RUSH protocol

中國附醫 急重症超音波訓練中心

Patient:

Rapid, shallow breathing, cold , wet skin, obtunded

- HR: 140
- BP: 80/50
- T°: 38.5°


Hypotension or Shock
High mortality rates

Rapid

Ultrasound for

Shock and

Hypotension

Why? – stop guessing, start seeing

Where? – everywhere

When? – as soon as possible/suitable

uabcd---abcdu---aubucudueu

RUSH protocol

Pump	LV contractility/dysfunction
	RV strain/dilatation
	Valve disease
	Pericardial effusion/tamponade
Tank	IVC filling/collapse/plethora
	Volume loss to certain spaces
	eFast (Morison, Koller, Douglas, Proust)
Pipes	Aortic dissection/aneurysm/rupture
	Pulmonary embolism
	DVT

Table 1: RUSH protocol summary.

RUSH exam	Hypovolemic shock	Cardiogenic shock	Obstructive shock	Distributive shock
Pump	Hypercontractile heart Small heart size	Hypocontractile heart Dilated heart size	Pericardial effusion, RV strain Hypercontractile heart	Hypercontractile heart (early sepsis) Hypocontractile heart (late sepsis)
Tank	Flat IVC Flat IJV Peritoneal fluid Pleural fluid	Distended IVC Distended IJV Lung rockets Pleural effusions, ascites	Distended IVC Distended IJV Absent lung sliding (PTX)	Normal/small IVC Normal/small IJV Pleural fluid (empyema) Peritoneal fluid (peritonitis)
Pipes	AAA Aortic dissection	Normal	DVT	Normal

RUSH exam	Hypovolemic shock	
Pump	Hypercontractile heart Small heart size	**Pump**
Tank	Flat IVC Flat IJV Peritoneal fluid Pleural fluid	**Tank**
Pipes	AAA Aortic dissection	**Pipes**

TABLE 1: RUSH p

	Cardiogenic shock
Pump	Hypocontractile heart Dilated heart size
Tank	Distended IVC Distended IJV Lung rockets Pleural effusions, ascites
Pipes	Normal

rotocol summary.

	Obstructive shock
Pump	Pericardial effusion, RV strain Hypercontractile heart
Tank	Distended IVC Distended IJV Absent lung sliding (PTX)
Pipes	DVT

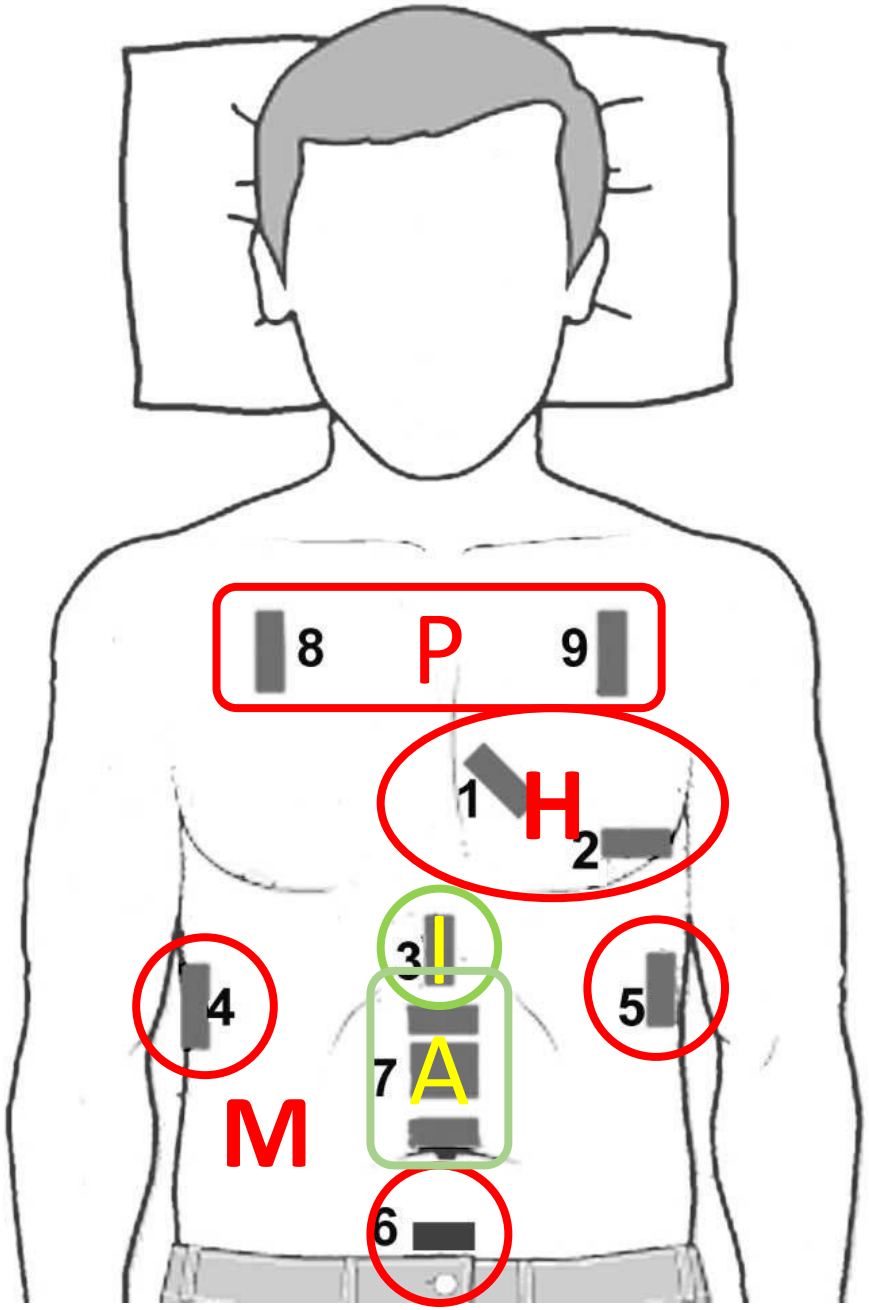
	Distributive shock
Pump	Hypercontractile heart (early sepsis) Hypocontractile heart (late sepsis)
Tank	Normal/small IVC Normal/small IJV Pleural fluid (empyema) Peritoneal fluid (peritonitis)
Pipes	Normal

HI-MAP approach

- **H** Heart
- **I** IVC
- **M** Morison's pouch/FAST abdominal views
- **A** Aorta, Vein
- **P** Pleura/PNx

HI-MAP approach

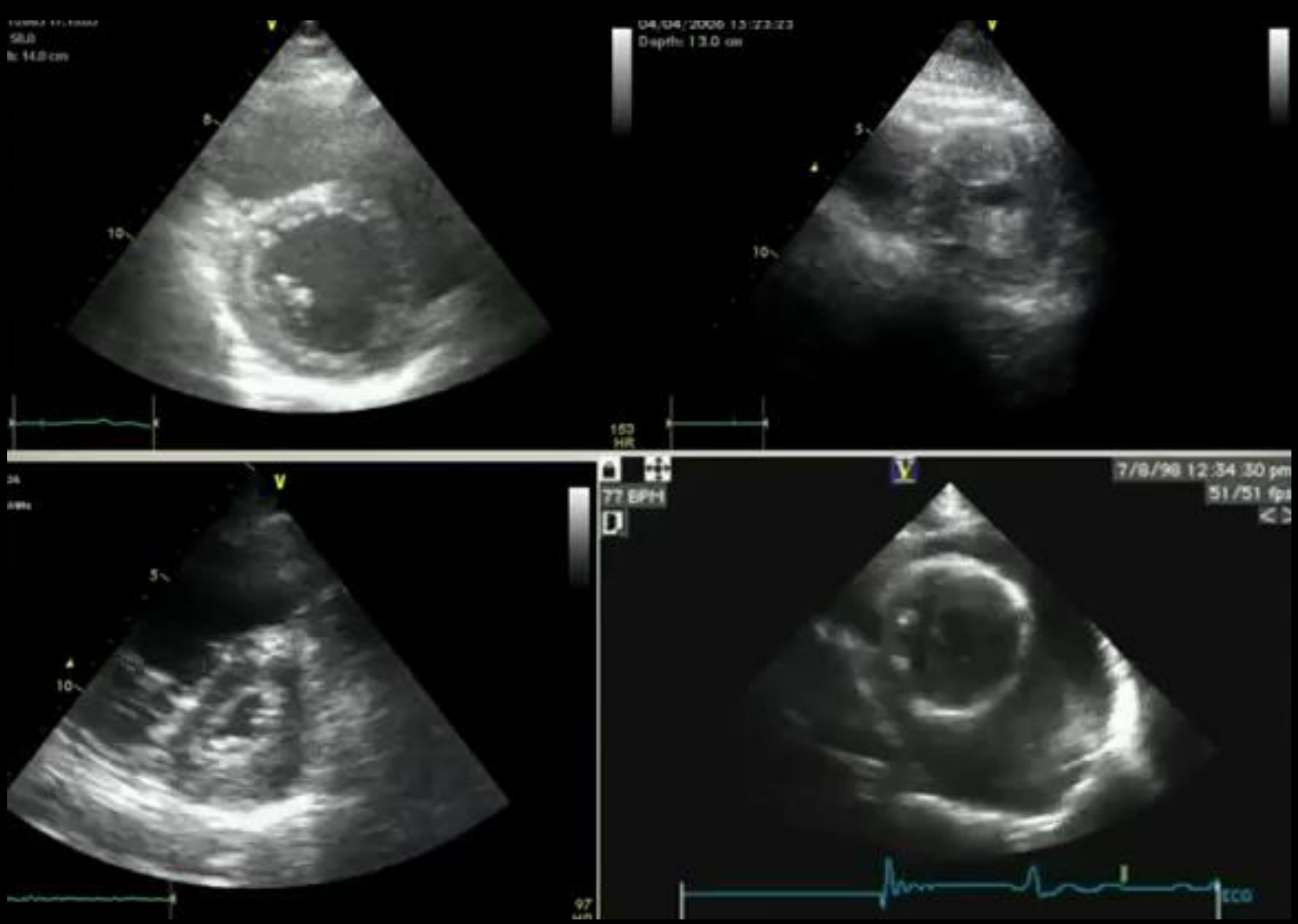
- **H** Heart
- **I** IVC
- **M** Morison's pouch/FAST abdominal views
  + Pleura
- **A** Aorta, Vein
- **P** PNx



RUSH(ed) Exam Sequencing

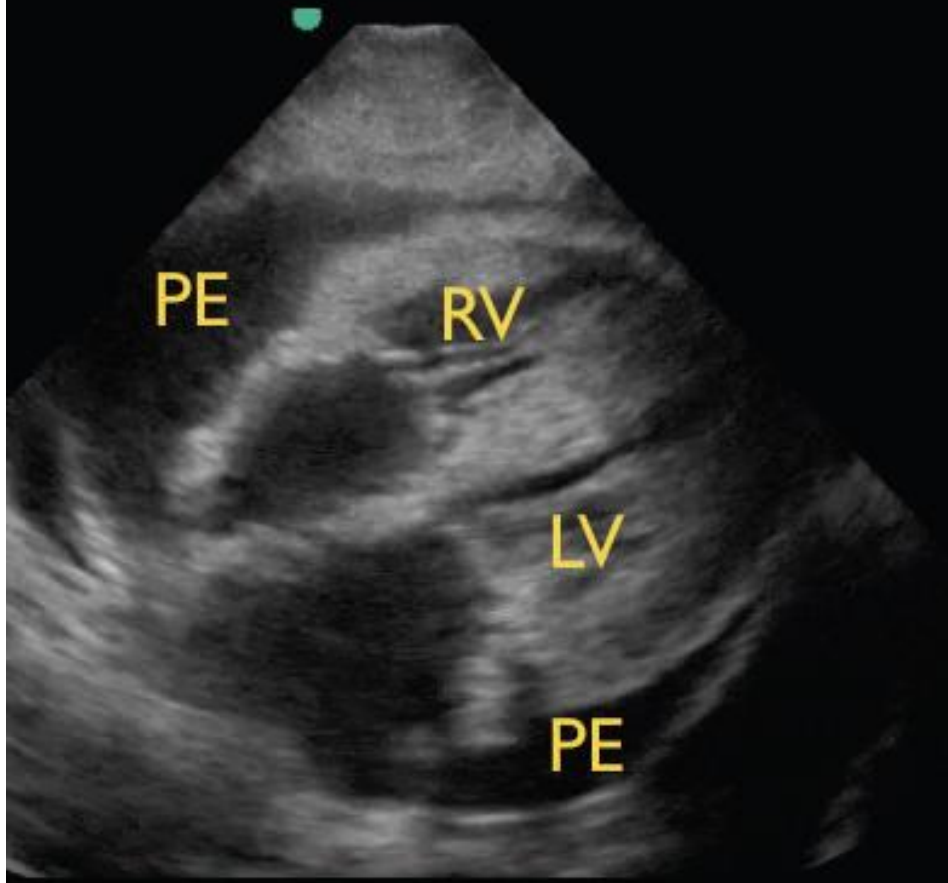
1. Parasternal Long Cardiac View
2. Apical Four-Chamber Cardiac View
3. Inferior Vena Cava View
4. Morison's with Hemothorax View
5. Splenorenal with Hemothorax View
6. Bladder View
7. Aortic Slide Views
8. Pulmonary View
9. Pulmonary View

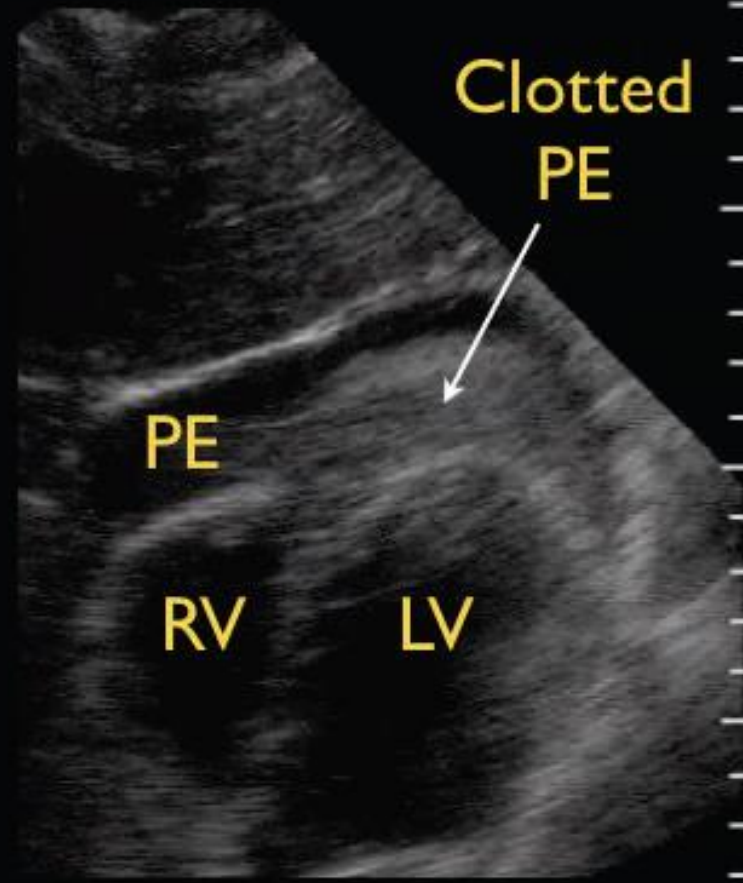
Use Curvilinear Array for all Views
Add in a search for Ectopic Pregnancy and DVT depending on clinical circumstances


Depth: 13.0 cm
183
HR
77 BPM
7/8/98 12:34:30 pm
51/51 fps
ECG

Heart 1

- **Pericardial effusion (tamponade)**





Tamponade: compression of the RV (Singh S et al
Sens 92%, Spec 100%, PPV 100%)

