

Introduction to Cardiac Ultrasound

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Disclosures

- None



Learning Objectives

- Describe cardiac ultrasound convention
- Acquire parasternal long axis view and estimate systolic function
- Acquire subcostal four chamber view and describe right ventricular dilation
- Acquire inferior vena cava view and identify plethora
- Recognize pericardial effusion

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Transducer Selection

- Phased-array transducer (1-5 MHz)
- Small footprint
- High frame rate, low frequency
- Ideal for imaging intrathoracic structures

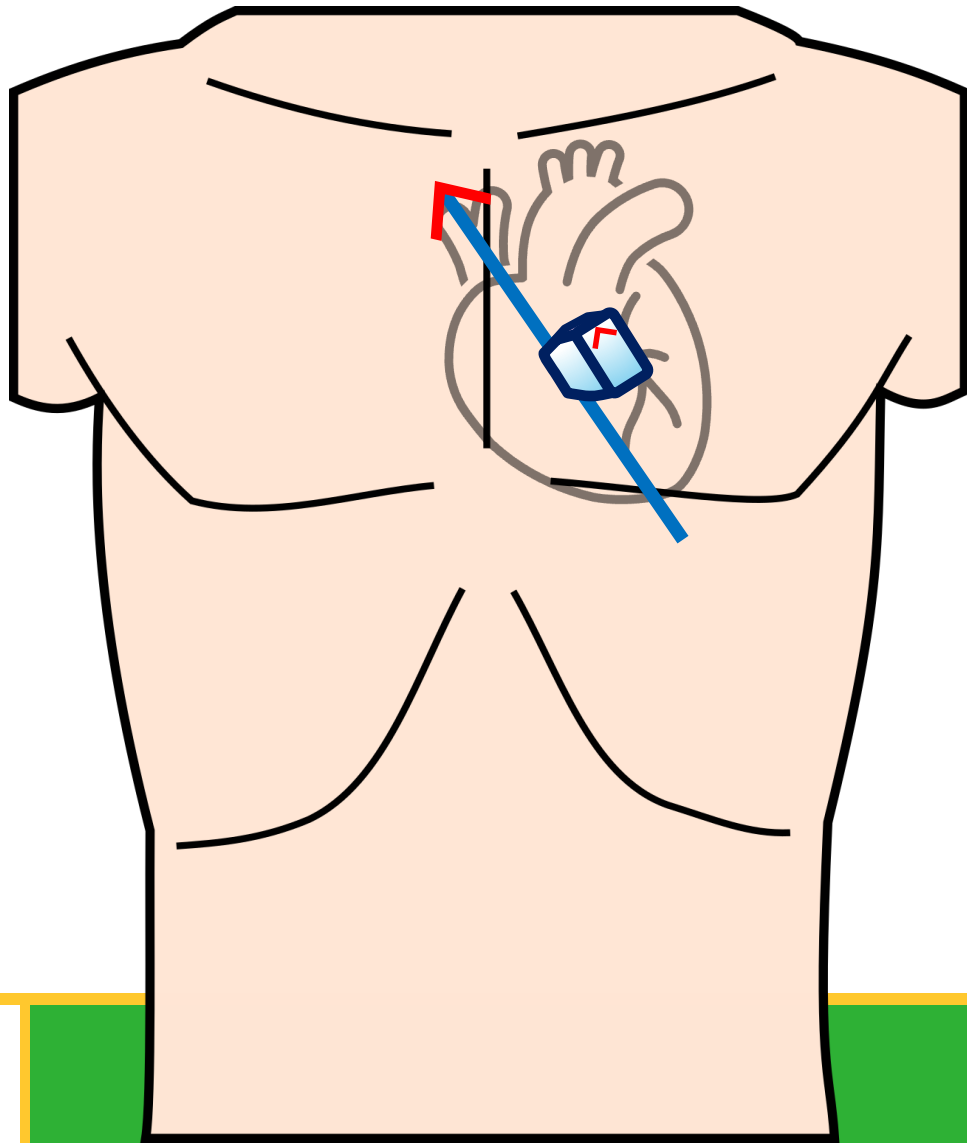


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Cardiac Convention

- Longitudinal views: Transducer index marker cephalad
- Transverse views: Transducer index marker to the left
- Screen index marker: Right upper corner
- Superior aspect of the display will be most superficial

Longitudinal (long) Axis



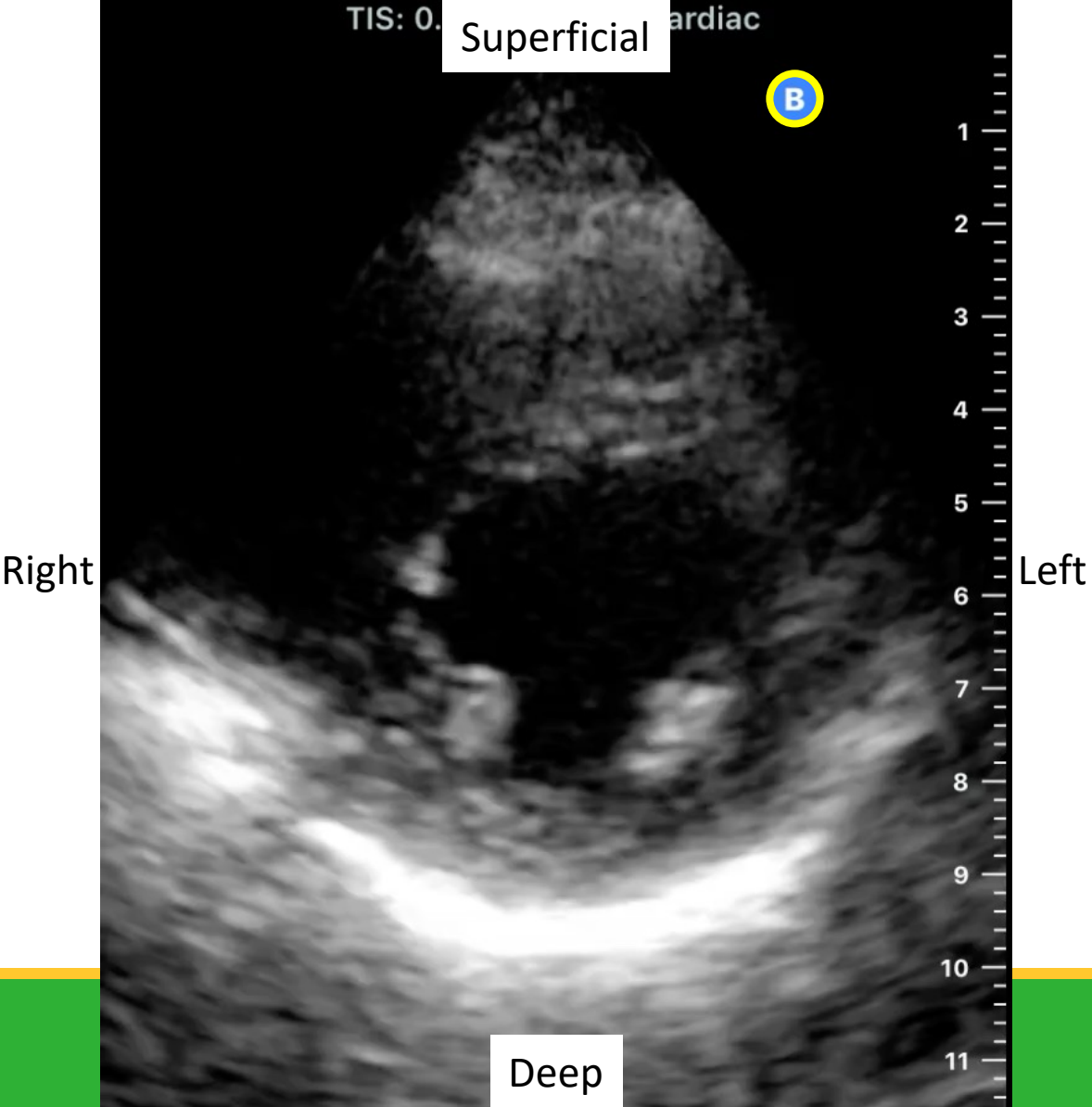
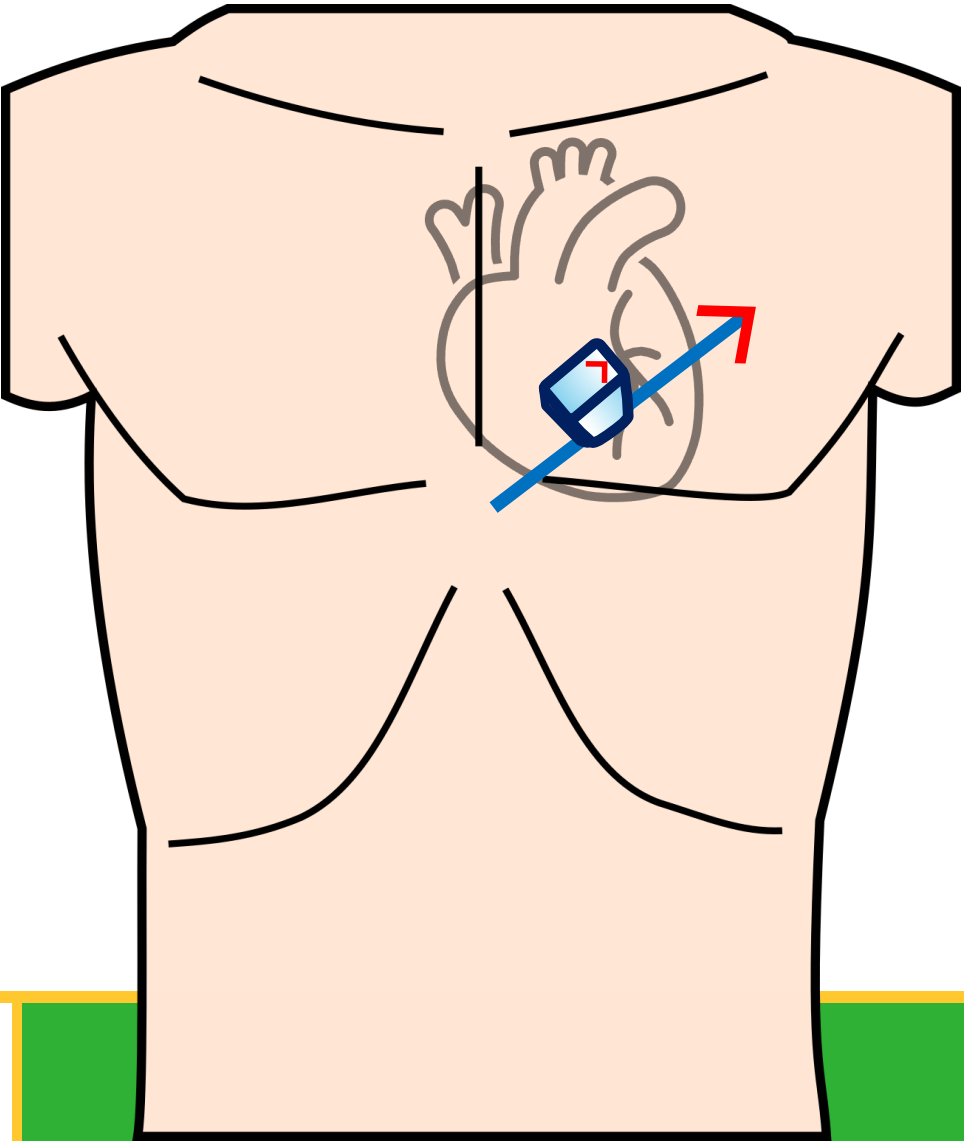
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Cephalad

