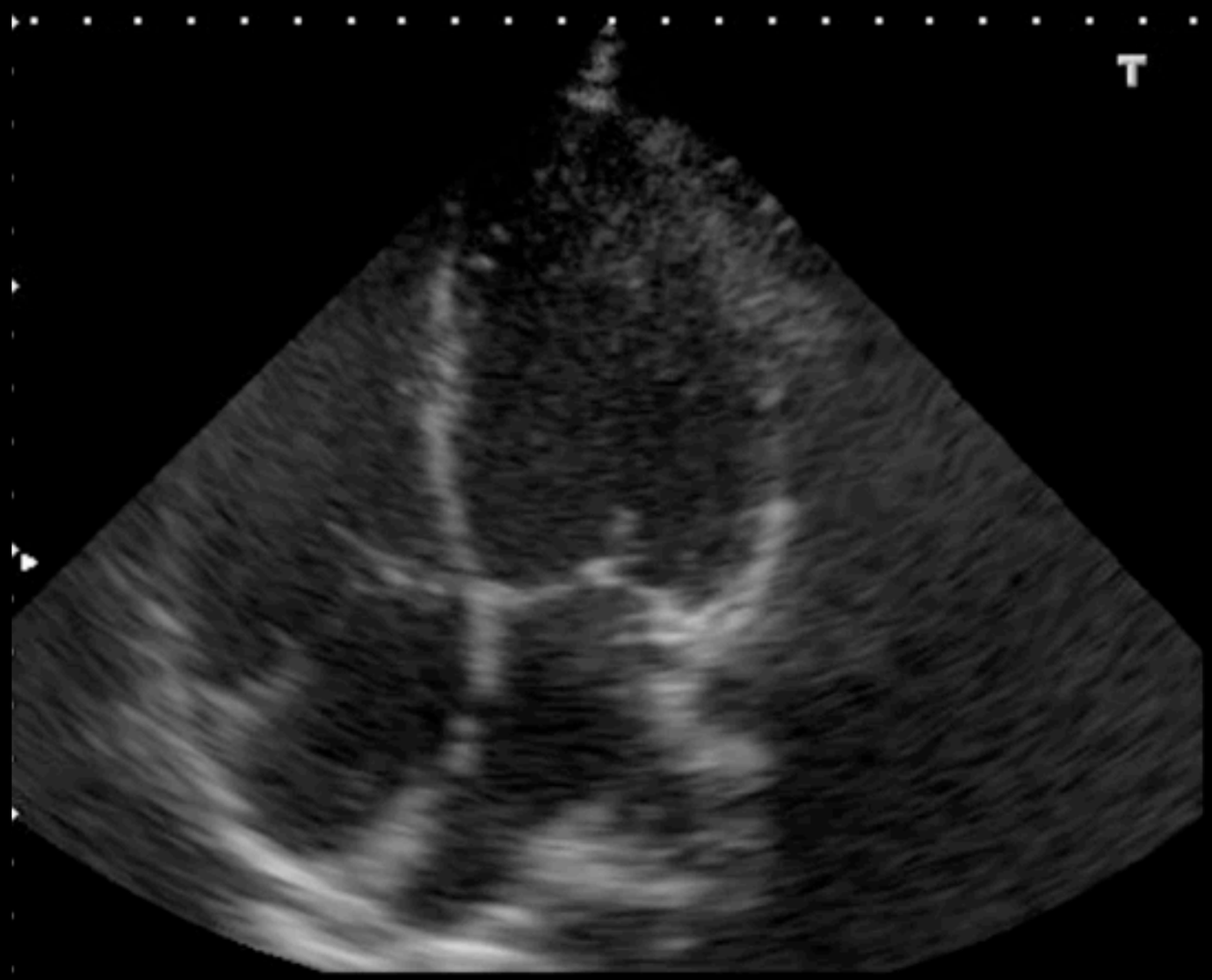
Normal Sonographic Findings

Apical Four-Chamber

Normal Sonographic Findings

Apical Four-Chamber



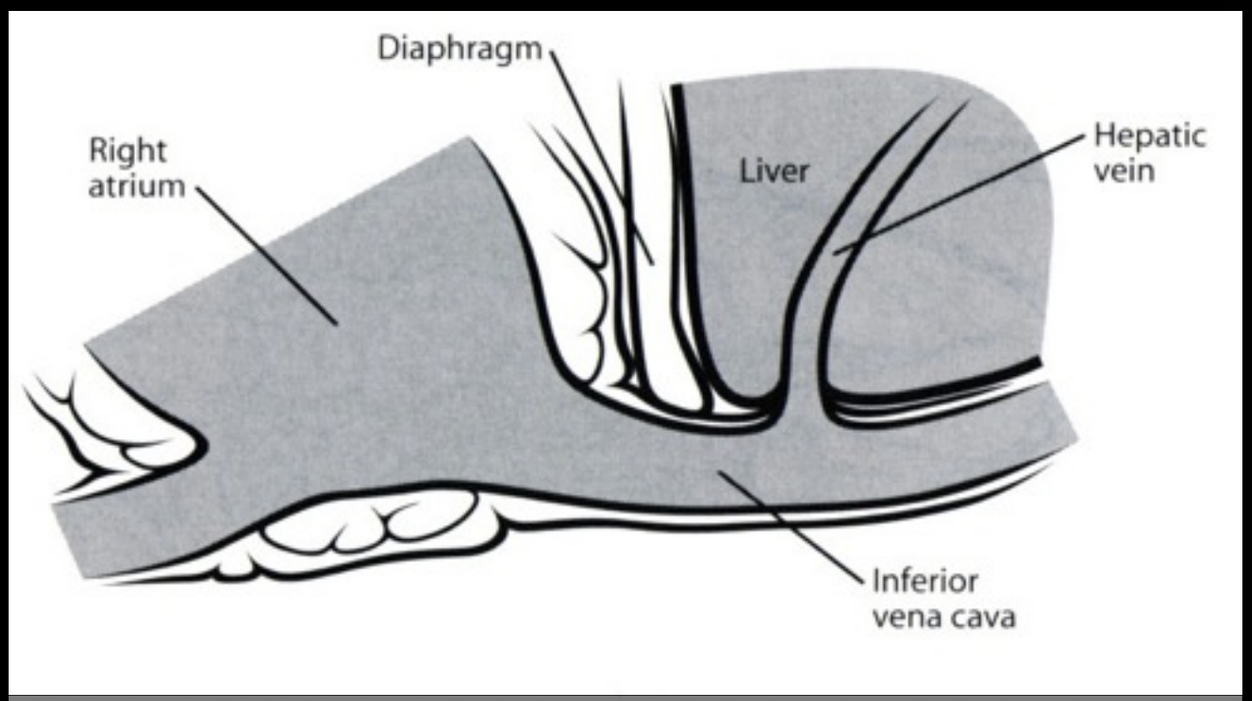


Normal Sonographic Findings

Subcostal Long-Axis

Normal Sonographic Findings

Subcostal Long-Axis



Normal Sonographic Findings

Subcostal Long-Axis

Pericardial Effusion

Pathologic Sonographic Findings

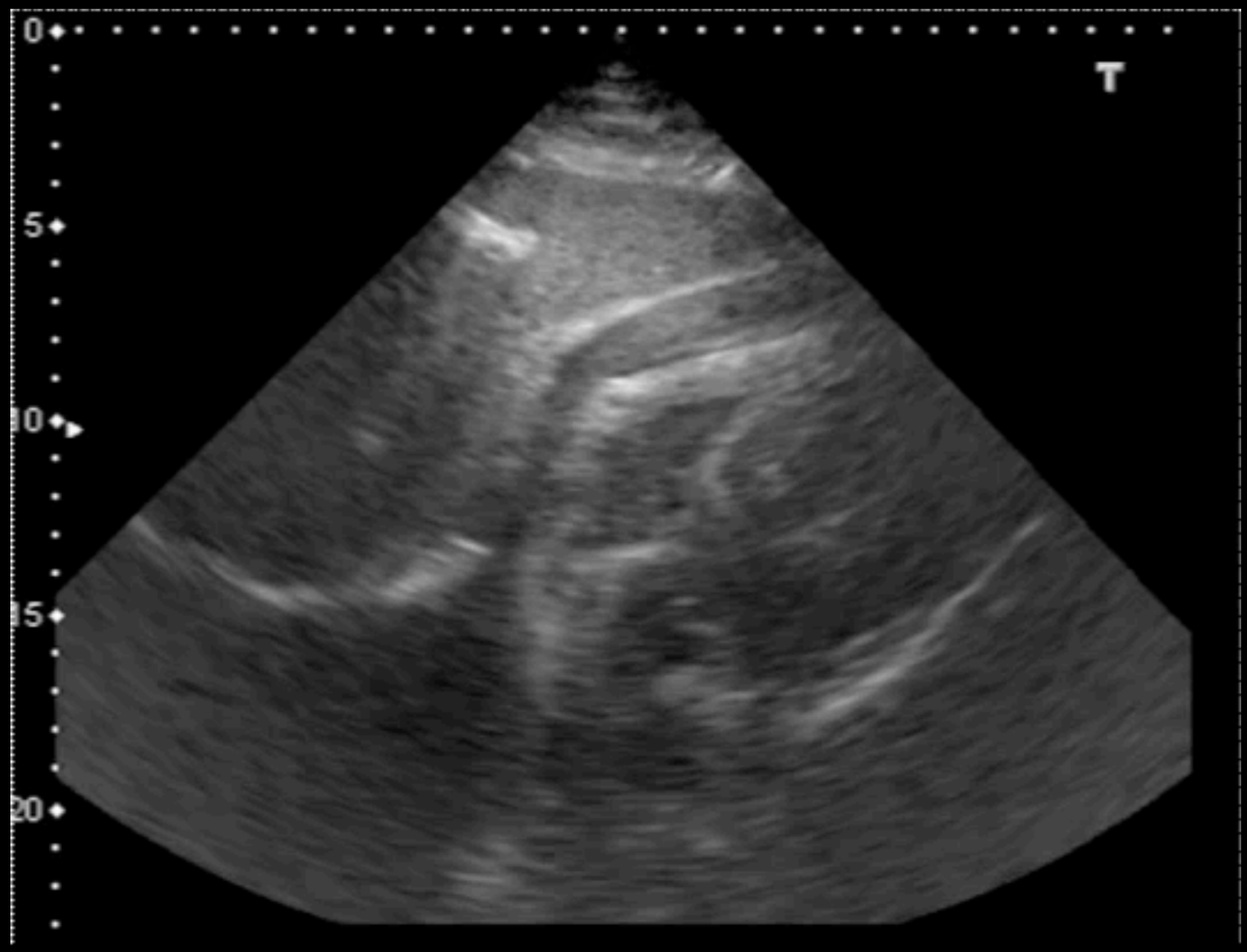
Pericardial Effusion

- 515 patients with suspicion of pericardial effusion
- EP's determined presence/absence of pericardial effusion
- 103 patients ultimately had pericardial effusion
- 96% sensitivity, 98% specificity

Mandavia D, Hoffner R, Mahaney K. Bedside echocardiography by emergency physicians. *Ann Emerg Med* 2001, 38:4 377-82.

Pathologic Sonographic Findings

Pericardial Effusion



Pericardial fluid/clot from penetrating trauma

Pathologic Sonographic Findings

Pericardial Effusion

pericardial clot

Pathologic Sonographic Findings

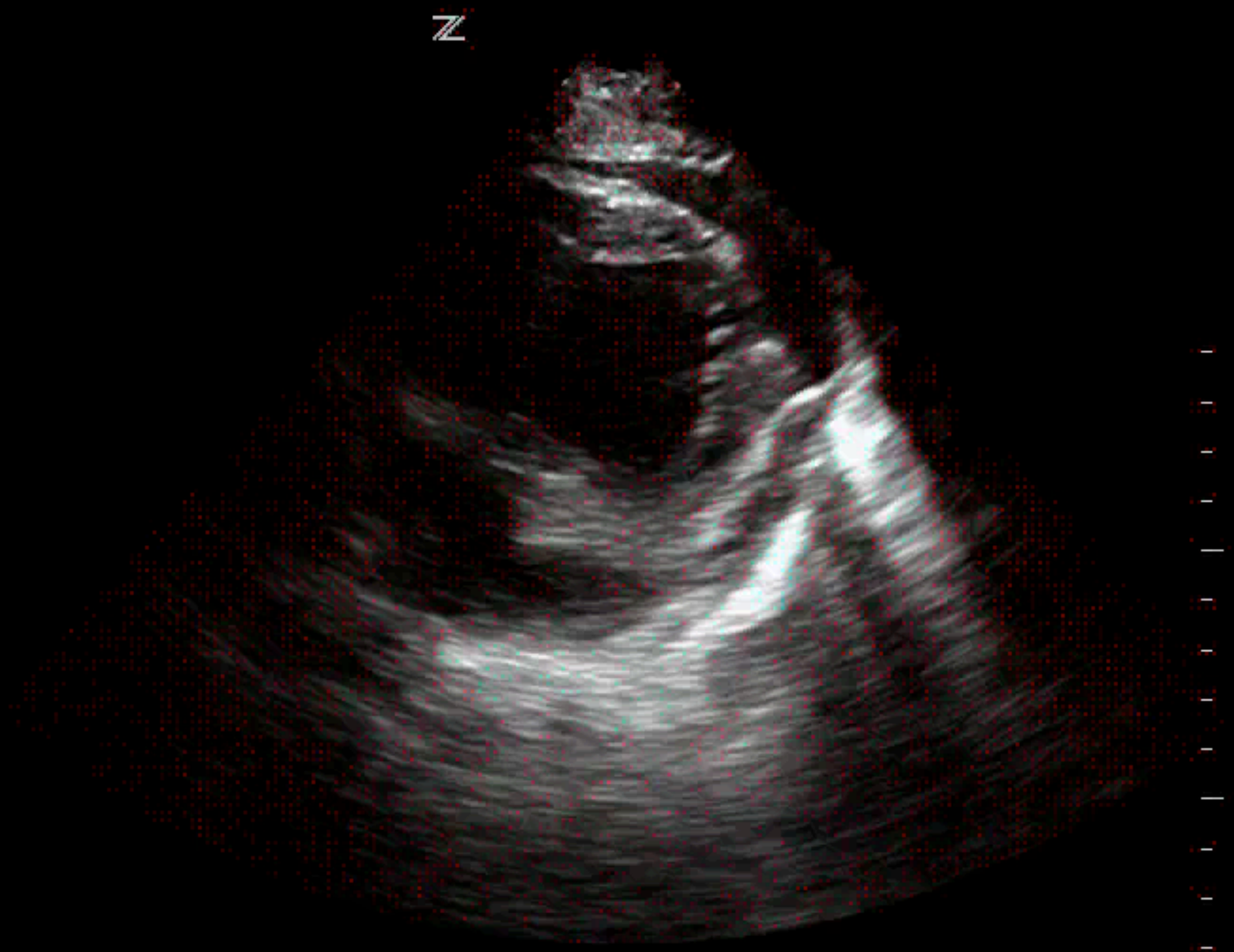
Pericardial Effusion

Pathologic Sonographic Findings

Pericardial Effusion

Pathologic Sonographic Findings

Pericardial Effusion



Pathologic Sonographic Findings

Pericardial Effusion

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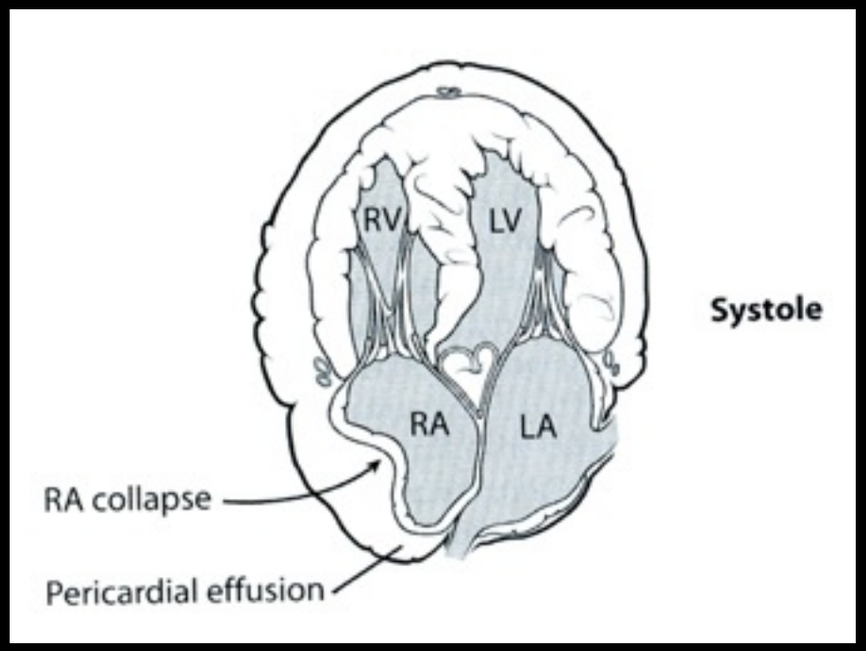
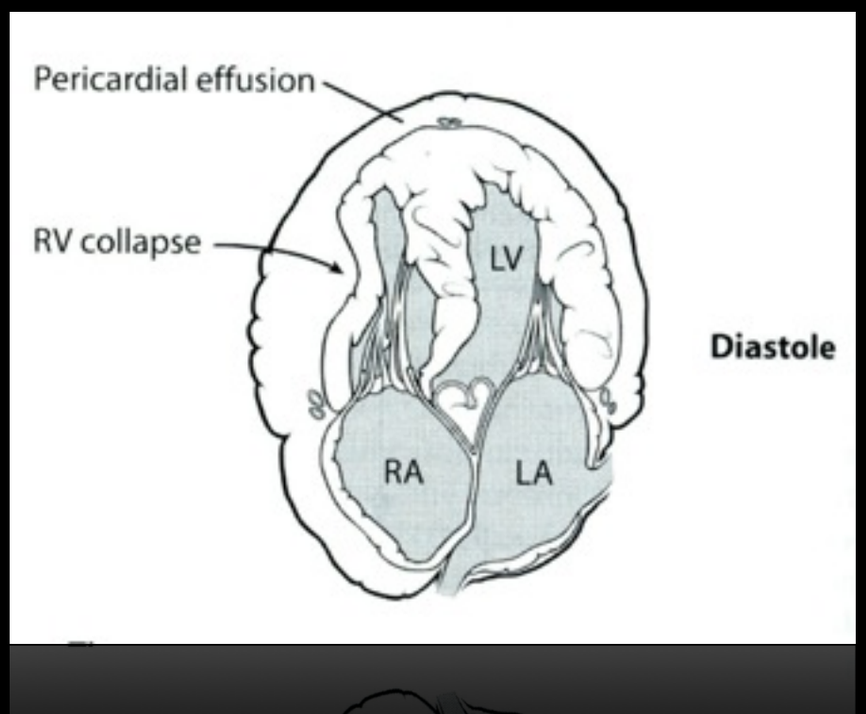
Pericardial Effusion

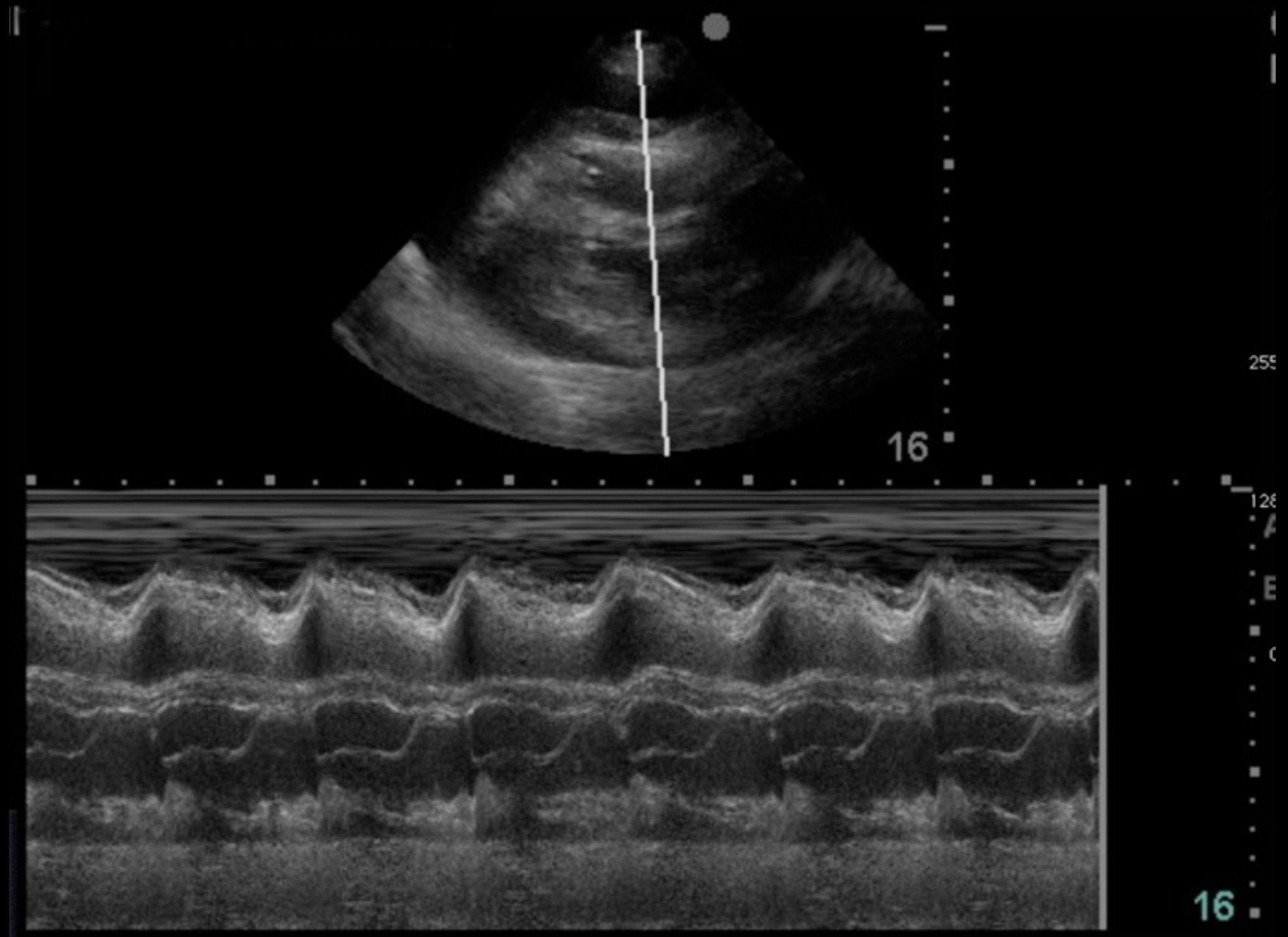




- pericardial tamponade
  - RA collapses in systole
  - RV collapses in diastole
- IVC may be dilated