Cardiac tamponade

- Dependent on the rate of fluid accumulation within the pericardial sac

- Findings:
  1. RA collapse during ventricular systole
  2. RV diastolic collapse
  3. Lack of respiratory variation in the IVC and hepatic vein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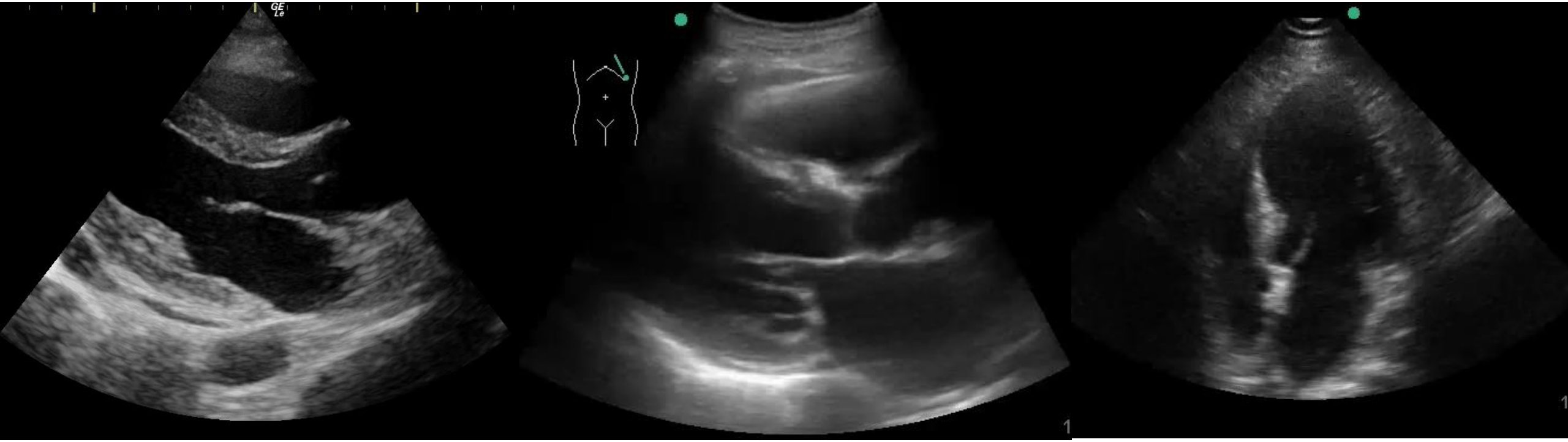
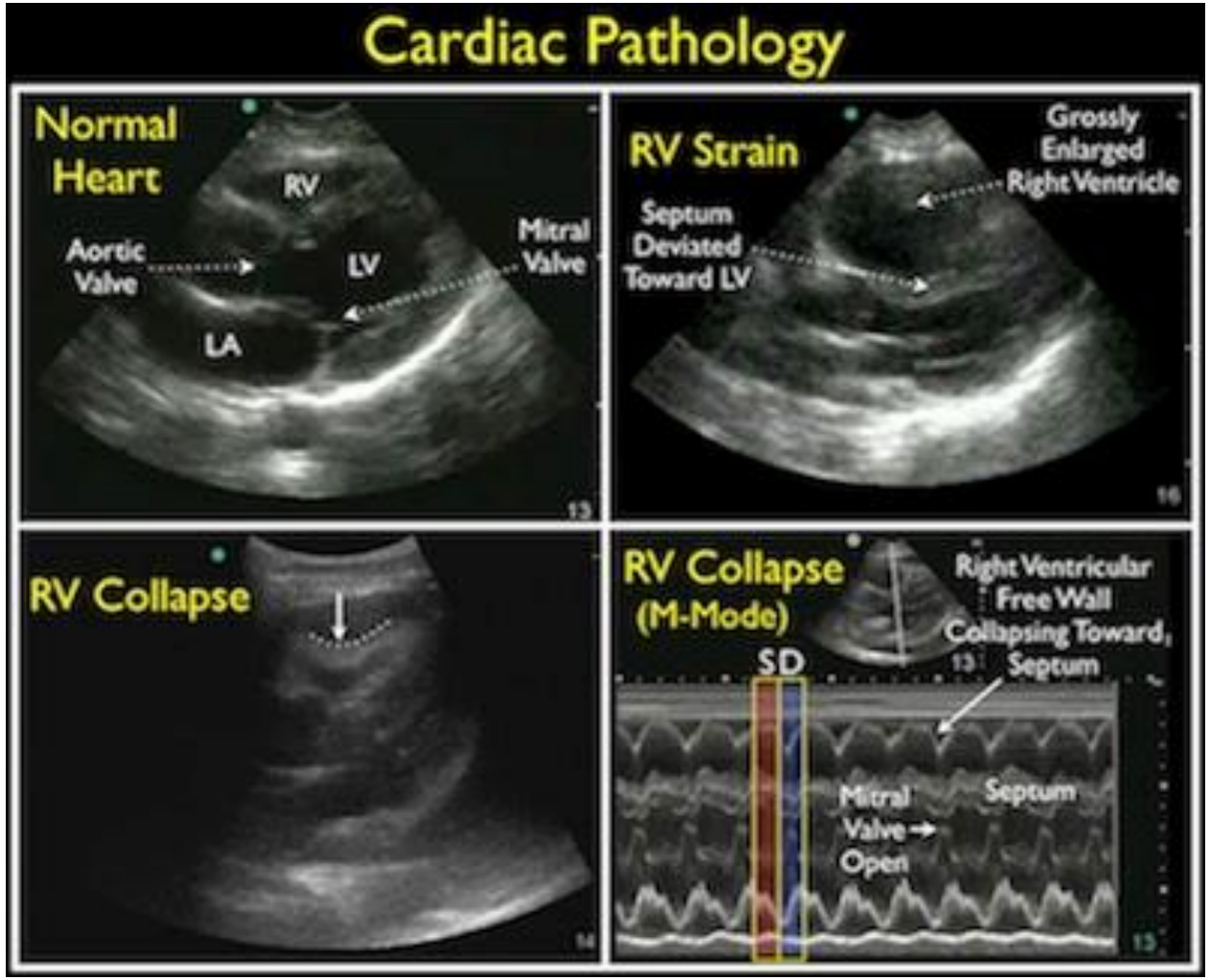
Heart 2

- **LV function**
  - <30% difference of LV size→ severely decreased LV function



Heart 3

- **RV function**
  - Normally RV should be 60% of LV size (If RV = LV size, this is abnormal)
  - Lodato JC et al: If McConnell Sign (reduction in RV free wall motility with sparing of the apex) is present, specificity for PE is 96%, but sensitivity is 16%.

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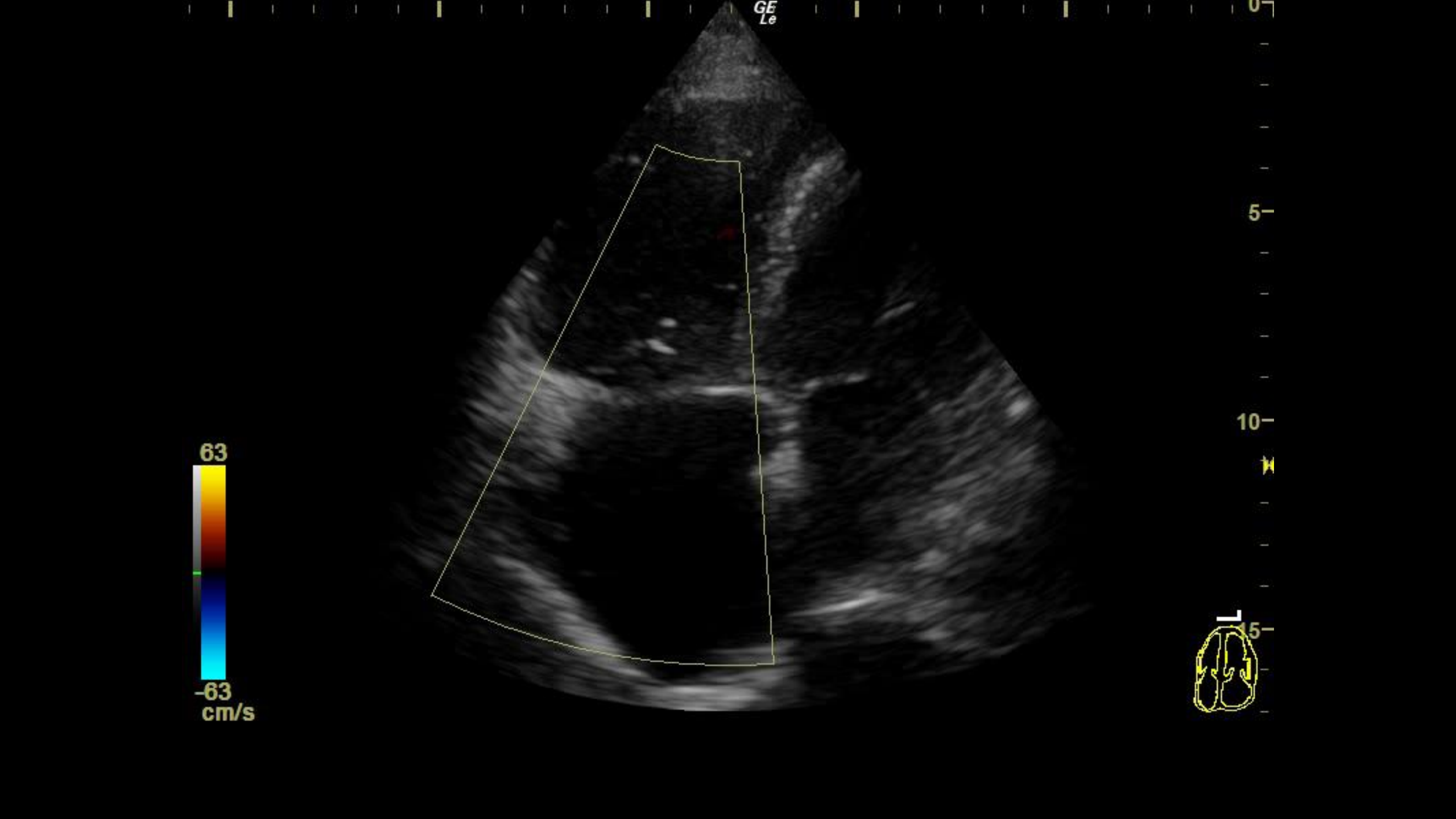
63
-63
cm/s
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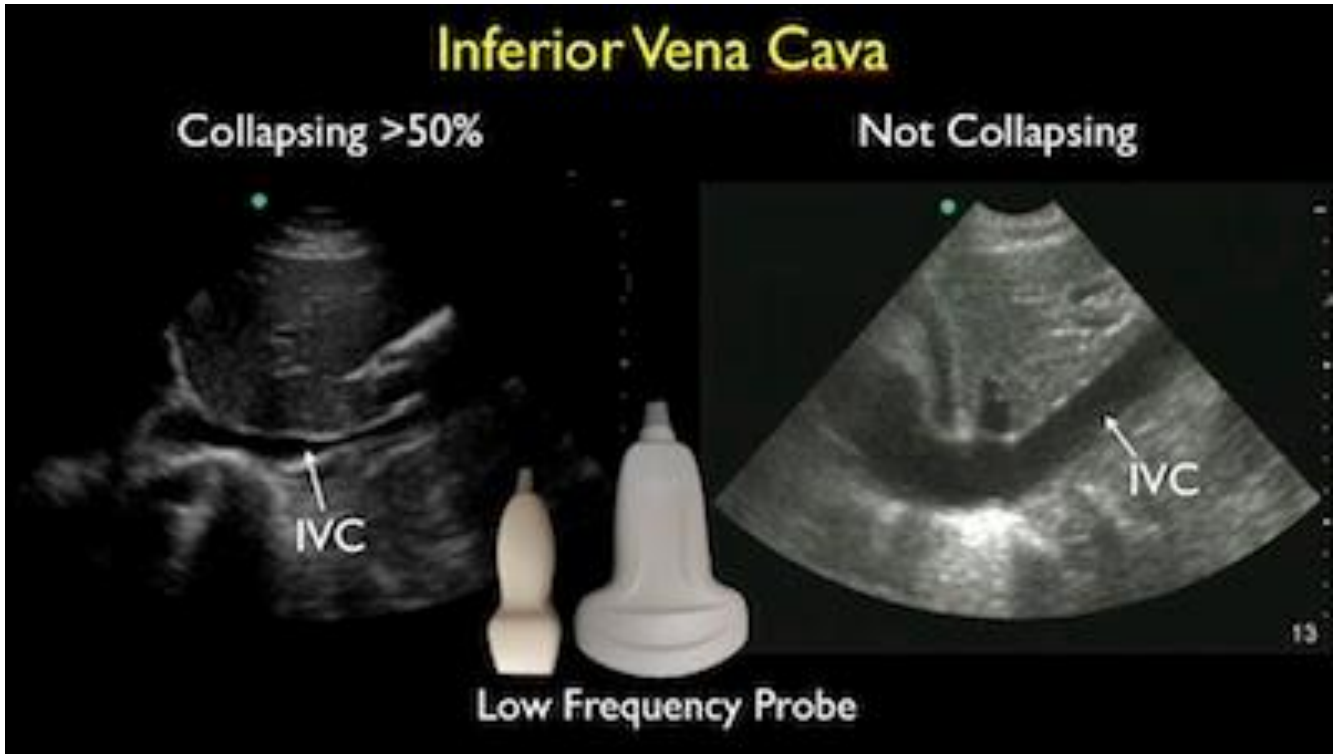
26 F, sales with SOB and CP

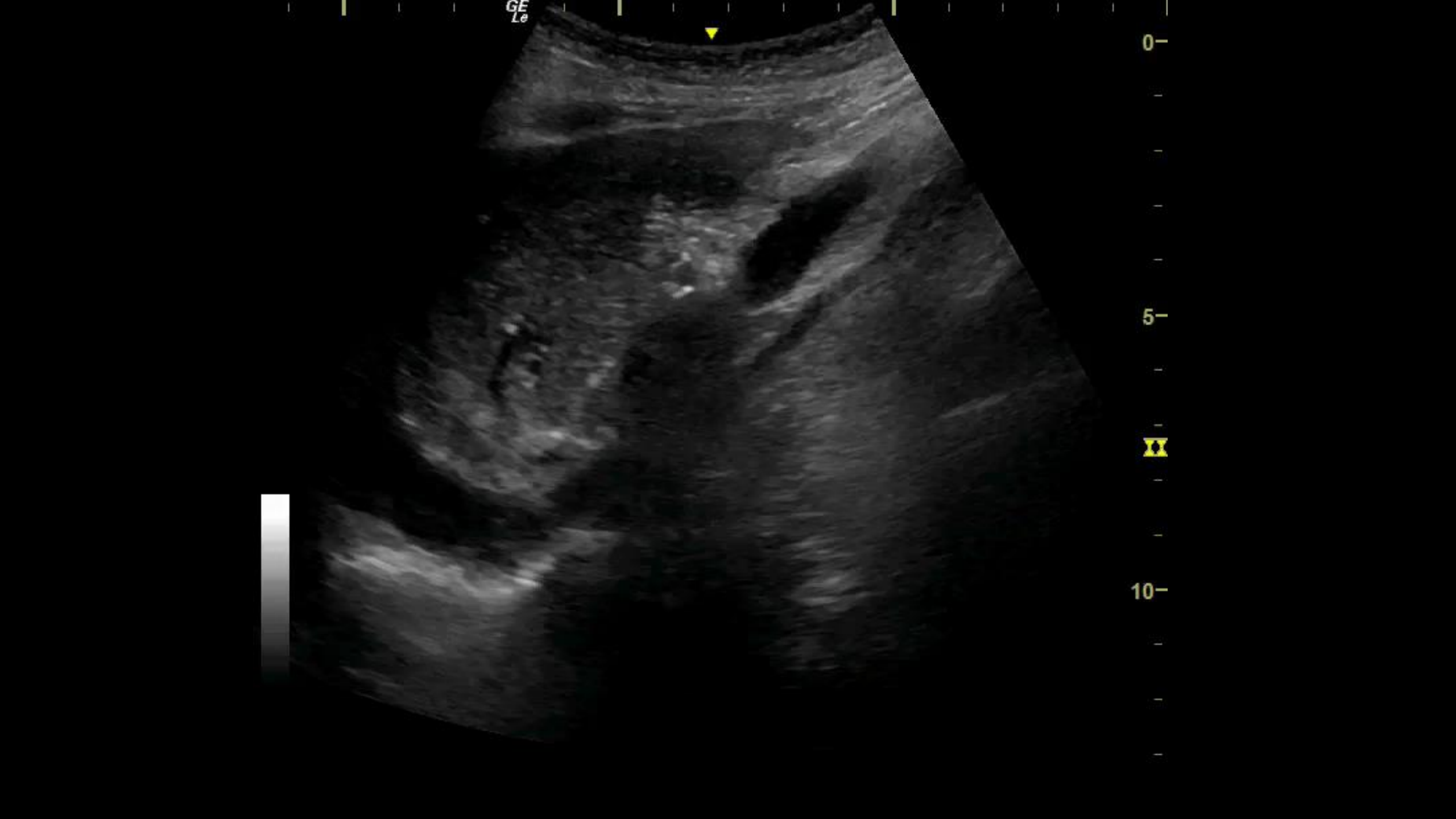
- Meds: OCPs
- SH: Heavy tobacco use
- HR: 148 BP: 60/38 RR: 38
- Lungs: silent
- Cardiac: Sinus tachycardia, no murmurs


1
19

IVC

- < 1.5 cm + complete inspiratory collapse → volume deficit
- > 2.5 cm + no/poor collapse → e.g.: fluid overload or RV failure → look for DVT