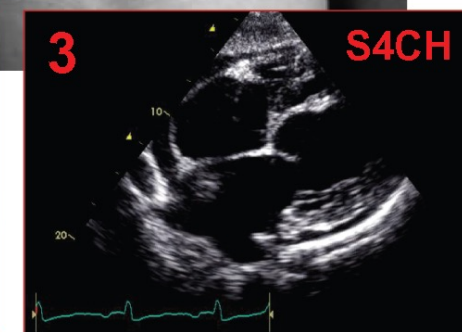
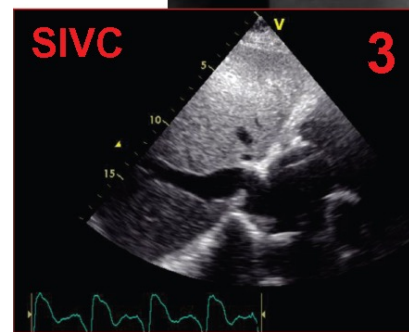
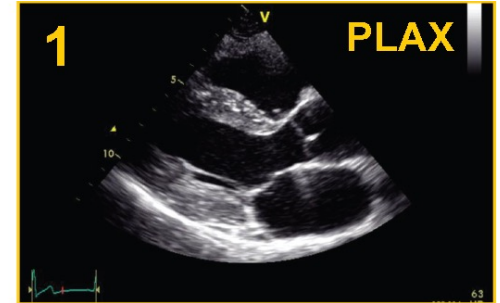
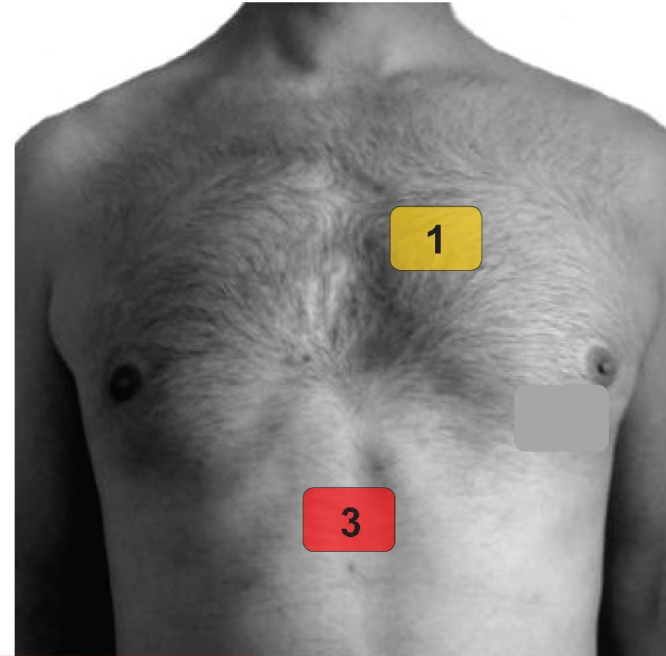
Deep

Transverse (short) Axis



Cardiac Ultrasound Exam Views

- Parasternal long axis
- Subcostal four chamber
- Inferior vena cava



Learning Objectives

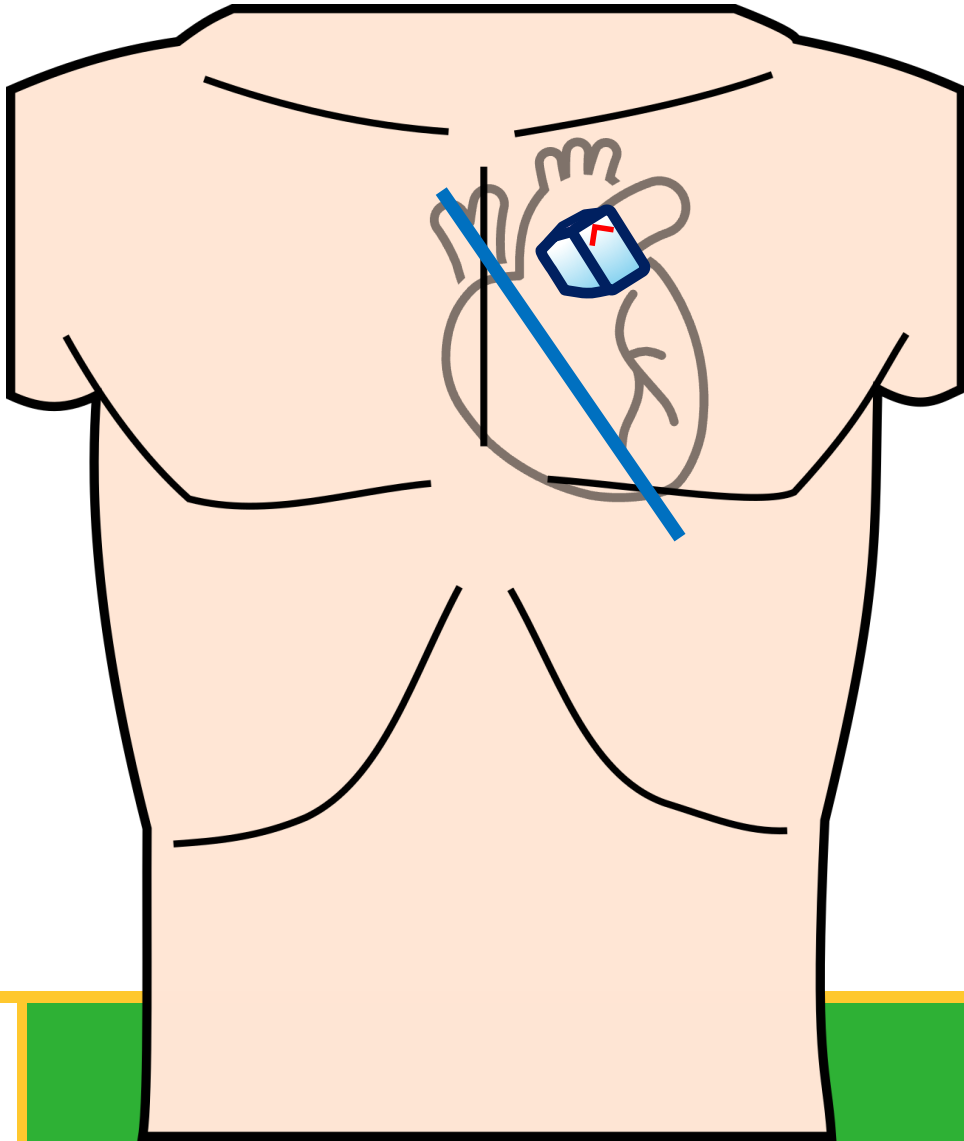
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Parasternal Long Axis

- Estimate **left** and right ventricular size and function
- Pericardial effusion and pleural effusion
- Left atrial enlargement
- Color flow Doppler can detect severe valvular pathology
 - Pitfall: Angle of insonation