Pathologic Sonographic Findings

Pericardial Effusion



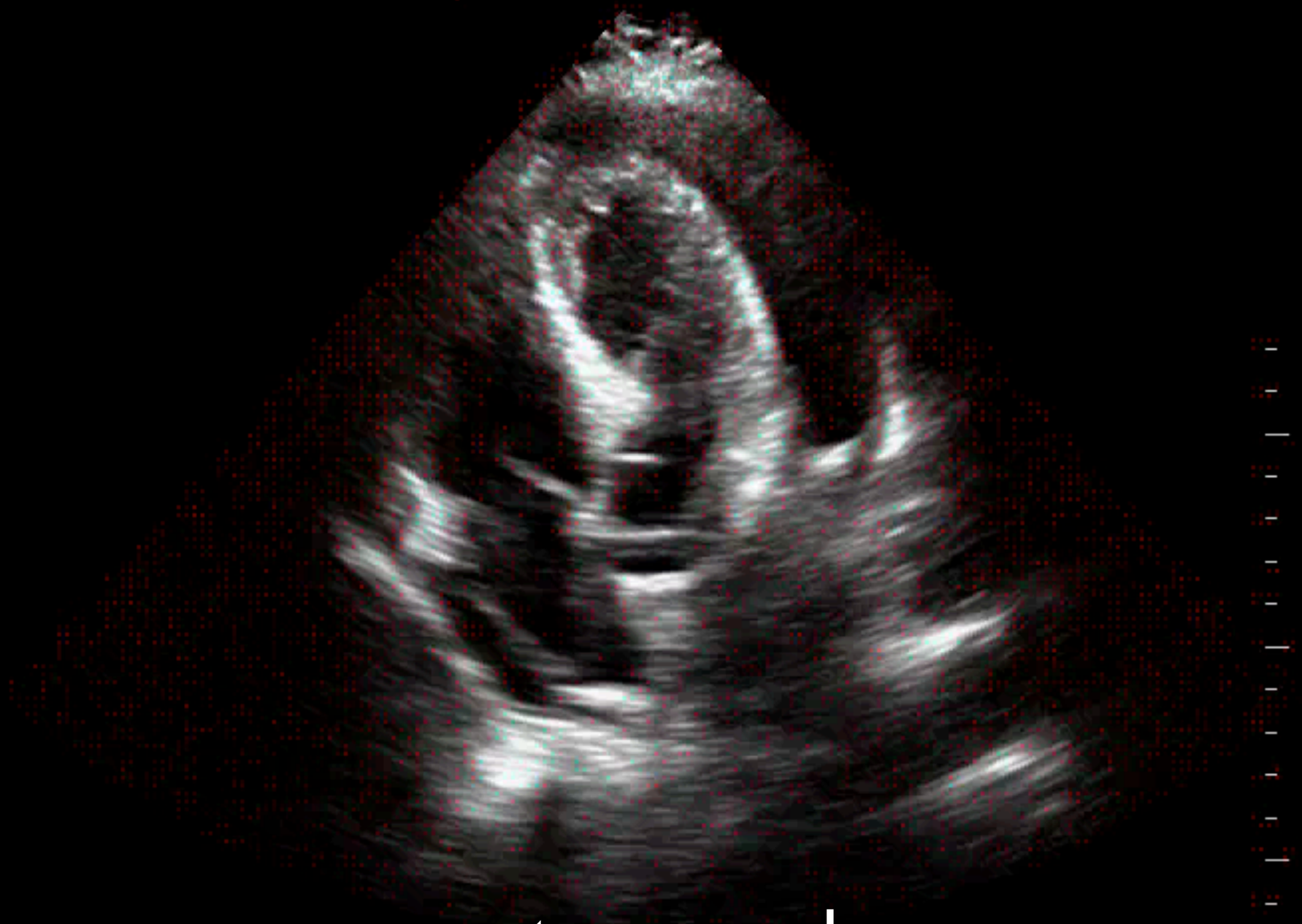
Pathologic Sonographic Findings

Pericardial Effusion

tamponade

Pathologic Sonographic Findings

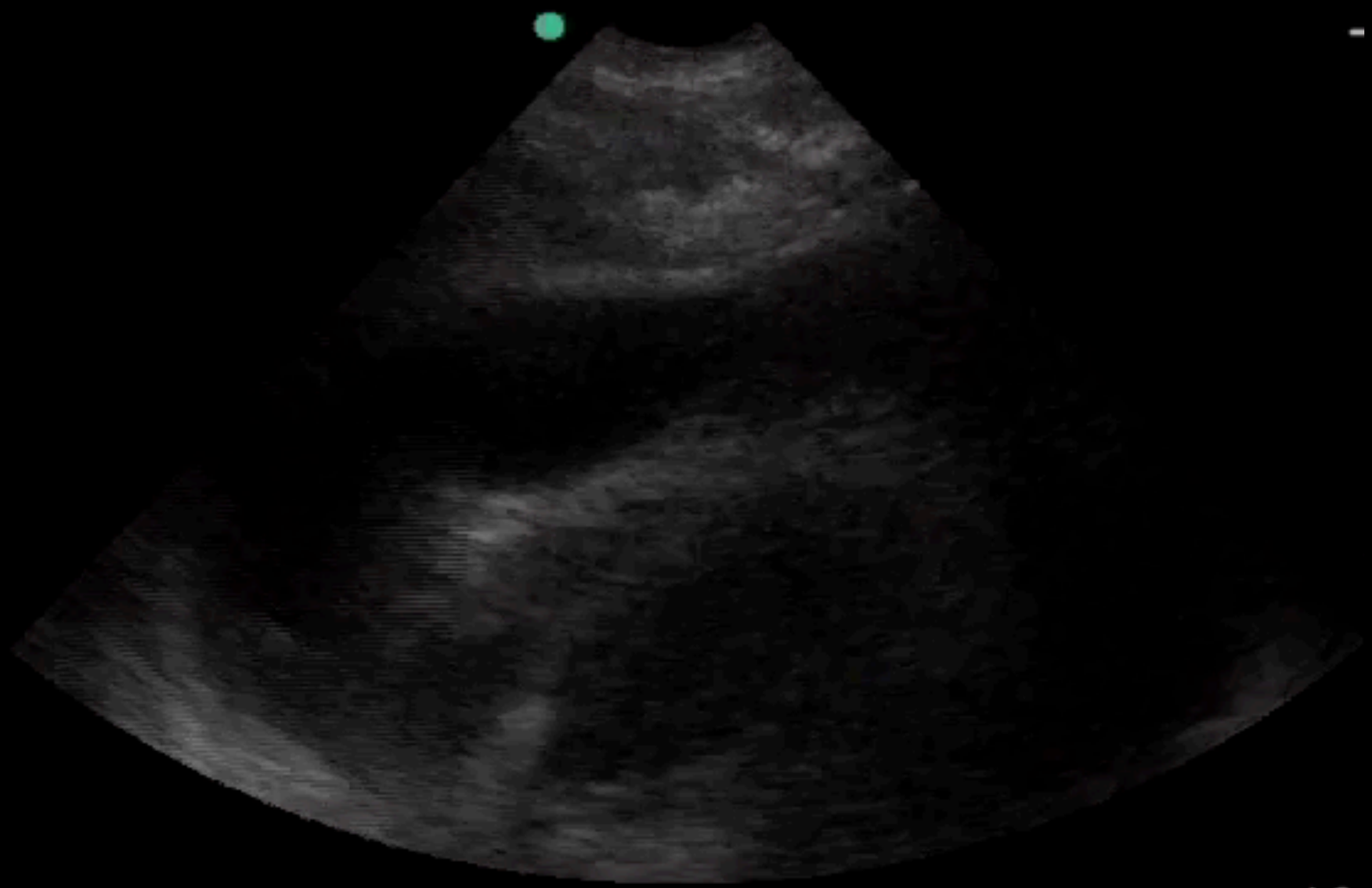
Pericardial Effusion



tamponade

Pathologic Sonographic Findings

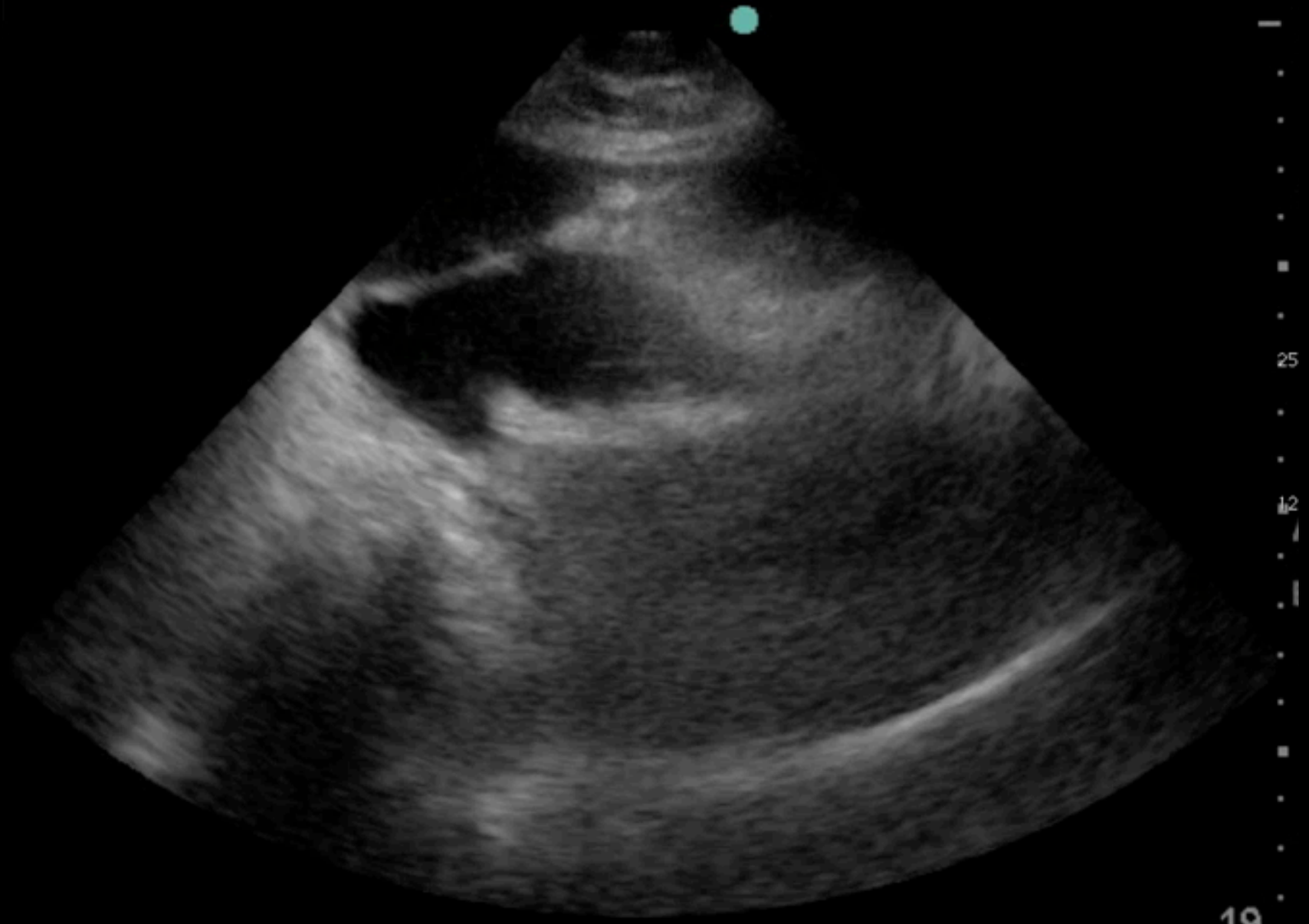
Pericardial Effusion



tamponade

Pathologic Sonographic Findings

Pericardial Effusion



tamponade

Left Ventricular Function

Pathologic Sonographic Findings

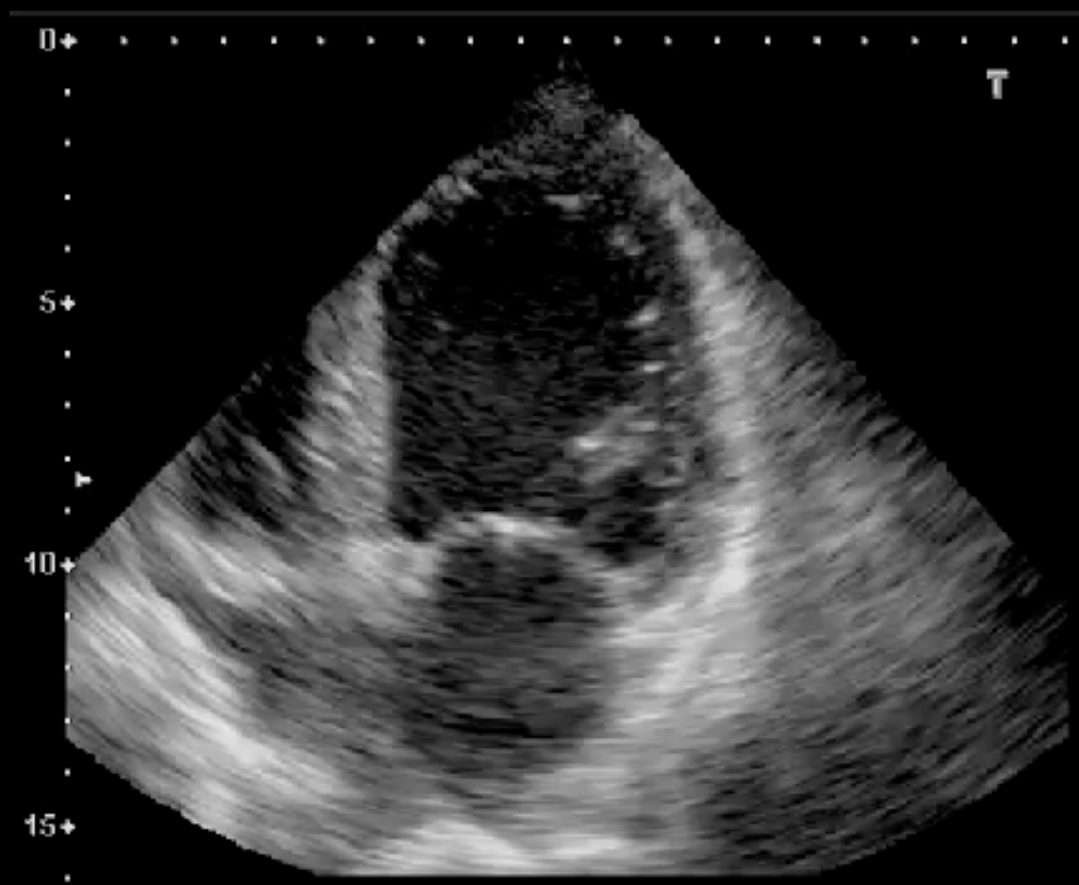
Left Ventricular Function

- Comparison of visual LVEF vs cubed M-mode formula, Teicholz M-mode, length-area method, Simpson's as compared to biplane contrast ventriculography
- Best correlation with BCV was by *visual estimation*

Mueller et al. Subjective visual echocardiographyic estimate of left ventricular ejection fraction as an alternative to conventional echocardiographic comparison with contrast angiography. *Clin Cardiology* 1991(14) 898-907.

Pathologic Sonographic Findings

Left Ventricular Function

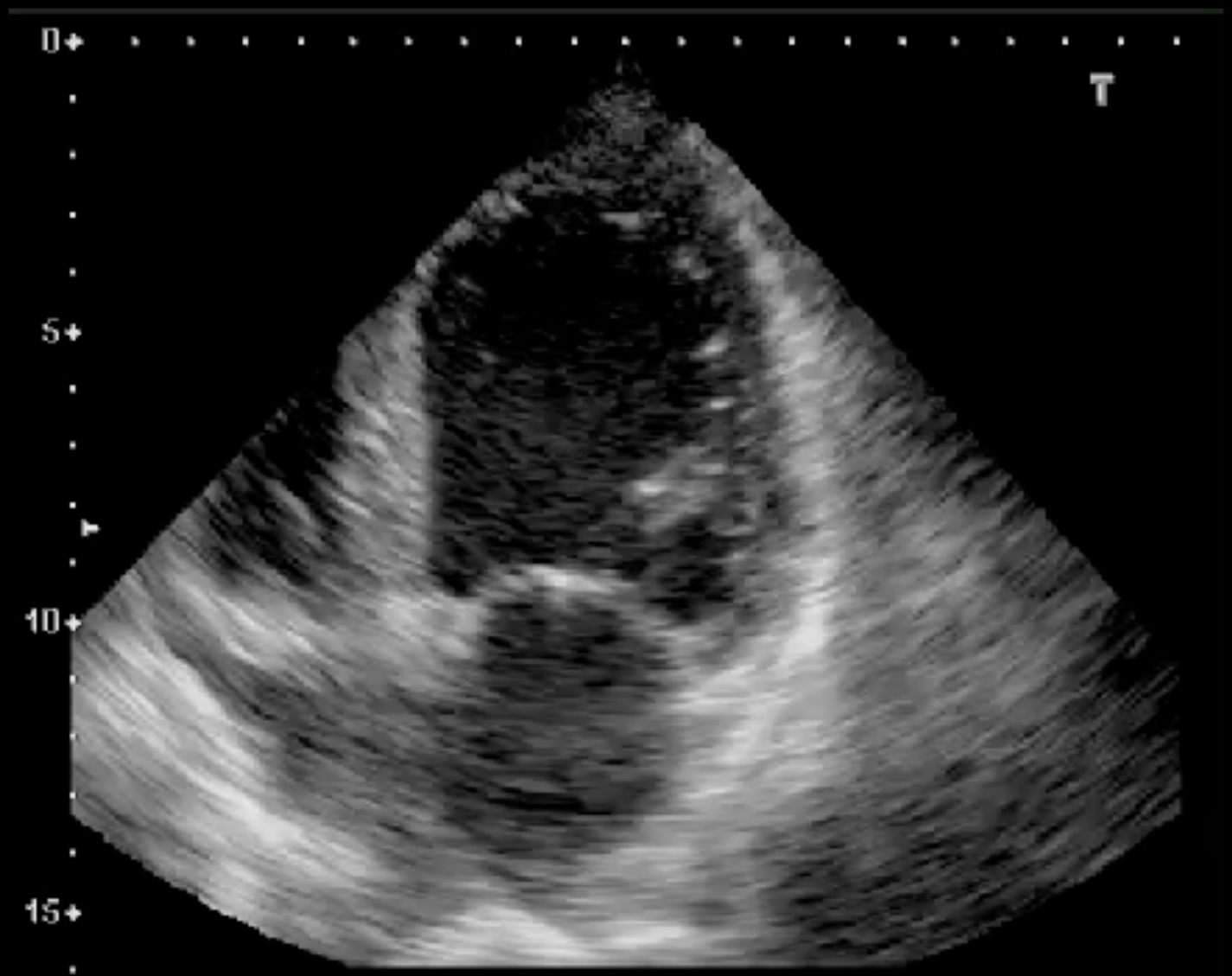


poor

normal

Pathologic Sonographic Findings

Left Ventricular Function



- Poor LV function
  - Assessed by gross estimation
  - Anterior MV leaflet should touch septum

Pathologic Sonographic Findings

Left Ventricular Function

Pathologic Sonographic Findings

Left Ventricular Function

poor

normal

Pathologic Sonographic Findings

Left Ventricular Function

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Pathologic Sonographic Findings

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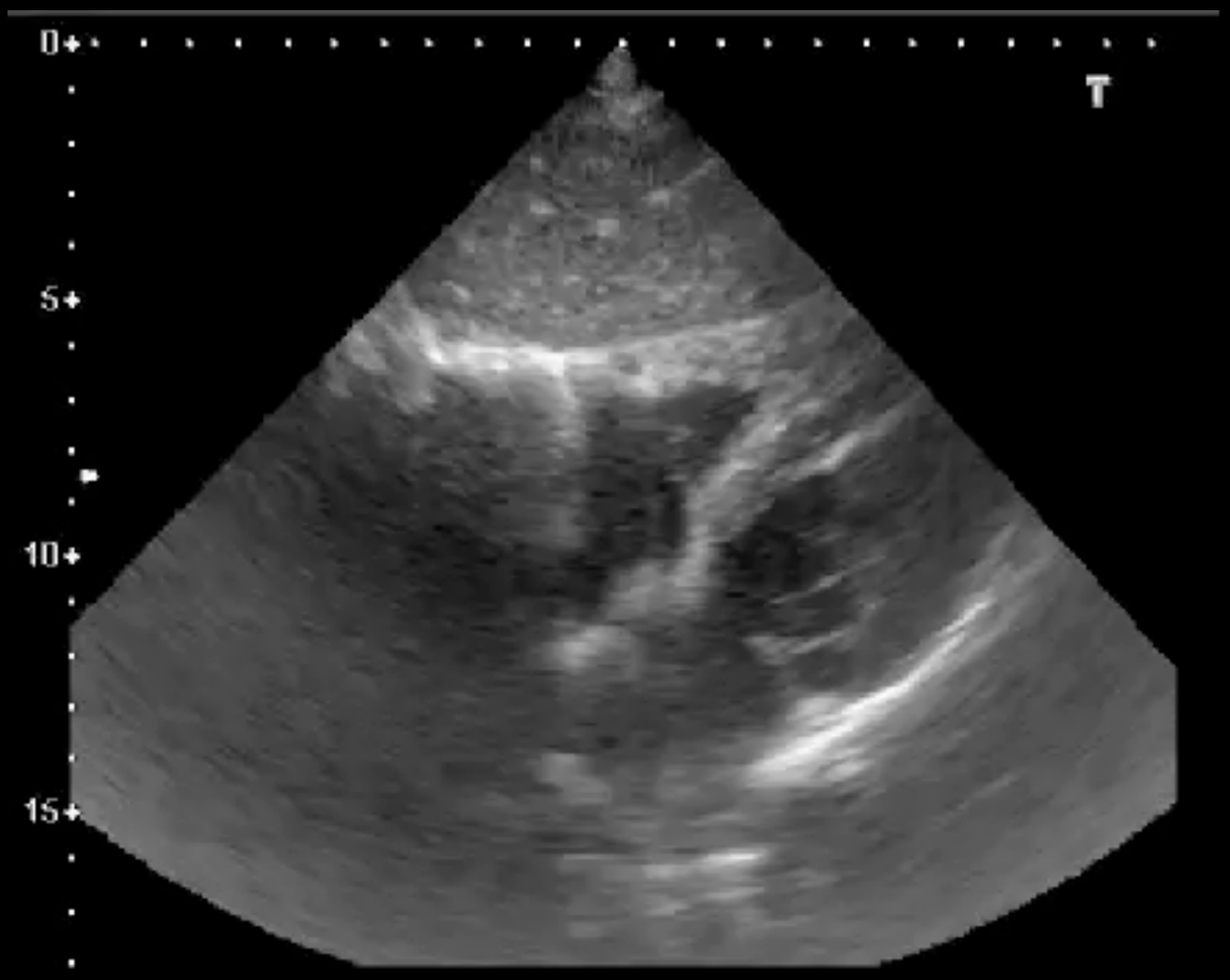
Pathologic Sonographic Findings

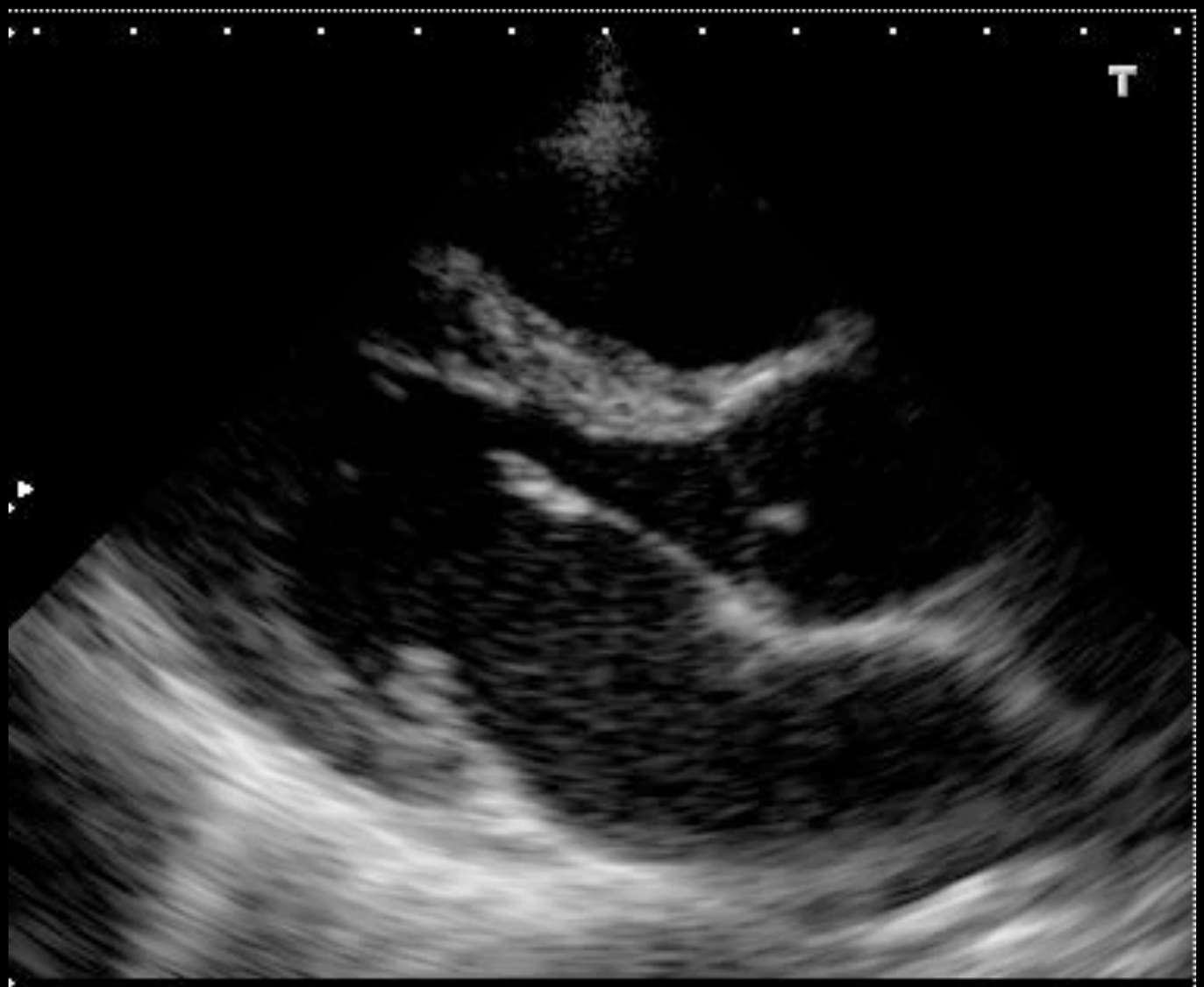
Left Ventricular Function



hyperdynamic

Pathologic Sonographic Findings

Left Ventricular Function



hyperdynamic

Right Ventricular Function

Pathologic Sonographic Findings

Right Ventricular Function

- Ribeiro et al, 1998
  - 121 patients with PE by VQ examined with echo
    - Patients with perfusion defect >20% more often had RV distention and hypokinesis
    - Other studies confirm 20-30% perfusion defect causes RV dysfunction on echo

Ribeiro et al. Pulmonary embolism: relation between the degree of right ventricle overload and the extent of perfusion defects. *Am Heart J.* 1998, 135: 868-74