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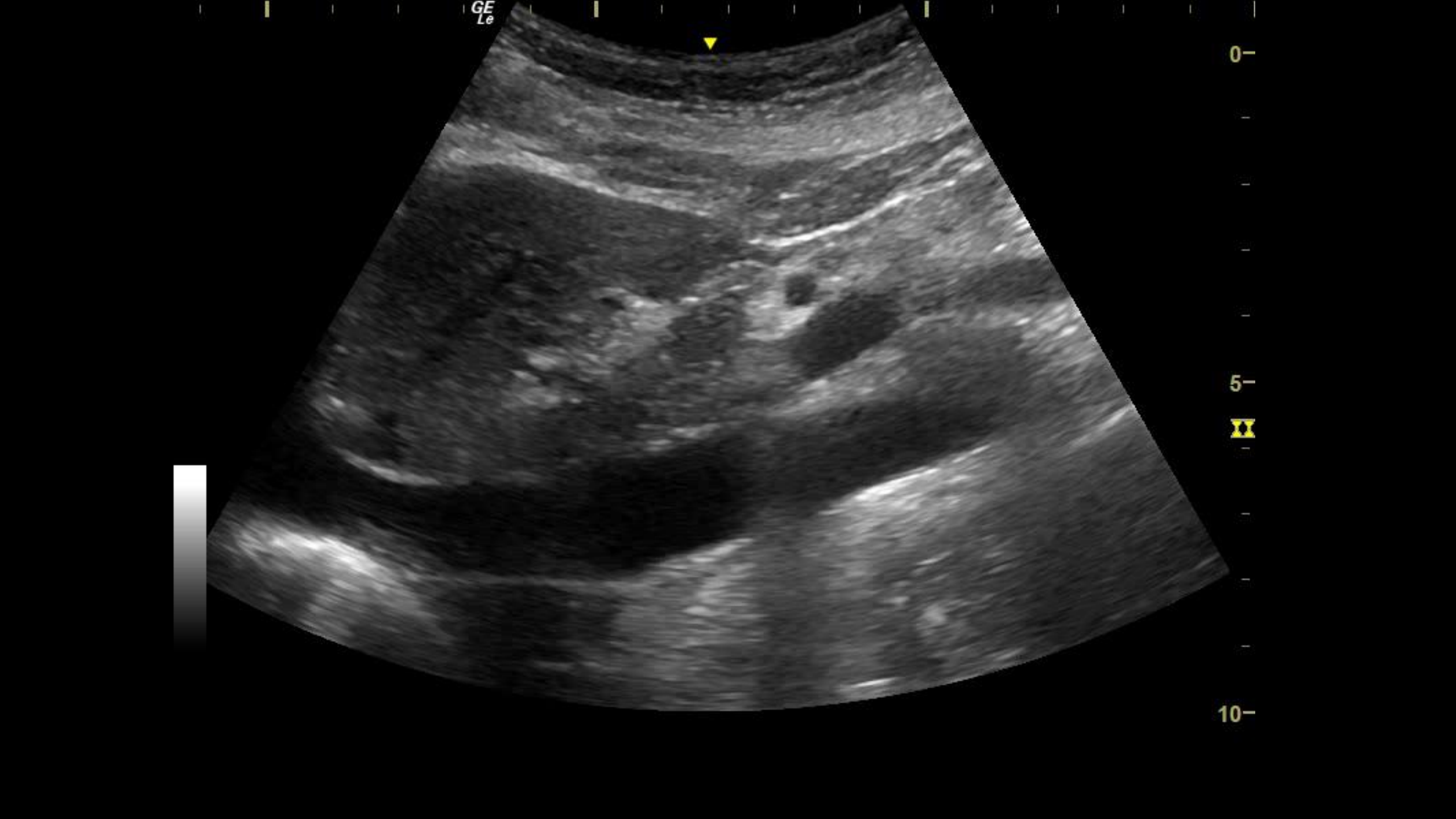
Abd
C60
47%
MI
0.6
TIS
0.1
A
18
Gen
0
Guide
MB On
THI
On
Page 1/2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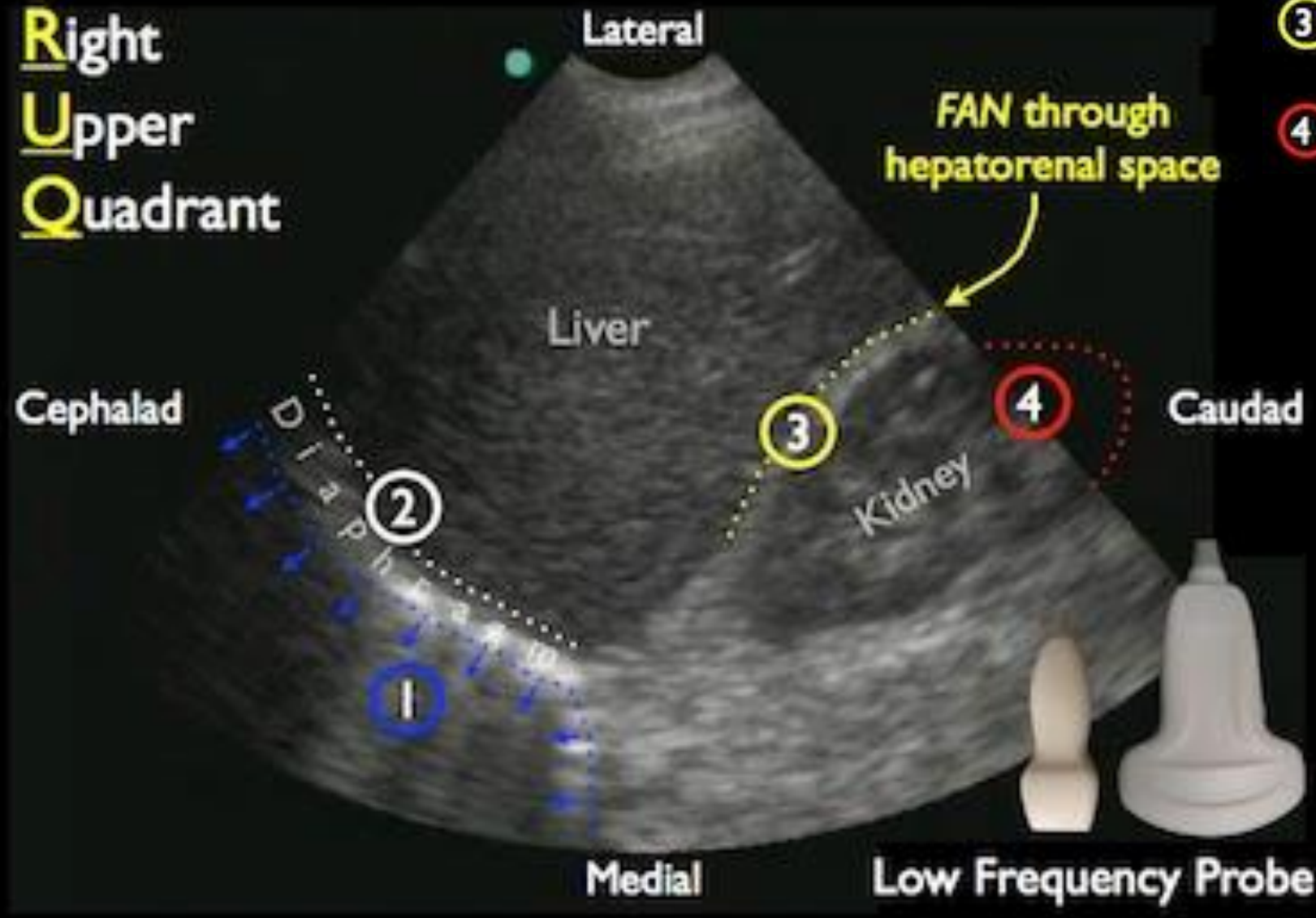
69 M, TIPS 3 months ago, waiting for liver transplant

- During the day fever, shivers, general malaise, dyspnea
- Obtunded, RR 30/min, Sat 88%, BP 90/65, HR 110
- Distended aching abdomen, severely edematous

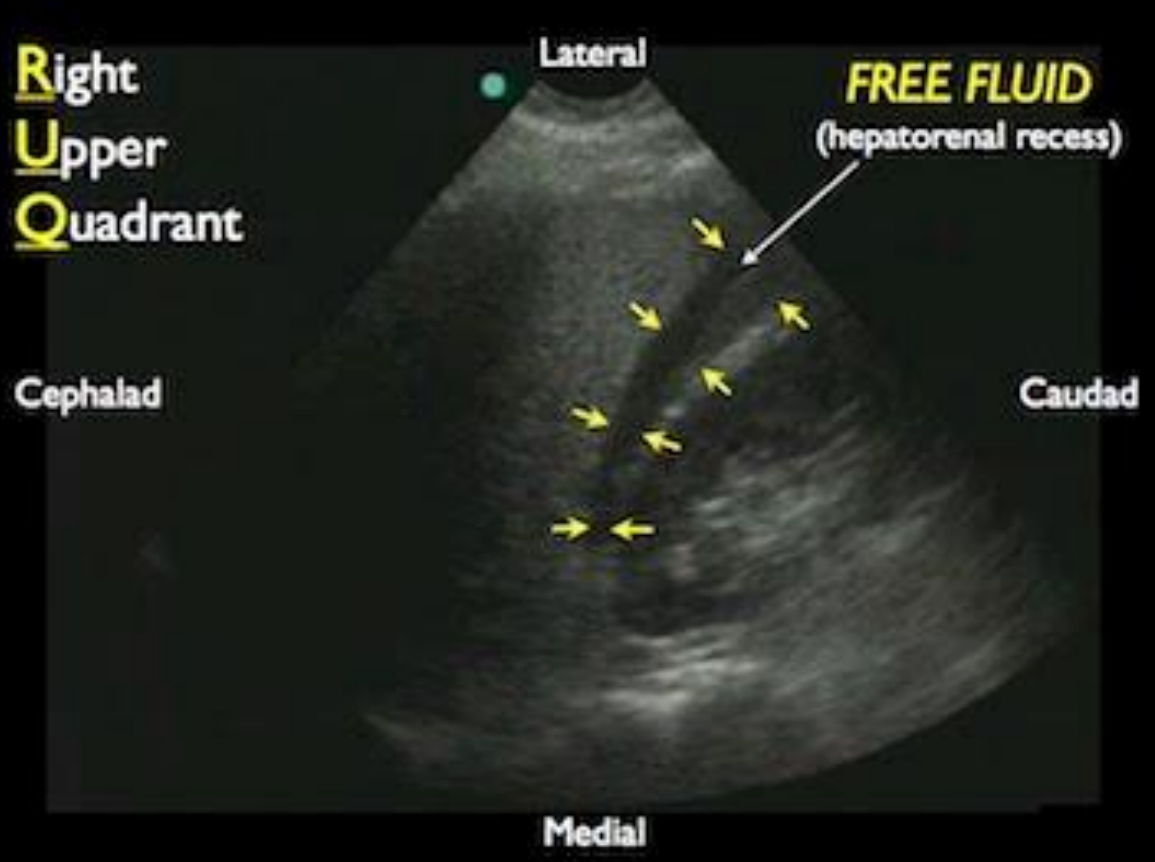
- O2-IV-Monitor
- HIMAP
  - Hyper-dynamic kissing heart
  - Narrow IVC with resp. collapse
  - Massive ascites & right pleural effusion
- Echo guided CVC & A-line insertion, ABG
- Blood lab, lactate, B/C
- Empirical antibiotics
- Ascites tapping, pleural drainage & fluid study

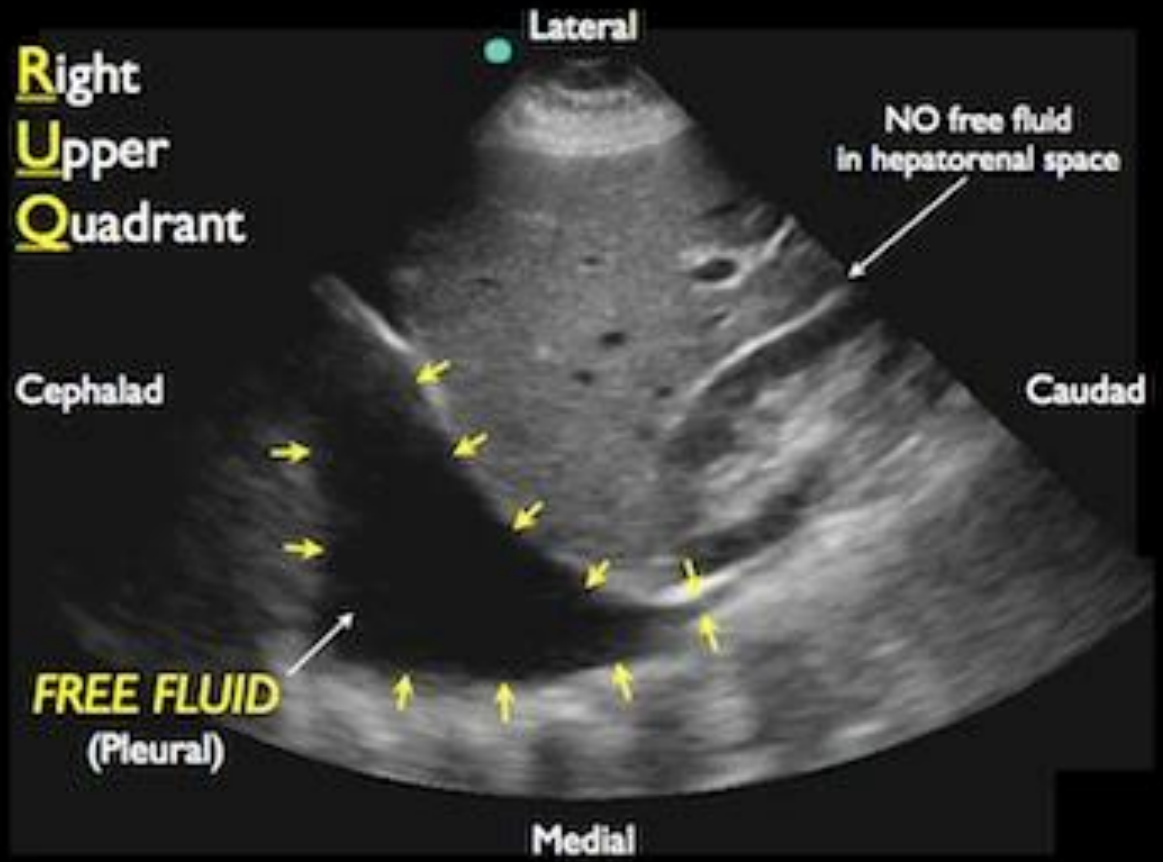
Morison's pouch/FAST abdominal views

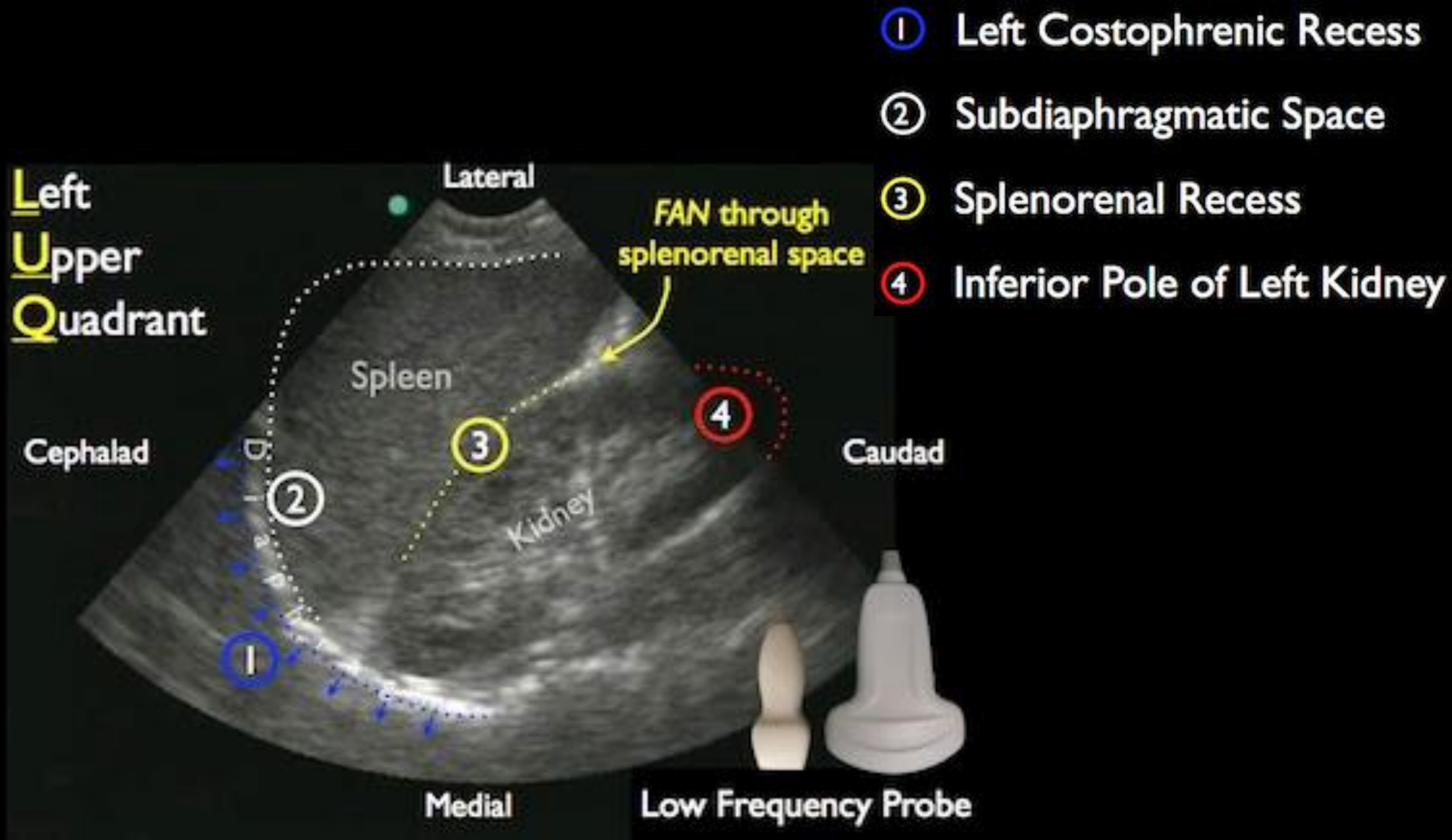
- Location: Hepatorenal recess, Splenorenal recess, and bladder
- **Finding: Internal blood loss**