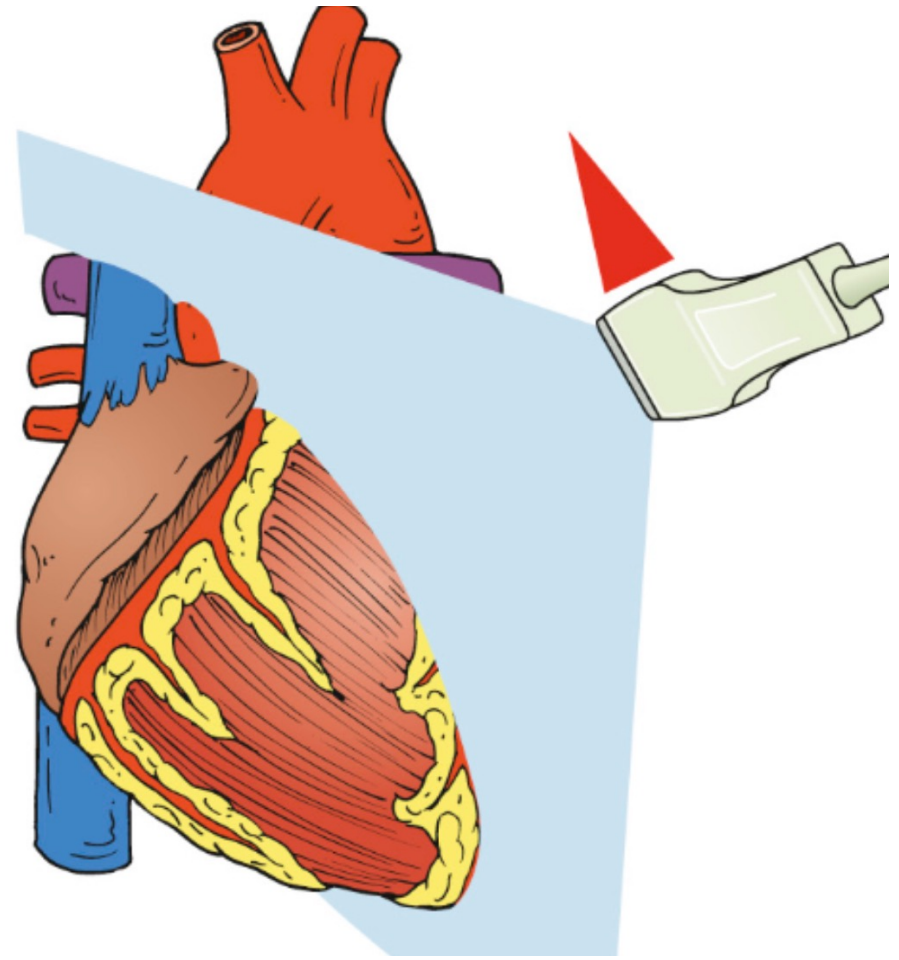
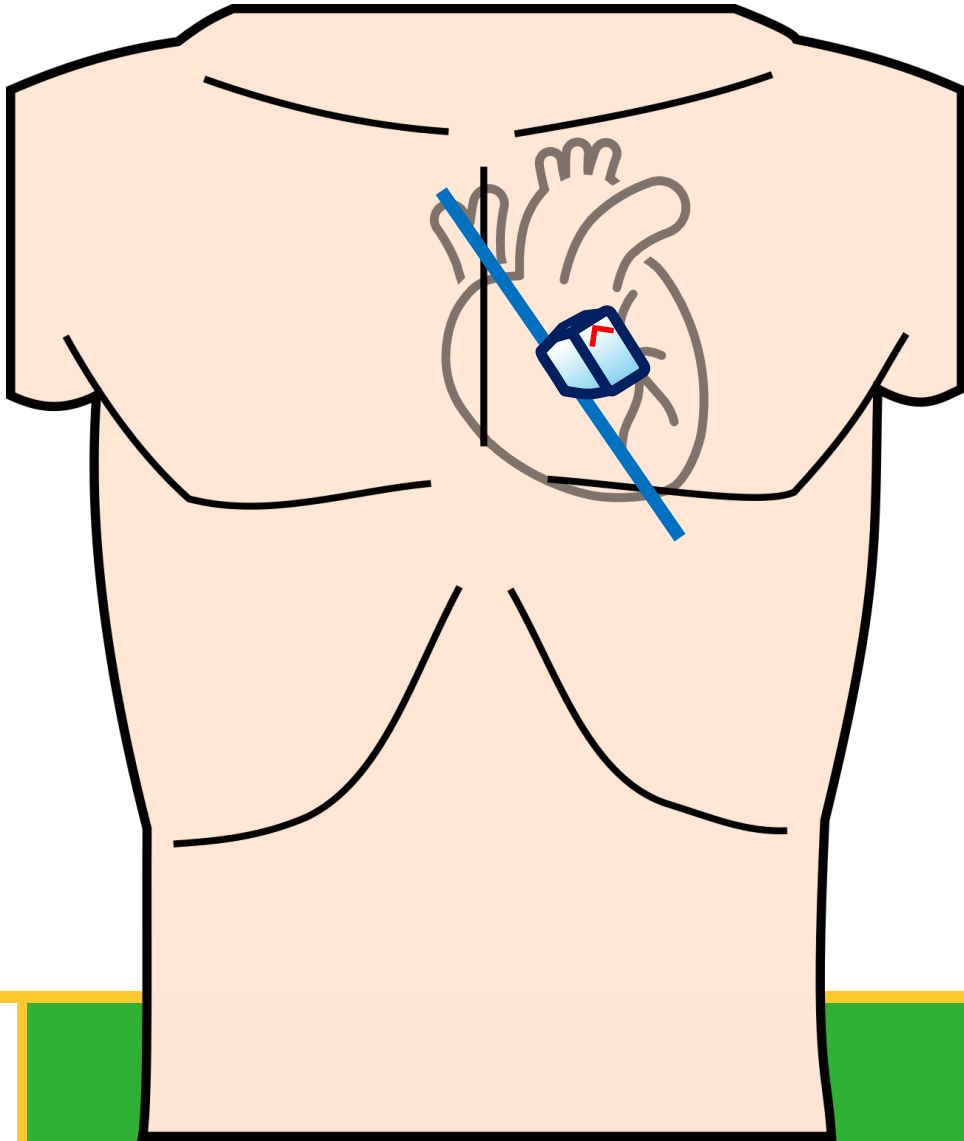


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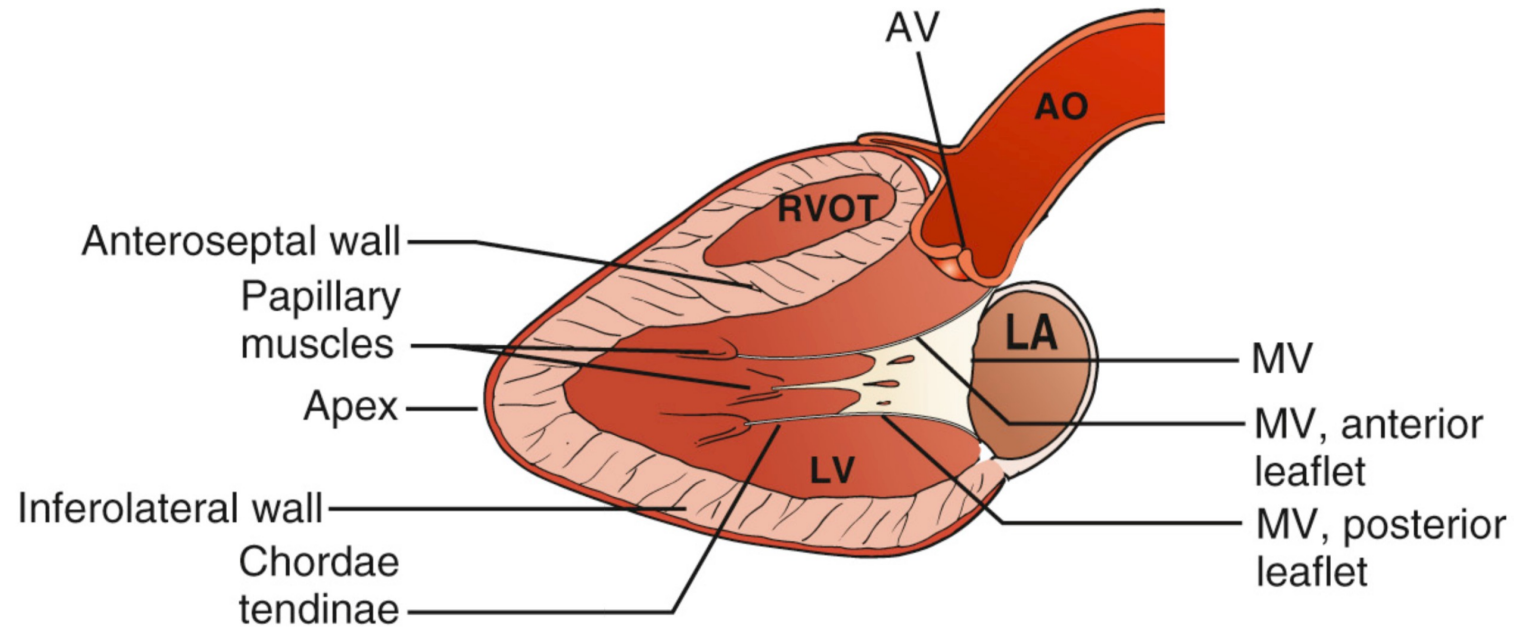


- Transducer: Left of the sternum
- Index marker: Right shoulder
- Slide the transducer down until the heart is visible
- Adjust depth: Include the descending thoracic aorta

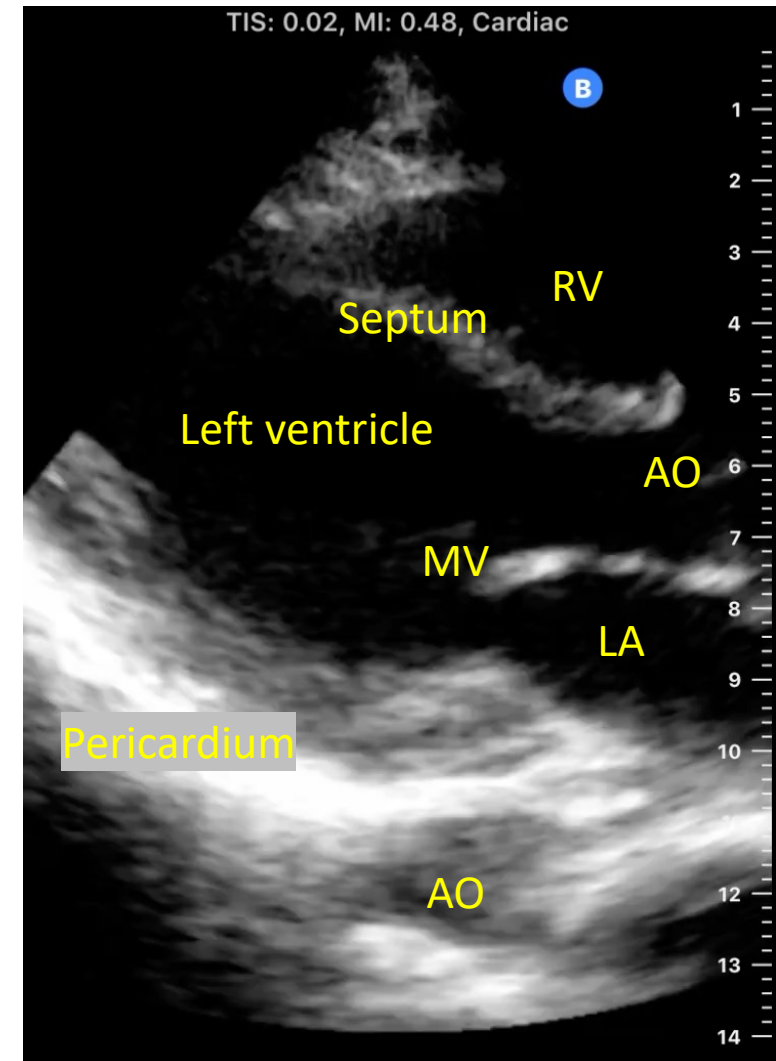
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Parasternal Long Axis