Pathologic Sonographic Findings

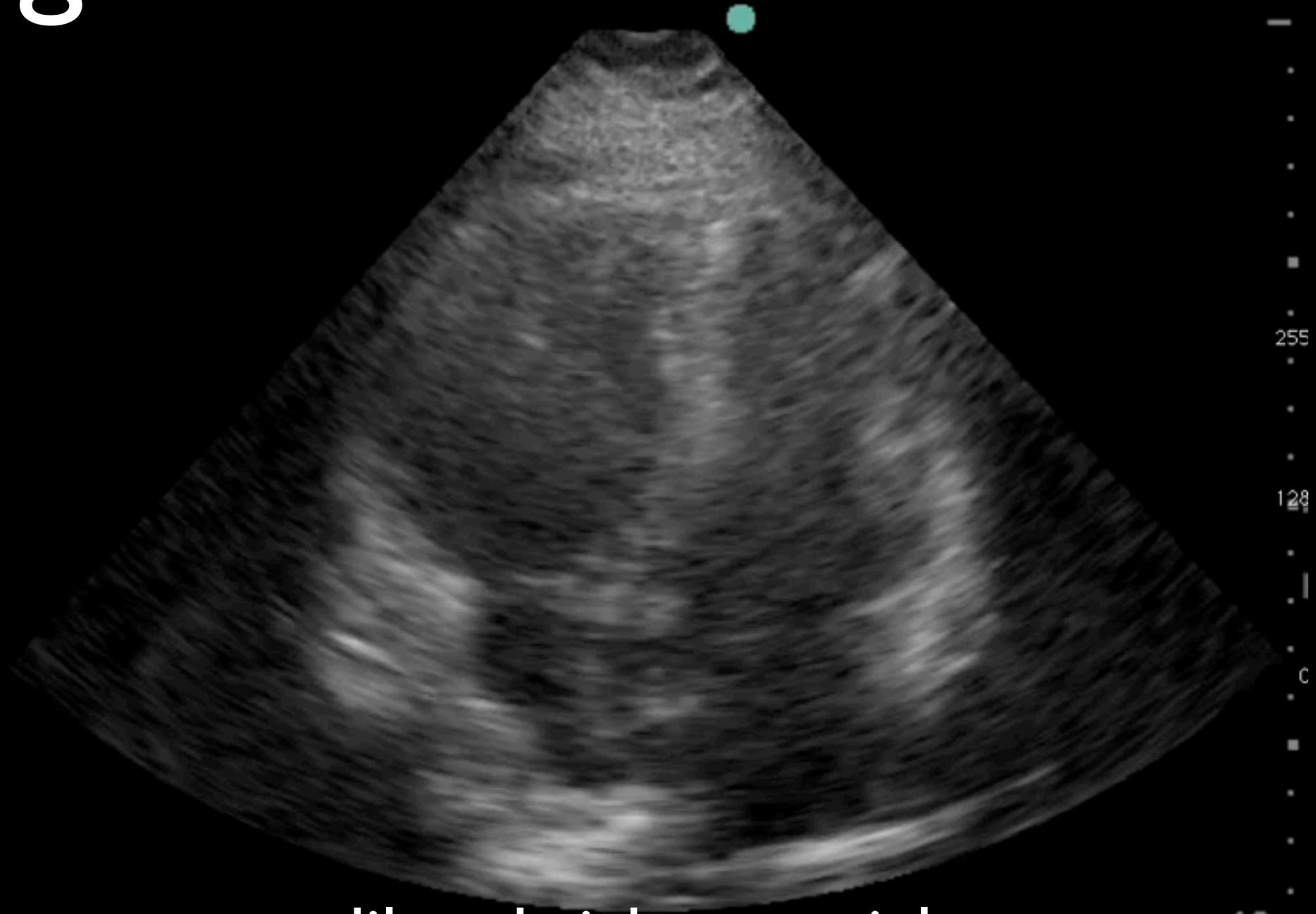
Right Ventricular Function

	sensitivity	specificity
Grifoni	51%	87%
Miniati	56%	90%
Lodato	66%	77%

Grifoni et al. Utility of integrated clinical, echocardiographic, and venous ultrasonographic approach for triage of patients with suspected pulmonary embolism. *Am J. Cardiol* 1998 Nov 15;82(10):1230-5
Miniati et al. Value of transthoracic echocardiography in the diagnosis of pulmonary embolism: results of a prospective study in unselected patients. *Am J Med* 110:528, 2001
Lodato et al. Echocardiographic predictors of pulmonary embolism in patients referred for helical CT. *Echocardiography* 2008. 25:584

Pathologic Sonographic Findings

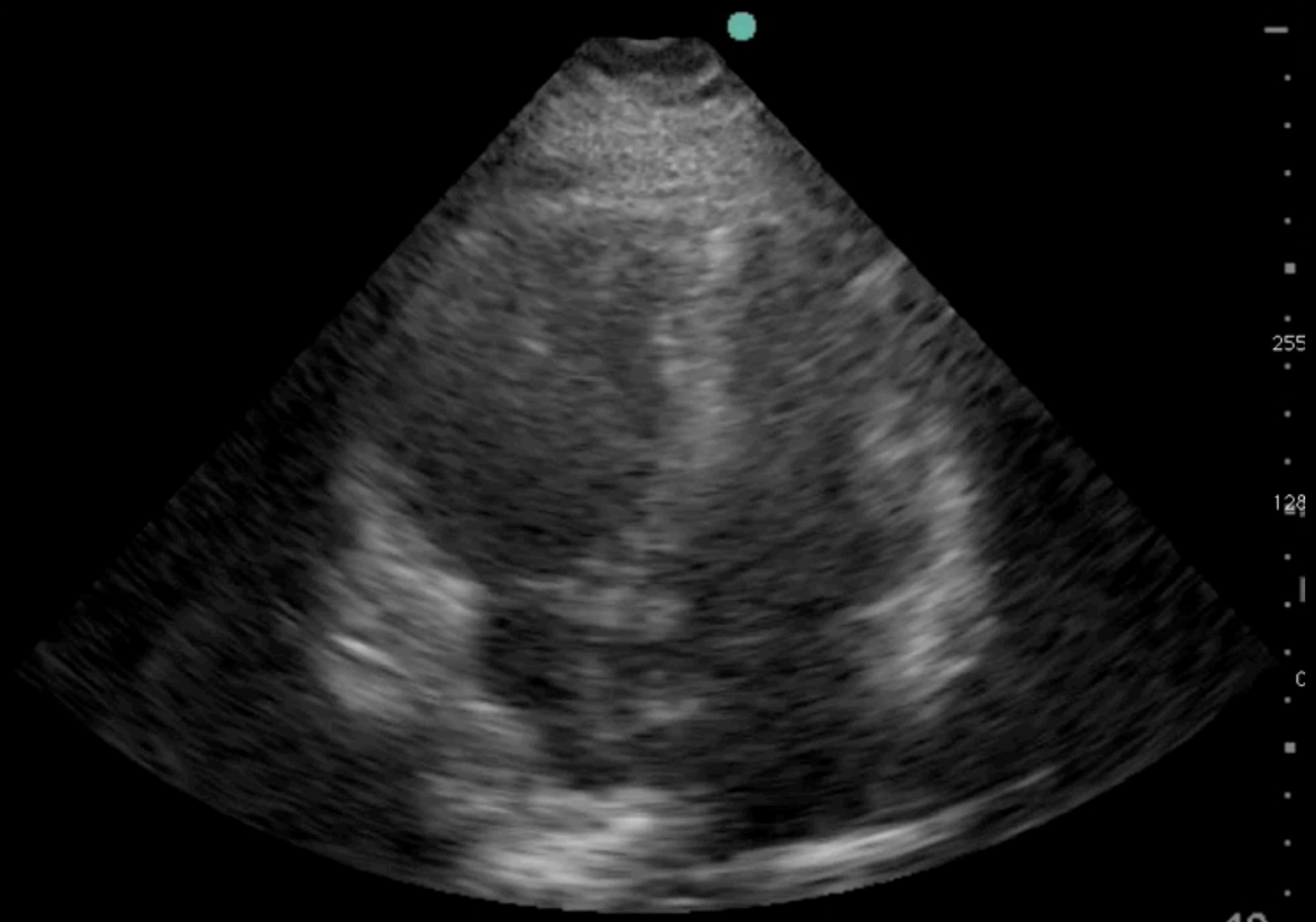
Right Ventricular Function



dilated right ventricle

Pathologic Sonographic Findings

Right Ventricular Function



- Pulmonary embolus
  - Thrombolytics for shock or RV dysfunction
  - Negative study does not rule out PE
  - Apical four-chamber is best