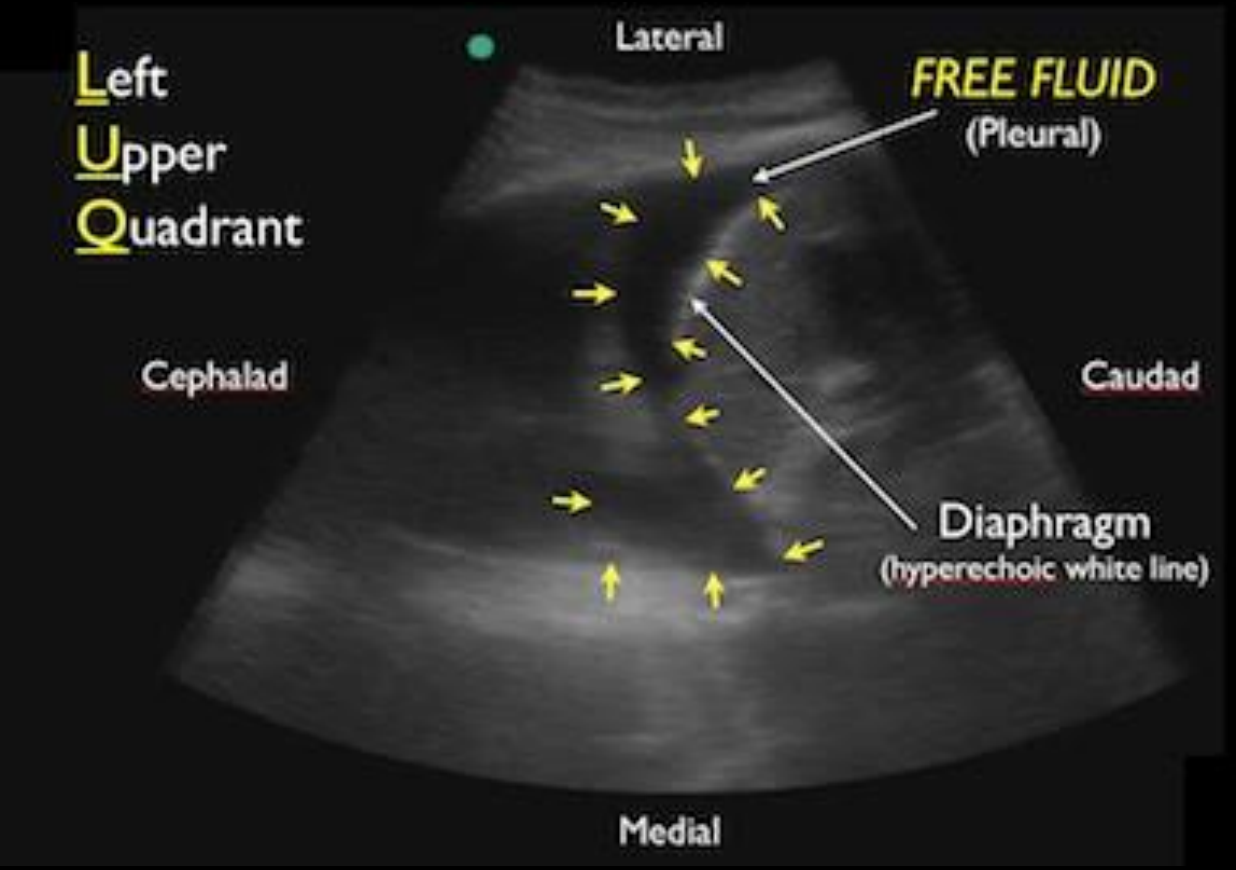


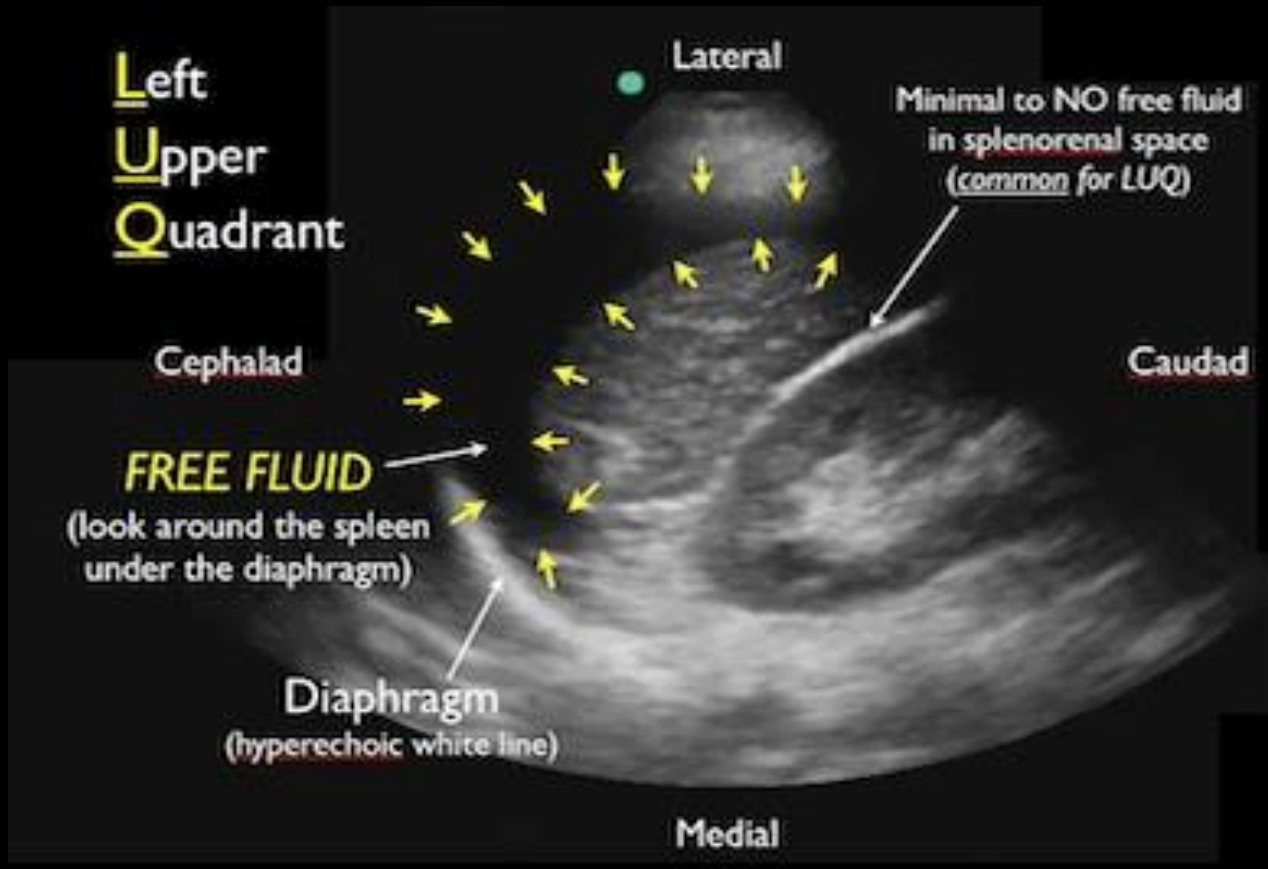
1. Right Costophrenic Recess
2. Subdiaphragmatic Space
3. Hepatorenal Recess
4. Inferior Pole of Right Kidney

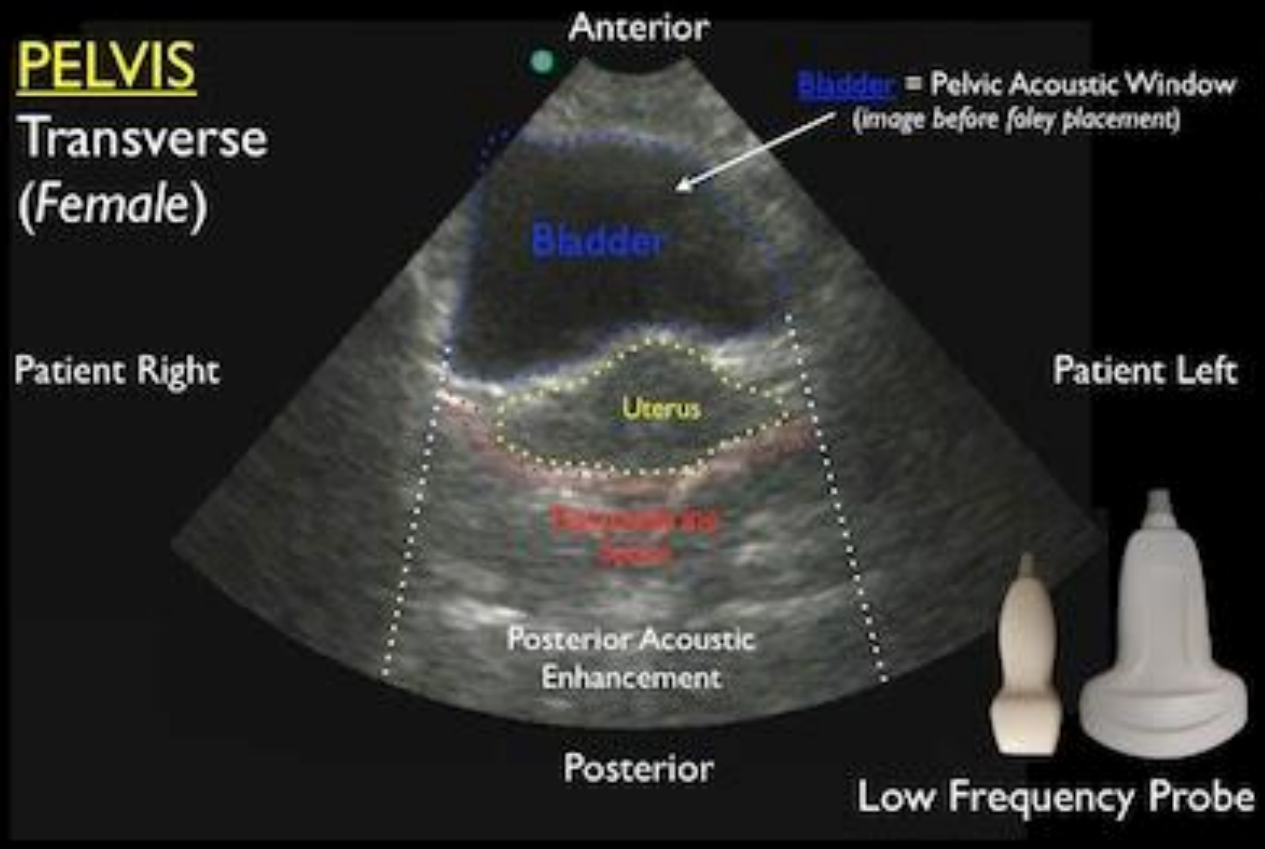

Right
Upper
Quadrant
Lateral
FREE FLUID
(hepatorenal recess)
Cephalad
Caudad
Medial

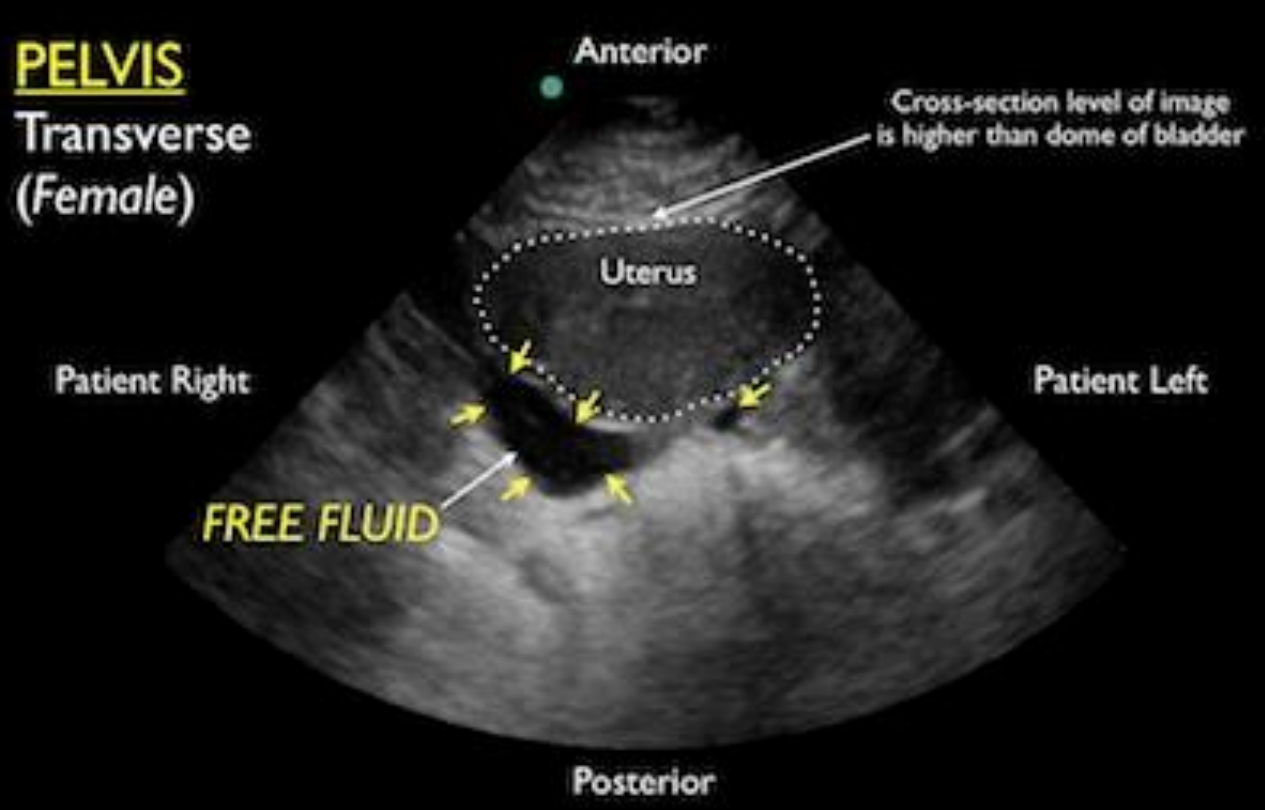

Right
Upper
Quadrant
Lateral
NO free fluid
in hepatorenal space
Cephalad
Caudad
FREE FLUID
(Pleural)
Medial

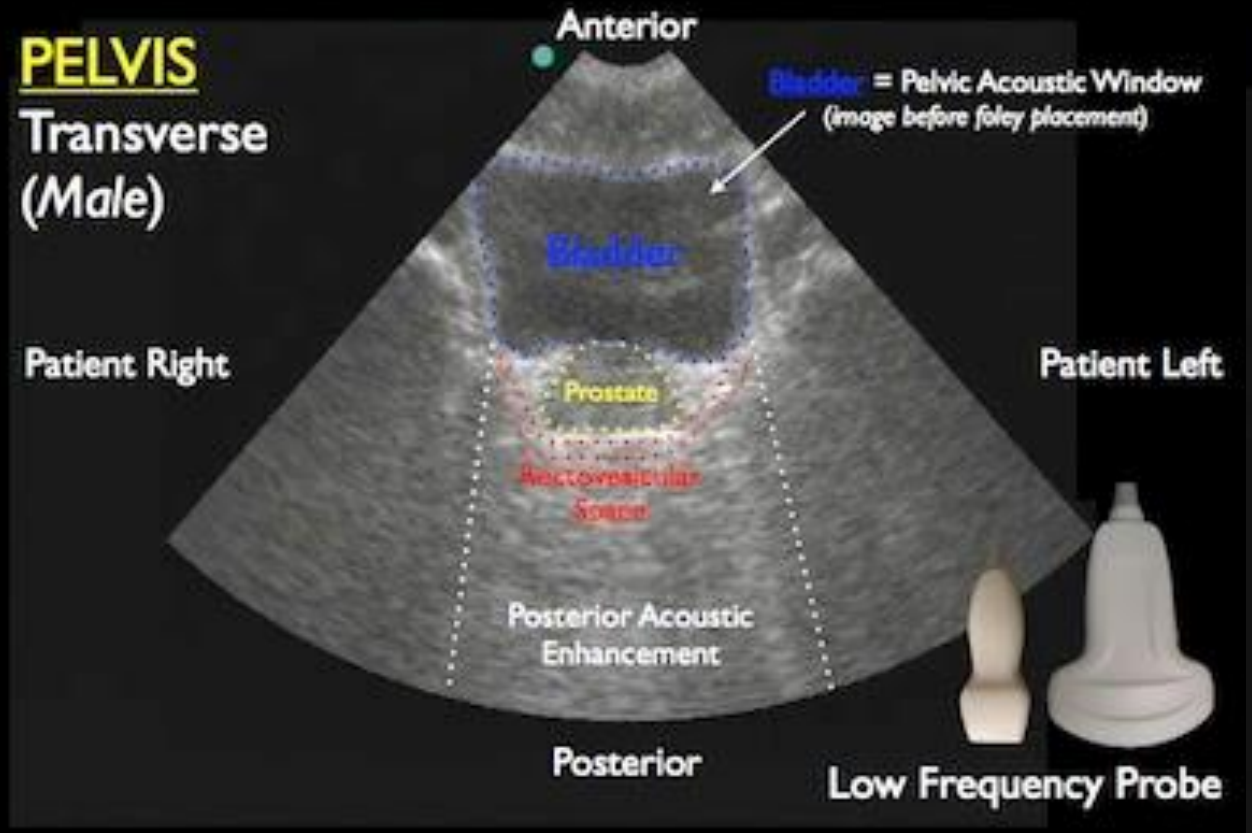

Left
Upper
Quadrant
Lateral
FAN through
splenorenal space
Spleen
Cephalad
Caudad
Kidney
Medial
Low Frequency Probe
1 Left Costophrenic Recess
2 Subdiaphragmatic Space
3 Splenorenal Recess
4 Inferior Pole of Left Kidney

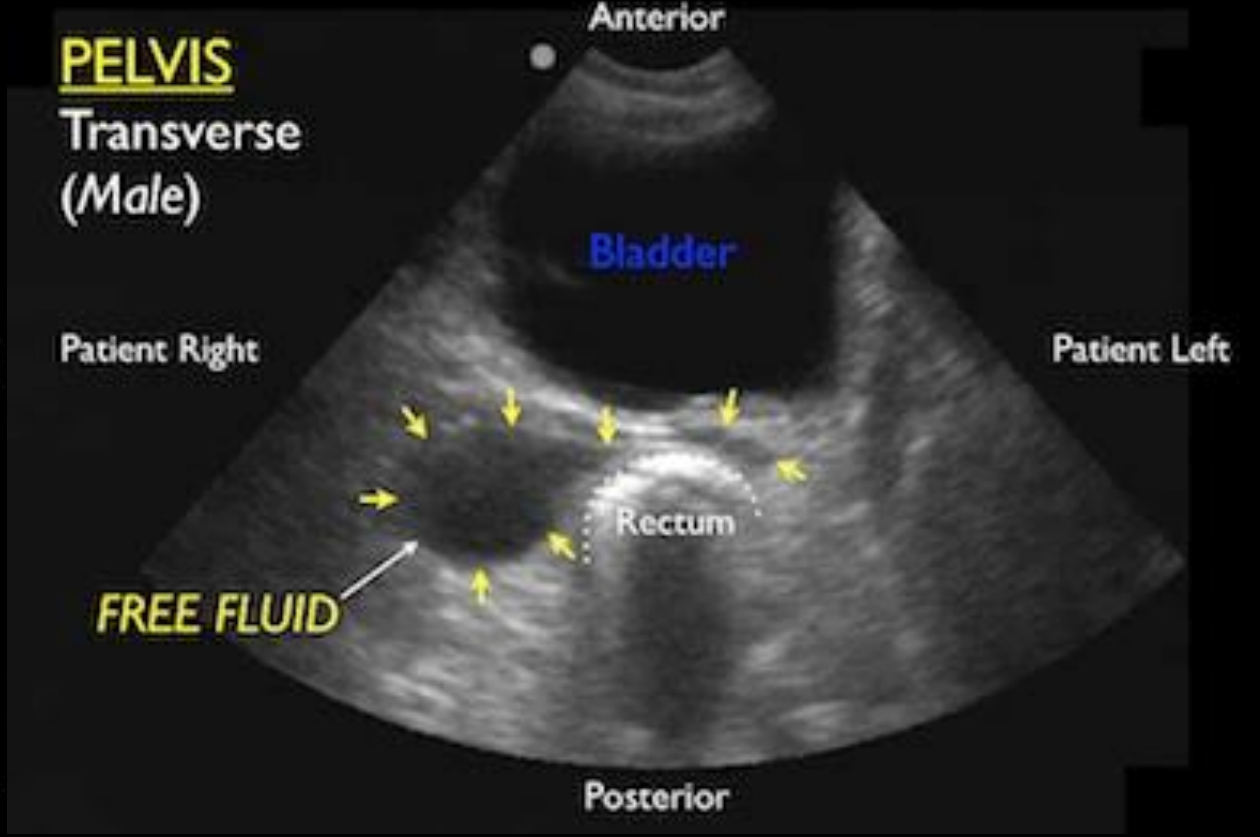

Left
Upper
Quadrant
Lateral
FREE FLUID
(Pleural)
Cephalad
Caudad
Diaphragm
(hyperechoic white line)
Medial