Point of Care Ultrasound 2nd edition. N. Soni

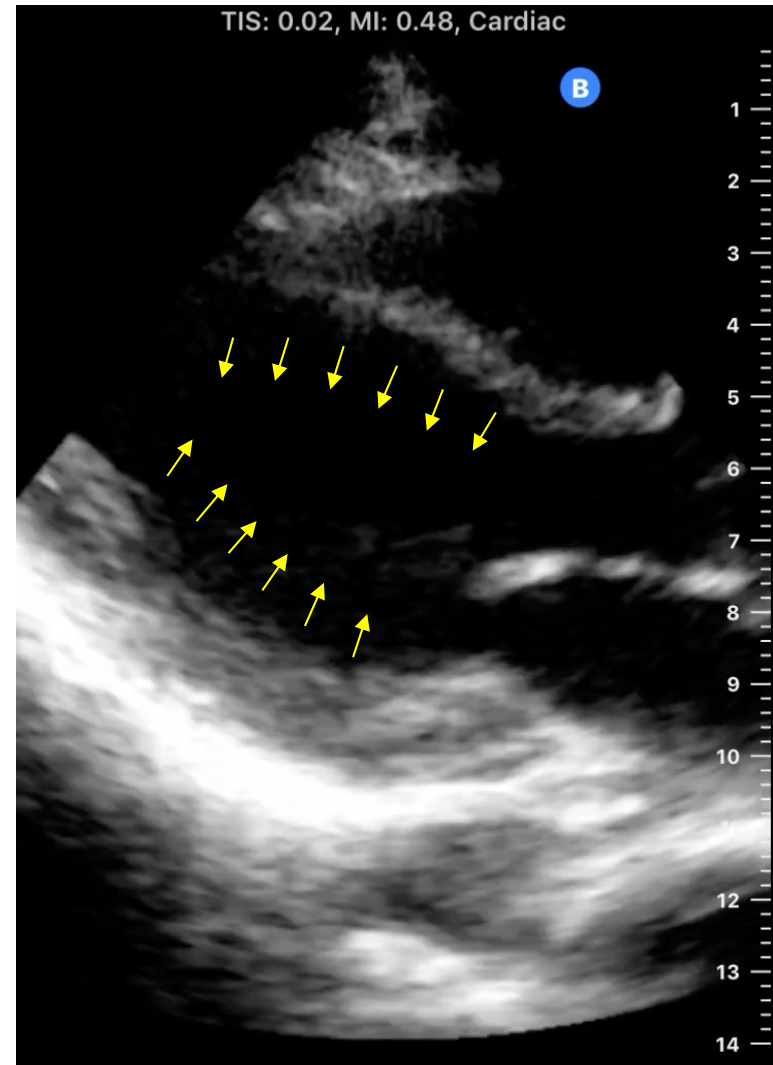


Left Ventricular Systolic Function

- Qualitative assessment: Normal, hyperdynamic, (severely)reduced
- Based on three criteria:
 - 1) Endocardial excursion
 - 2) Myocardial thickening
 - 3) Anterior mitral valve leaflet motion