Pathologic Sonographic Findings

Right Ventricular Function

dilated right ventricle

Pathologic Sonographic Findings

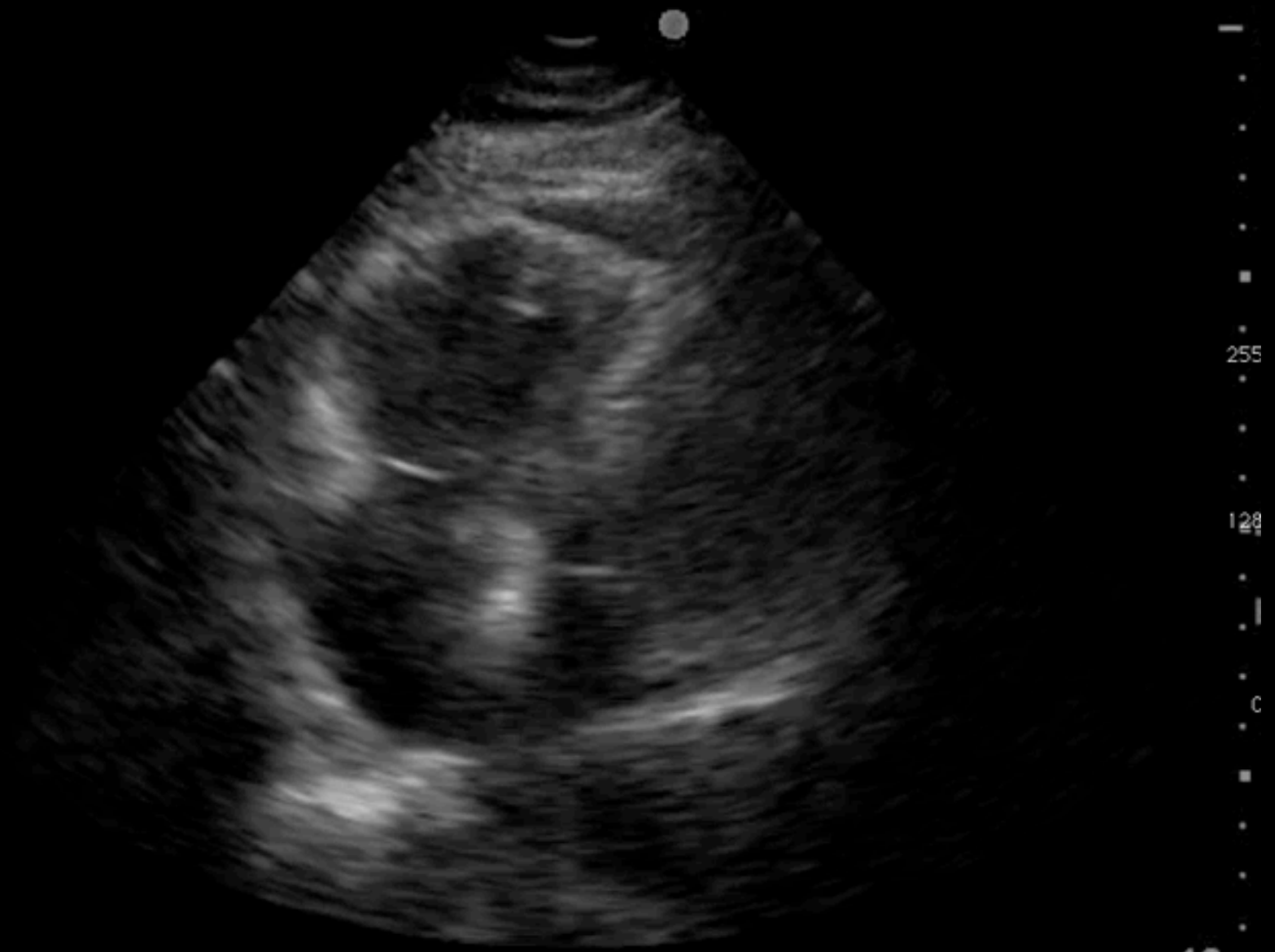
Right Ventricular Function

Pathologic Sonographic Findings

Right Ventricular Function

Pathologic Sonographic Findings

Right Ventricular Function

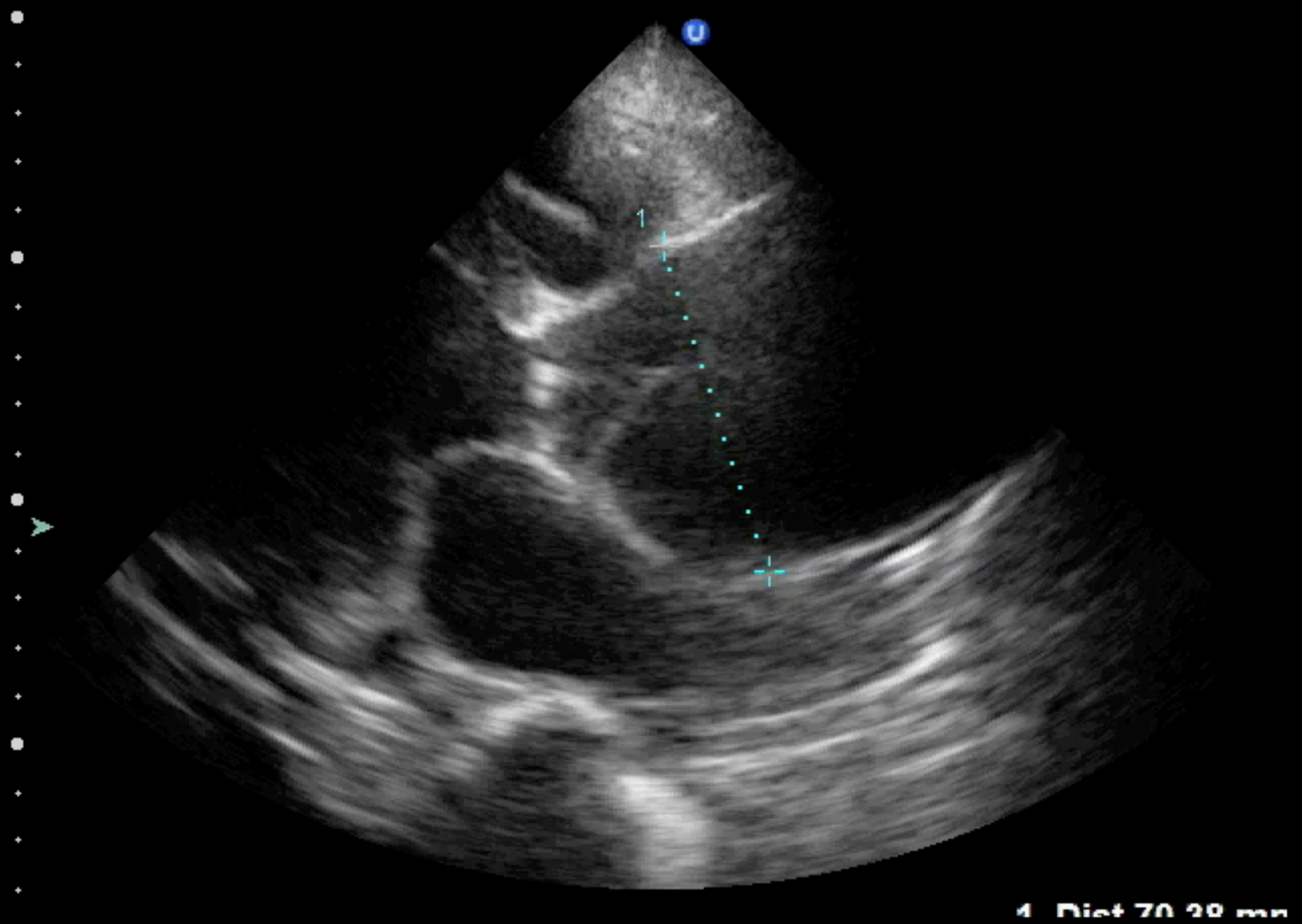


McConnell's Sign

Aortic Aneurysm/ Dissection

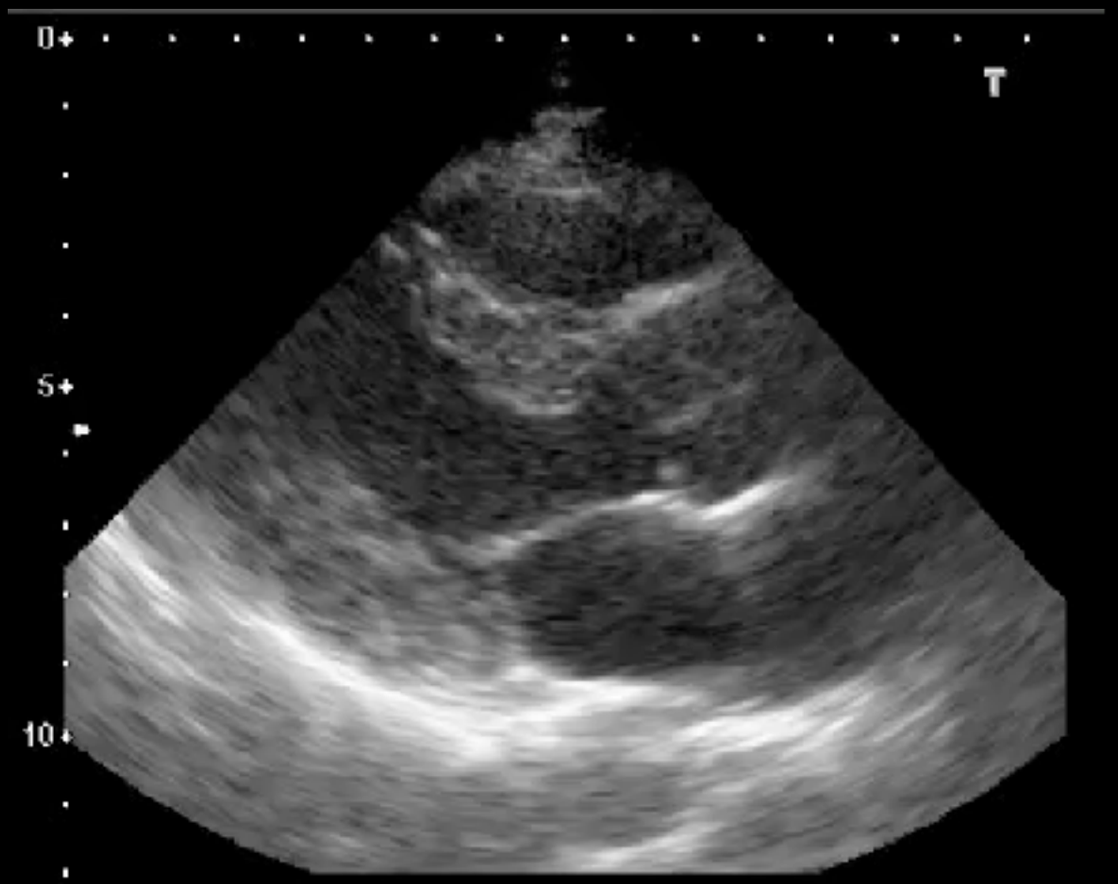
Pathologic Sonographic Findings

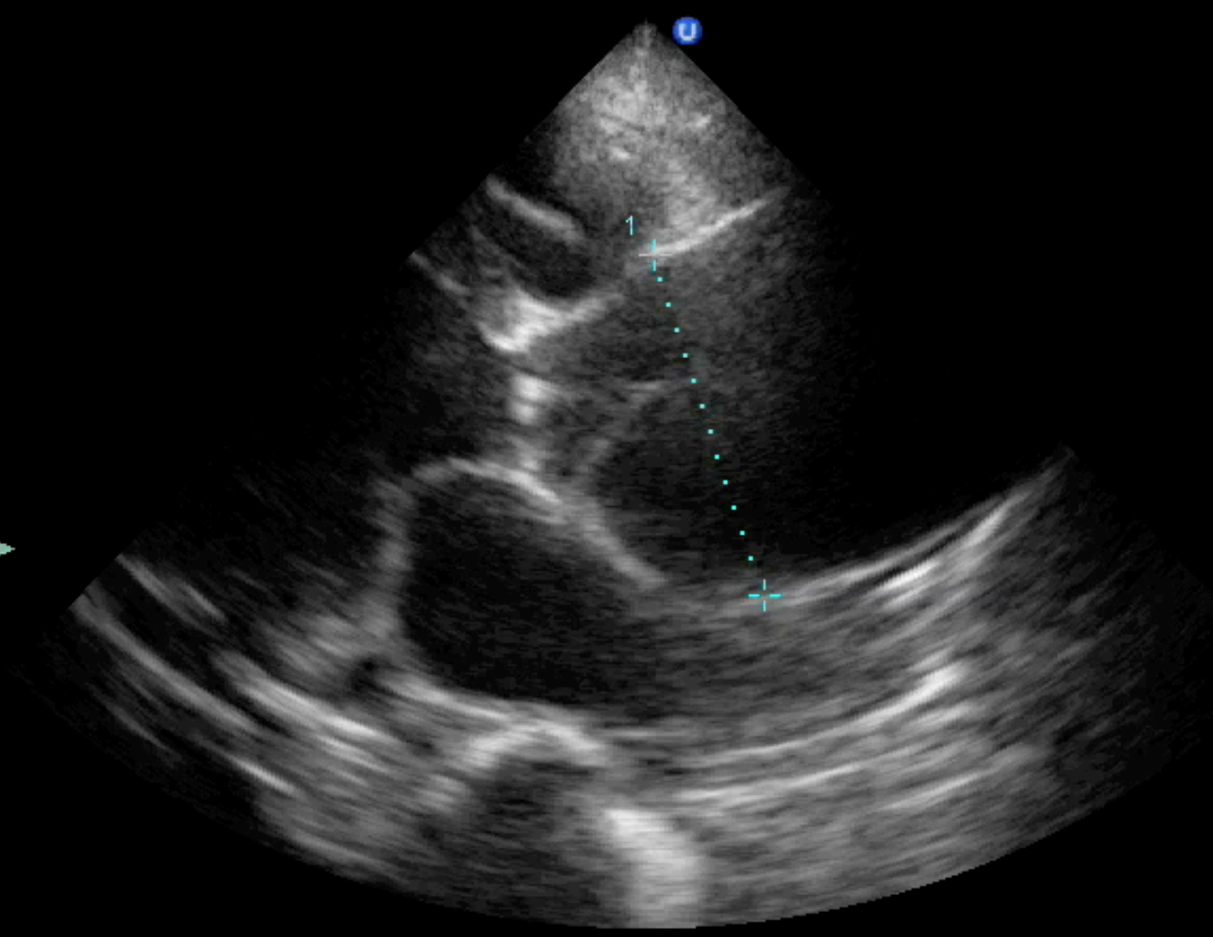
Aortic Dissection



Pathologic Sonographic Findings

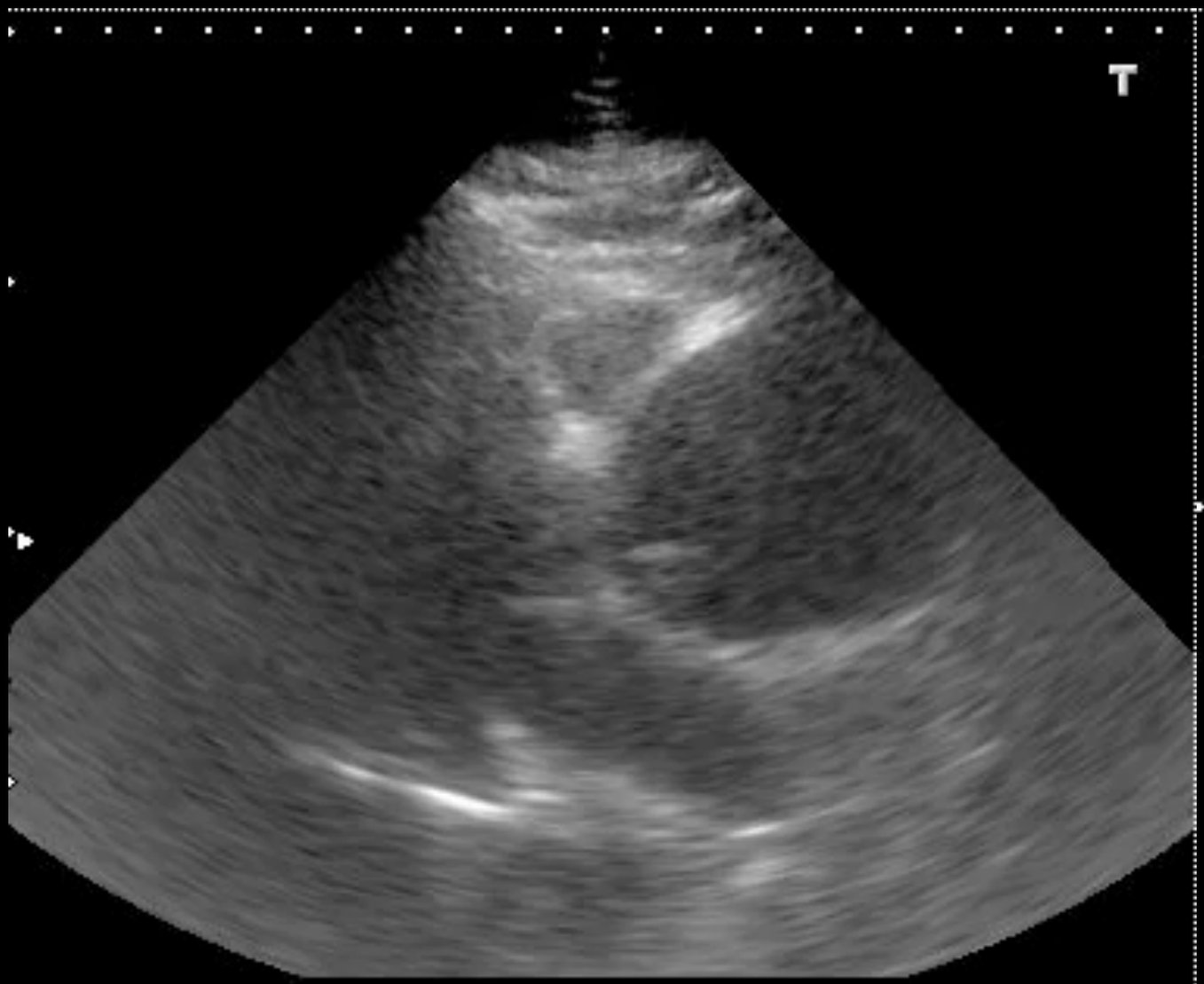
Aortic Dissection





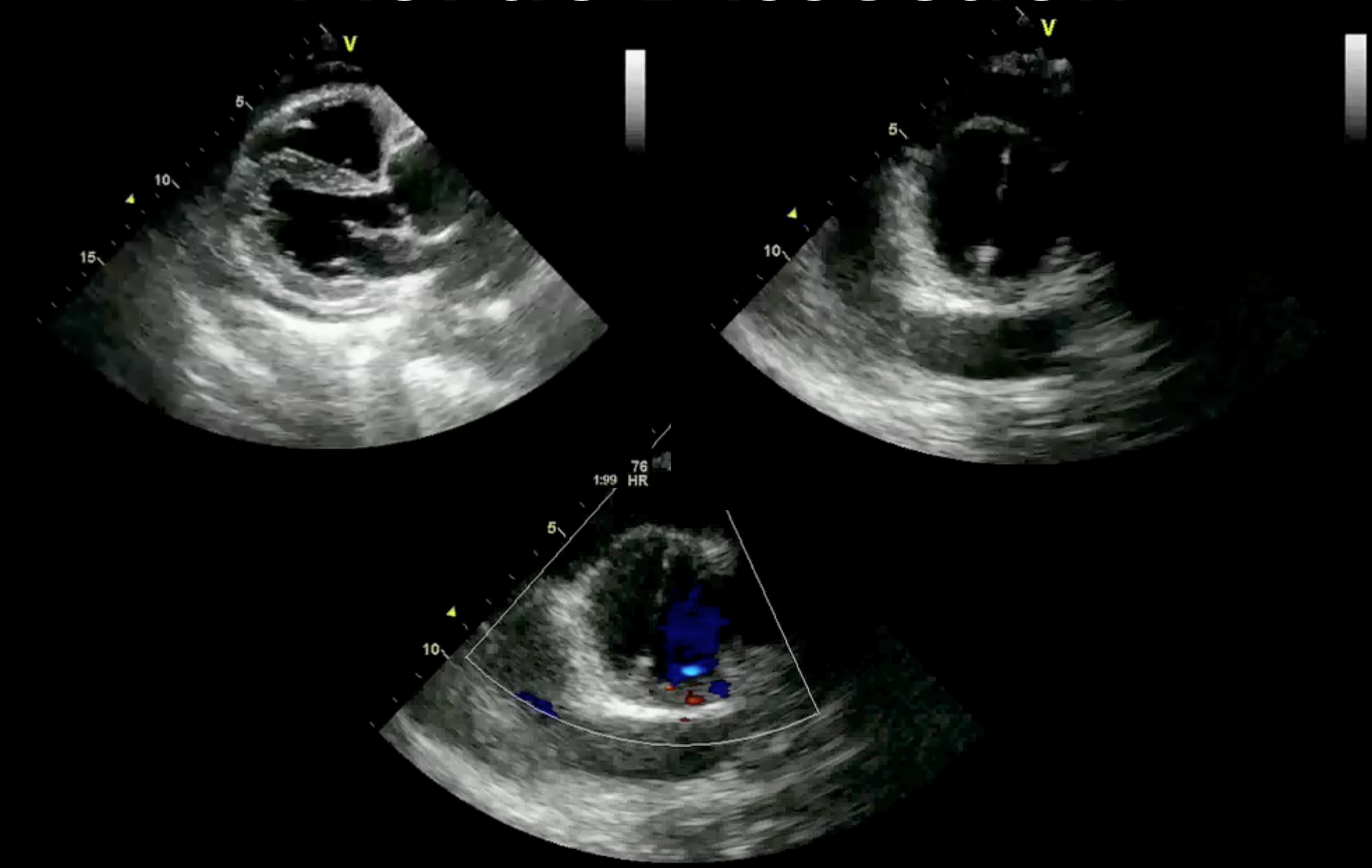
Pathologic Sonographic Findings

Aortic Dissection



Thoracic Aorta

Aortic Dissection

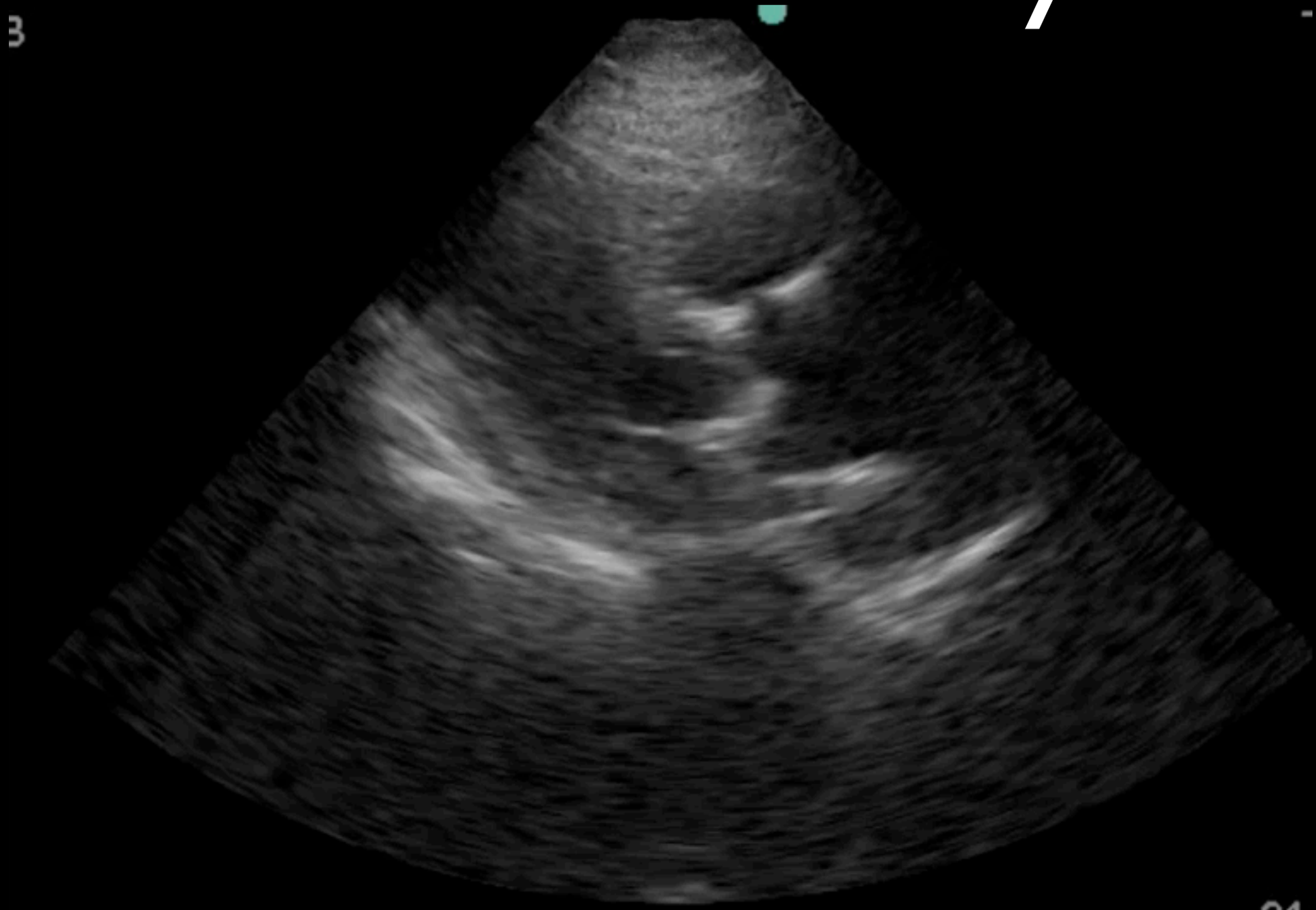


Aortic Dissection

- Ultrasound should *not* be used to rule out aortic dissection
  - Low sensitivity (often poor image quality)
  - If a definite undulating flap is seen, workup may be expedited

Pathologic Sonographic Findings

Thoracic Aneurysm



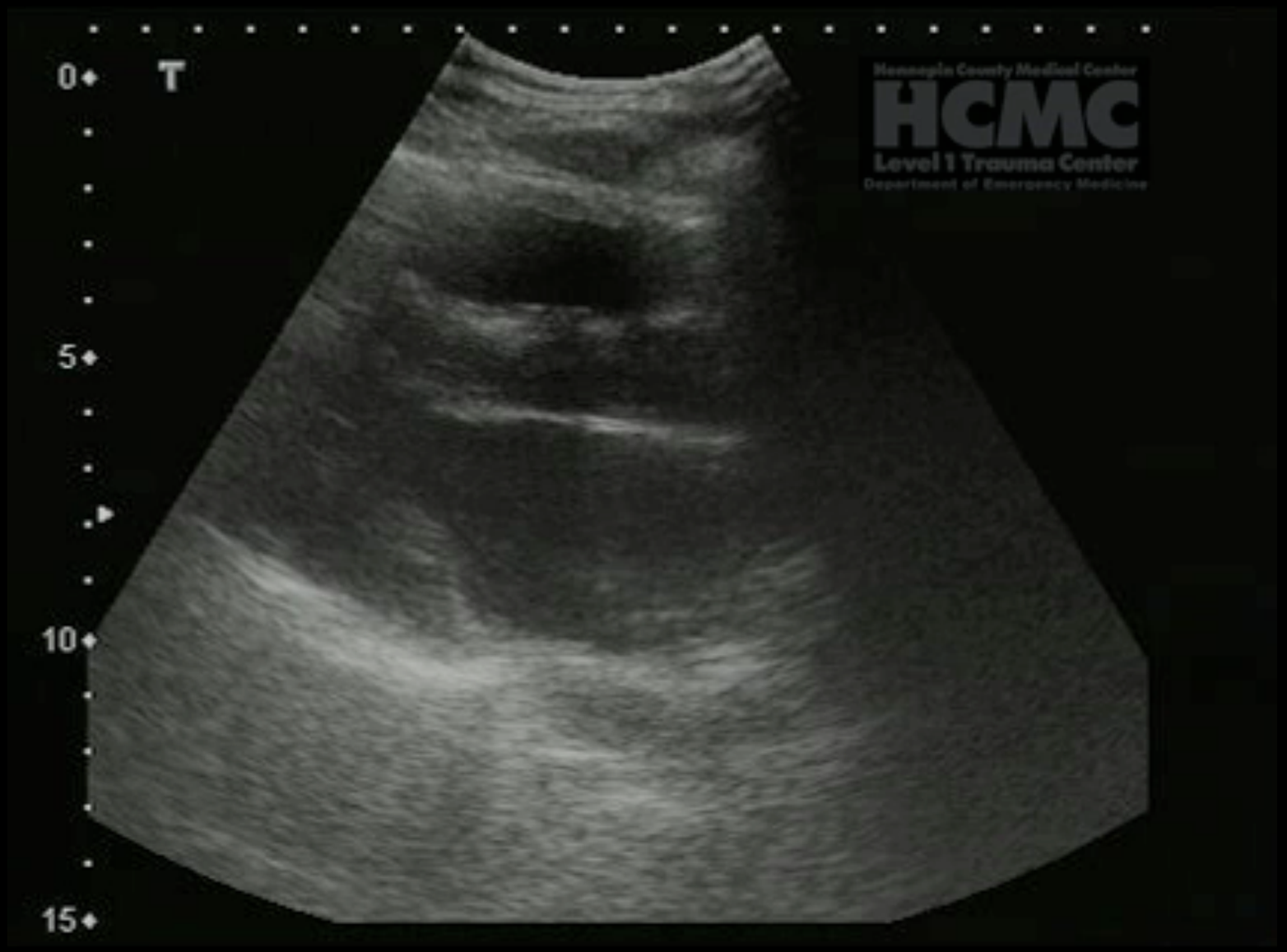
Pathologic Sonographic Findings

Cardiac Arrest

- Emergency echo should be performed on all "codes."
- Assess for other etiologies
  - pericardial effusion/tamponade
  - pulmonary embolism
  - ventricular fibrillation/tachycardia
- Most useful in PEA
- Will help in ending resuscitation

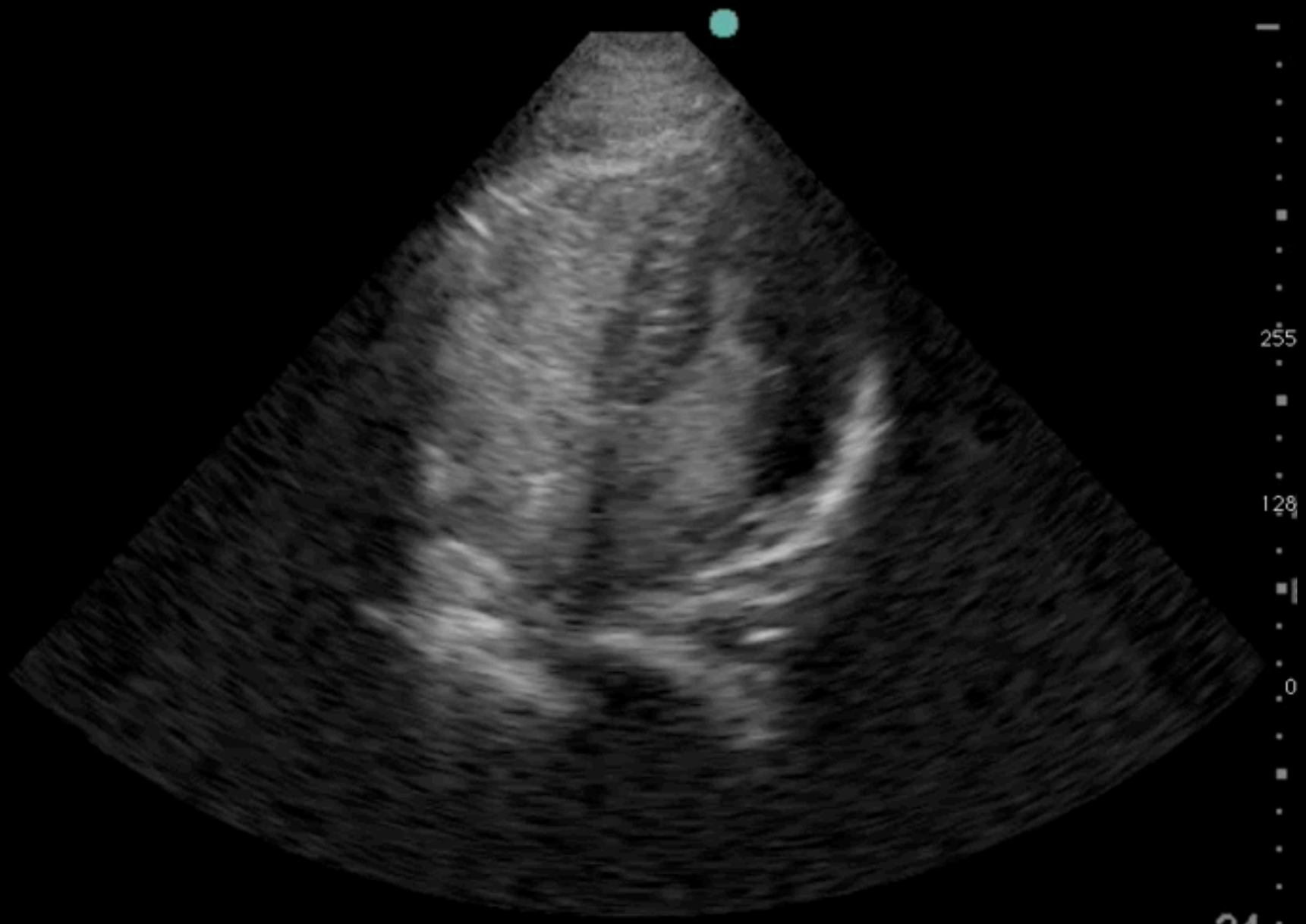
Pathologic Sonographic Findings

Asystole



Pathologic Sonographic Findings

Asystole

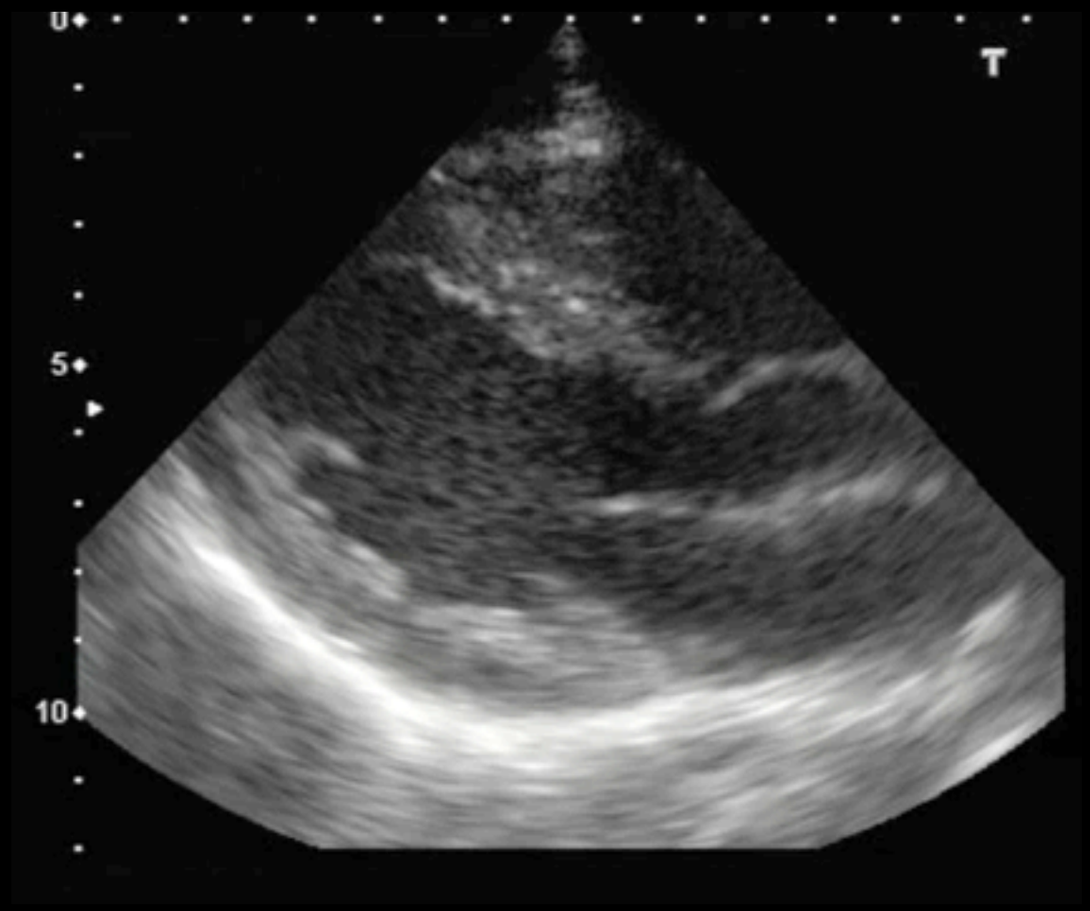


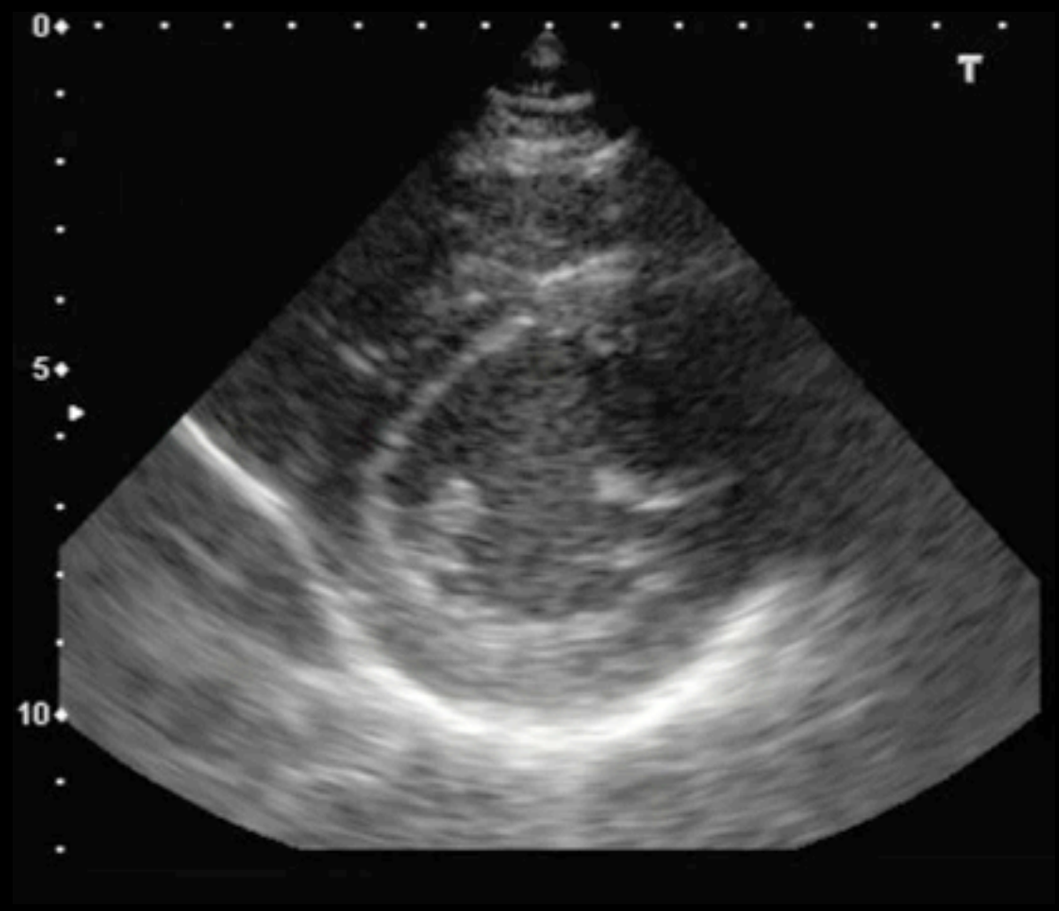
Pathologic Sonographic Findings

Asystole

Pathologic Sonographic Findings

Pulseless Electrical Activity



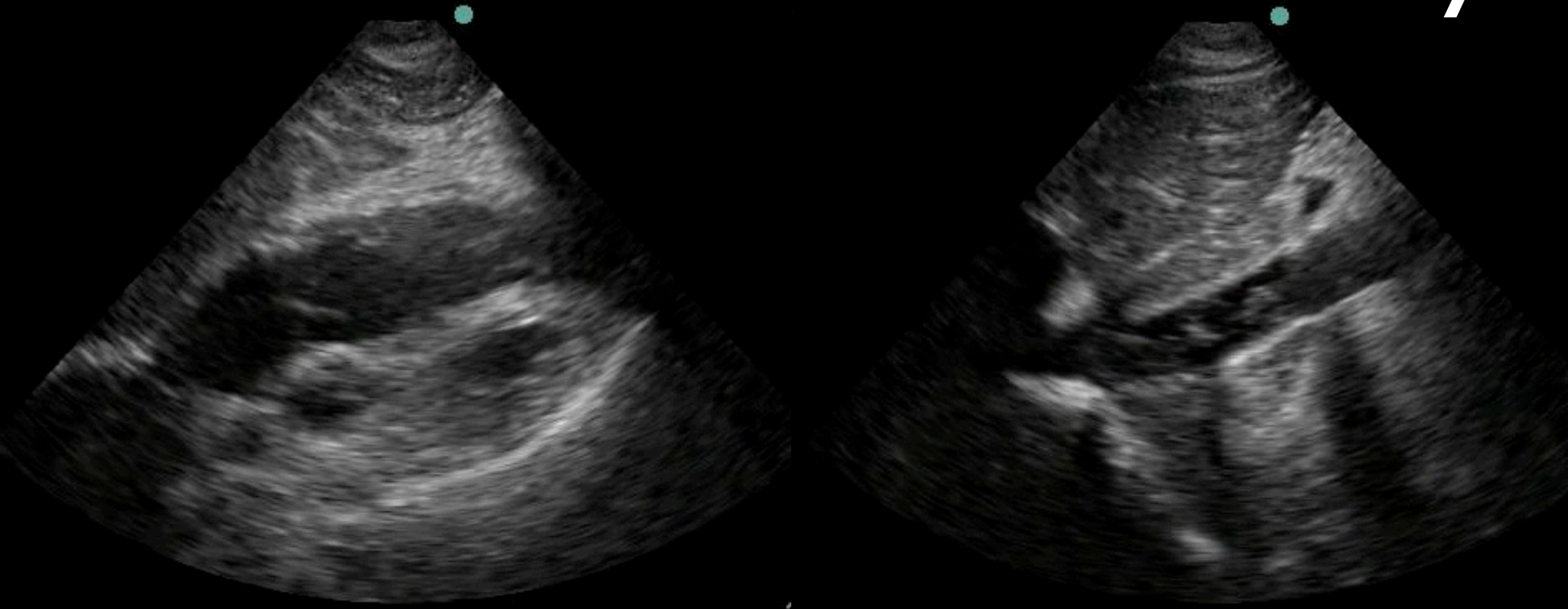


"True PEA"

Electrical activity likely not generating a pulse

Pathologic Sonographic Findings

Pulseless Electrical Activity



"Pseudo-PEA"