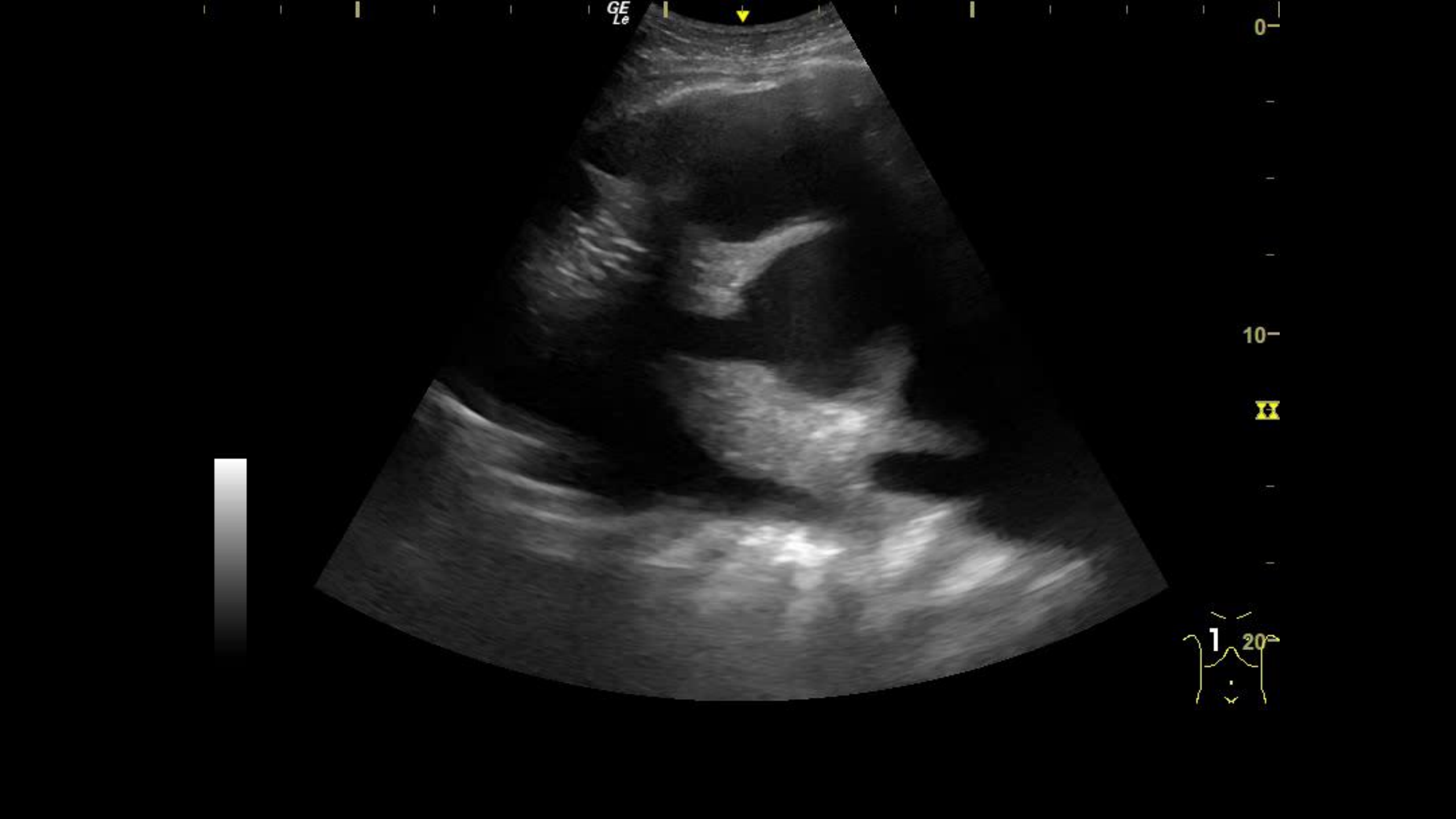

Left
Upper
Quadrant
Lateral
Minimal to NO free fluid
in splenorenal space
(common for LUQ)
Cephalad
Caudad
FREE FLUID
(look around the spleen
under the diaphragm)
Diaphragm
(hyperechoic white line)
Medial


PELVIS
Transverse
(Female)
Anterior
Bladder = Pelvic Acoustic Window
(image before foley placement)
Bladder
Patient Right
Patient Left
Uterus
Posterior Acoustic
Enhancement
Posterior
Low Frequency Probe


PELVIS
Transverse
(Female)
Anterior
Cross-section level of image
is higher than dome of bladder
Uterus
Patient Right
Patient Left
FREE FLUID
Posterior


PELVIS
Transverse
(Male)
Anterior
Bladder = Pelvic Acoustic Window
(image before foley placement)
Bladder
Patient Right
Patient Left
Prostate
Rectovesicular
Space
Posterior Acoustic
Enhancement
Posterior
Low Frequency Probe


PELVIS
Transverse
(Male)
Anterior
Bladder
Patient Right
Patient Left
Rectum
FREE FLUID
Posterior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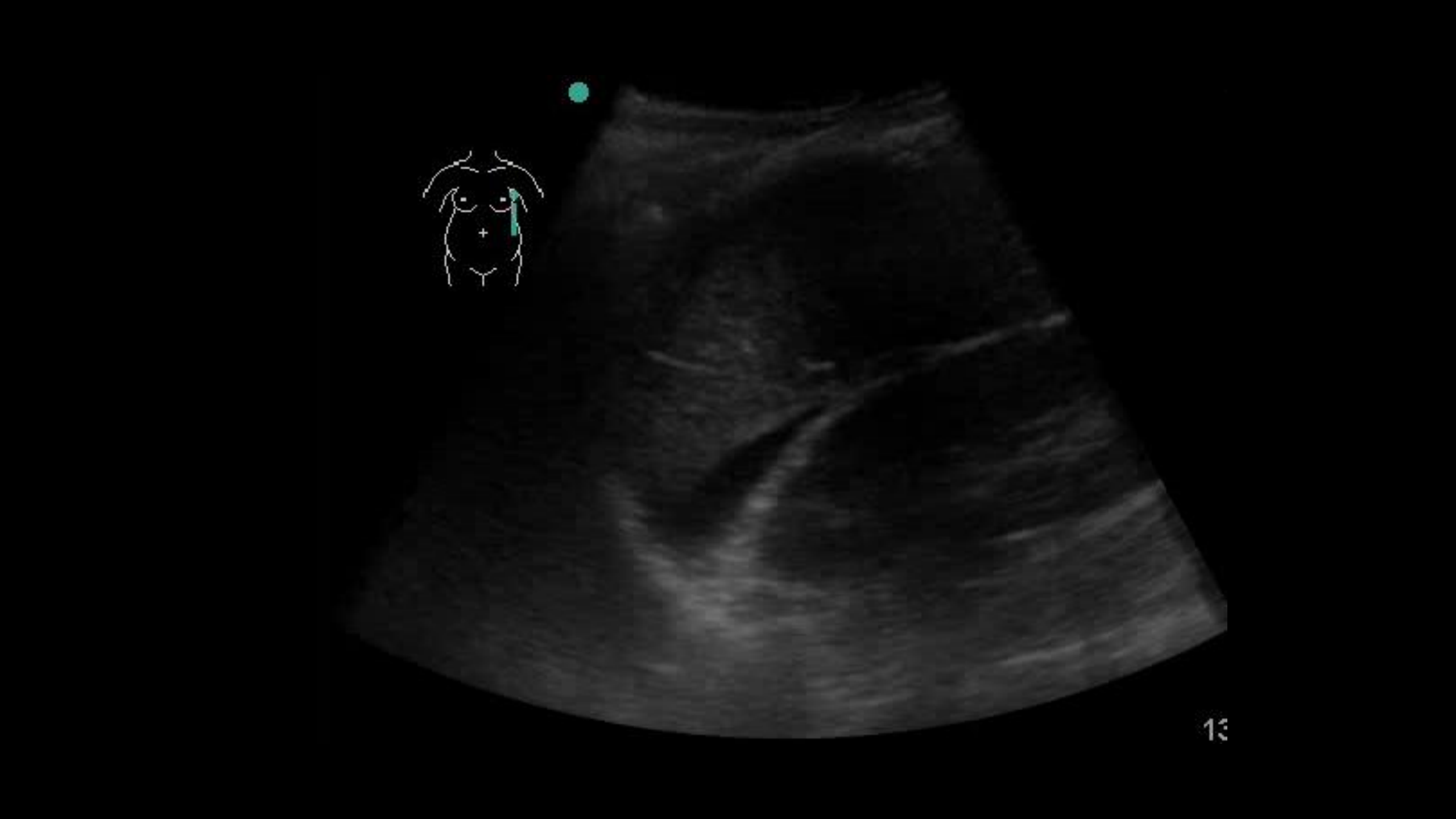

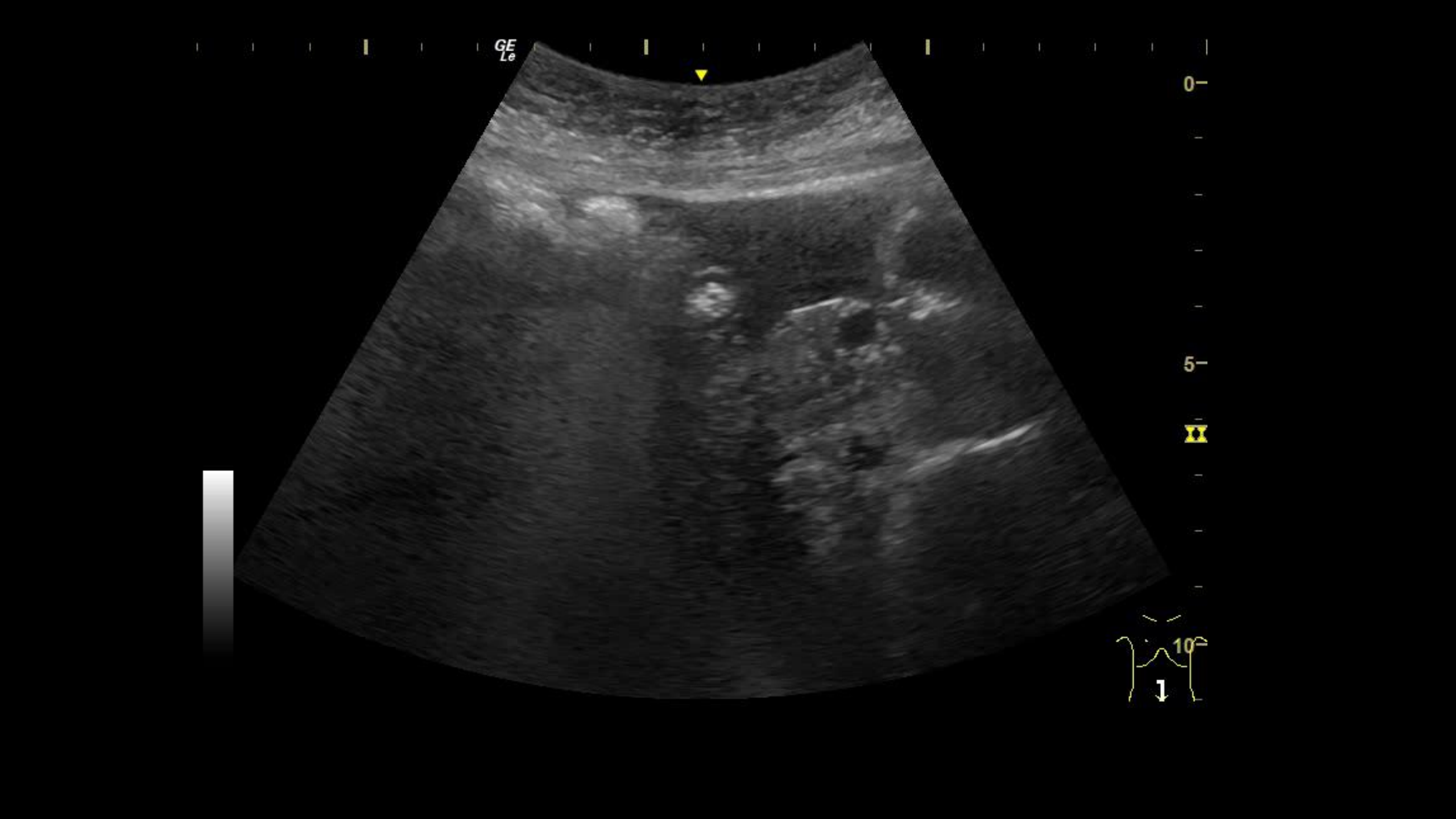
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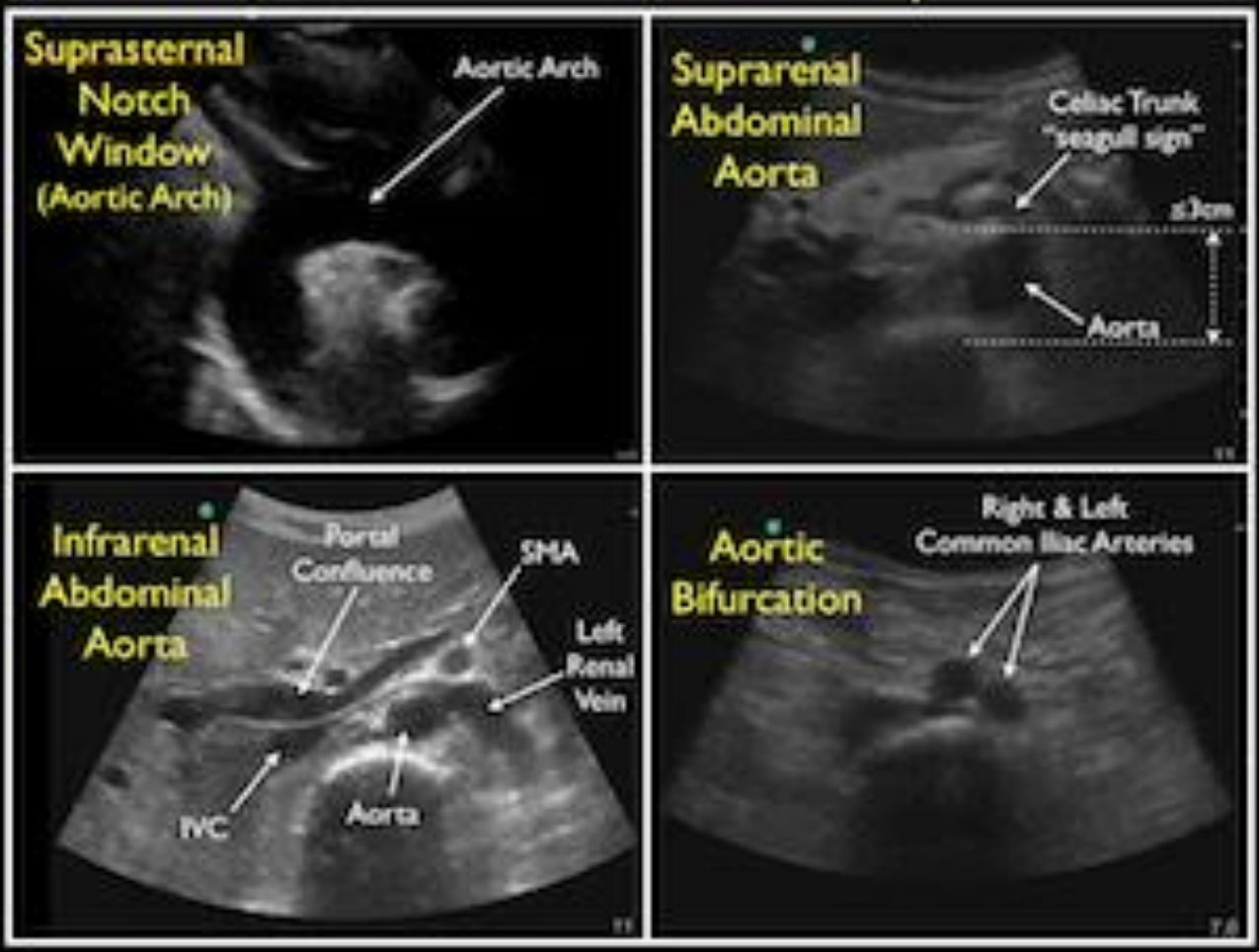
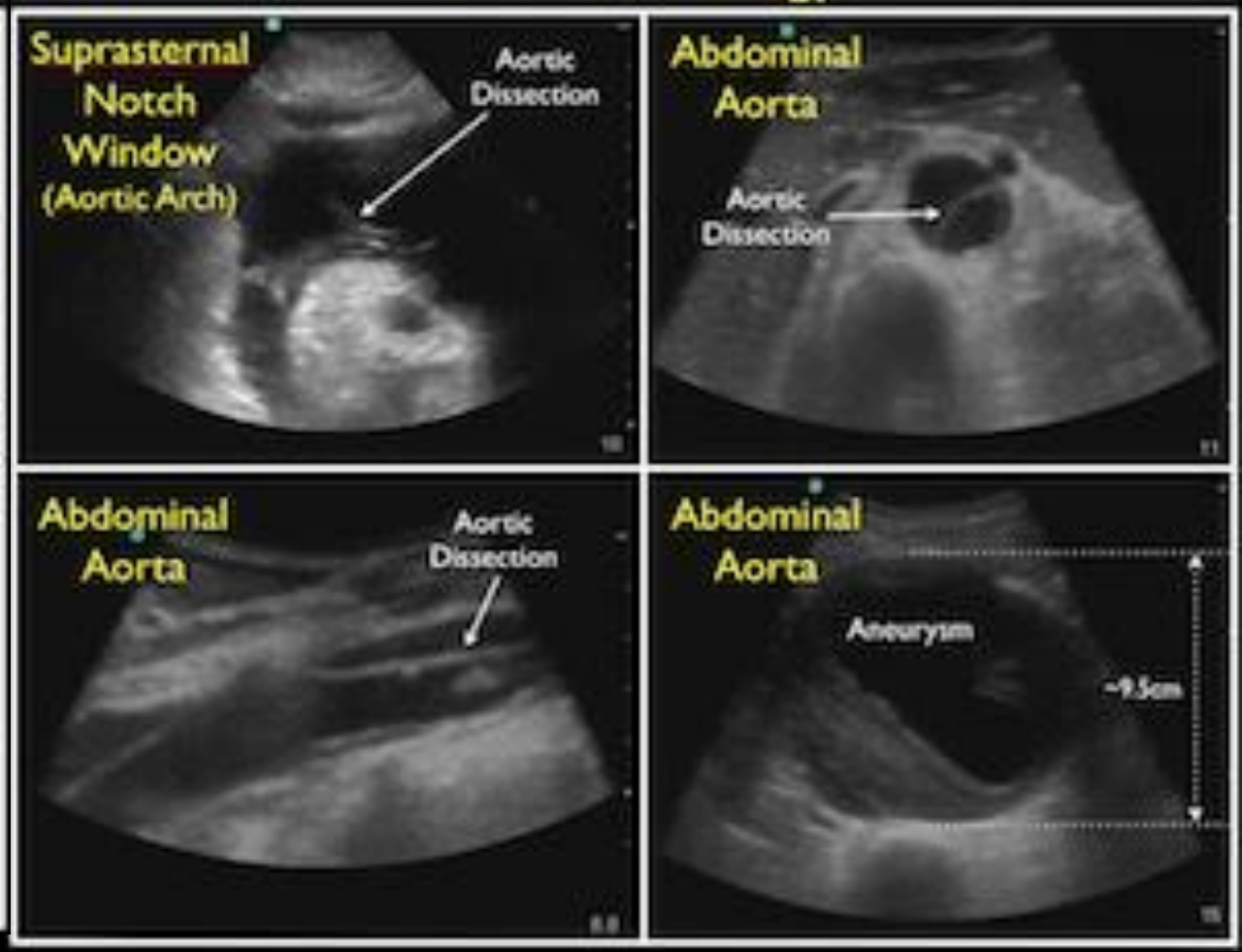
Aorta, Vein