Left Ventricular Systolic Function

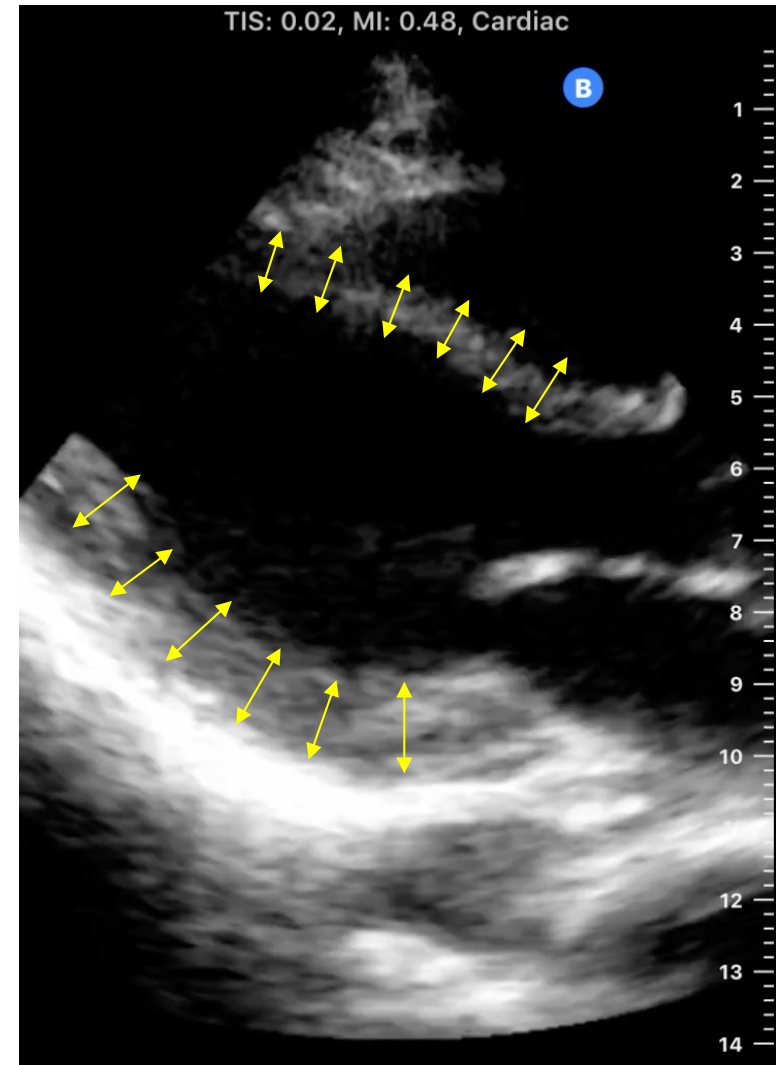
1) *Endocardial excursion:*



Left Ventricular Systolic Function

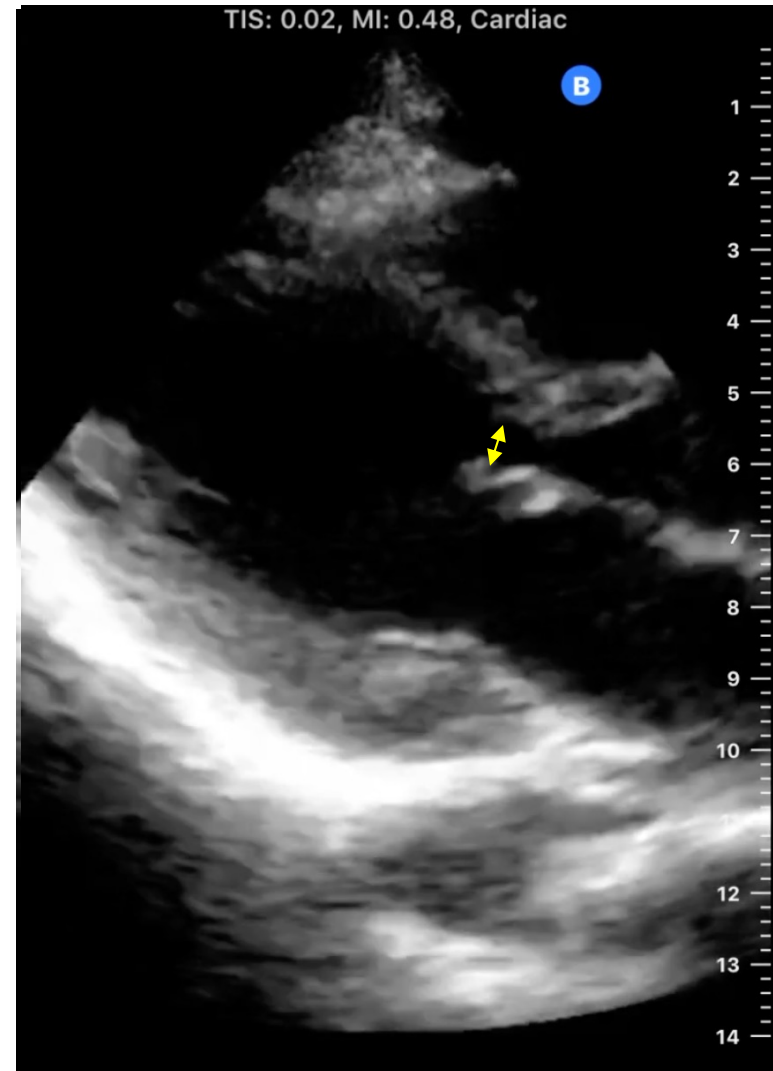
1) *Endocardial excursion:*

2) *Myocardial thickening:*

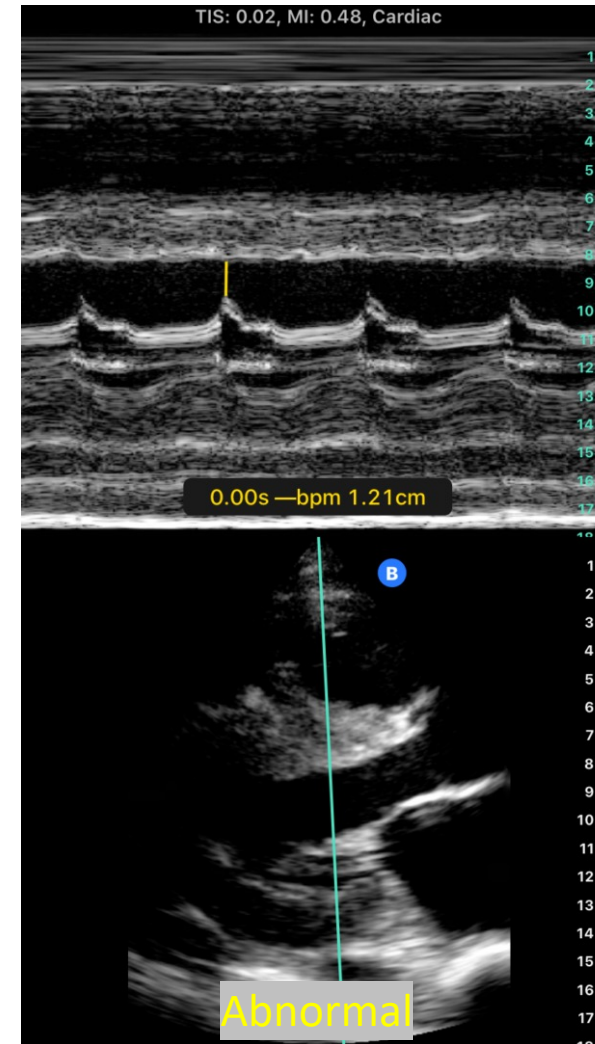
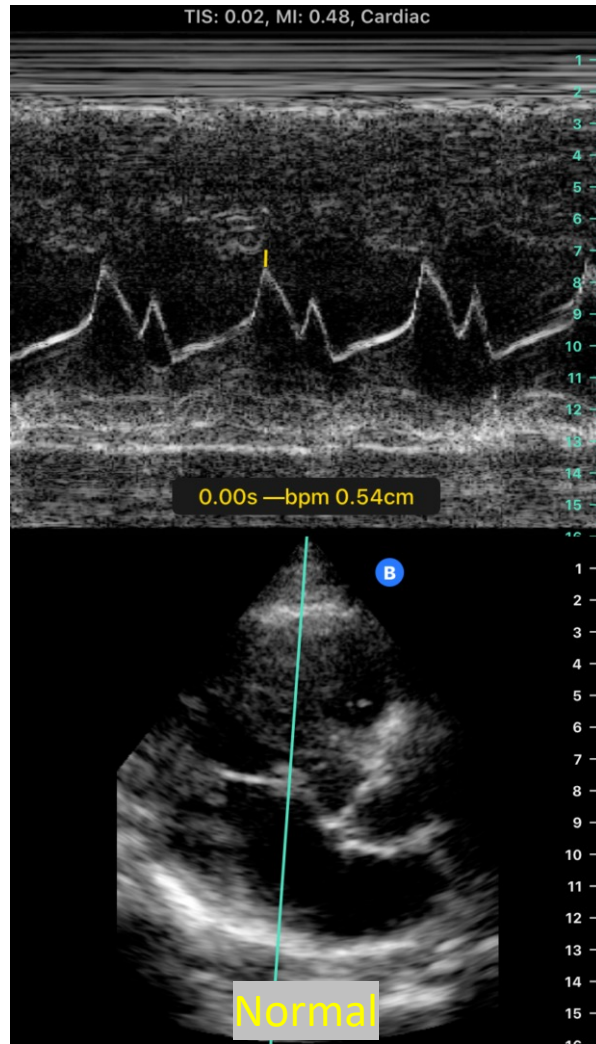


Left Ventricular Systolic Function

- 1) *Endocardial excursion:*
- 2) *Myocardial thickening:*
- 3) *Anterior mitral valve leaflet motion:*



Left Ventricular Systolic Function: M-Mode



Learning Objectives

- Describe cardiac ultrasound convention
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- Acquire inferior vena cava view and identify plethora
- Recognize pericardial effusion

Subcostal Four Chamber

- Rapid interpretation of information in an acutely ill patient
- Better visualized in patients with lung hyperinflation or who are mechanically ventilated
- **Right ventricular enlargement**

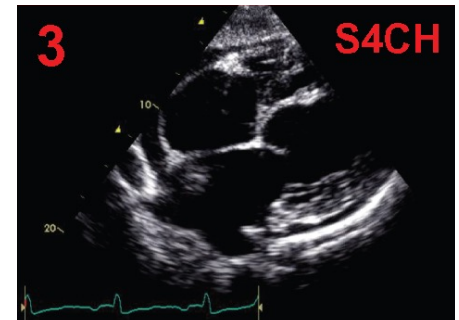
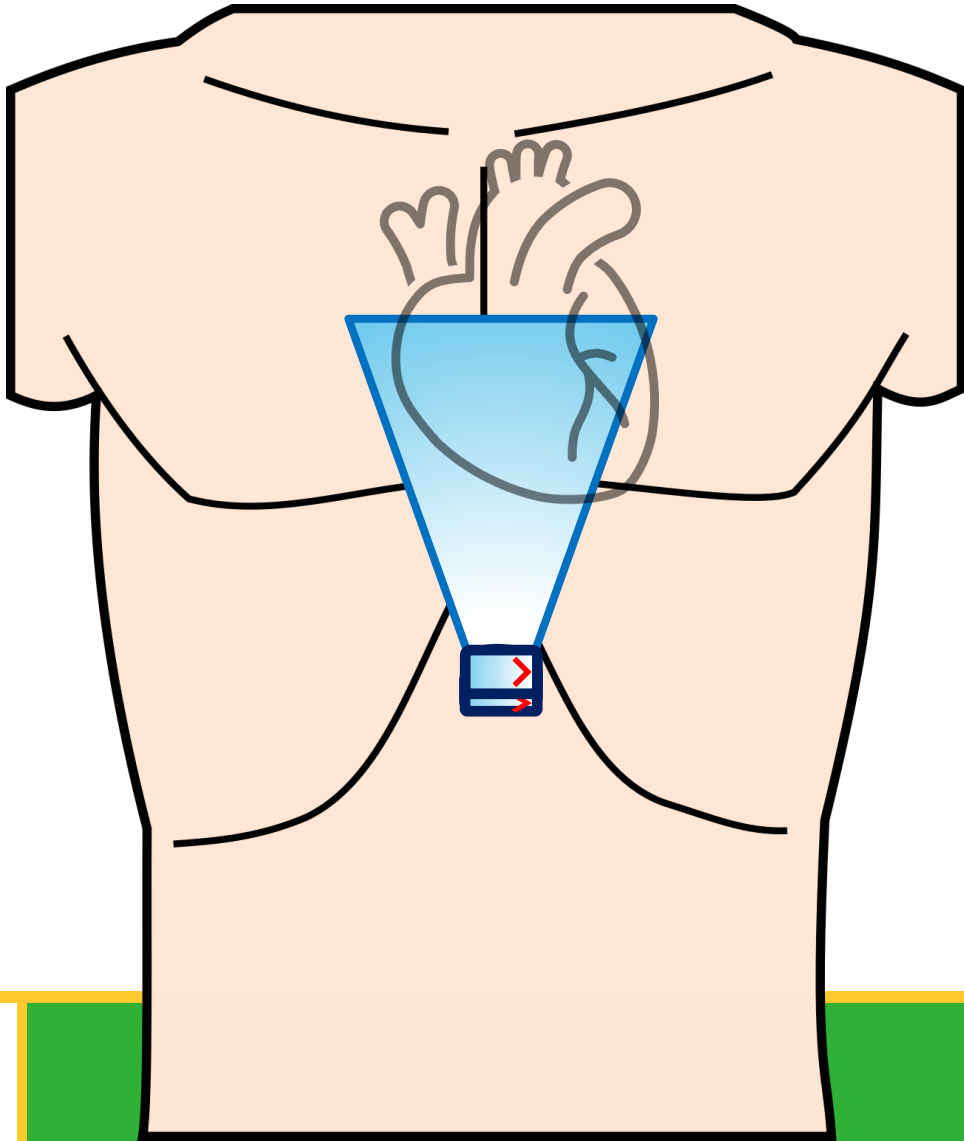
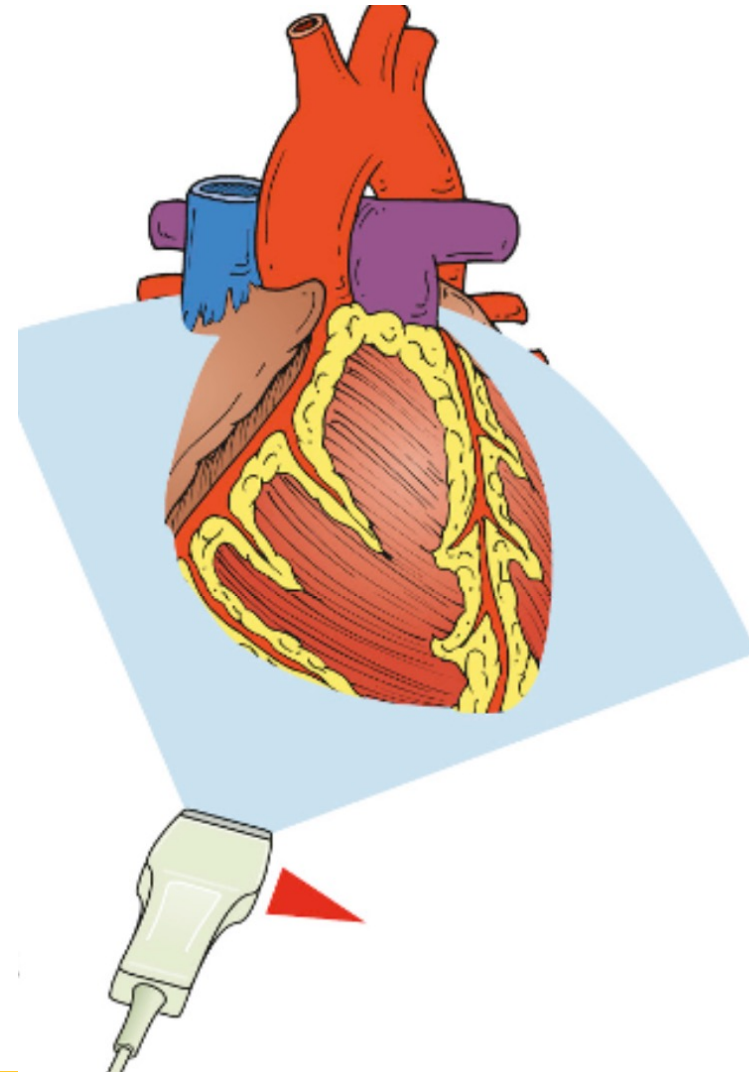
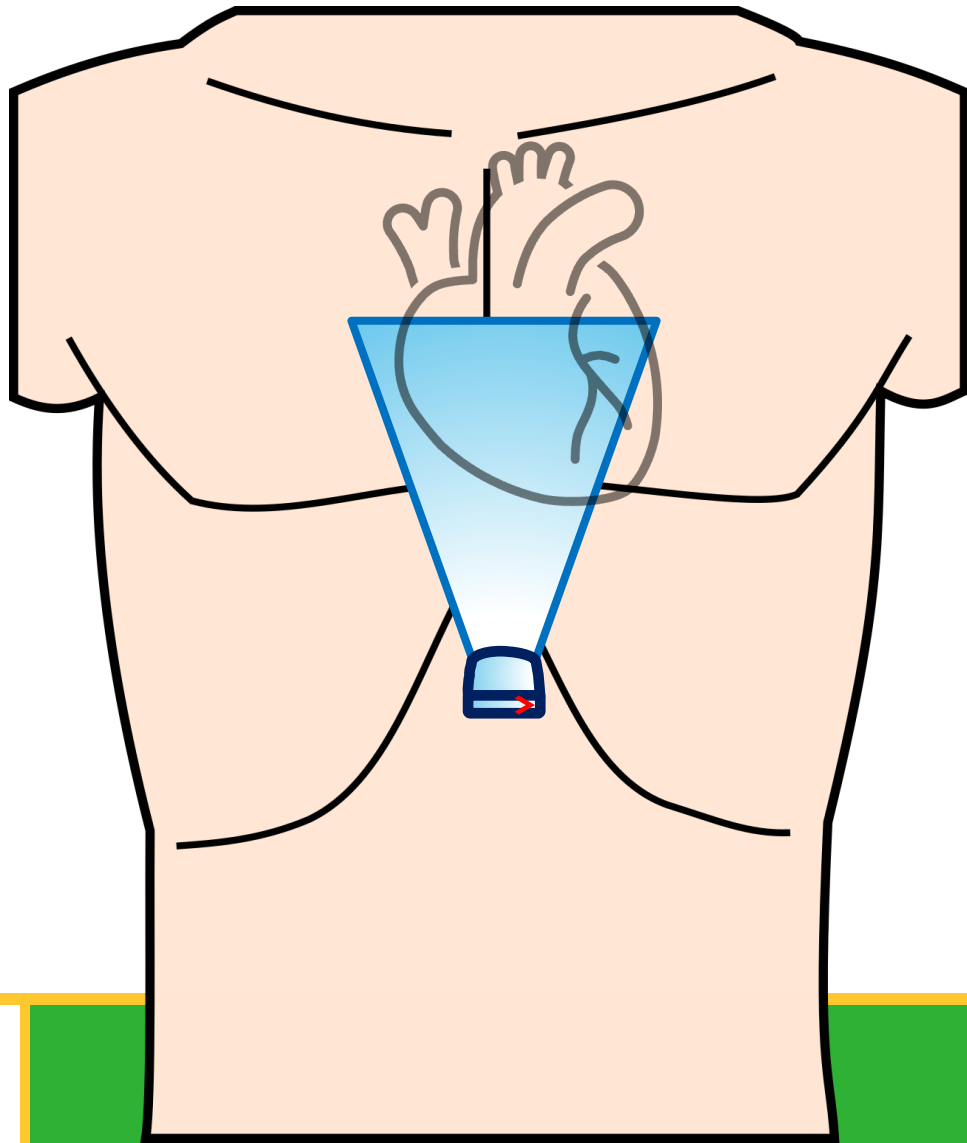