No pulses due to pulmonary embolism

Pathologic Sonographic Findings

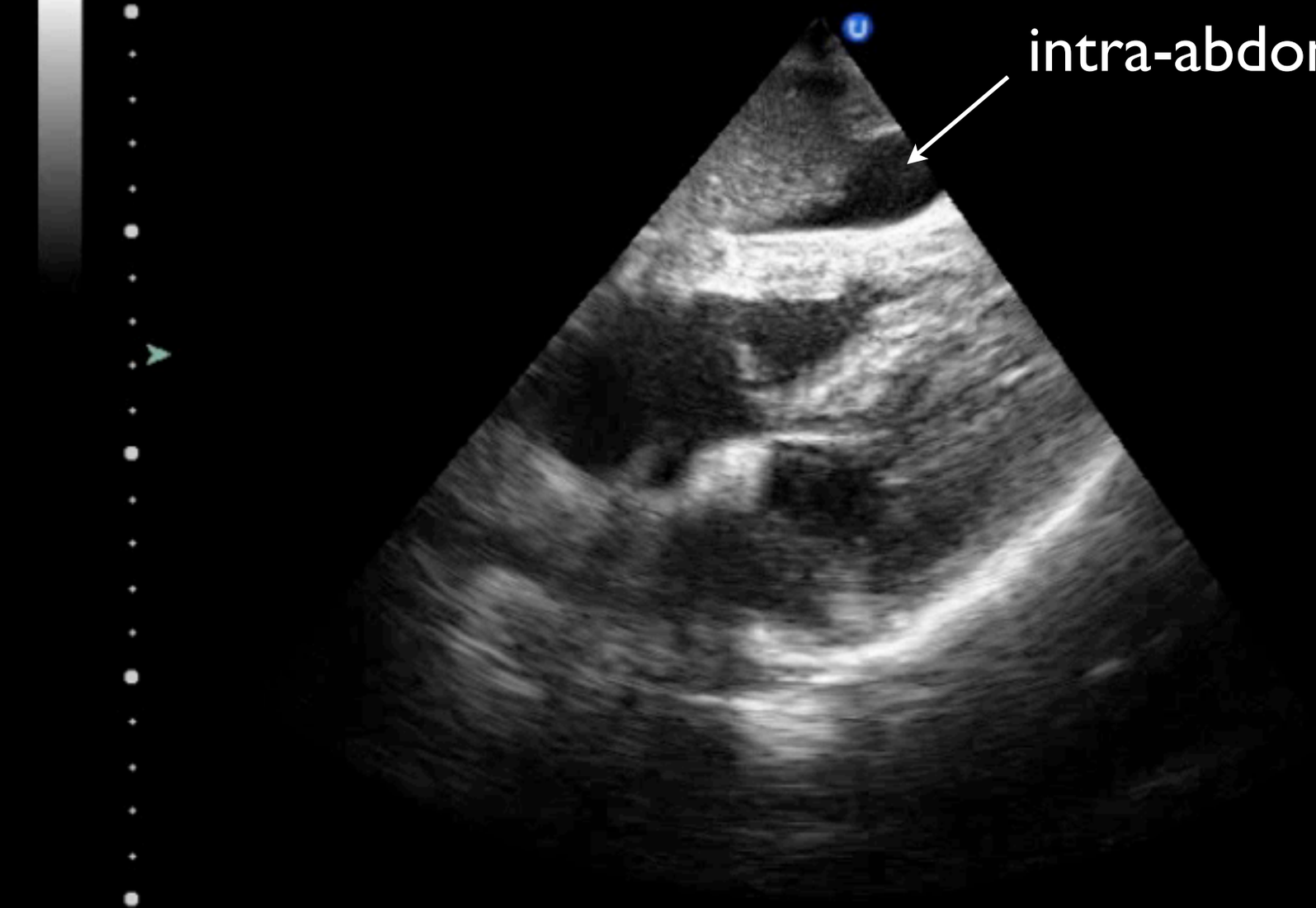
Pulseless Electrical Activity

"Pseudo-PEA"

No pulses due to pulmonary embolism

Pathologic Sonographic Findings

Pulseless Electrical Activity



"Pseudo-PEA"

No pulses due to hemorrhage

Pathologic Sonographic Findings

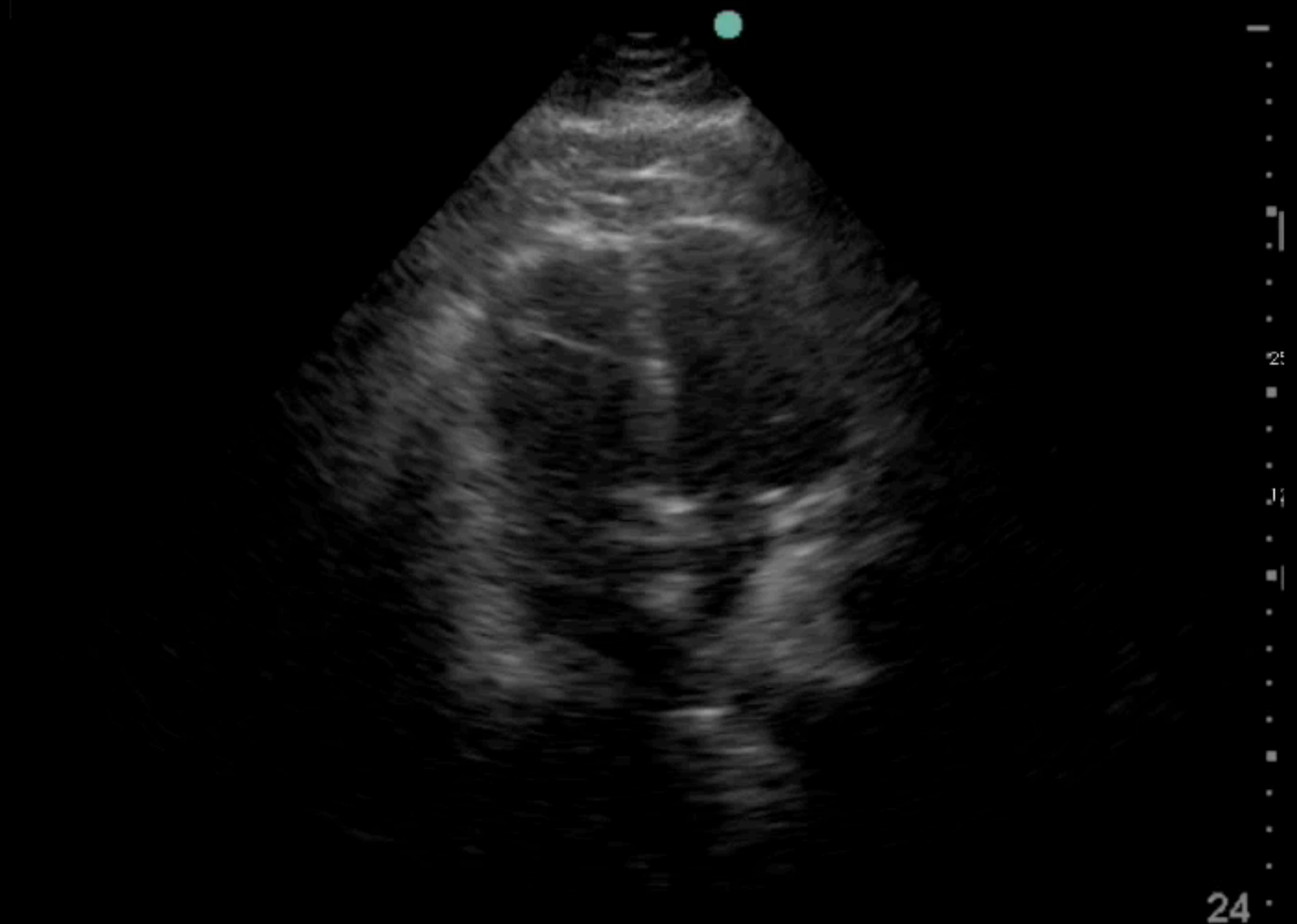
Pulseless Electrical Activity

"Pseudo-PEA"

No pulses due to tamponade

Pathologic Sonographic Findings

Ventricular Fibrillation



Pathologic Sonographic Findings

Ventricular Fibrillation

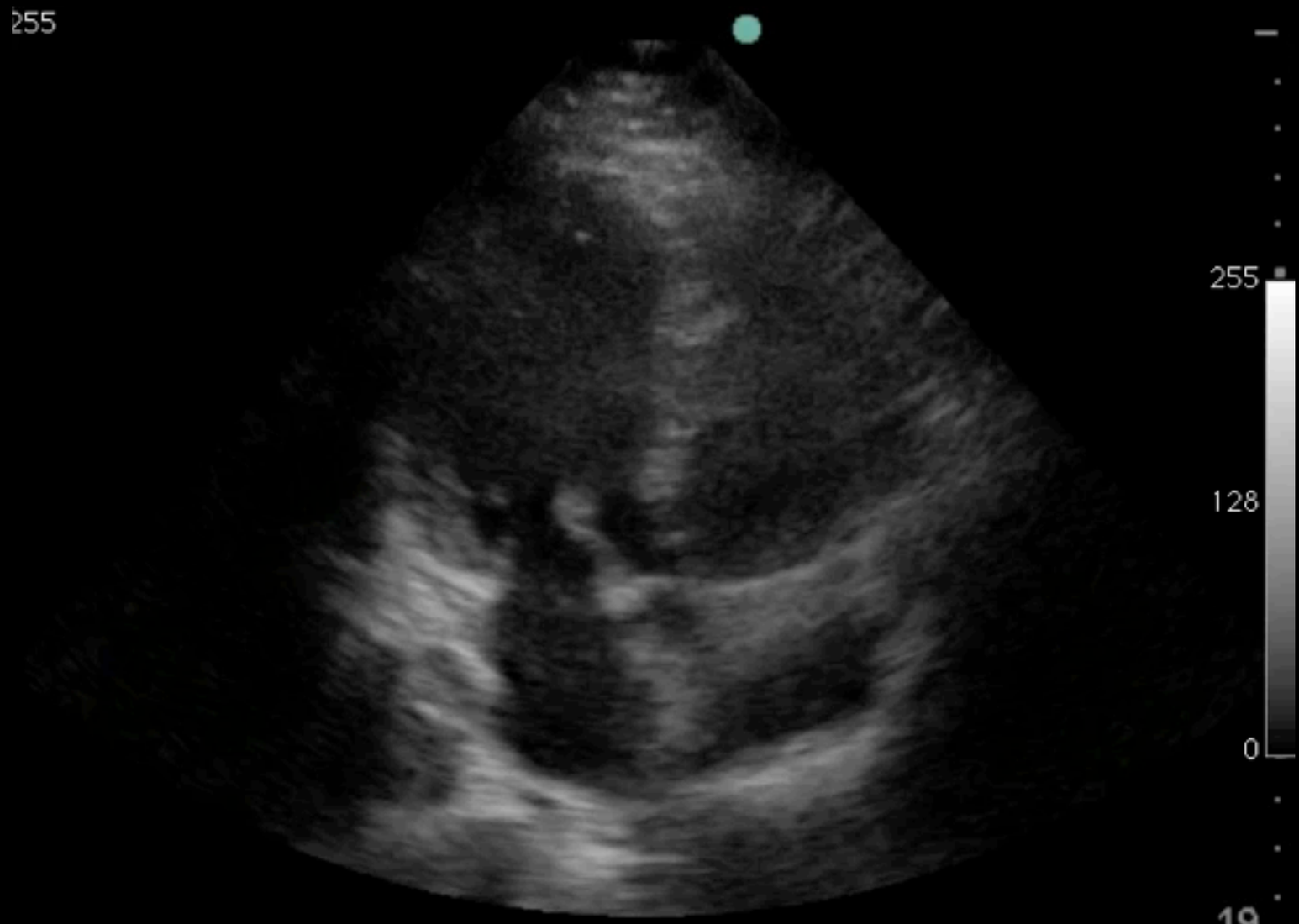
Pathologic Sonographic Findings

Ventricular Tachycardia

Pitfalls

Pitfalls

Probe Reversal



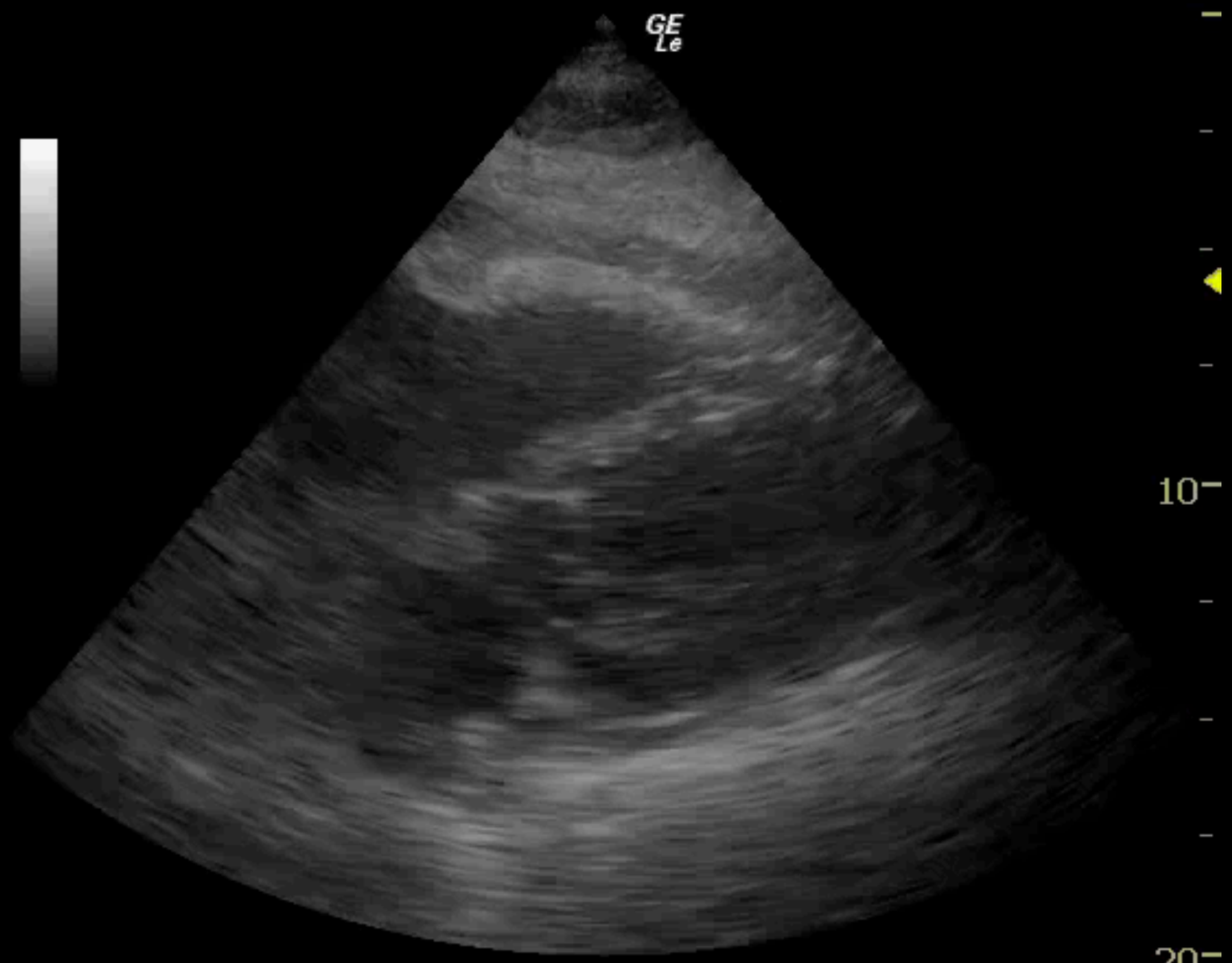
Pitfalls

Pericardial Fat

- pericardial fat
  - no effusion posteriorly
  - fat moves with heart
  - clotted blood may be echogenic