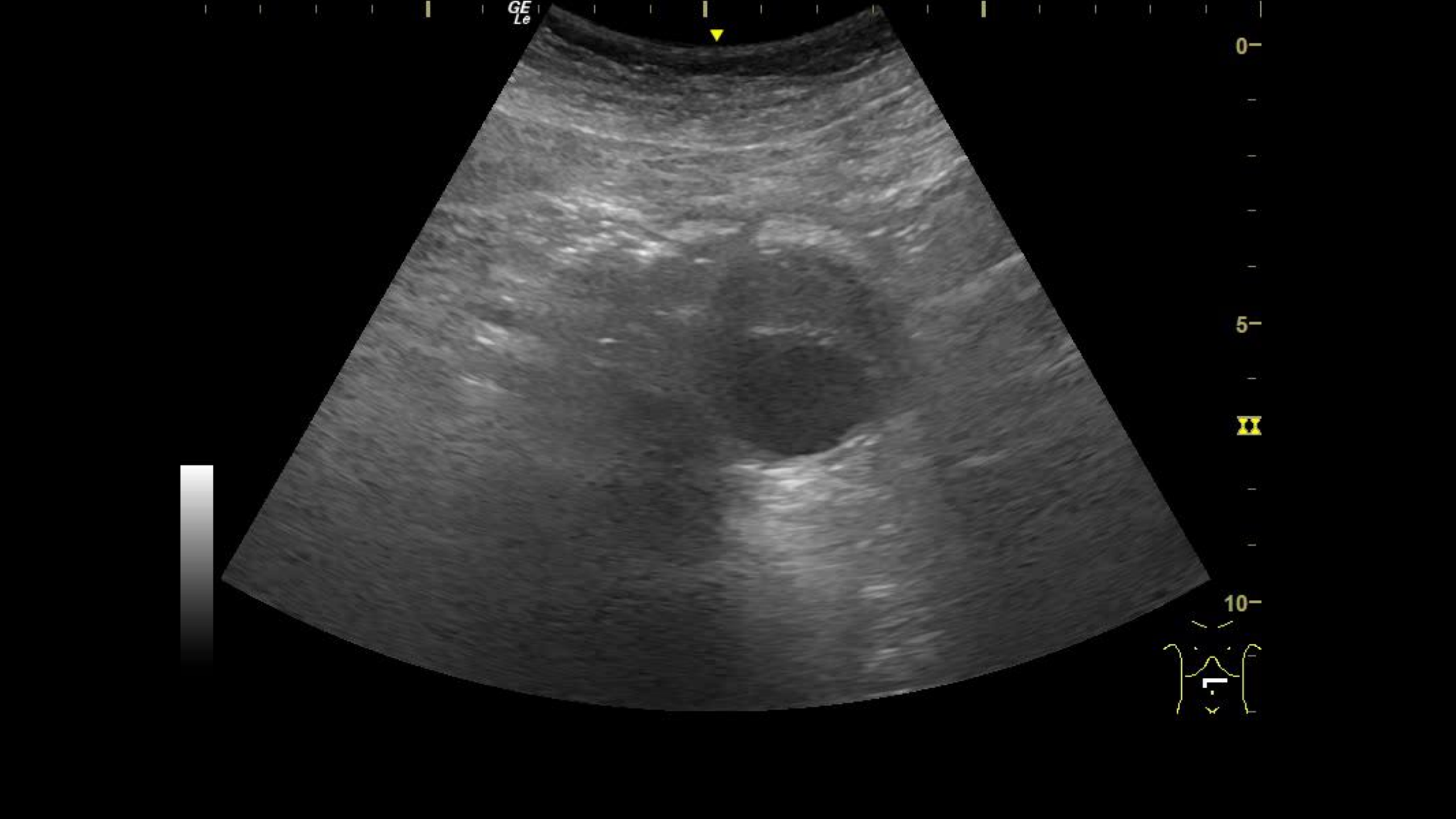
- Location: Longitudinal and transverse views of aorta at 4 levels (infracardiac, suprarenal, infrarenal, and right at the iliac bifurcation)
- Measurement >3 cm is abnormal.
- If >5 cm consider ruptured AAA if no other cause found.
- Most AAAs located below the renal arteries