Image Acquisition

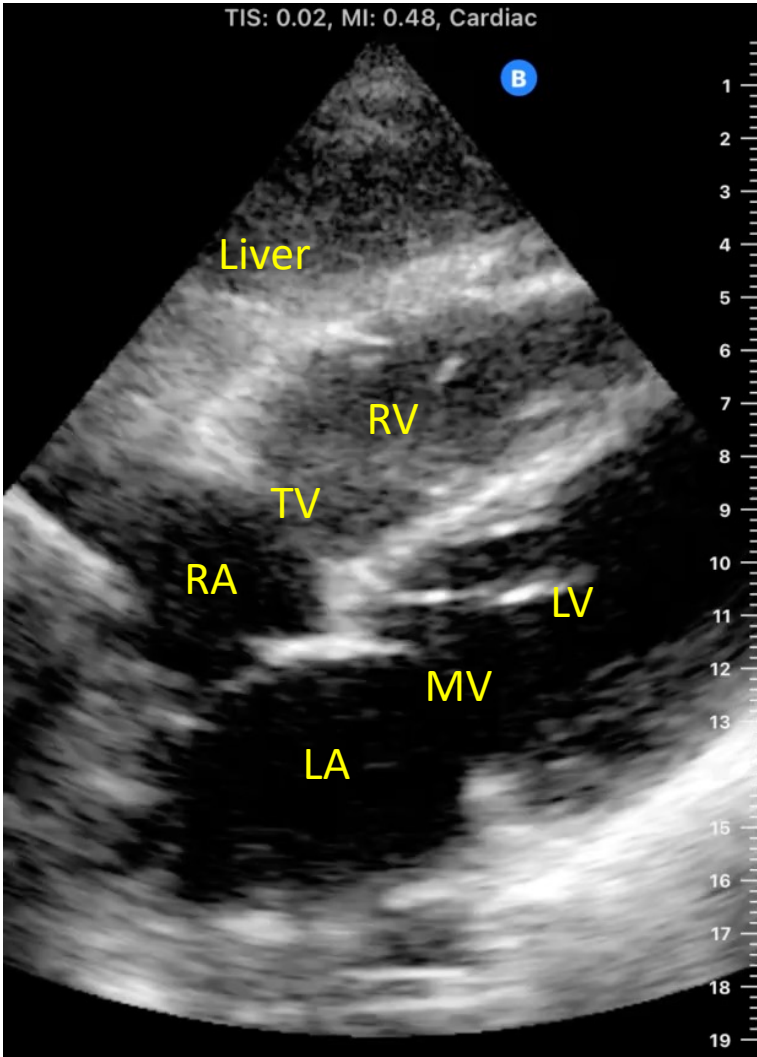
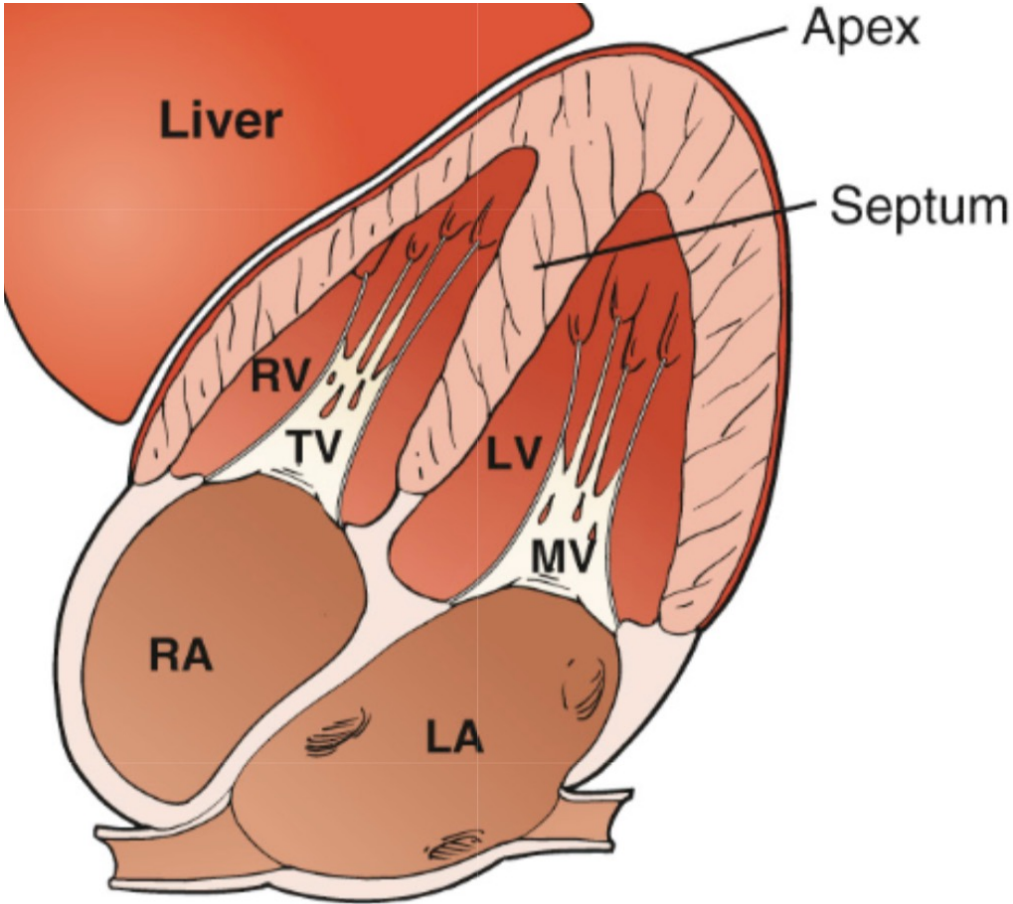


- Transducer: below the xiphoid process
- Index marker: Left
- Fan/tilt the transducer anteriorly
- Optional: Rock probe to the left
- Knee bend, breath hold may improve imaging