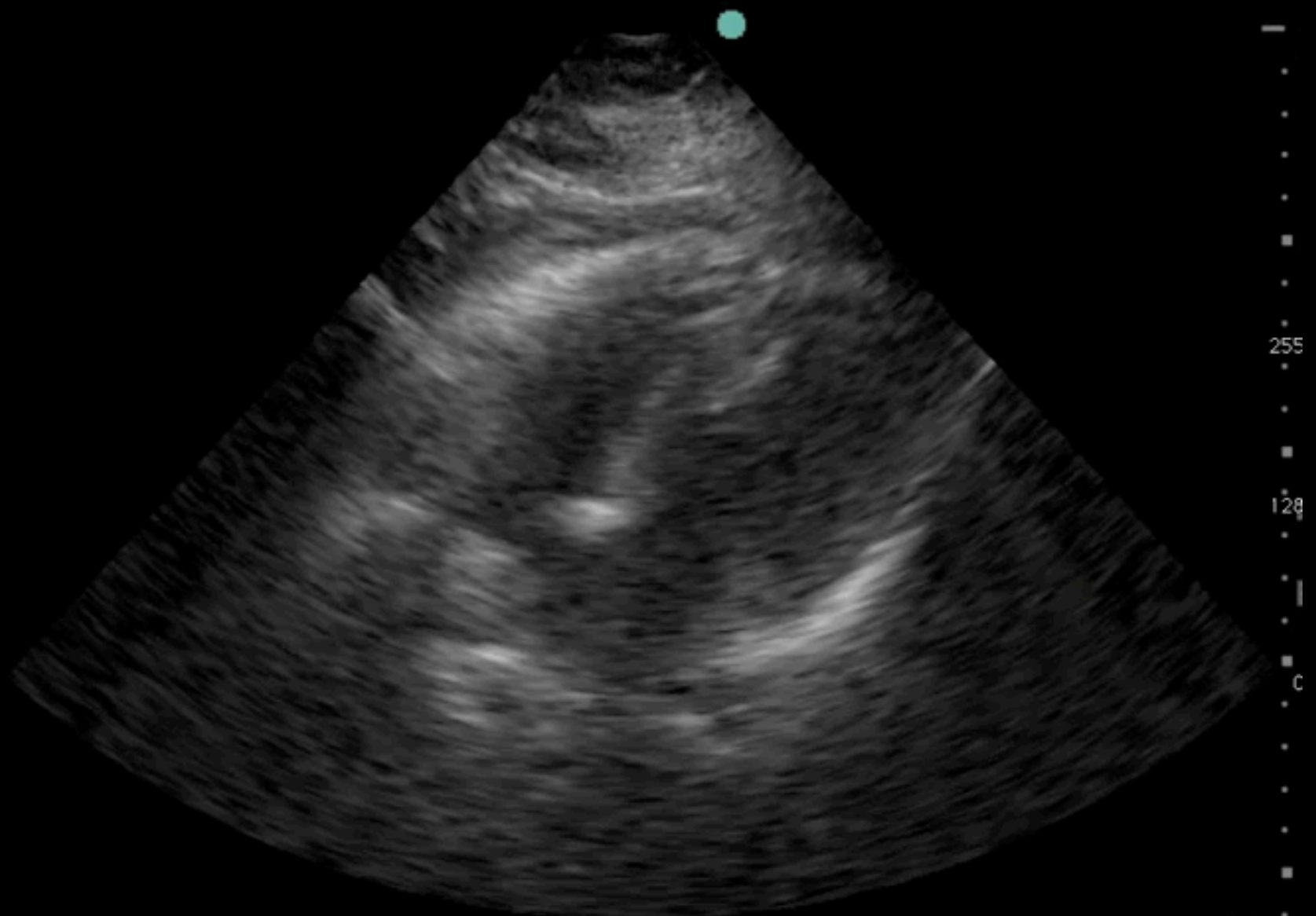
Pitfalls

Pericardial Fat



Pathologic Sonographic Findings

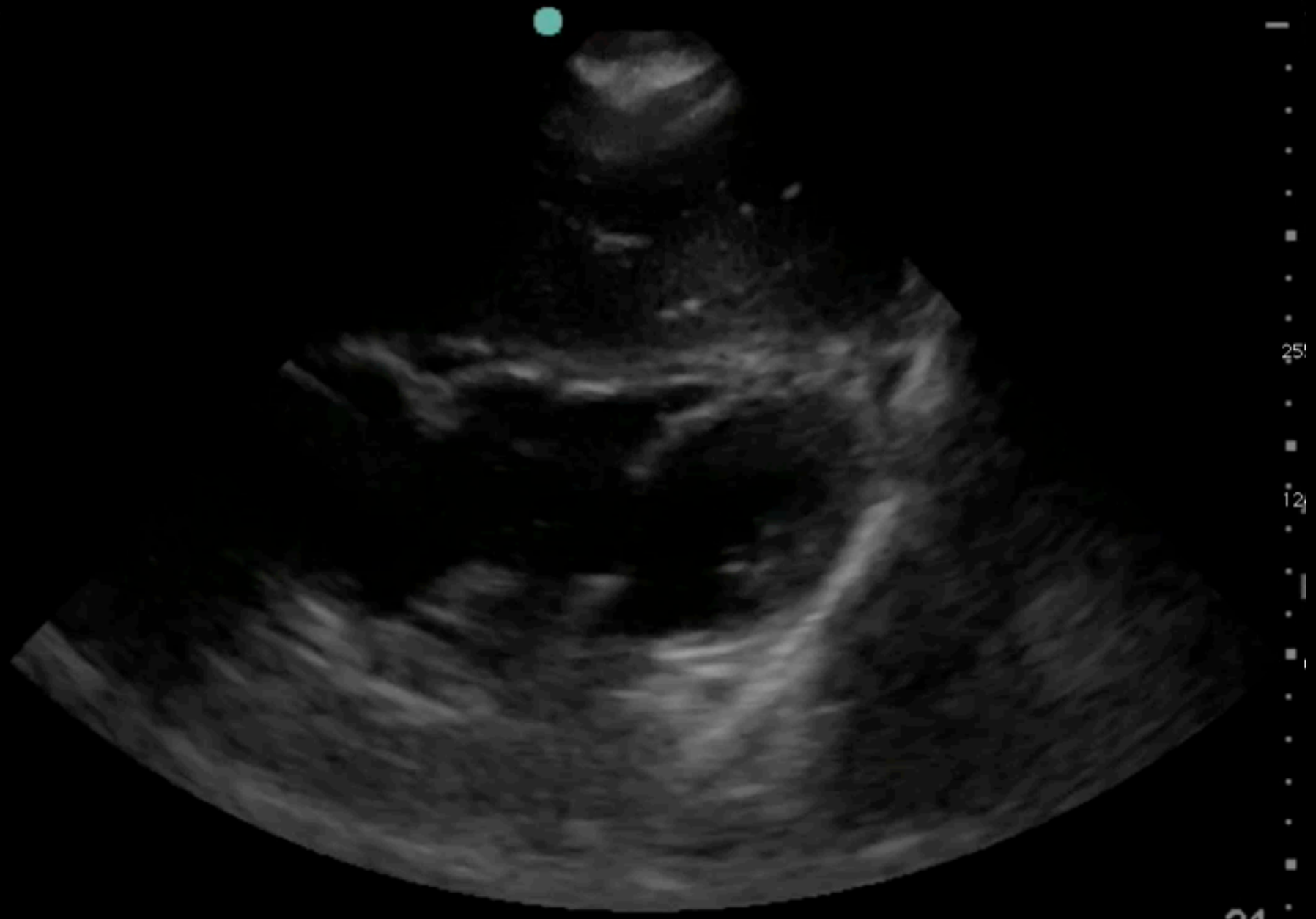
Pericardial Effusion



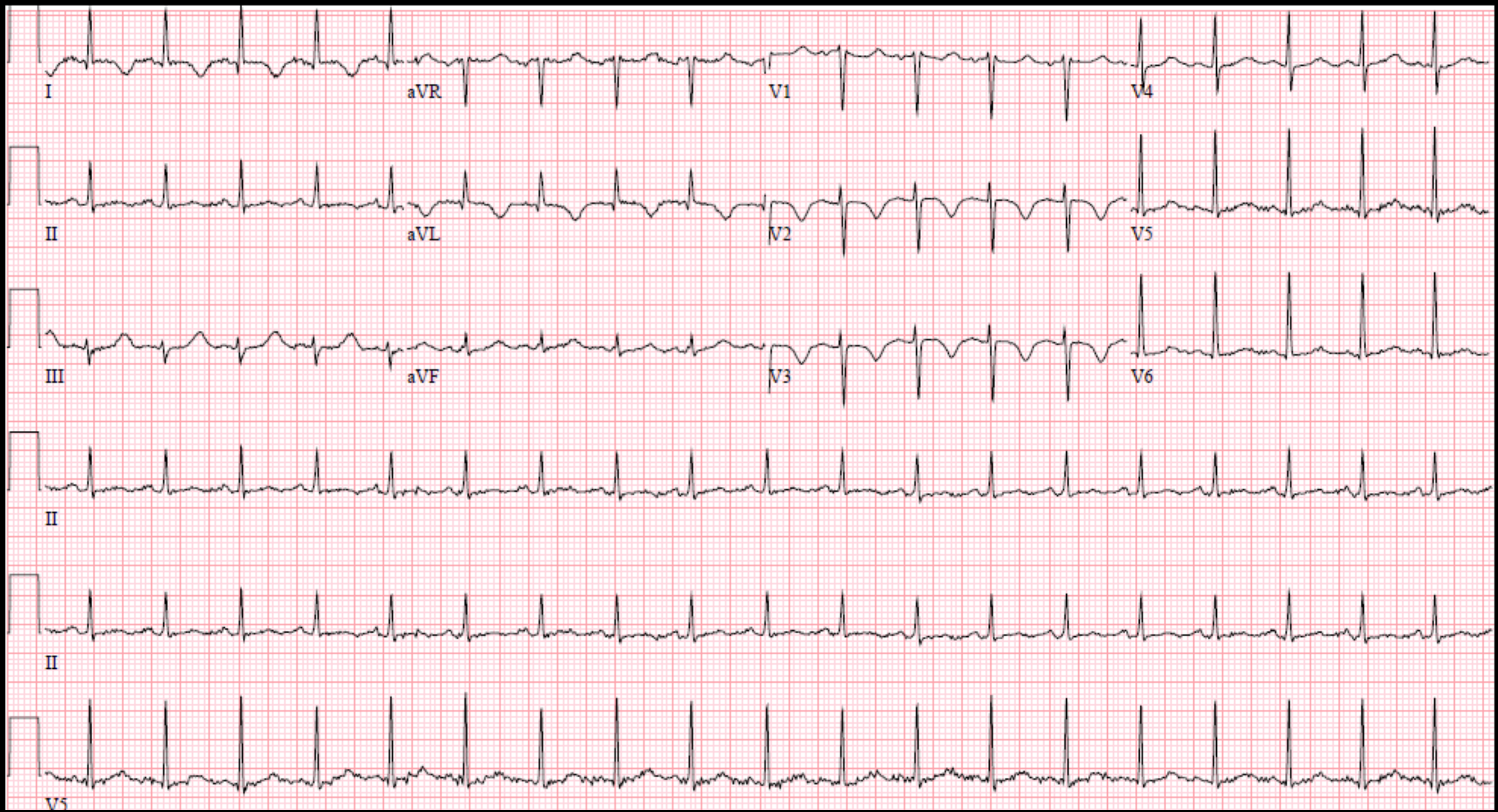
pericardial fat

Pathologic Sonographic Findings

Pericardial Effusion

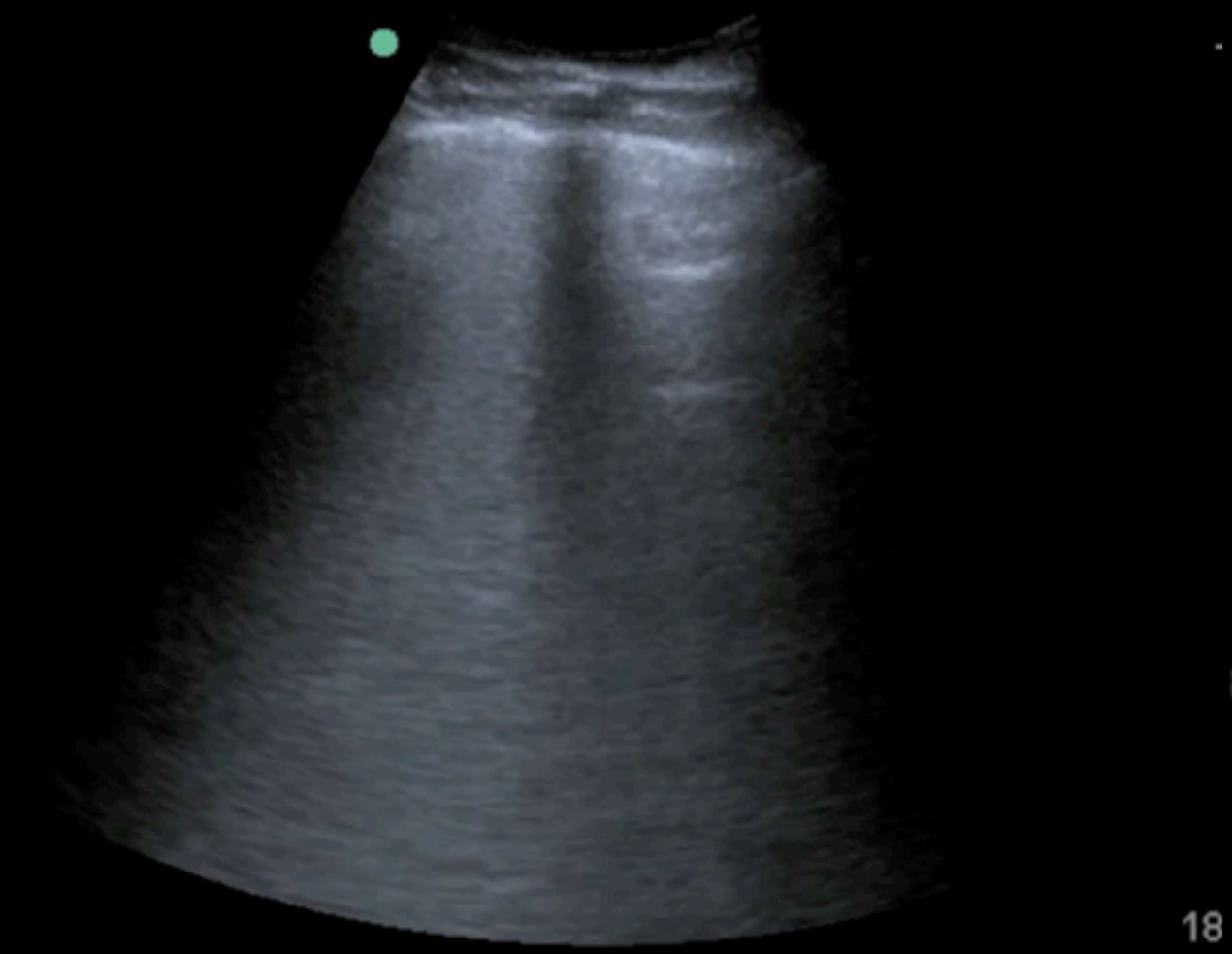


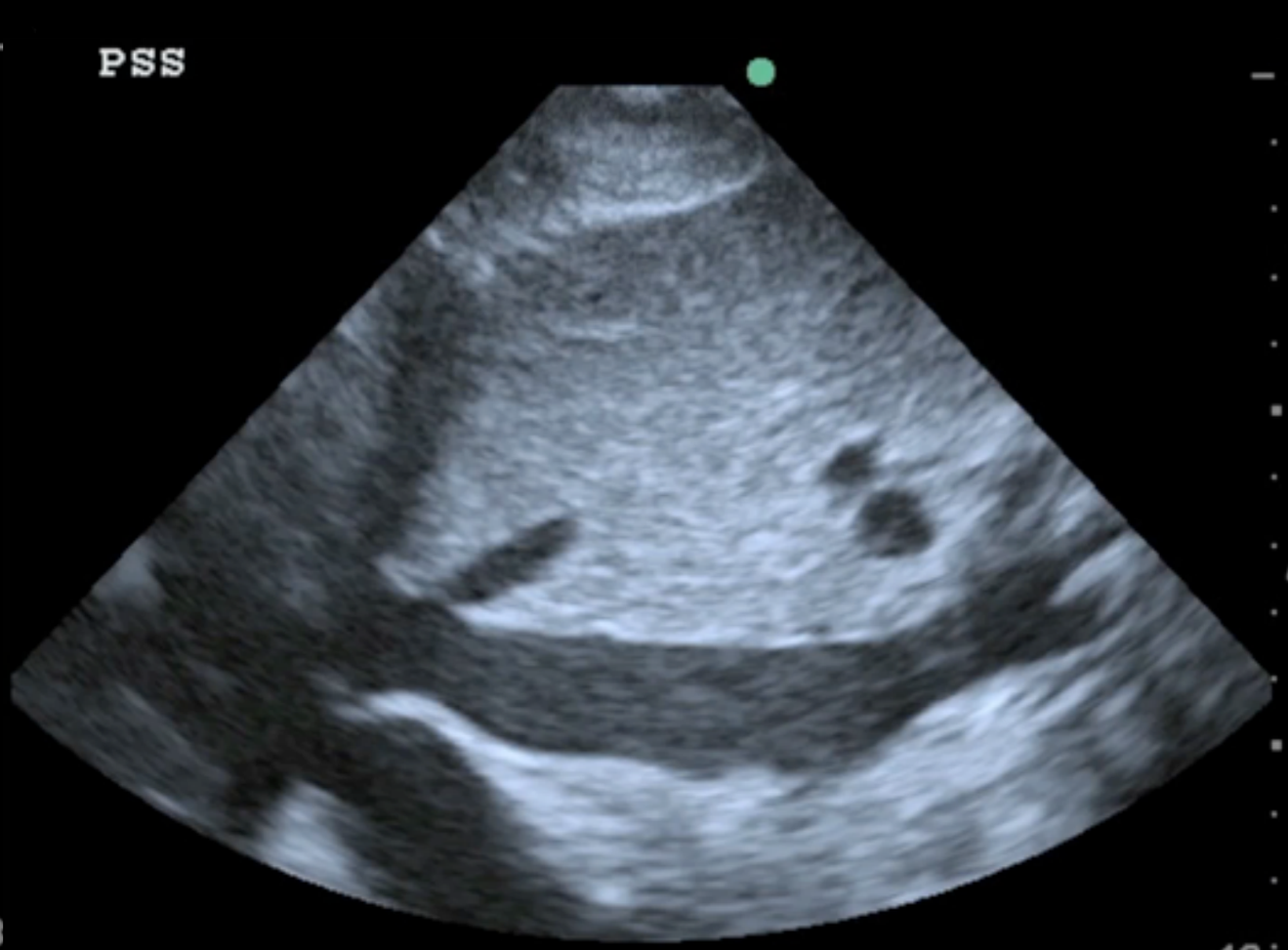
Cases

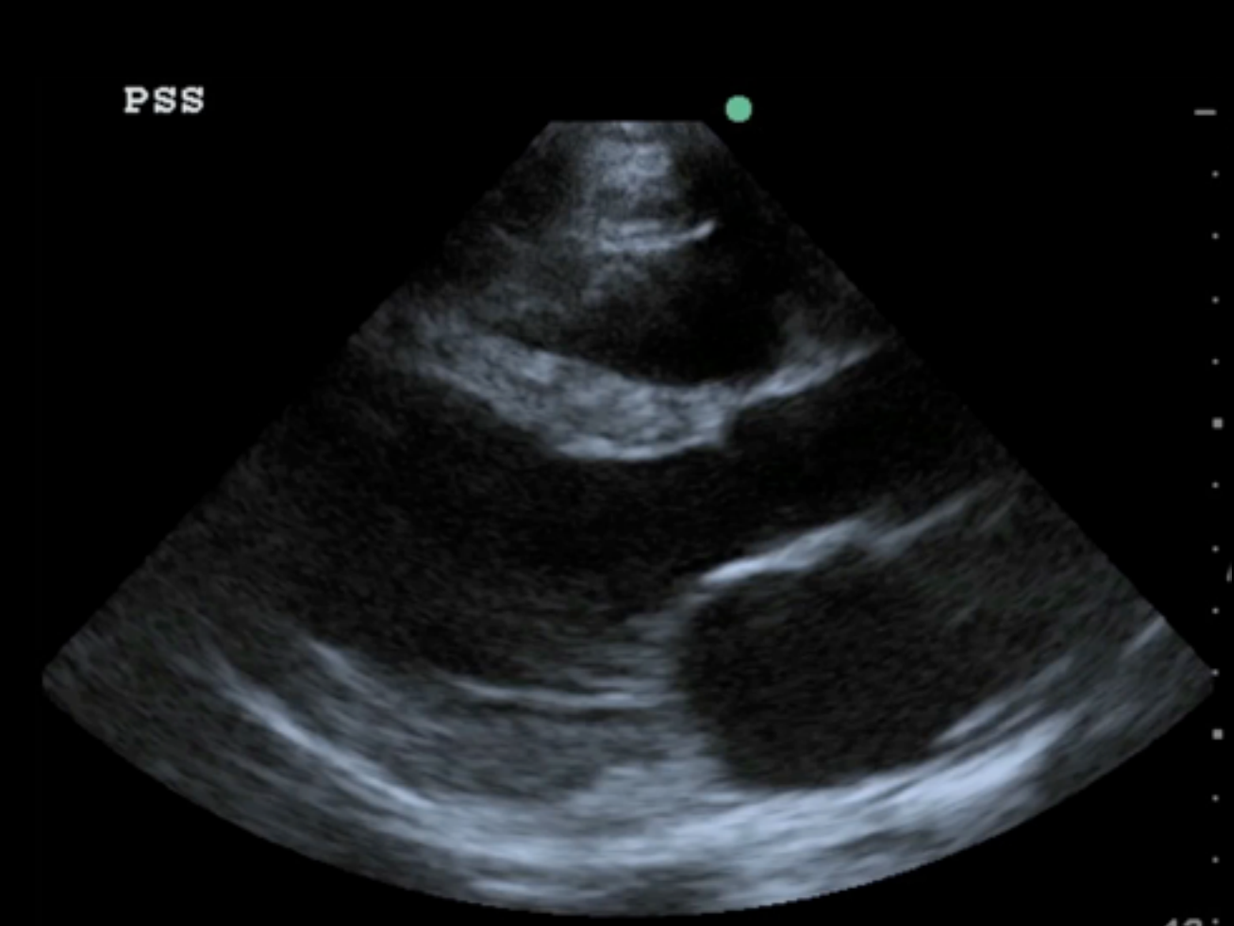


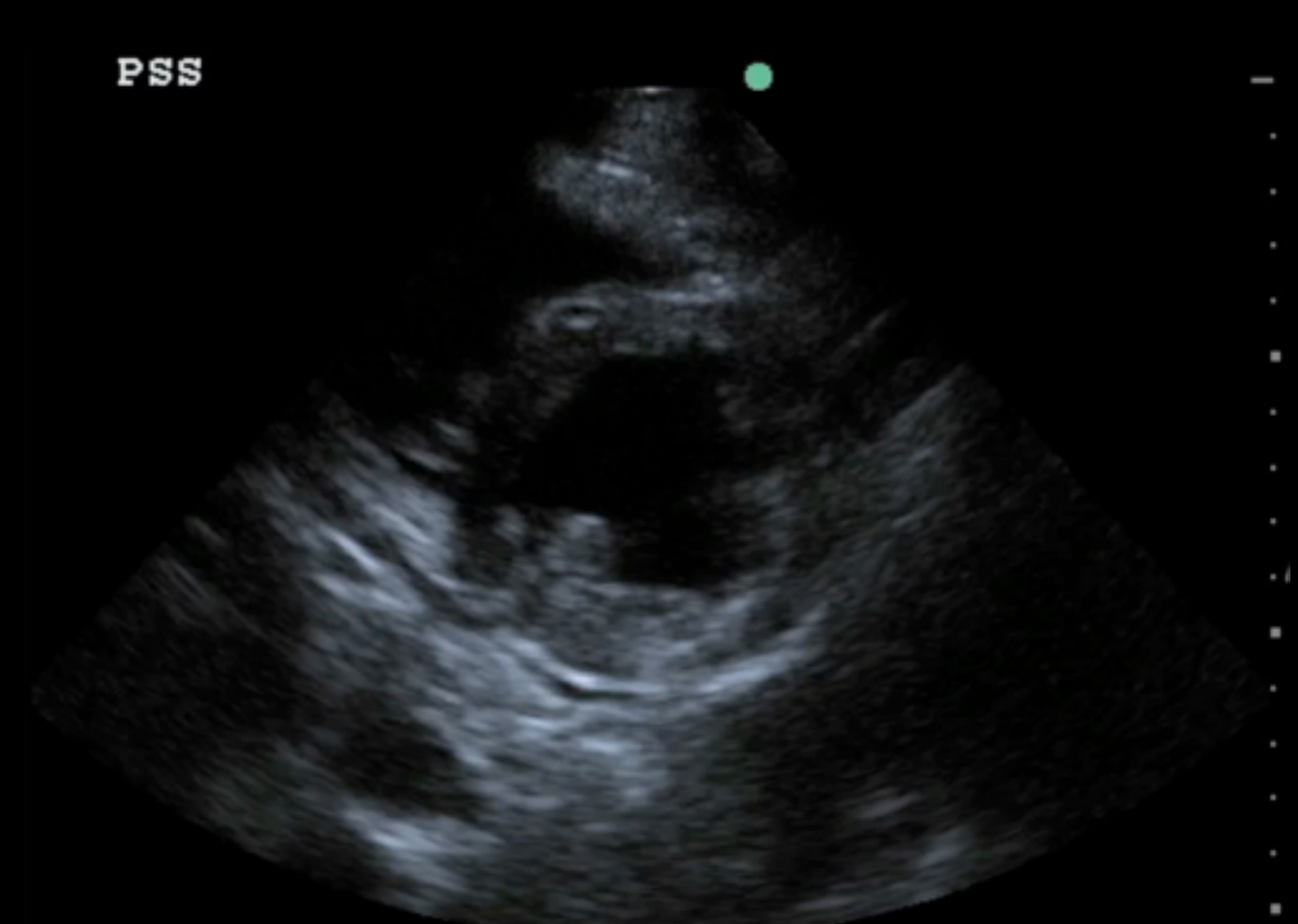
22 y/o female, 8 days post NSVD, 3 days gradually worsening SOB, no CP