Normal Aortic Anatomy



Aortic Pathology

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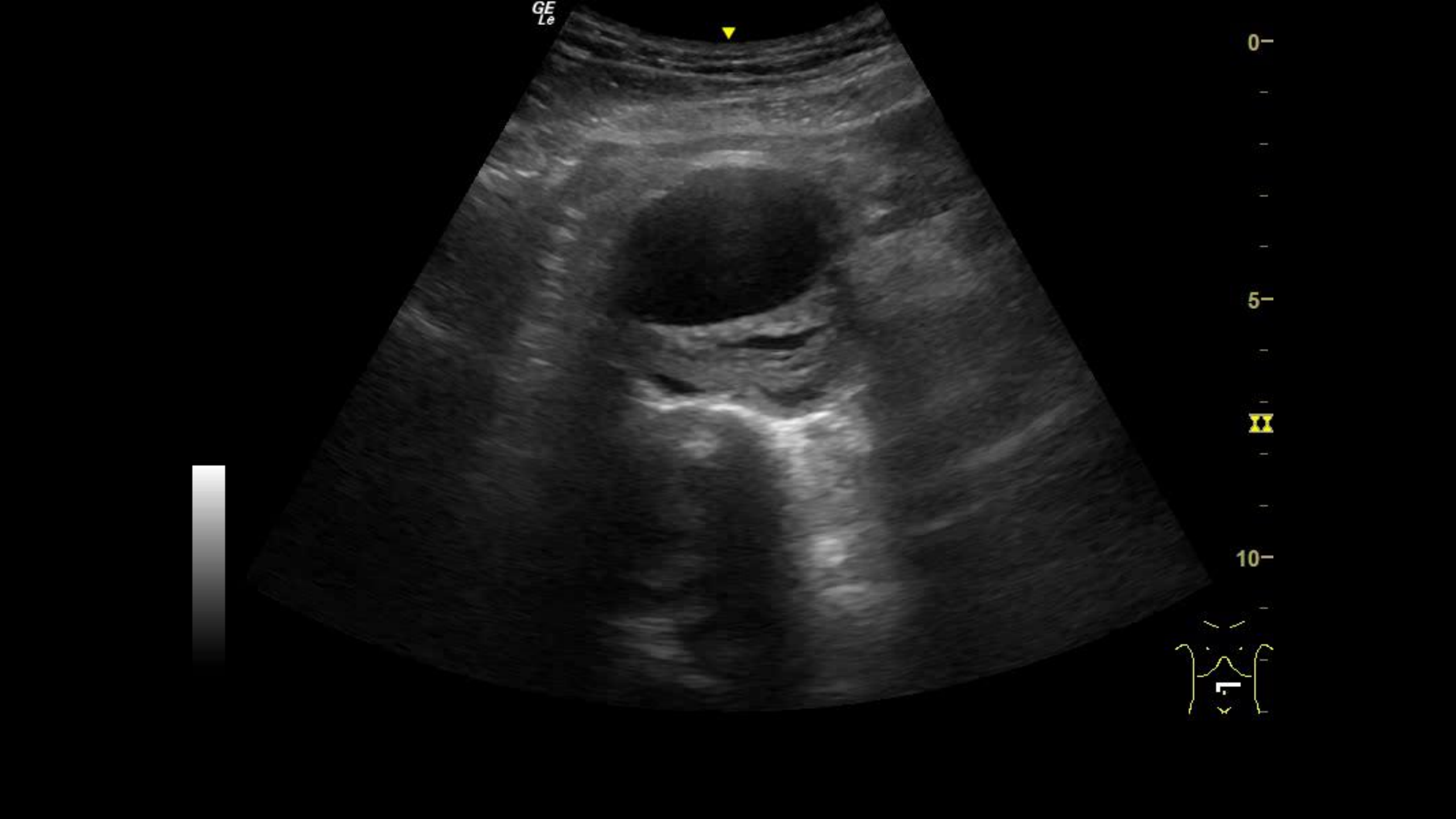
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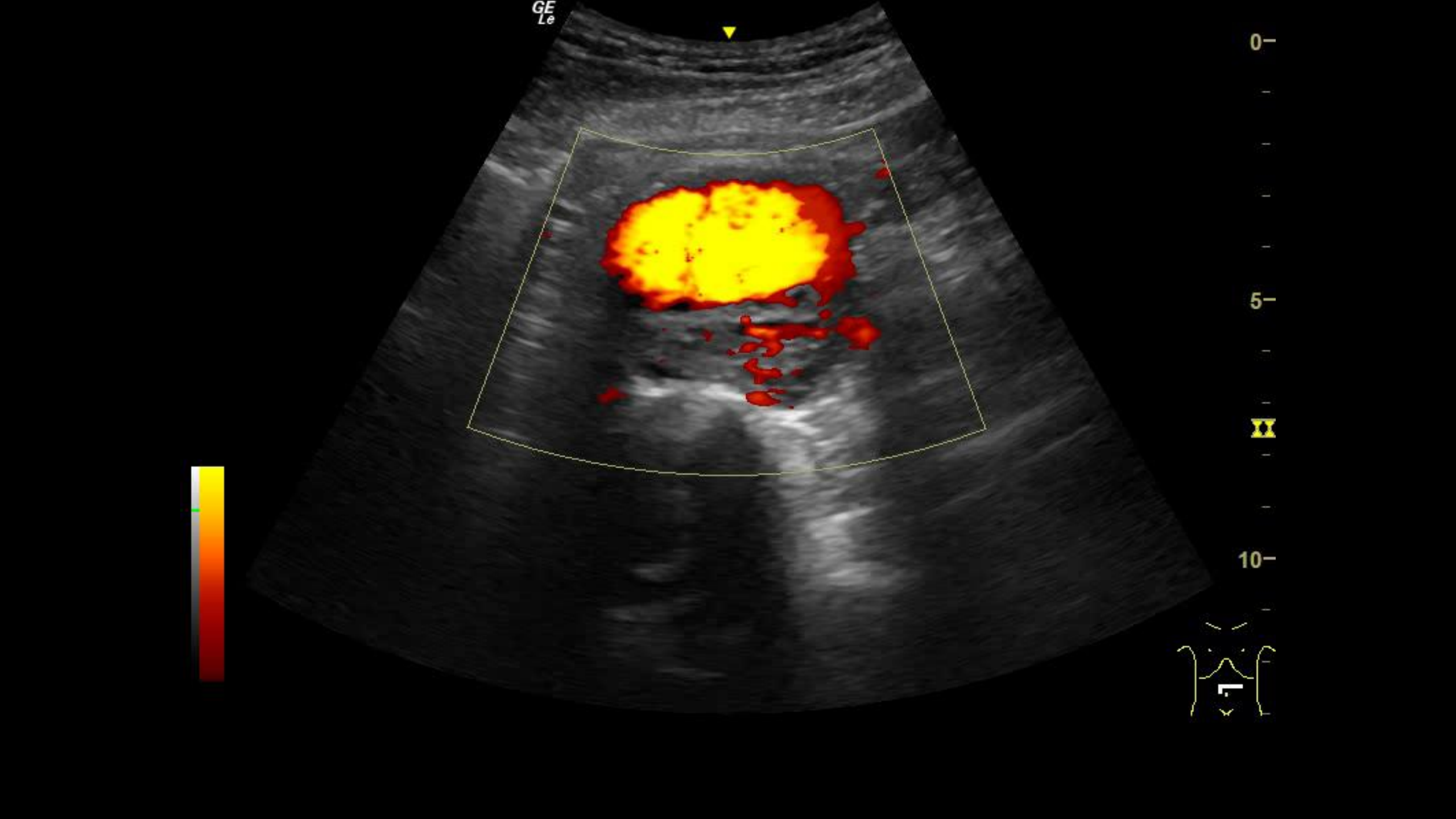
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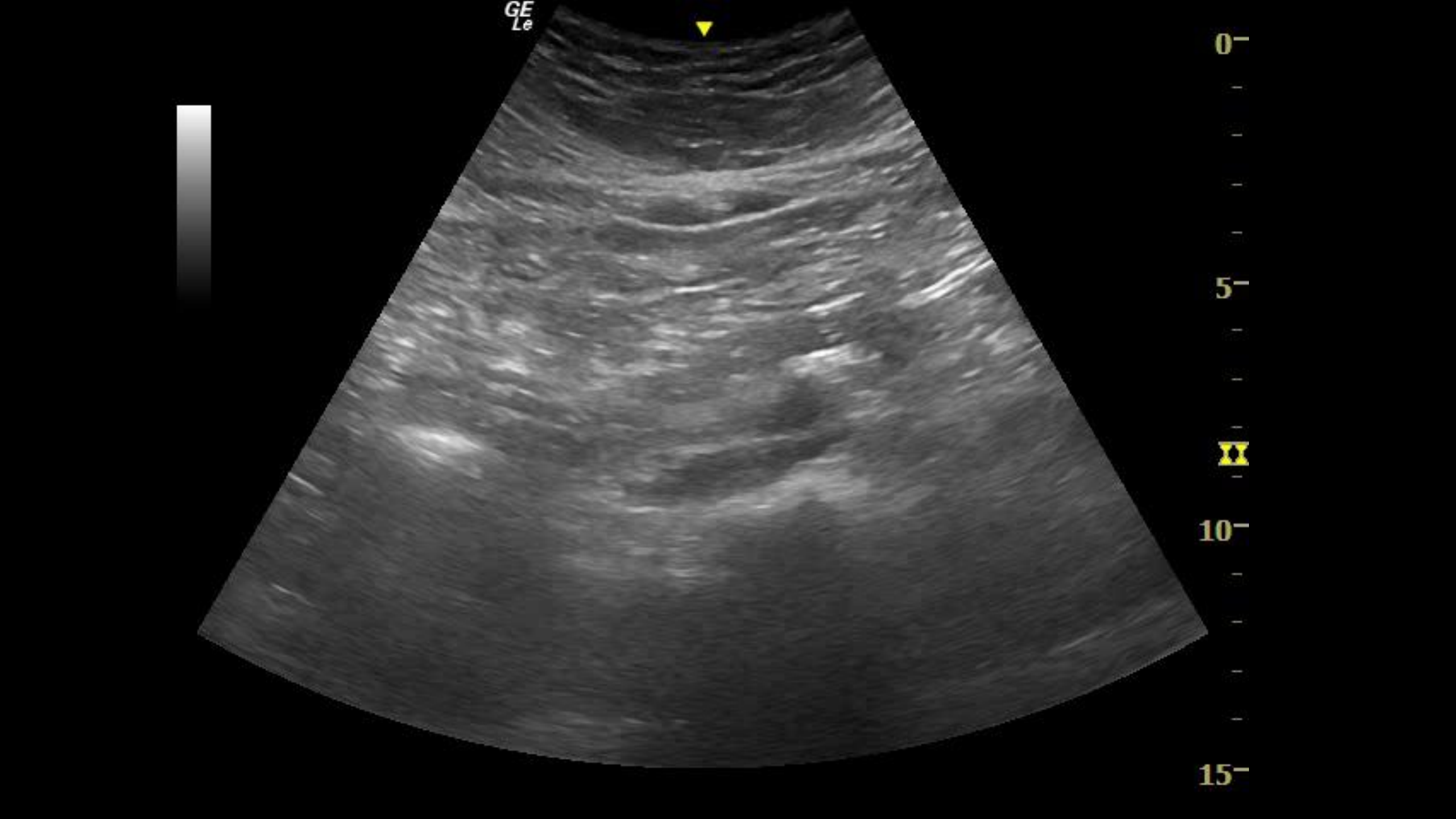
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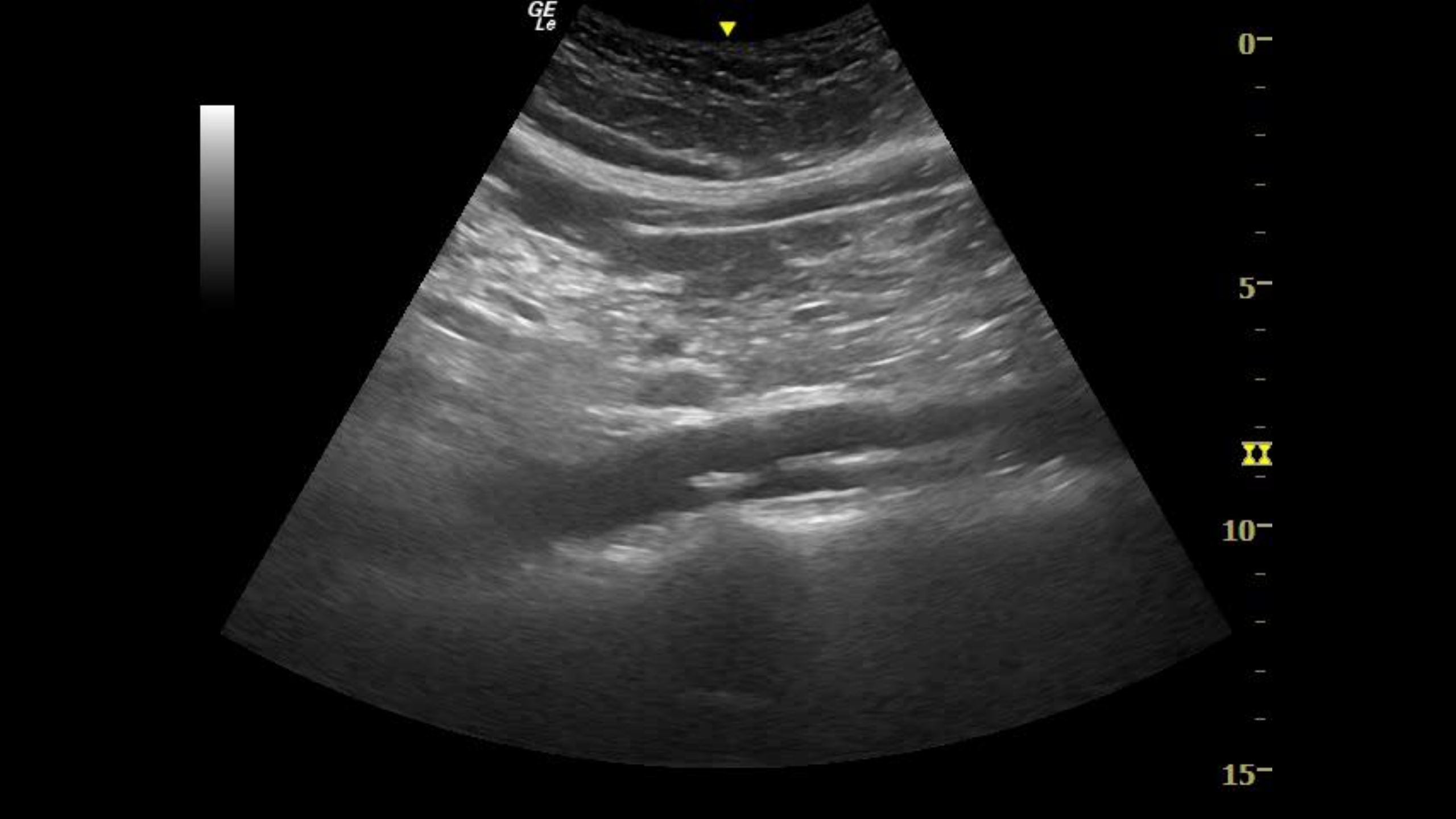
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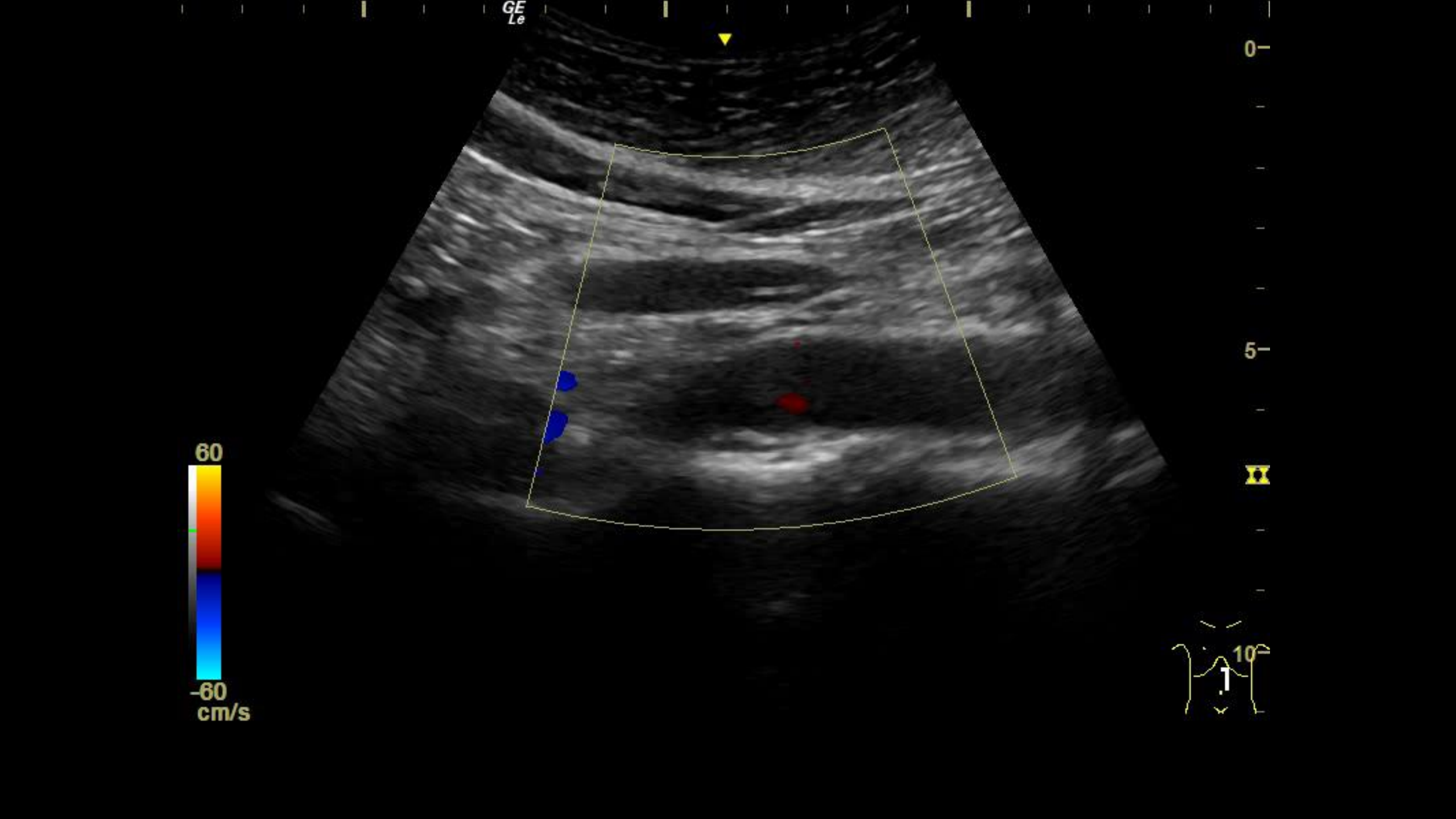
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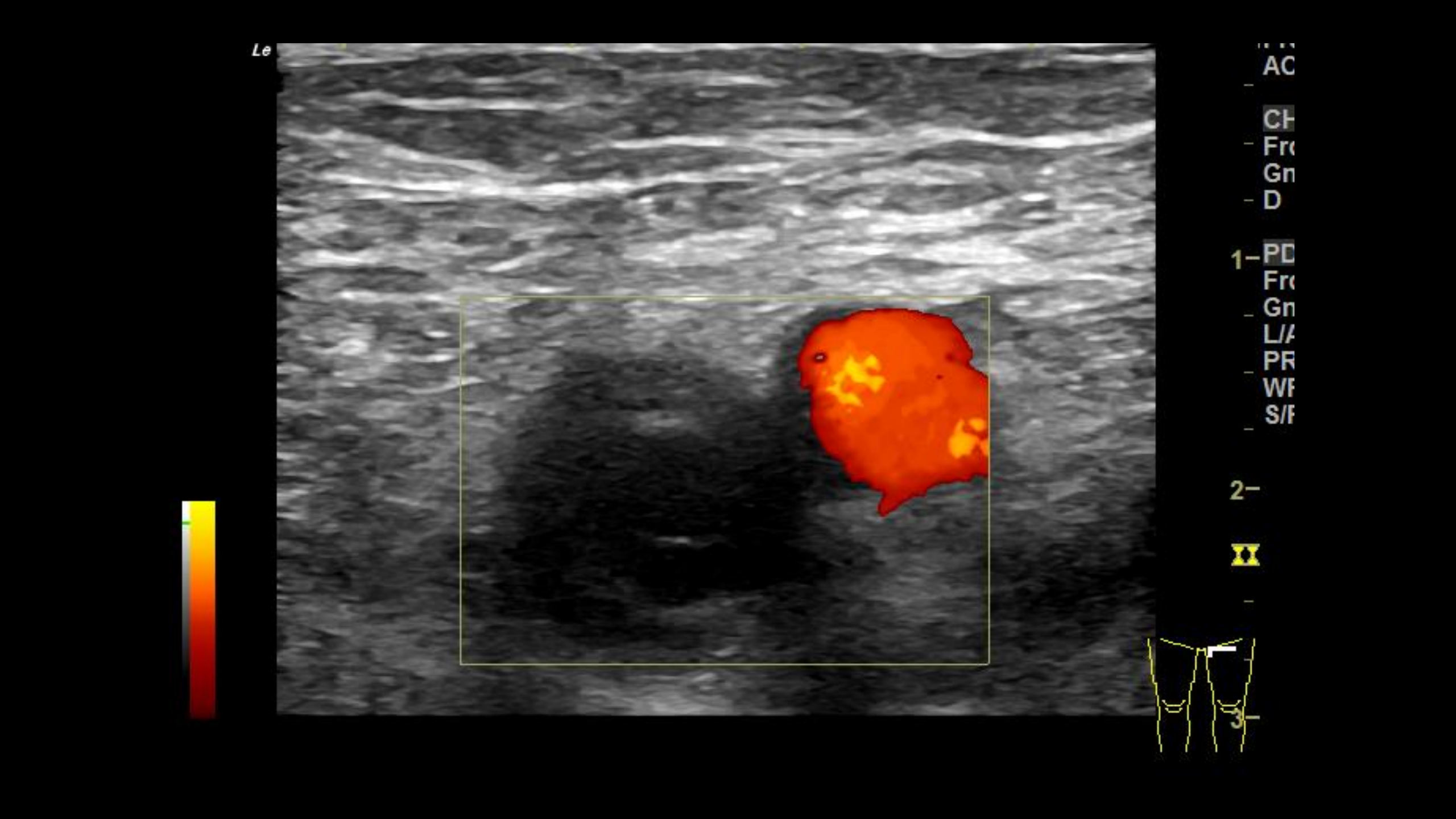
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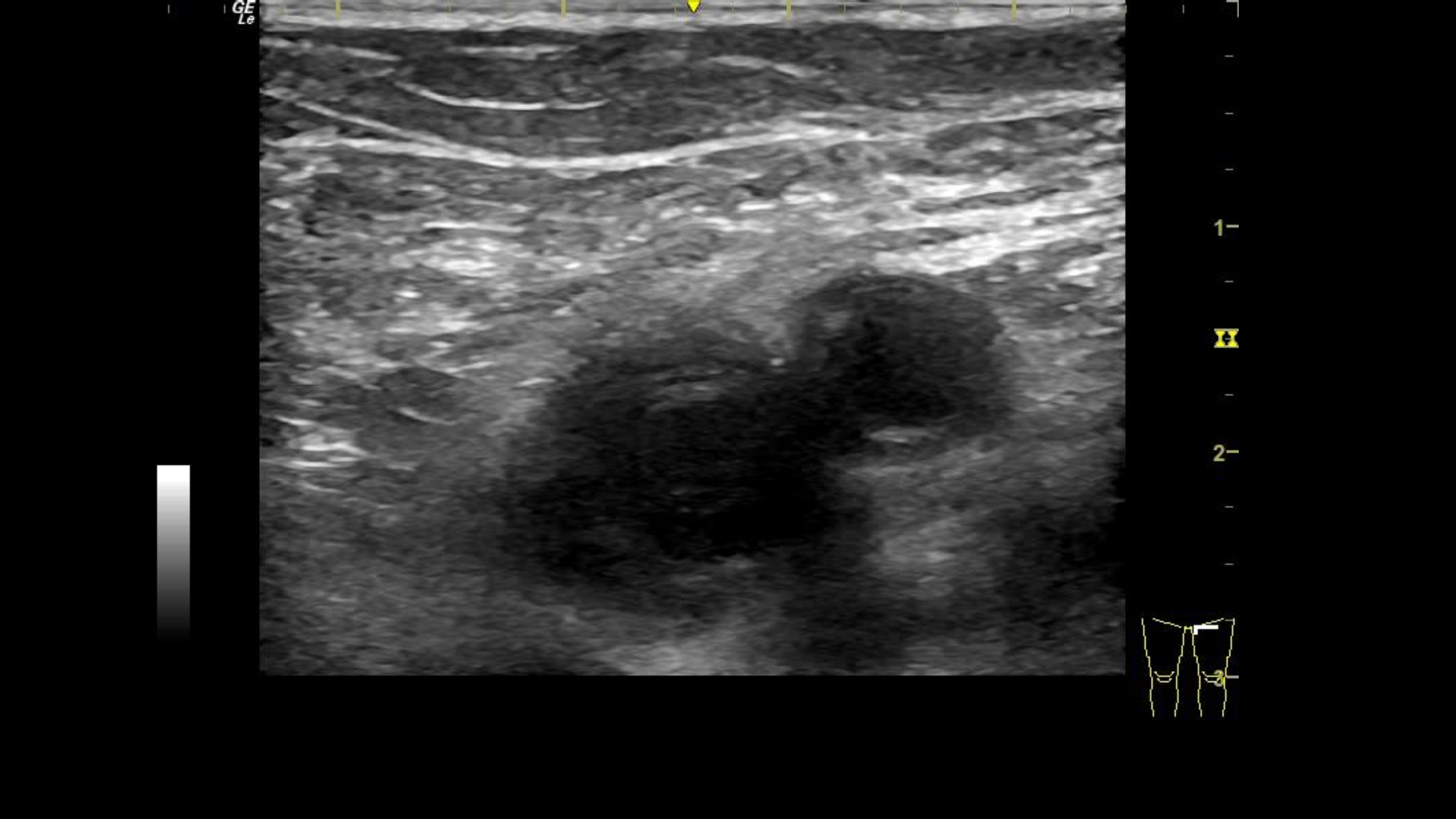
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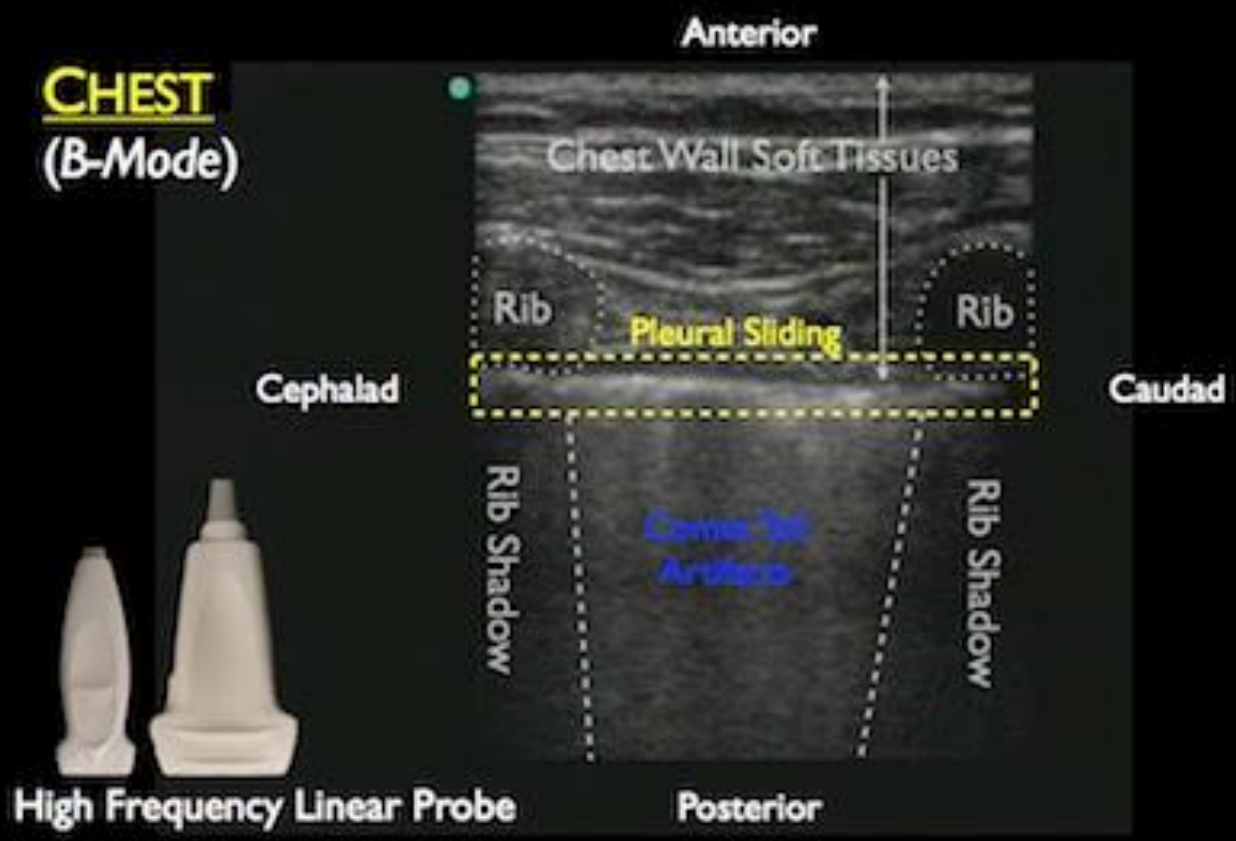
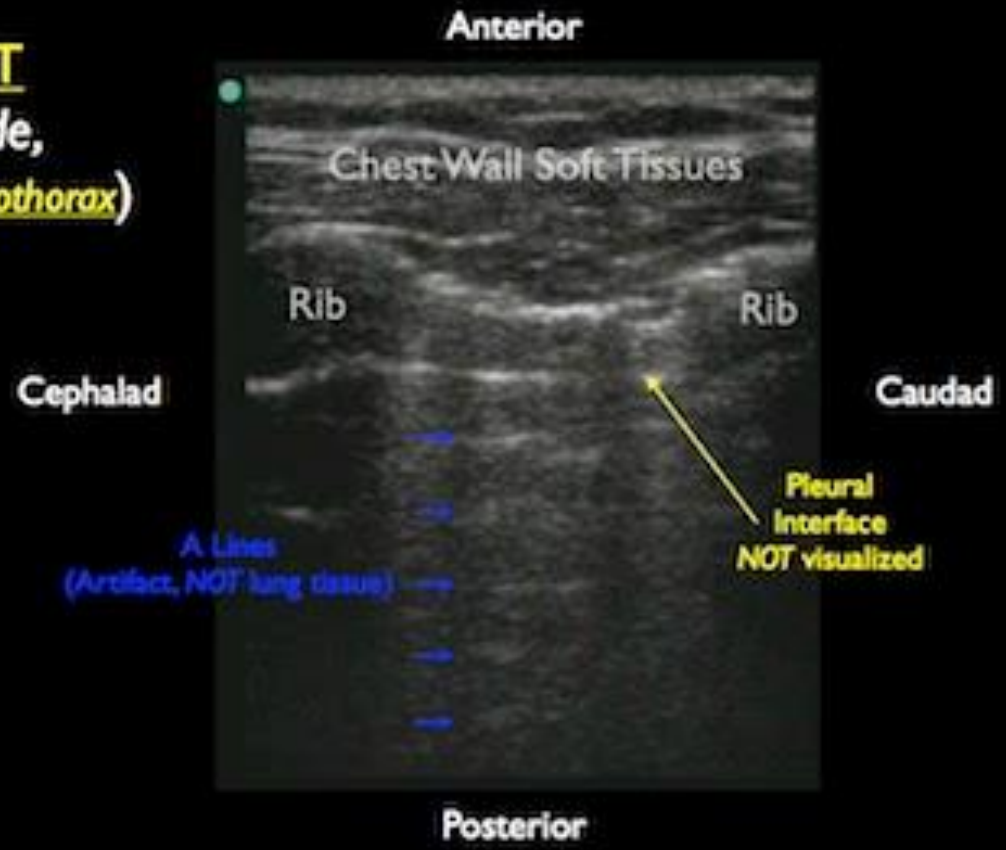
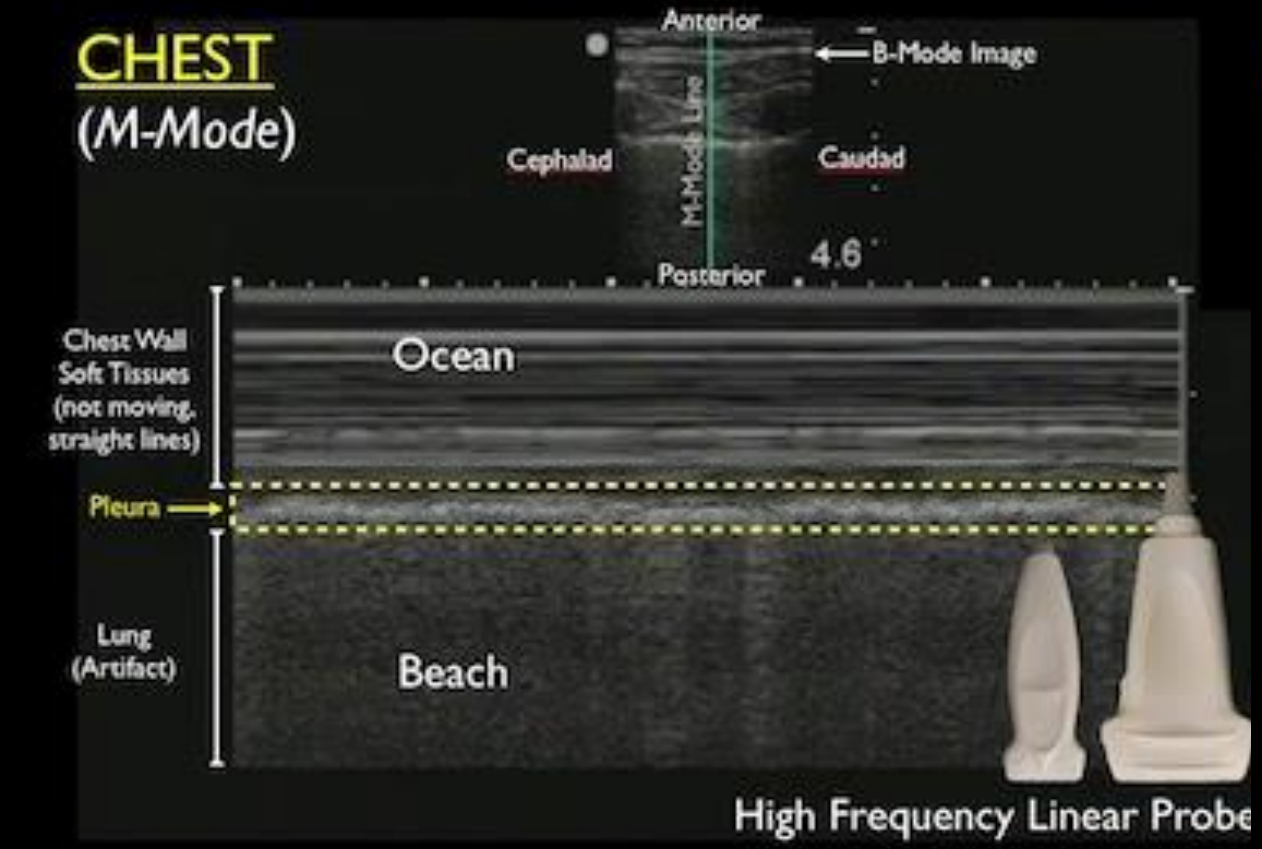
THROMBUS