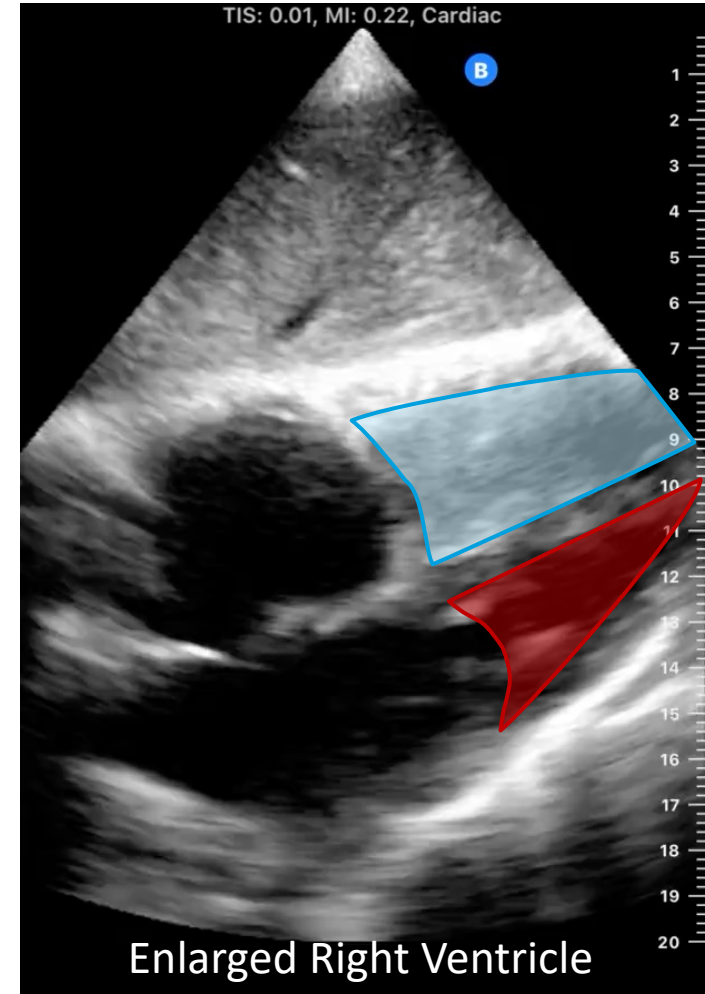
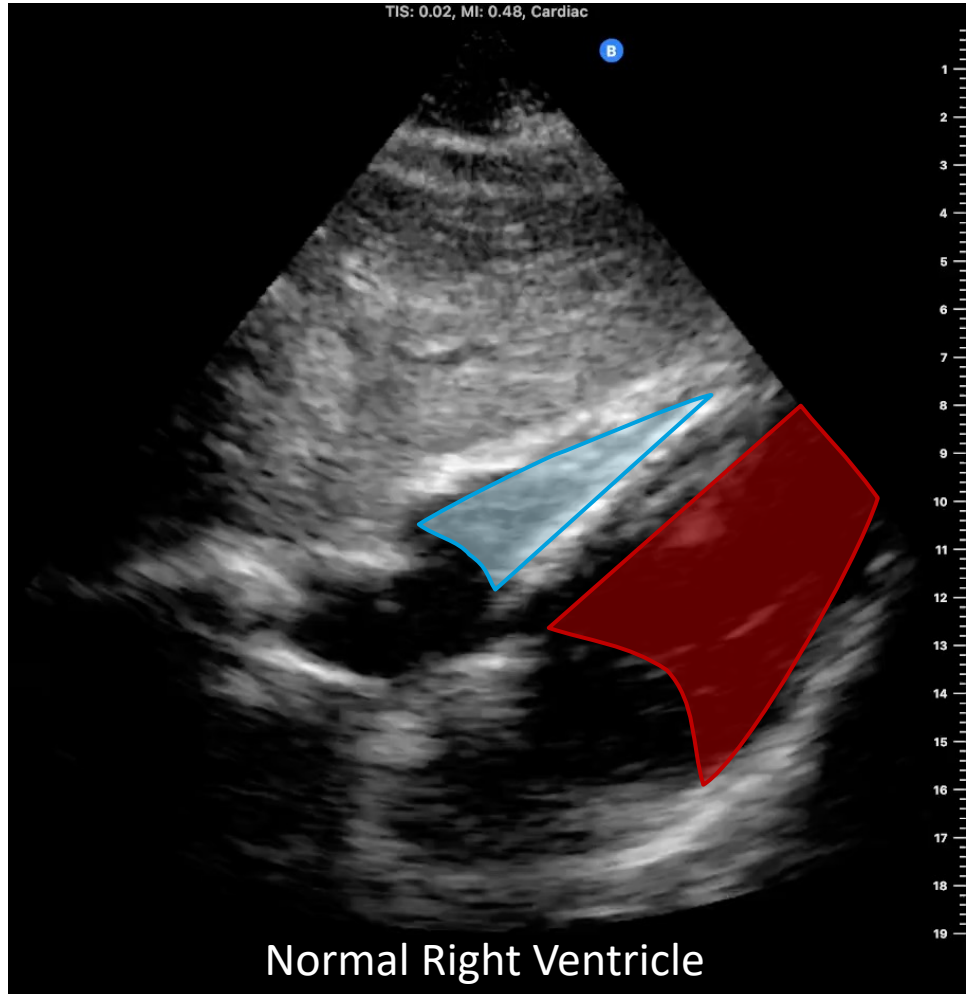
Image Acquisition



Subcostal Four Chamber



Right Ventricular Enlargement



Learning Objectives

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- **Acquire inferior vena cava view and identify plethora**
- Recognize pericardial effusion

Subcostal Inferior Vena Cava

- Used in conjunction with lung ultrasound to assess volume status
- Evaluate for cardiac tamponade in patients with pericardial effusion
 - Sensitivity: 97%, specificity: 40%
- Estimate central venous pressure and fluid responsiveness
 - Sensitivity: 73-87%, specificity 82-85%