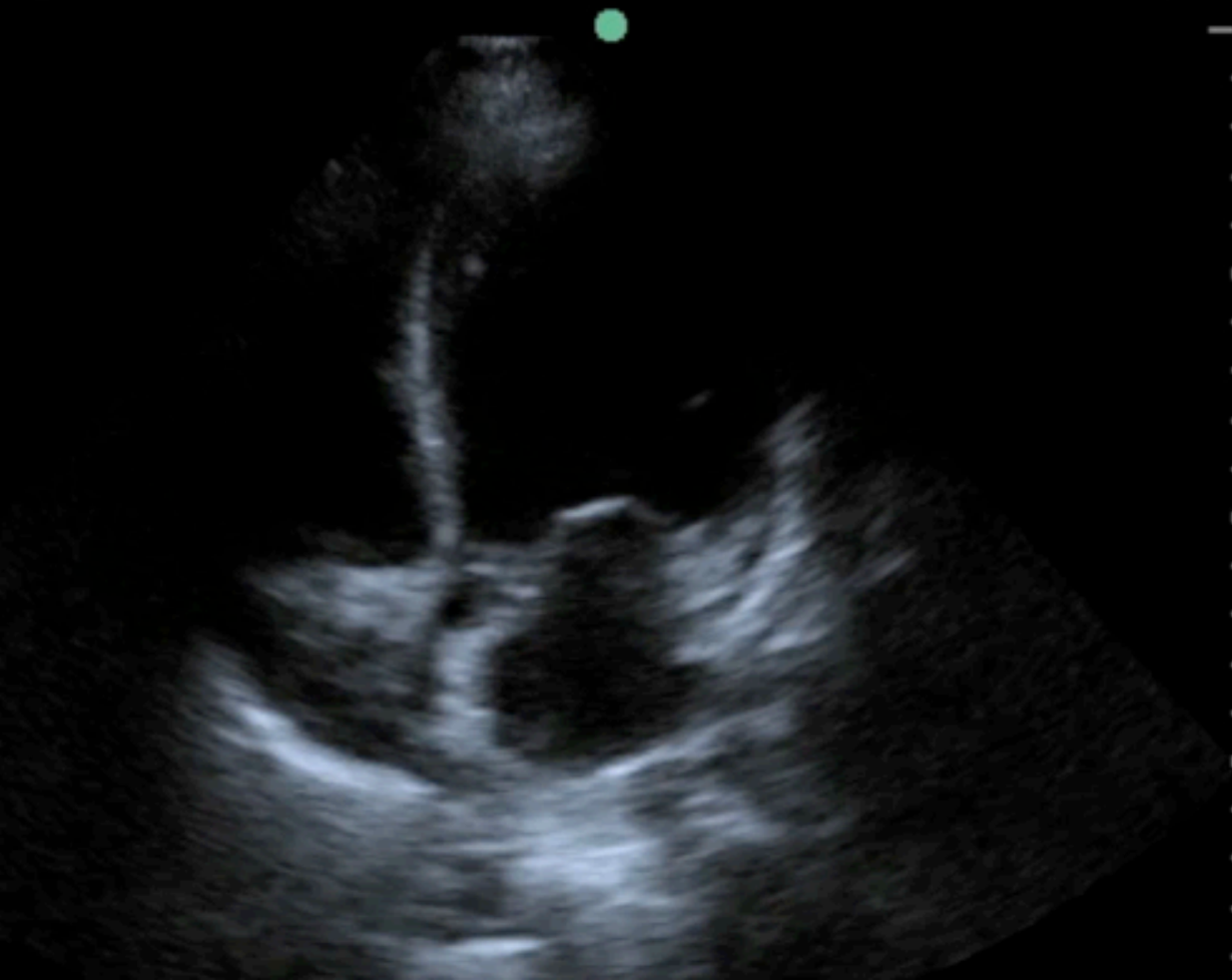
164/133, P124, O2 93%RA, RR 35

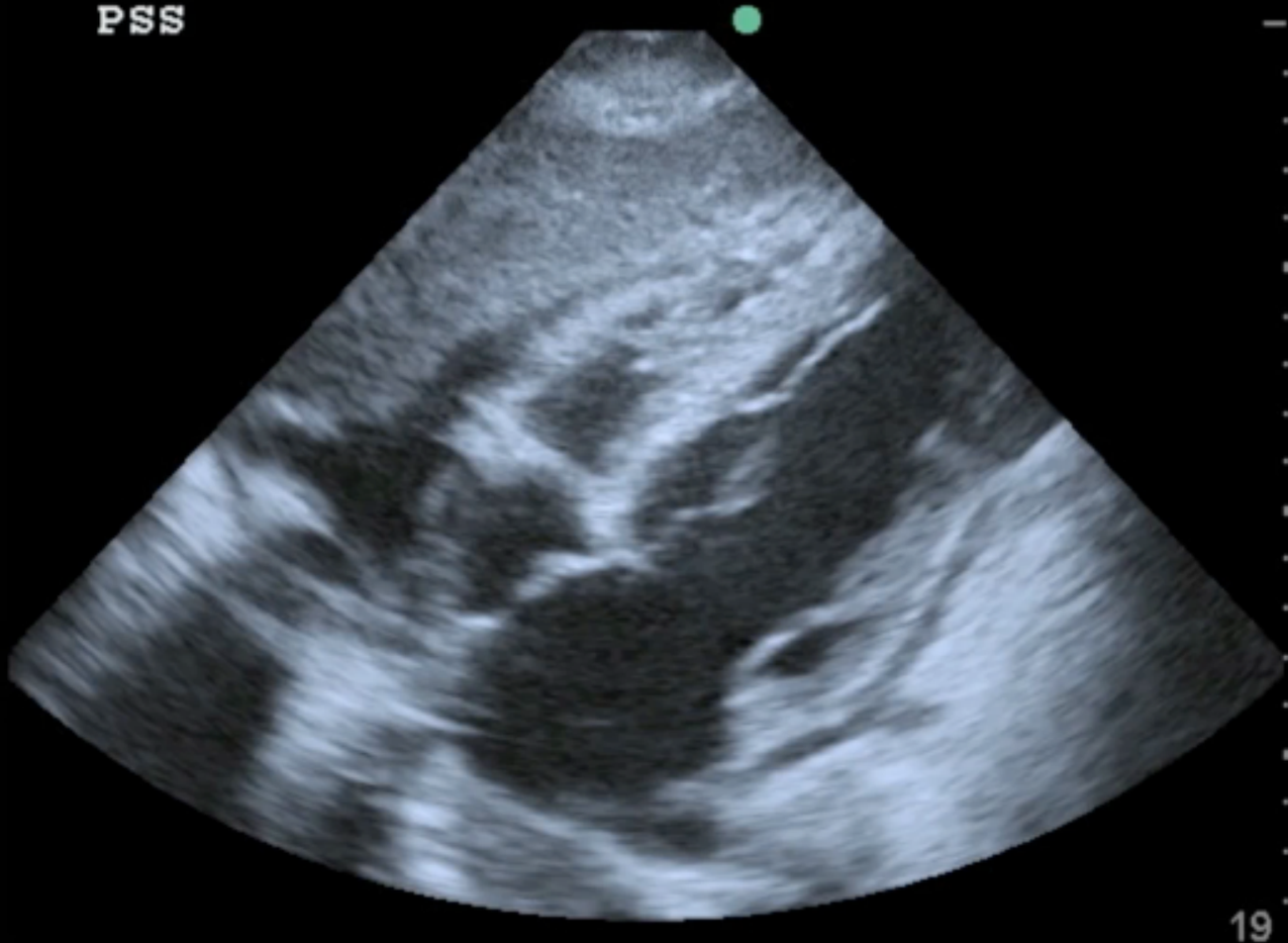


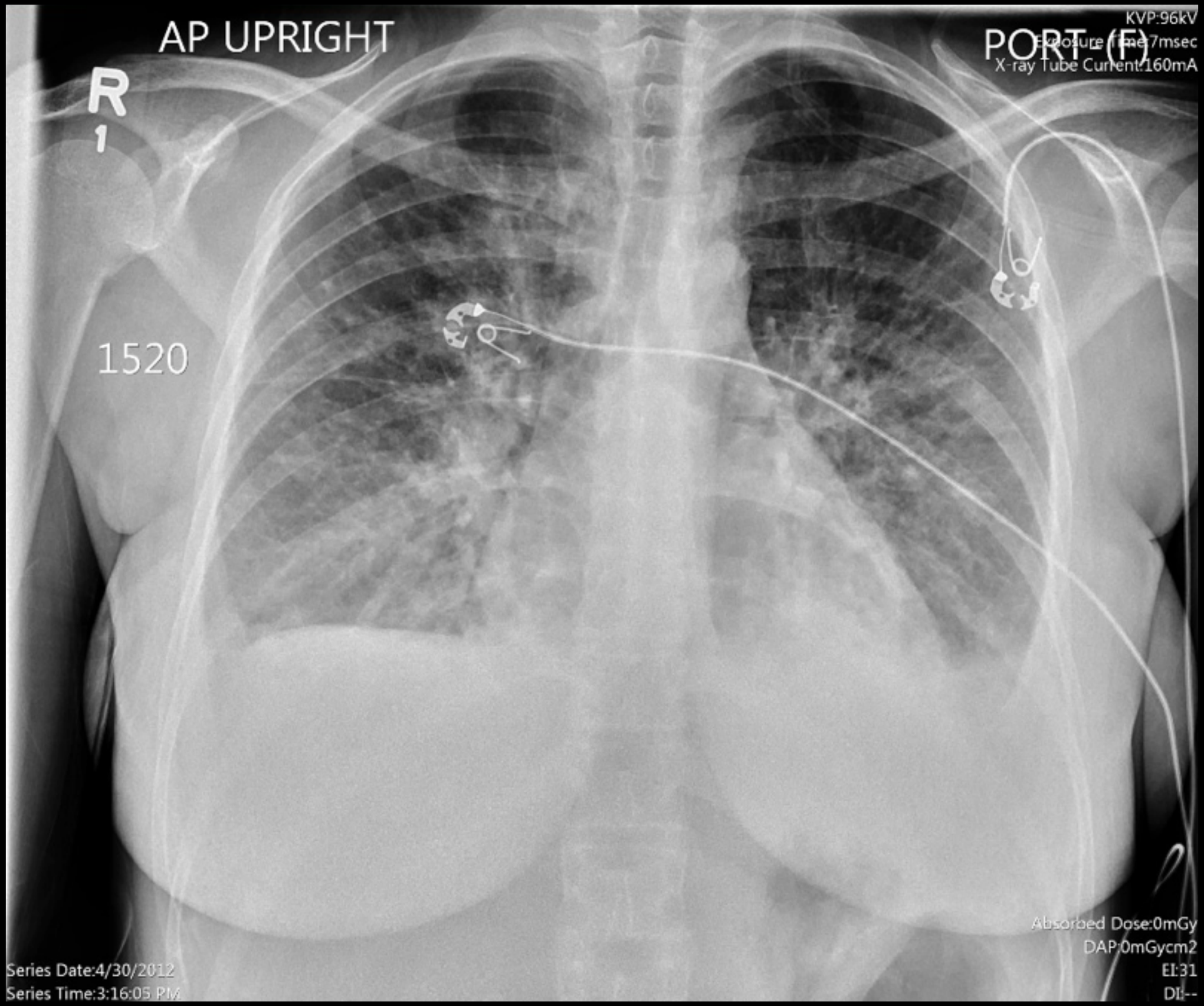

PSS

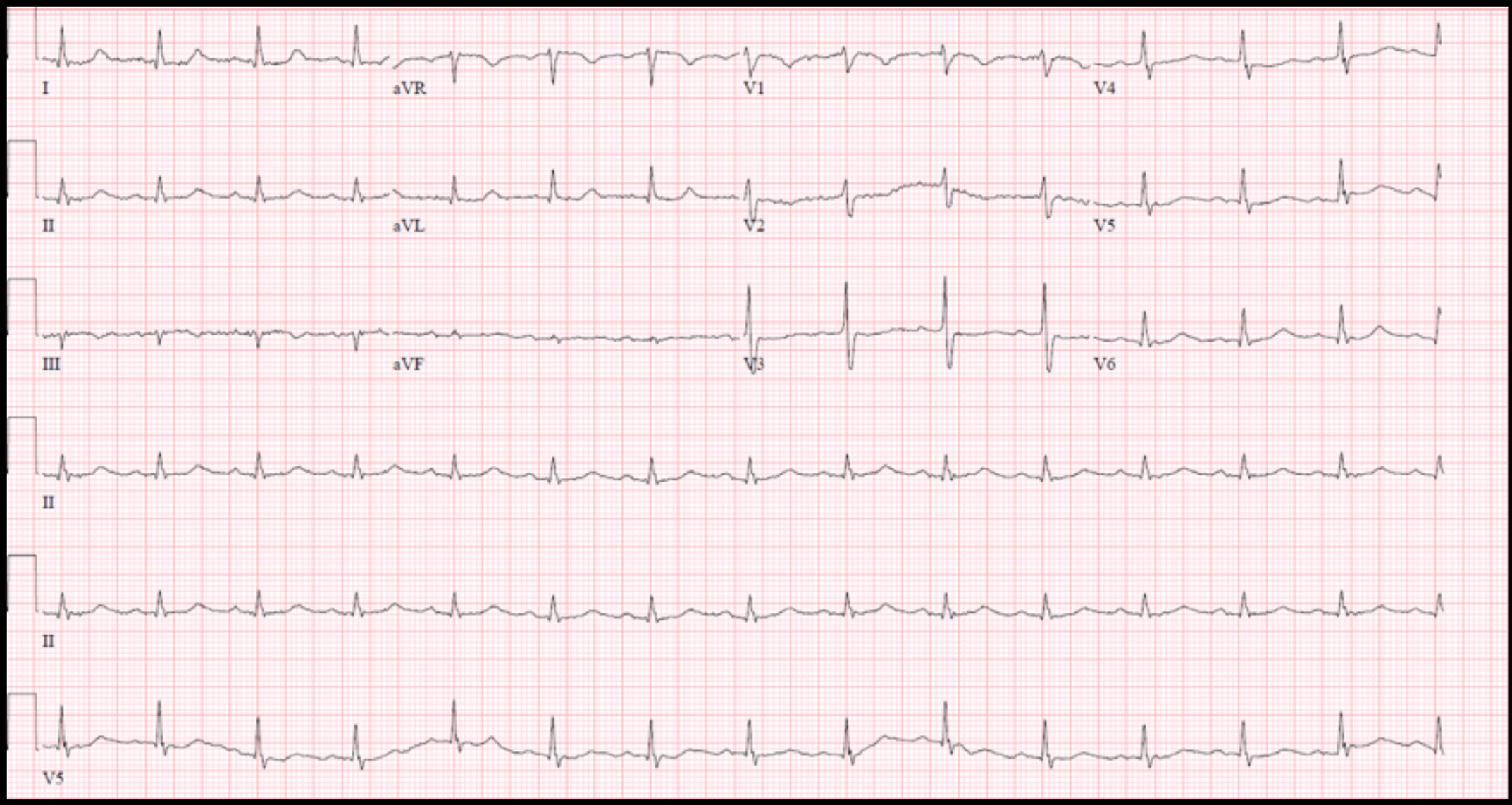

PSS
13


PSS



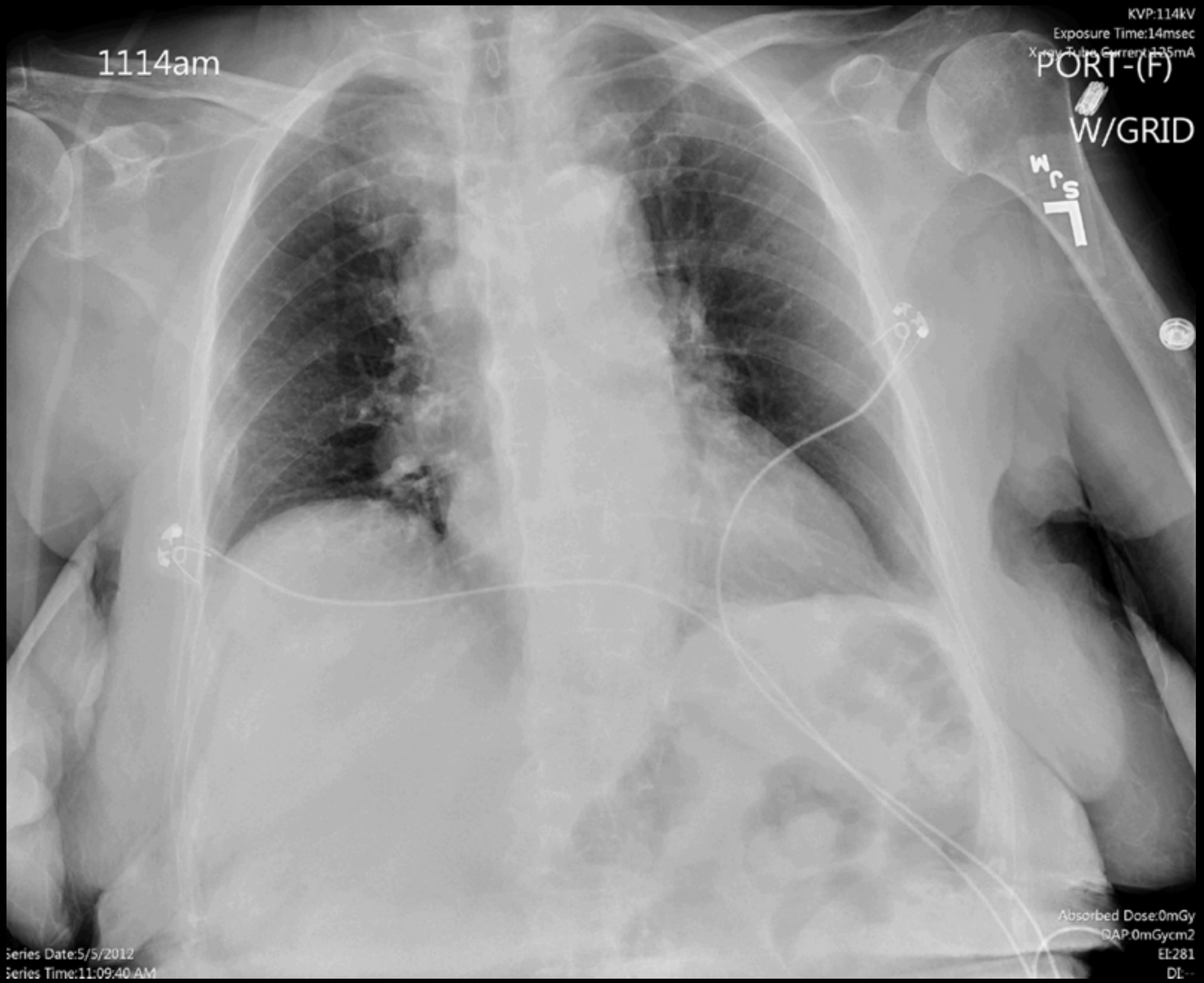

PSS
19

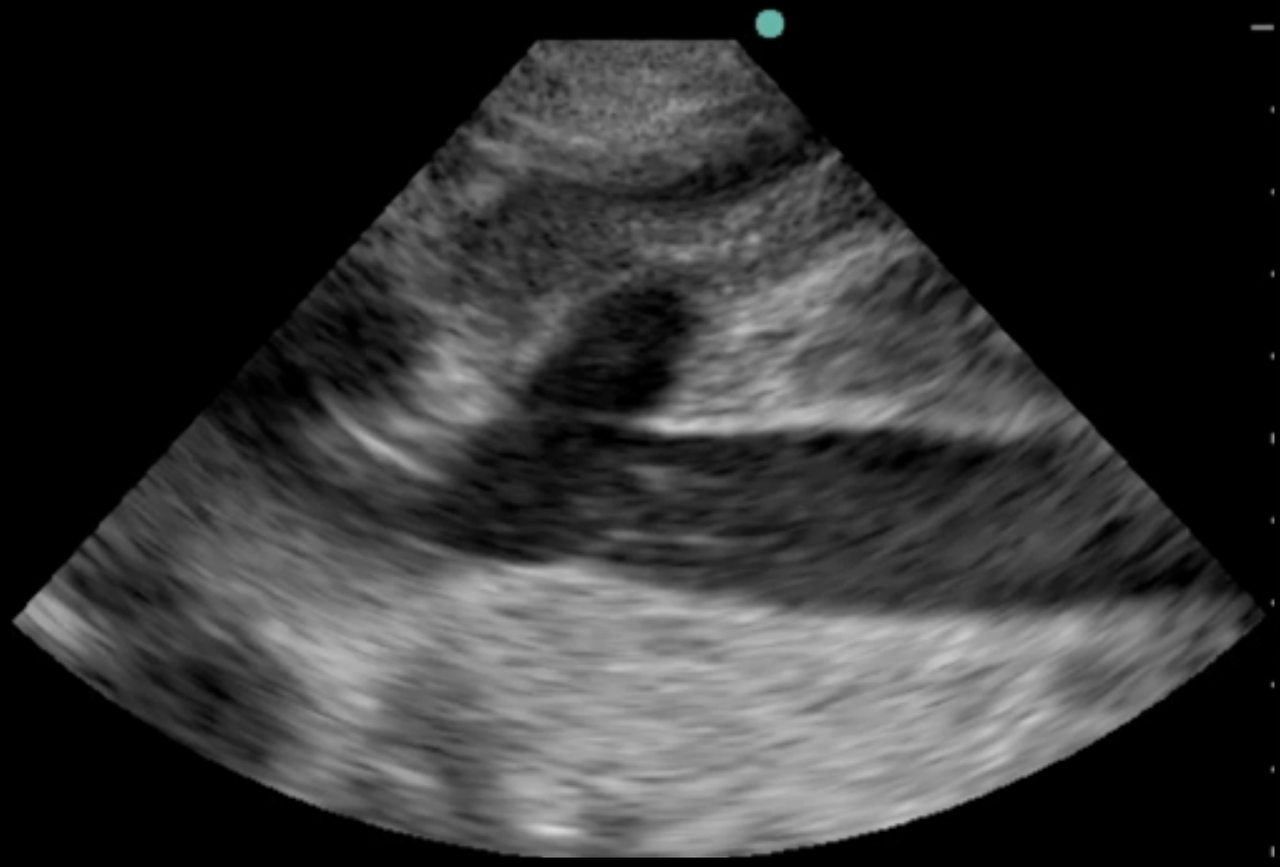

AP UPRIGHT
R
1
1520
PORT (F)
KVP:96kV
Exposure Time:7msec
X-ray Tube Current:160mA
Absorbed Dose:0mGy
DAP:0mGycm2
EI:31
DI:--
Series Date:4/30/2012
Series Time:3:16:05 PM

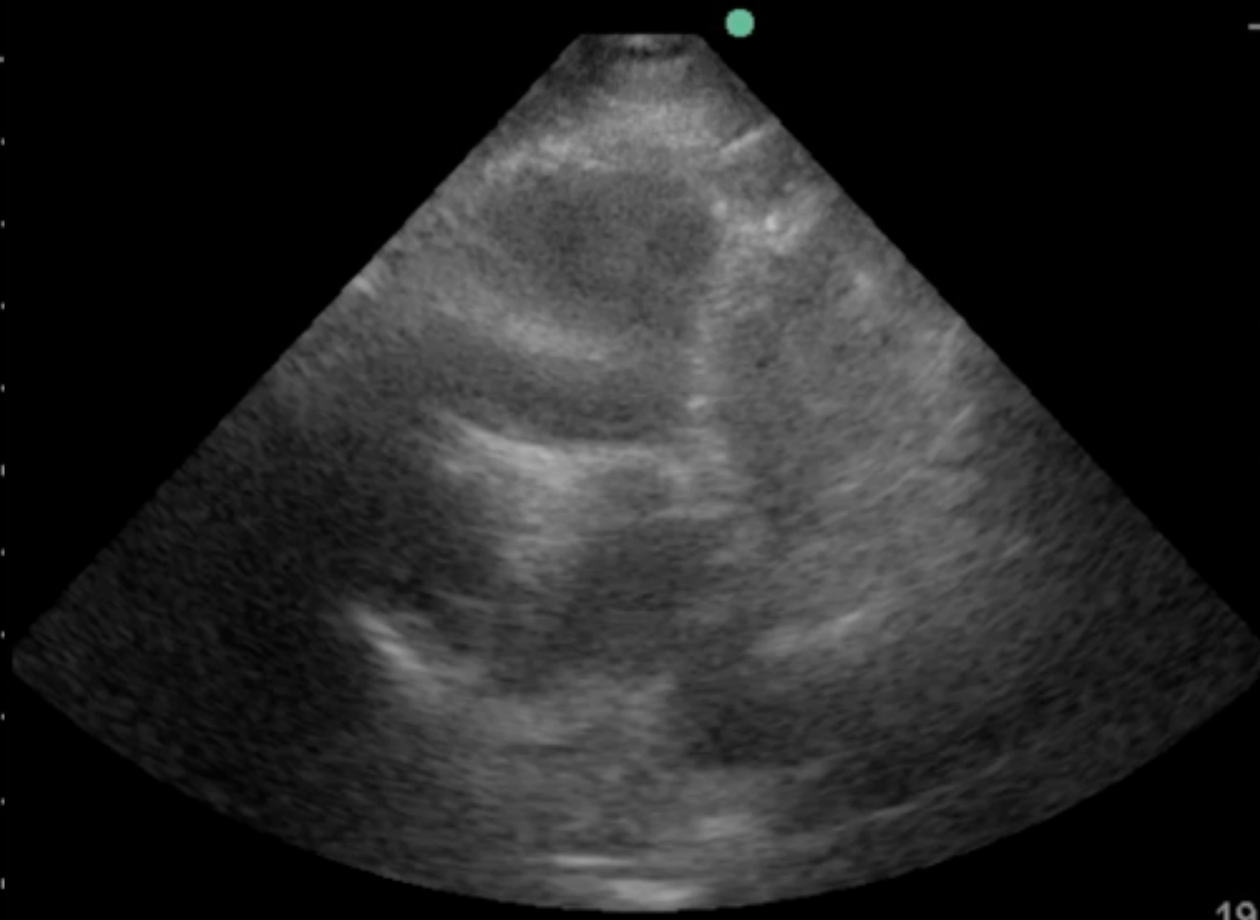


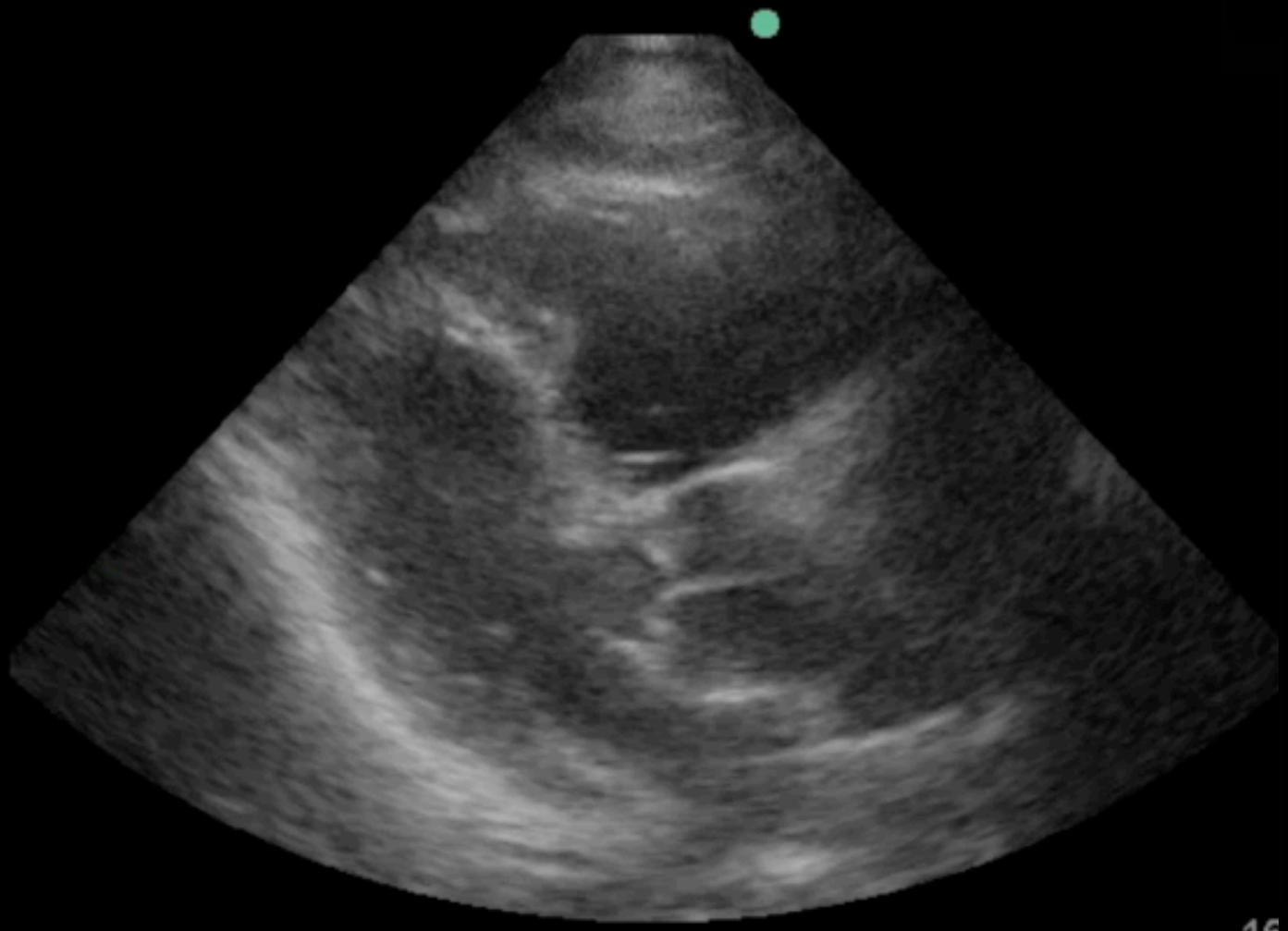
85 y/o female, recent L3 compression fx (non-op), sent by VNA for weakness and hypotension

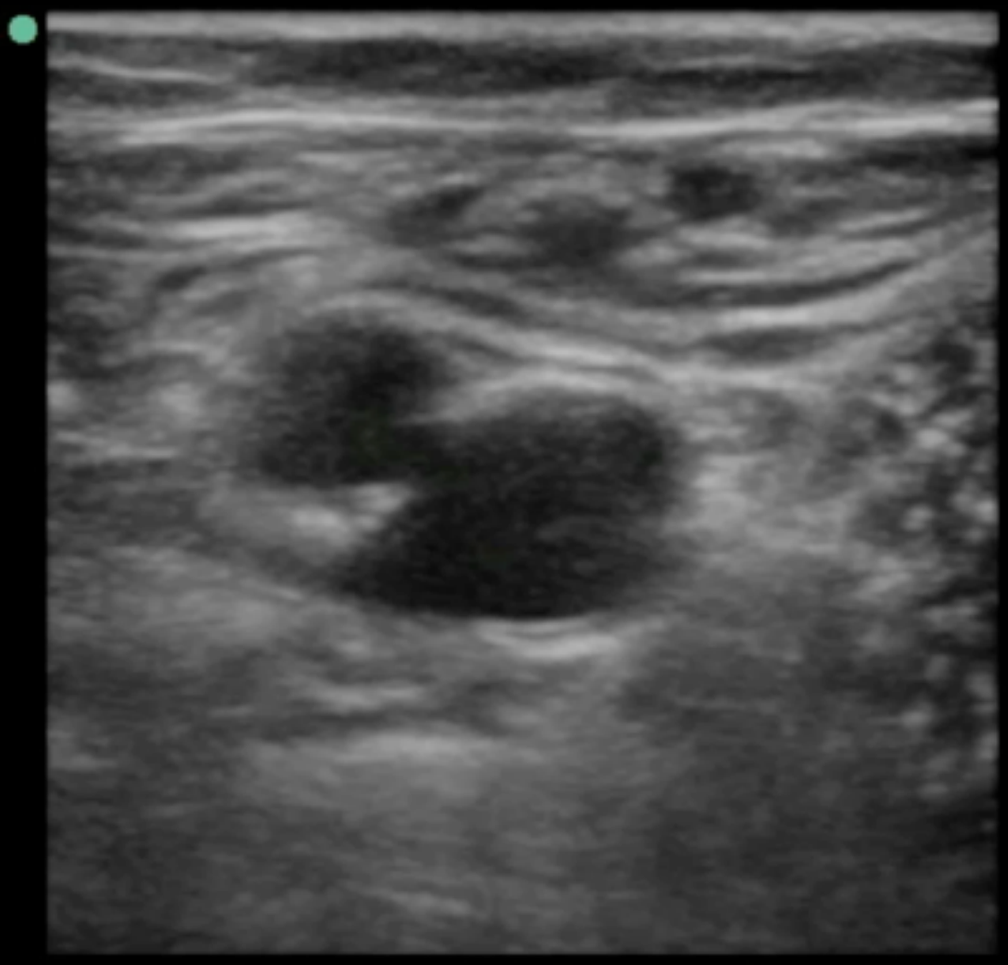
62/34, P 86, 99% 4LNC, RR20


1114am
KVP:114kV
Exposure Time:14msec
X-ray Tube Current:125mA
PORT-(F)
W/GRID
L
Absorbed Dose:0mGy
DAP:0mGycm2
EI:281
DI:--
Series Date:5/5/2012
Series Time:11:09:40 AM









Empiric thrombolytics initiated

Hypotension worsened, SBP 30's

Lytics bolused, IVF, levophed, dobutamine

BP, pulse stabilized. Pt to ICU

Follow up:

Stabilized, transferred to floor in the next few days, normal vitals and mental status

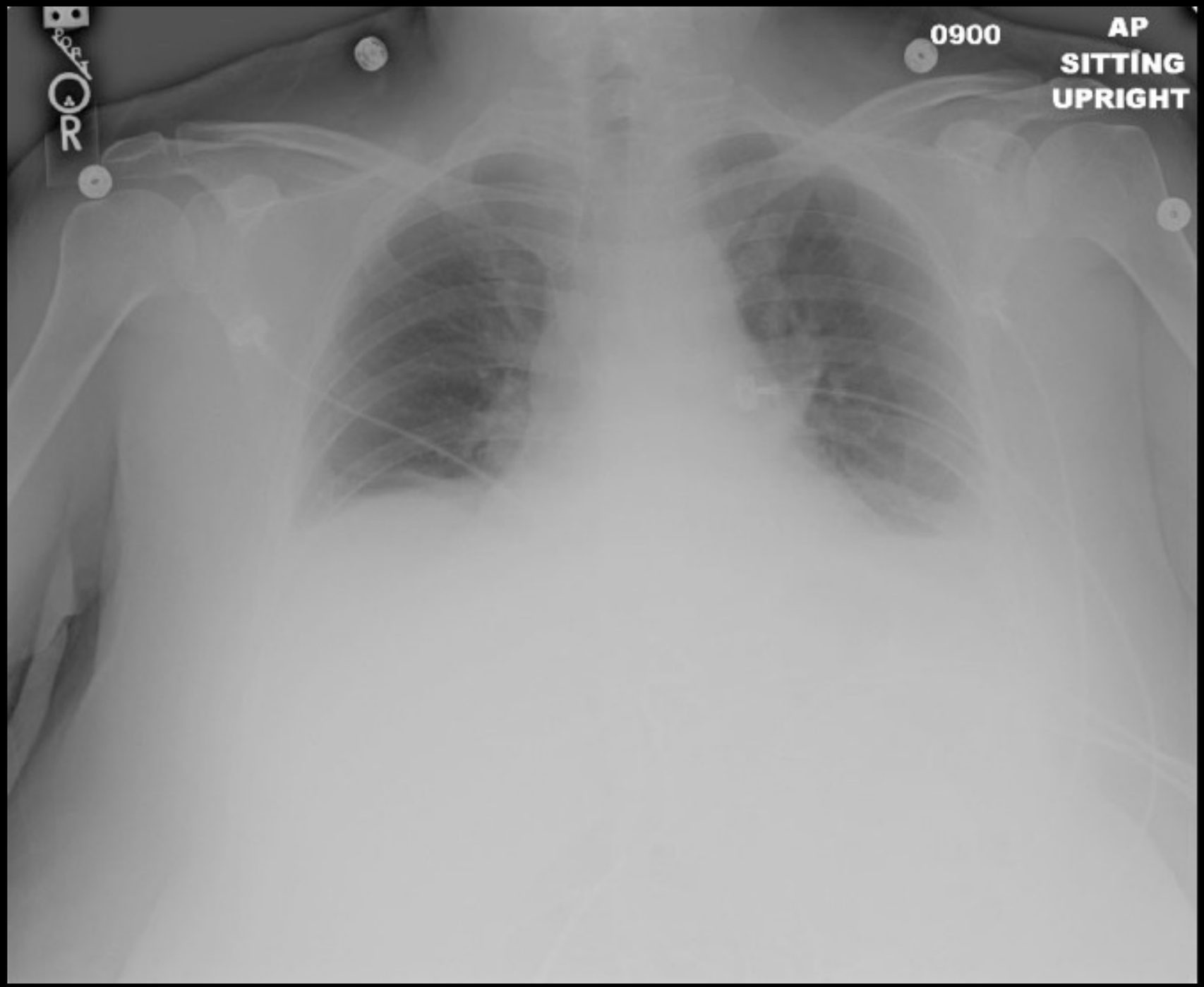
Cases

Dyspnea, Hypotension

- 54 y/o female presented with pleuritic CP, hypotension, syncope from home.
- P 120, BP 75/40, O2 85%, afebrile
- in distress, holding chest, lungs clear