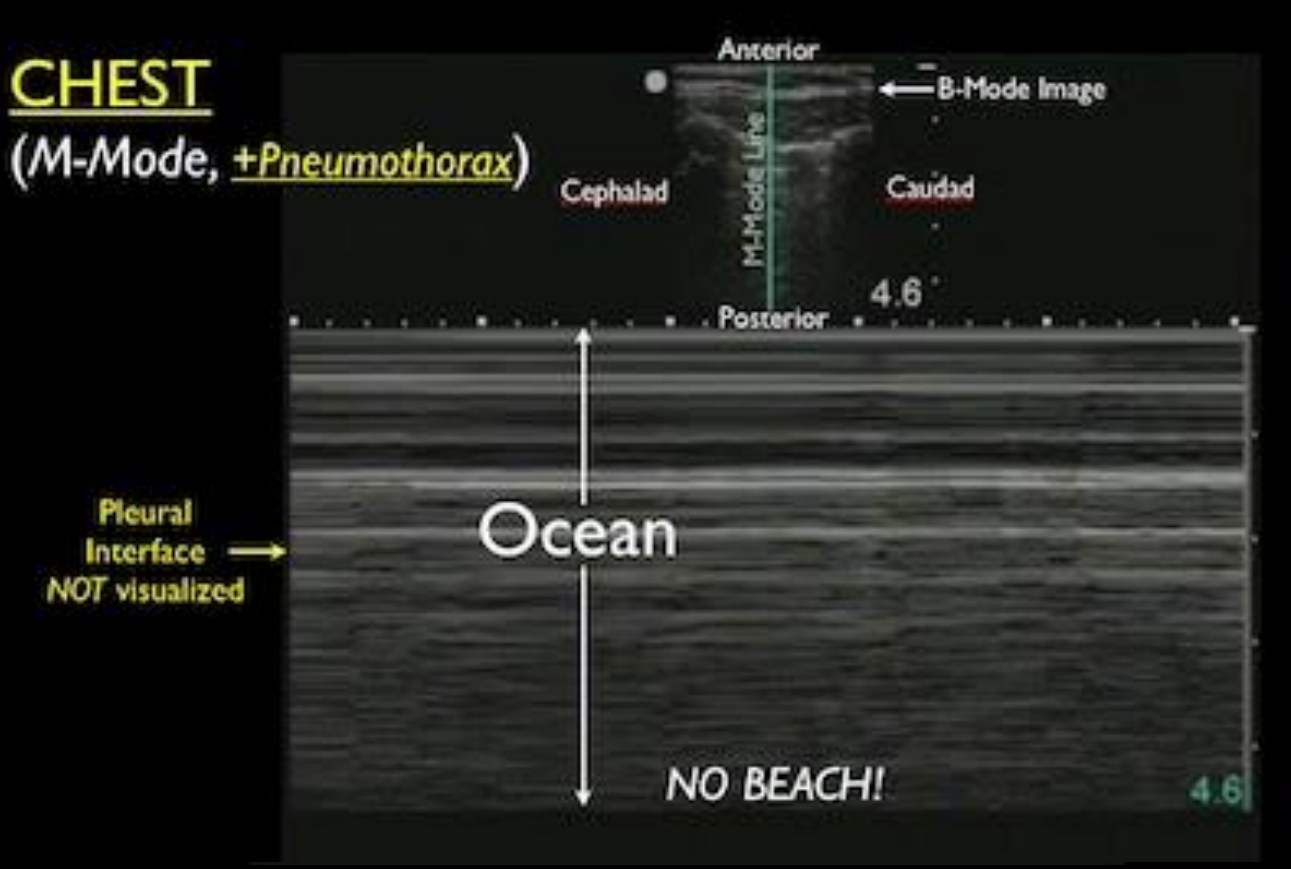
Pleura/PNx

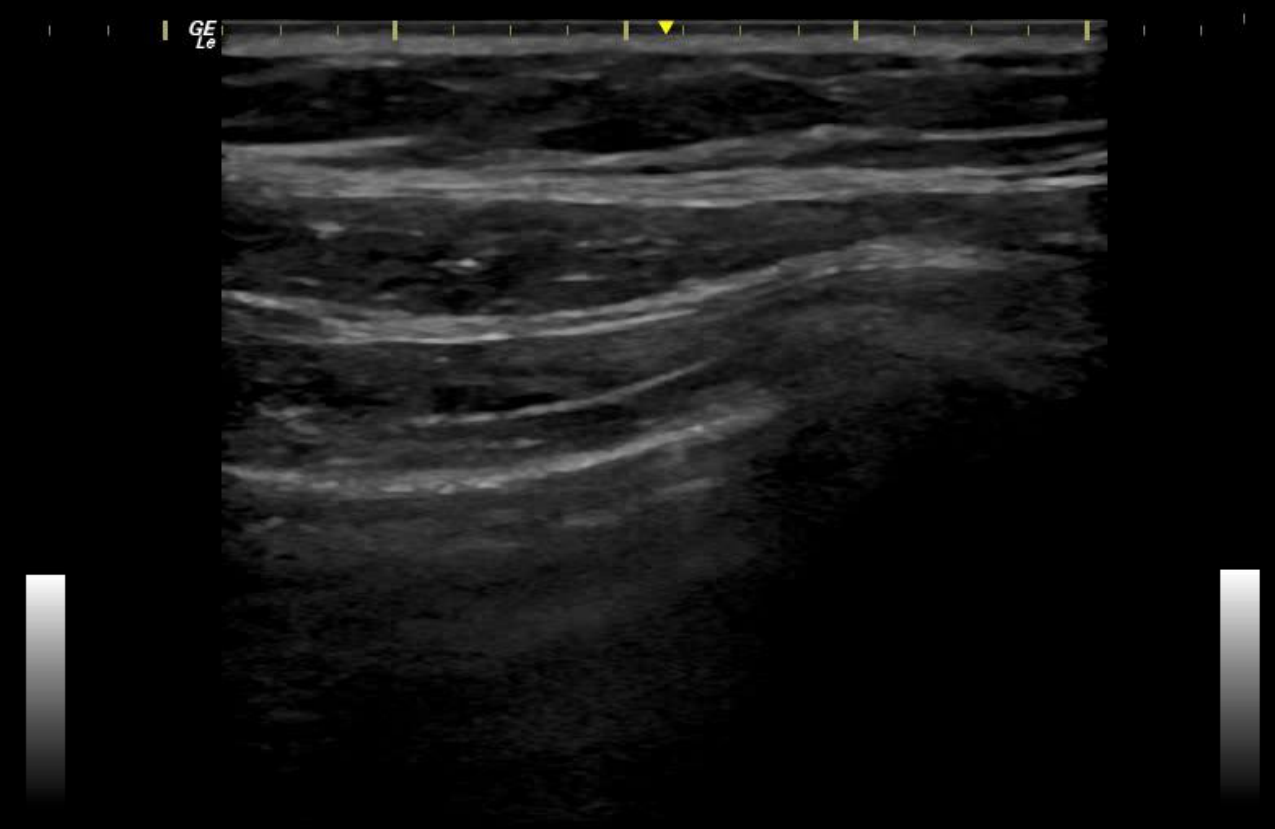
- Location: Midclavicular line, 3rd – 5th intercostal space
- Pneumothorax present: NO lung sliding and NO comet tails. M-Mode will look like a “bar graph” (no beach).


CHEST
(B-Mode)
Anterior
Chest Wall Soft Tissues
Rib
Pleural Sliding
Rib
Cephalad
Caudad
Rib Shadow
Comet Tail Artifacts
Rib Shadow
High Frequency Linear Probe
Posterior


CHEST
(B-Mode,
+Pneumothorax)
Anterior
Chest Wall Soft Tissues
Rib
Rib
Cephalad
Caudad
Pleural Interface NOT visualized
A Lines
(Artifact, NOT lung tissue)
Posterior


CHEST
(M-Mode)
Anterior
B-Mode Image
M-Mode Line
Cephalad
Caudad
Posterior
4.6
Chest Wall
Soft Tissues
(not moving,
straight lines)
Ocean
Pleura
Lung
(Artifact)
Beach
High Frequency Linear Probe


CHEST
(M-Mode, +Pneumothorax)
Anterior
B-Mode Image
M-Mode Line
Cephalad
Caudad
Posterior
4.6
Pleural
Interface
NOT visualized
Ocean
NO BEACH!
4.6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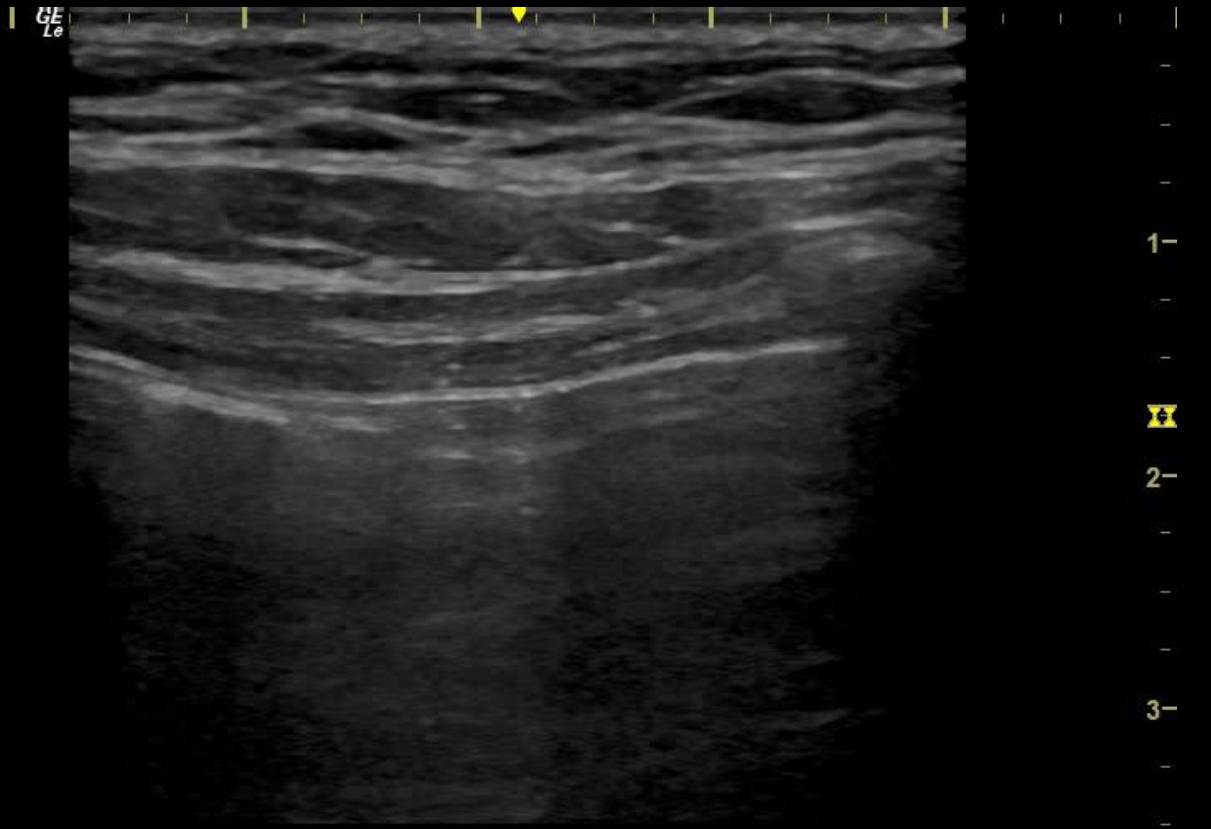
GE
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2
3

The RUSH protocol is to medical patients what the EFAST exam is to trauma patients.

HI-MAP approach

- **H** Heart
- **I** IVC
- **M** Morison's pouch/FAST abdominal views
  + Pleura
- **A** Aorta, Vein
- **P** PNx