Cases

Dyspnea, Hypotension



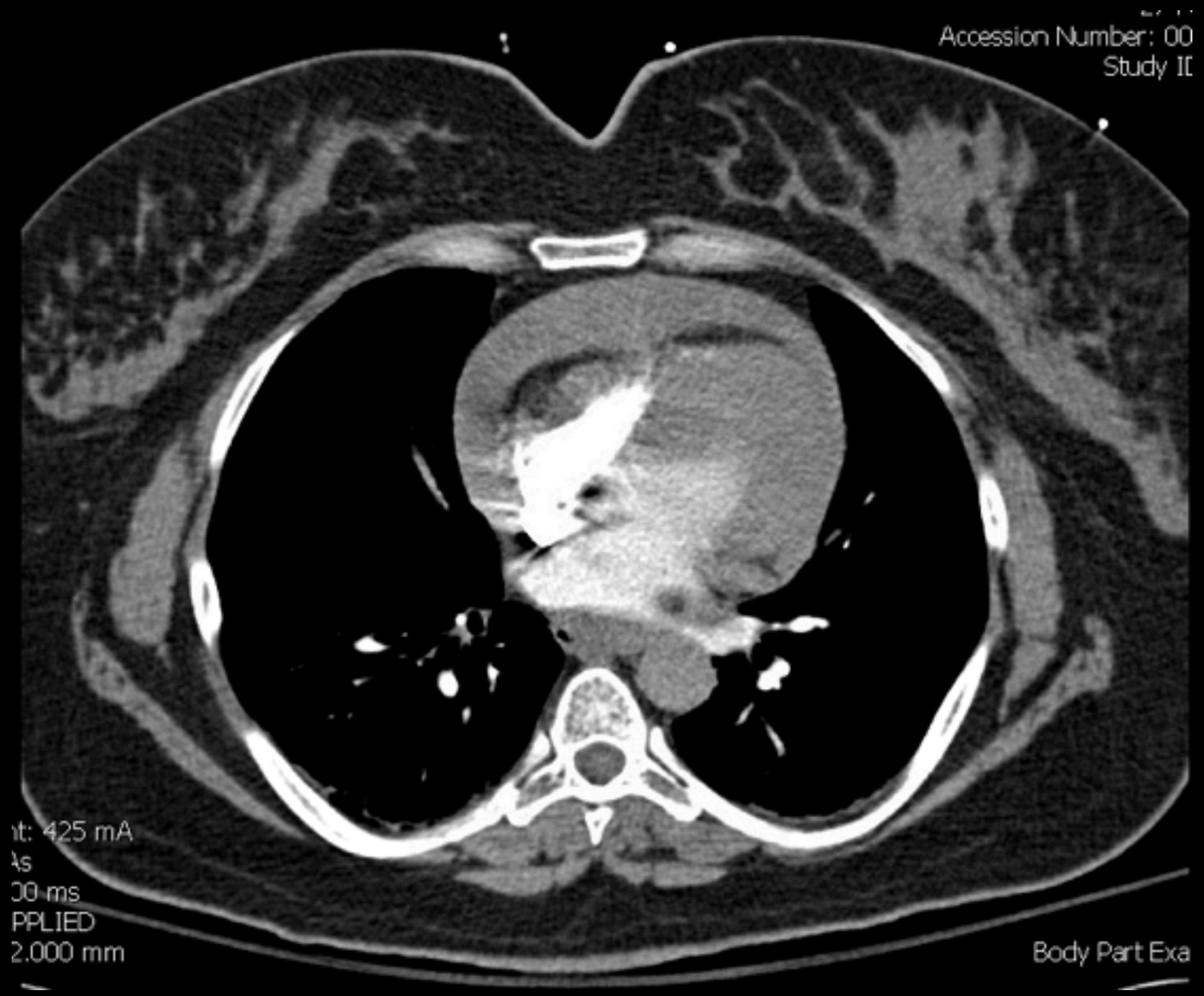
Cases

Dyspnea, Hypotension

- Initial presumption of pulmonary embolism
- Heparin started presumptively, fluid boluses, sent to CT
- CT angio negative for PE, but does show...

Cases

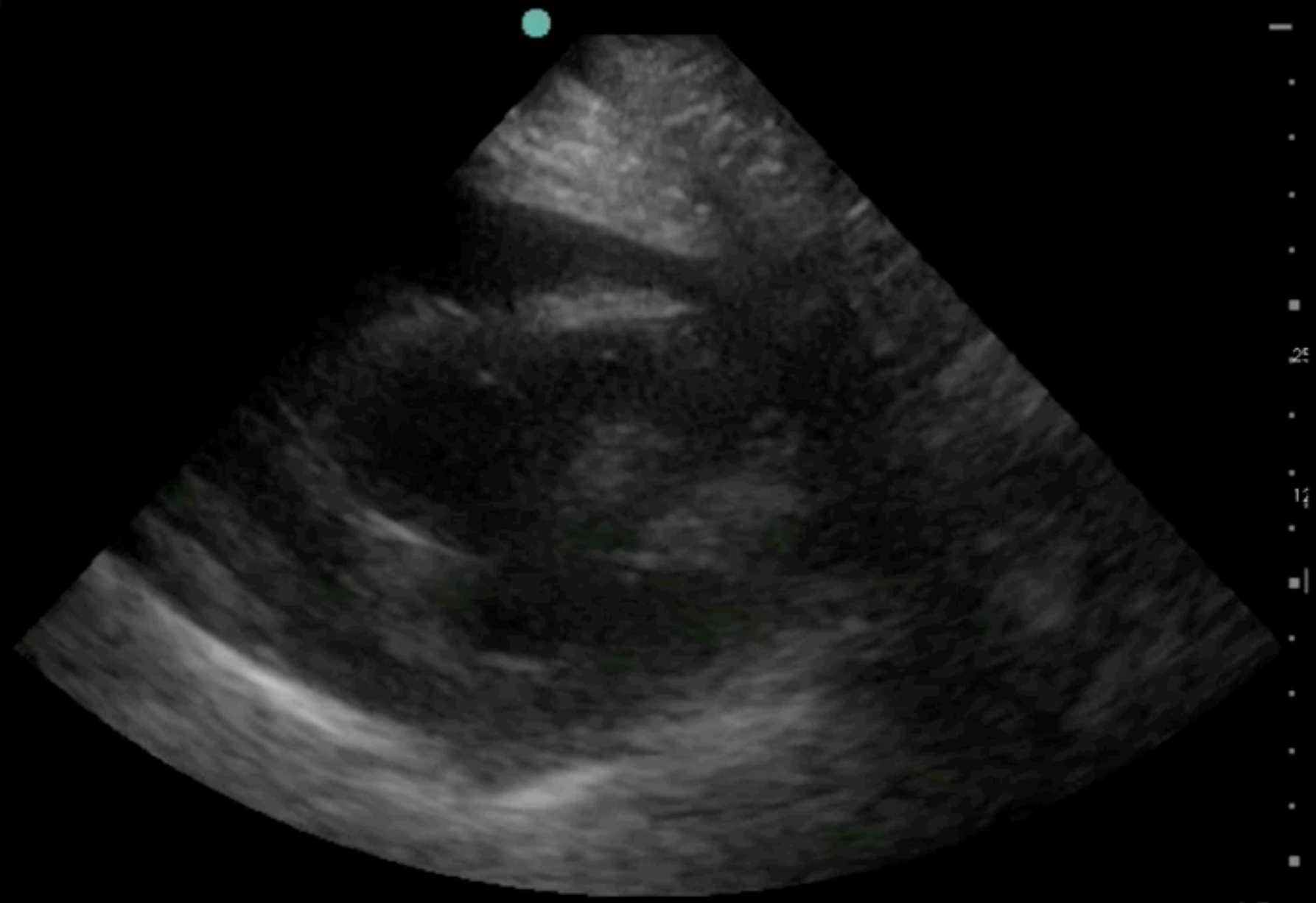
Dyspnea, Hypotension



pericardial effusion, likely hemorrhagic

Cases

Dyspnea, Hypotension



Cases

Dyspnea, Hypotension

- INR 15
- Interventionalist would not take patient until protamine given
- Pt had pericardiocentesis, reversal of anticoagulation, eventually discharged

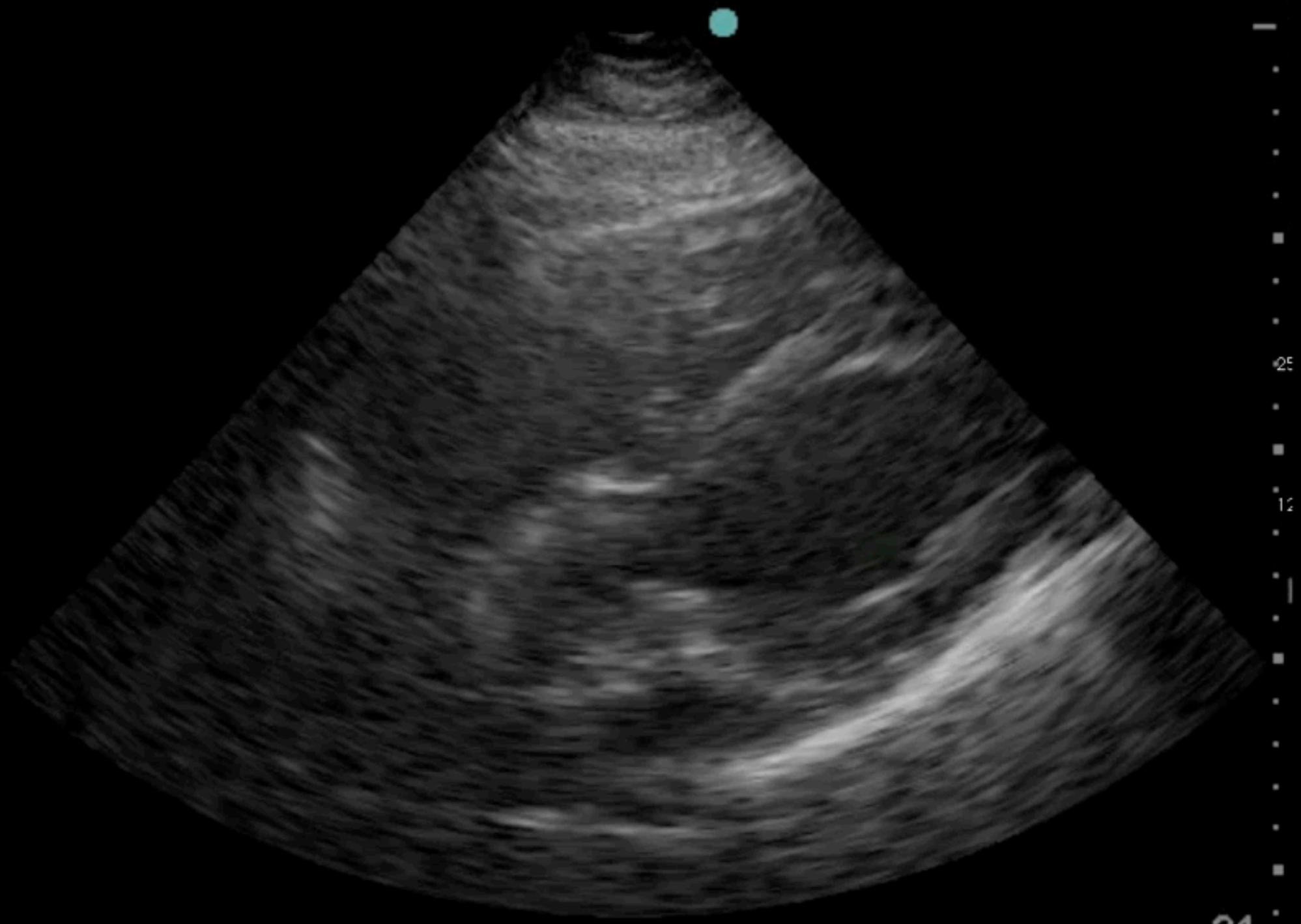
Cases

Weakness, Hypotension

- 83 y/o female, increasing weakness, dizziness x1 week, h/o CHF
- Vitals: P 90, BP 68/30, RR 25, T 103.5, O2 98%RA
- Source: Urosepsis

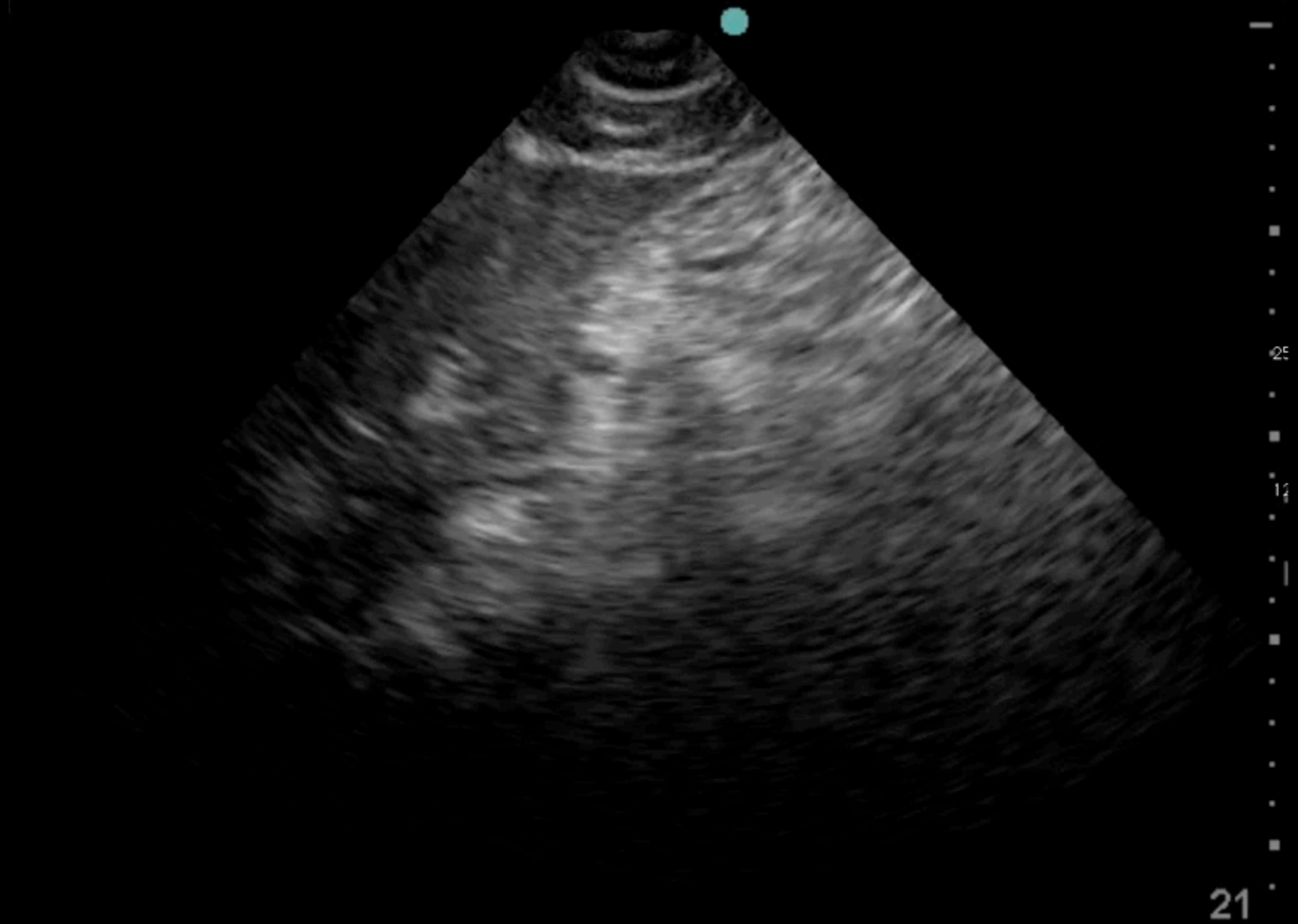
Cases

Weakness, Hypotension



Cases

Weakness, Hypotension



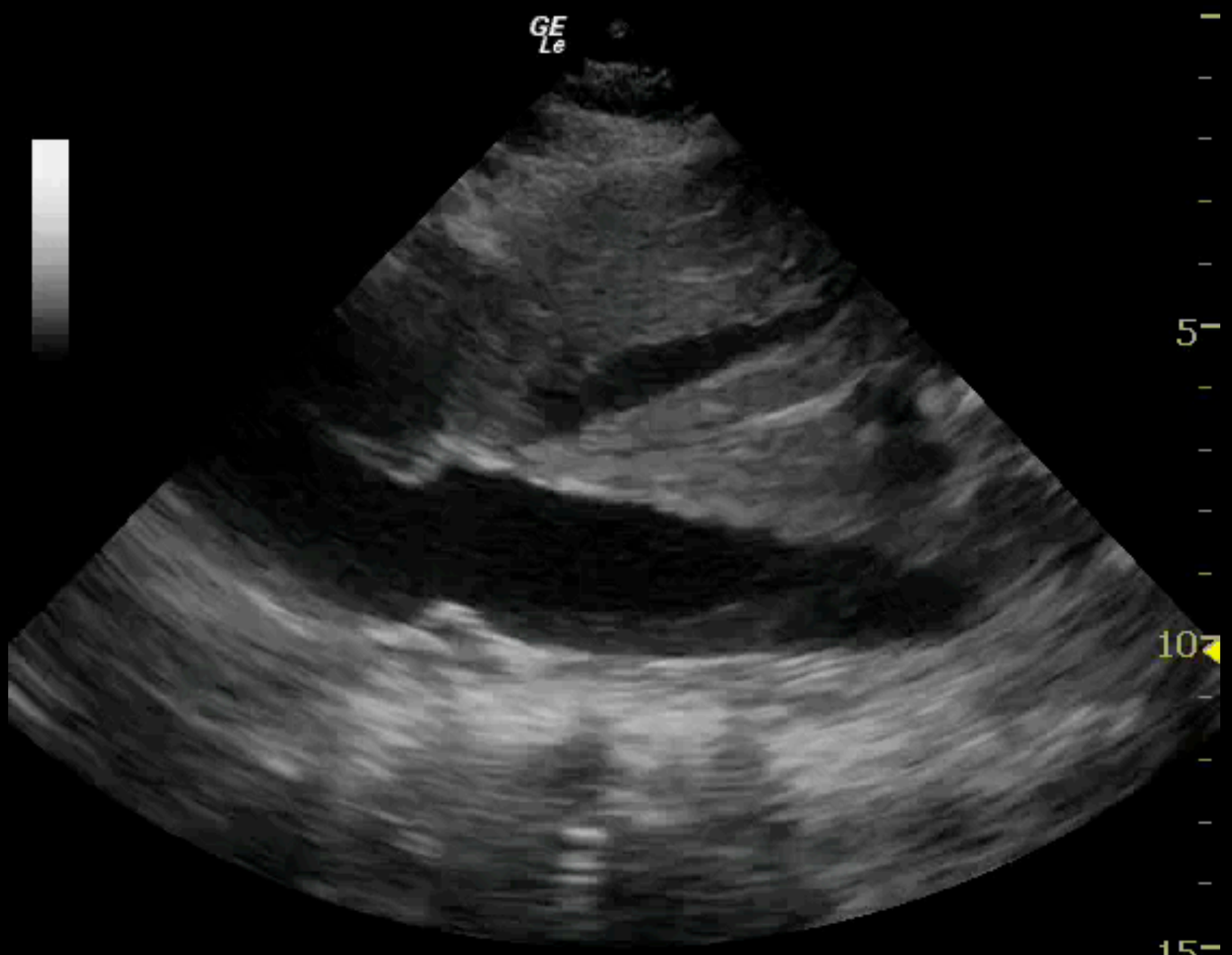
Cases

Weakness, Hypotension

- Source: urosepsis
- Pt resuscitated with IV fluids: 4.5L, BP still 76/40

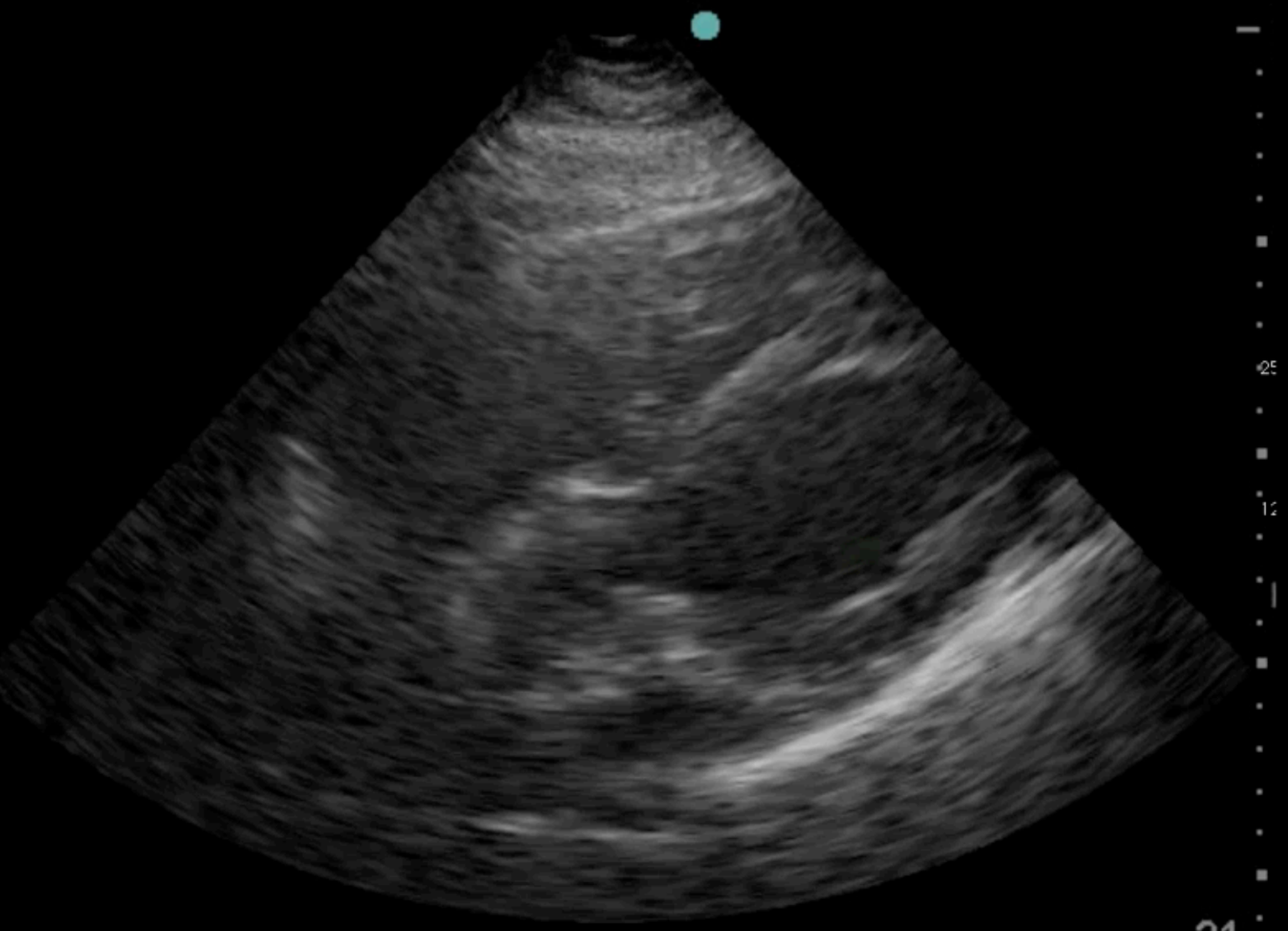
Cases

Weakness, Hypotension



Cases

Weakness, Hypotension



After levophed:
consider epinephrine
or dobutamine

Cases

Weakness, Hypotension

In this situation, consider vasopressin at .03 units/minute

Summary

Basic Echocardiography

- Learn basic views
- Try to produce standard images
- Pattern recognition
- Practice on normal patients
- Abnormalities may be obvious
- With practice you will be able to identify pathology