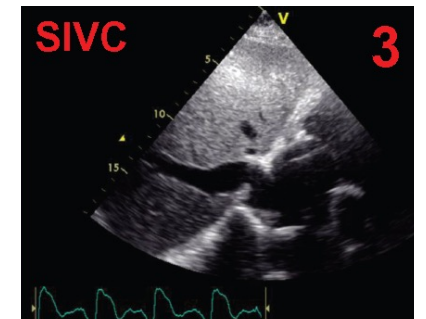
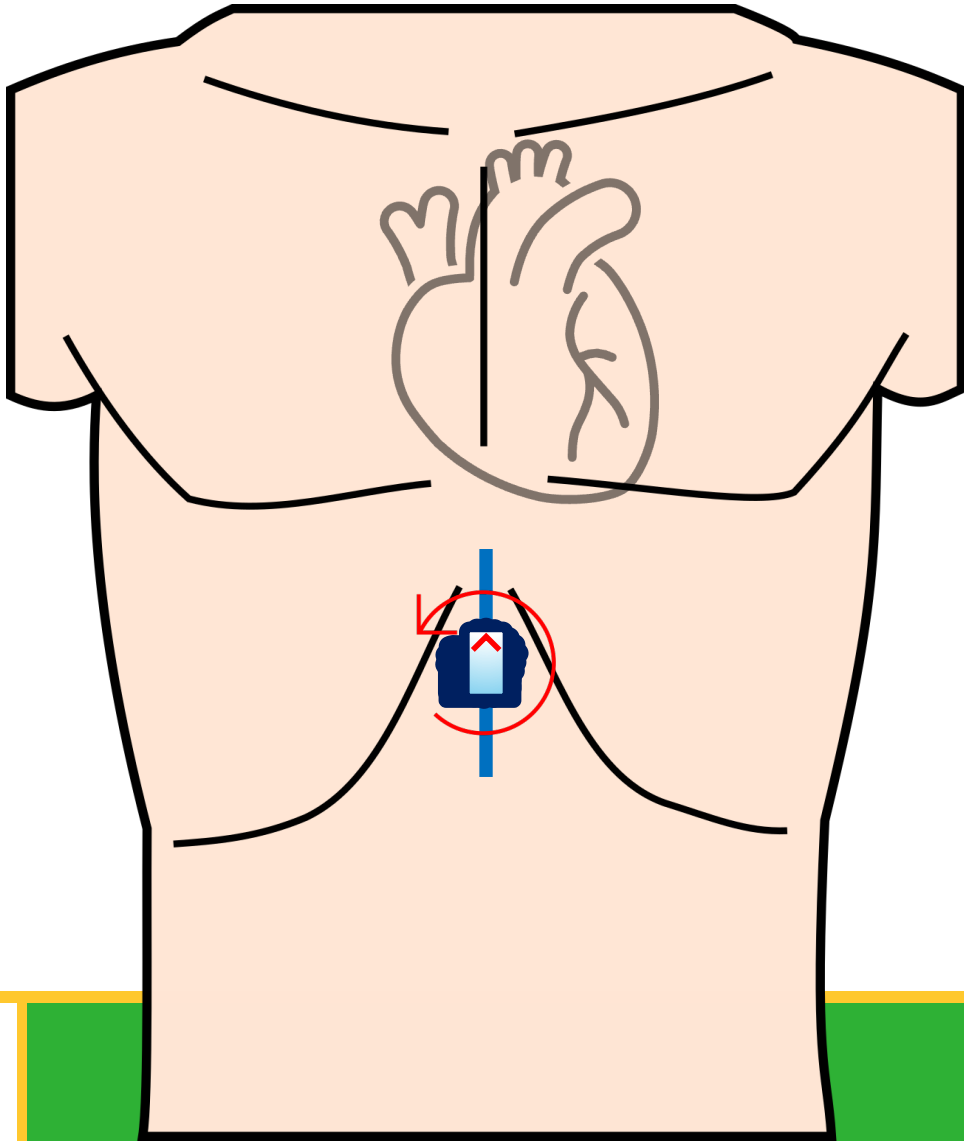
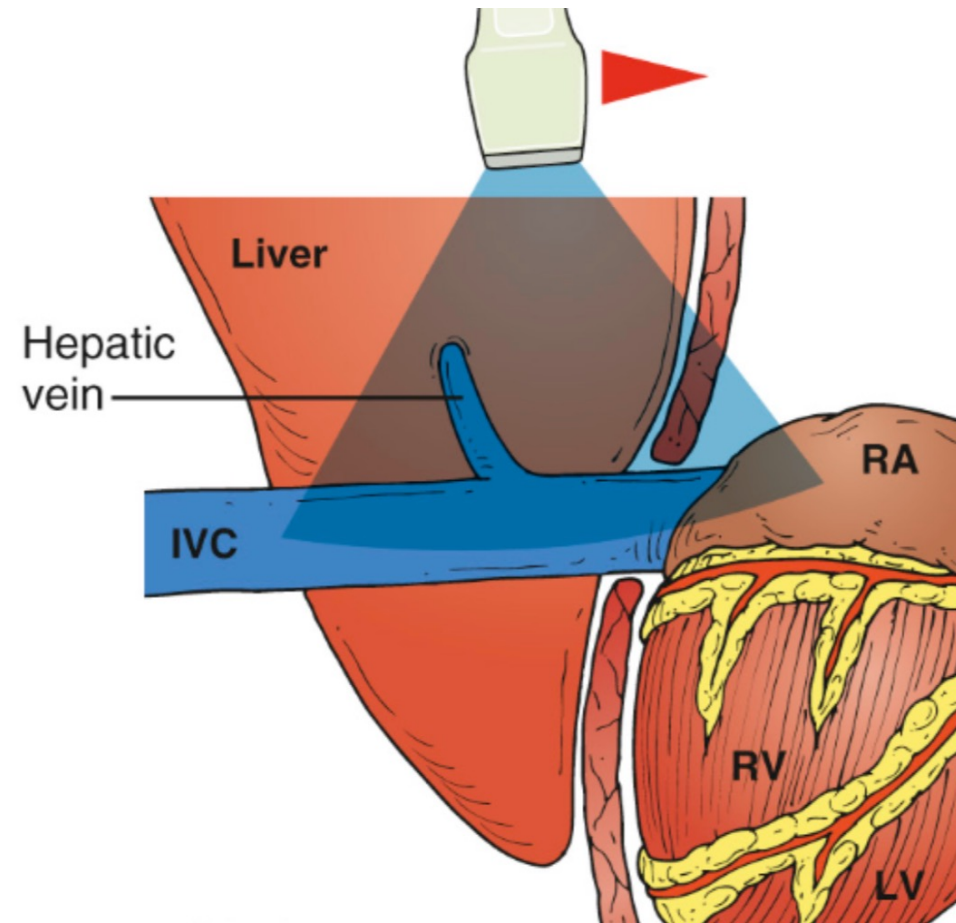
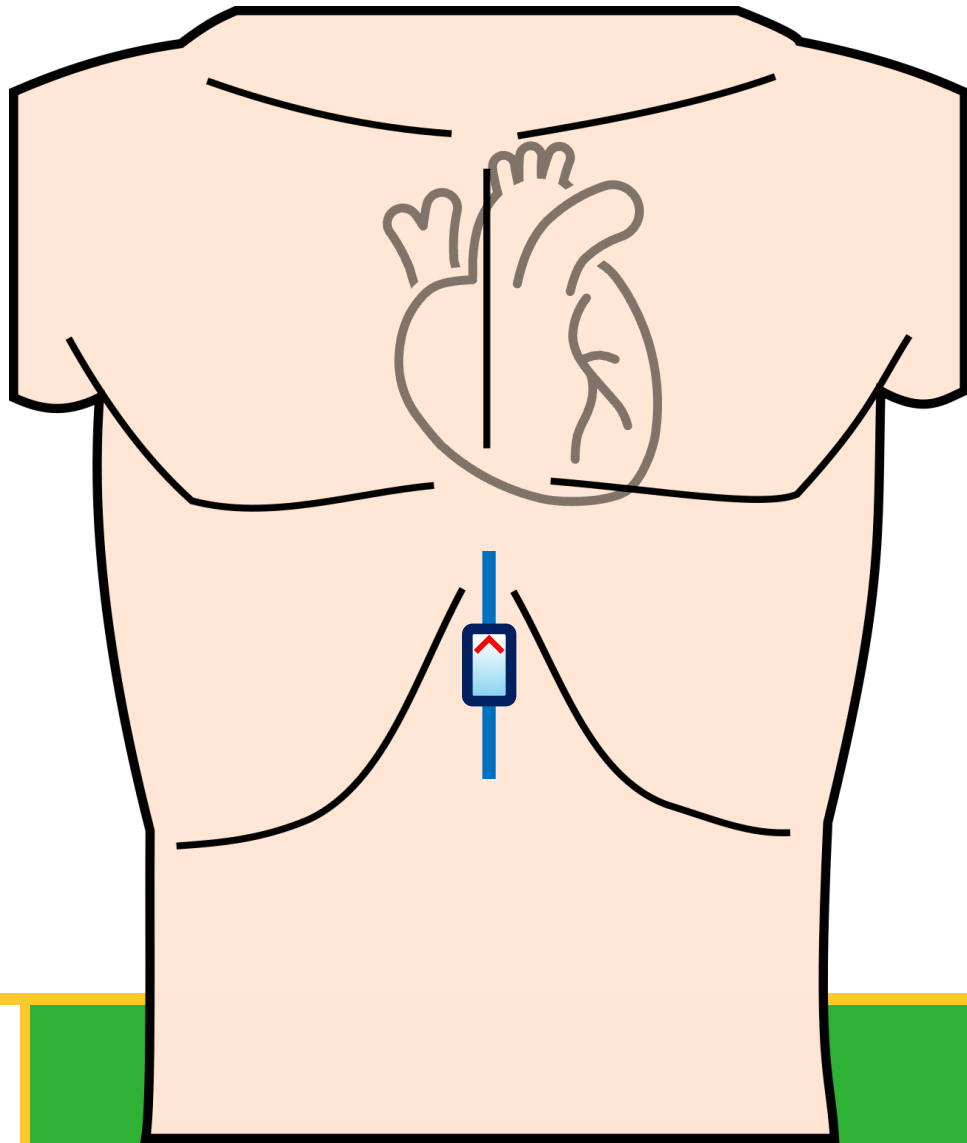


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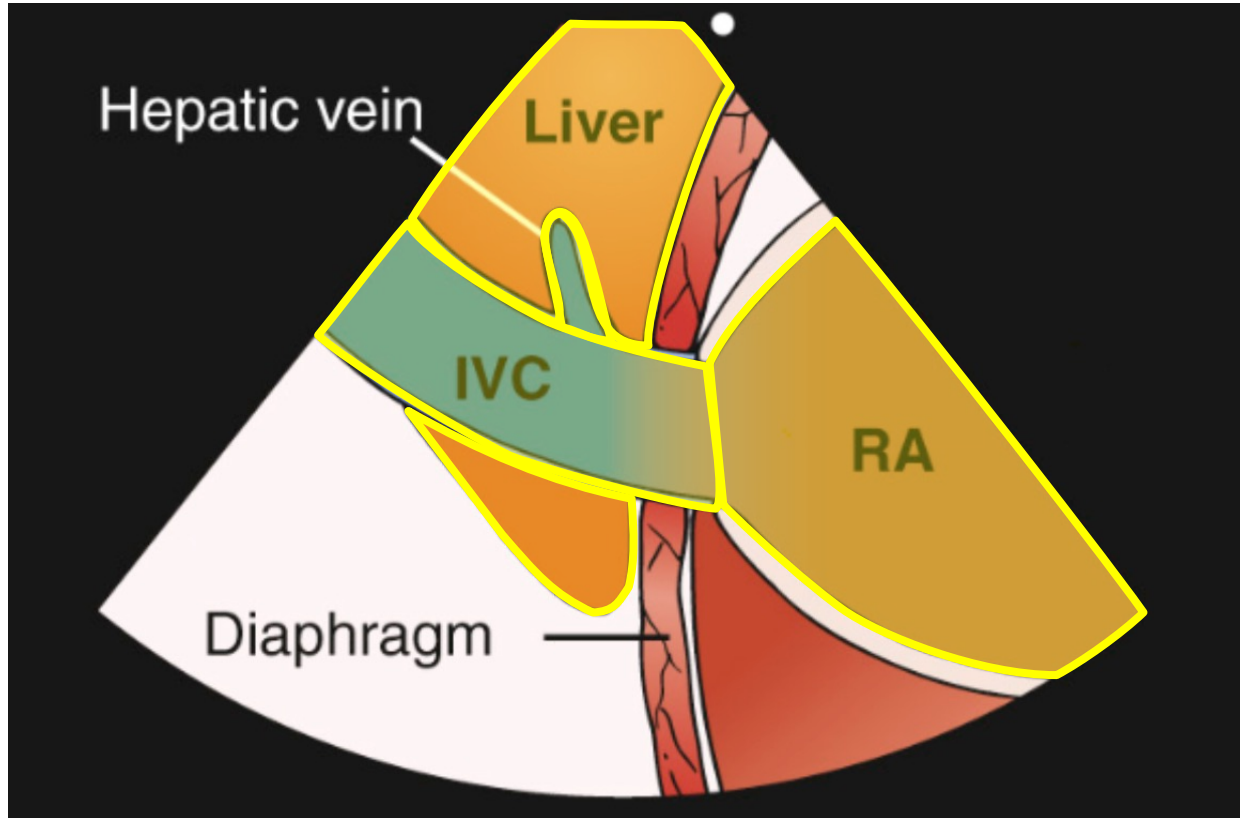


- Transducer: Start from the SC4
 - Fan to position probe perpendicular to skin
 - Rotate 90° counterclockwise
- Index marker: Cephalad
- Align the ultrasound beam with inferior vena cava long axis
- Rock cephalad to visualize the right atrium

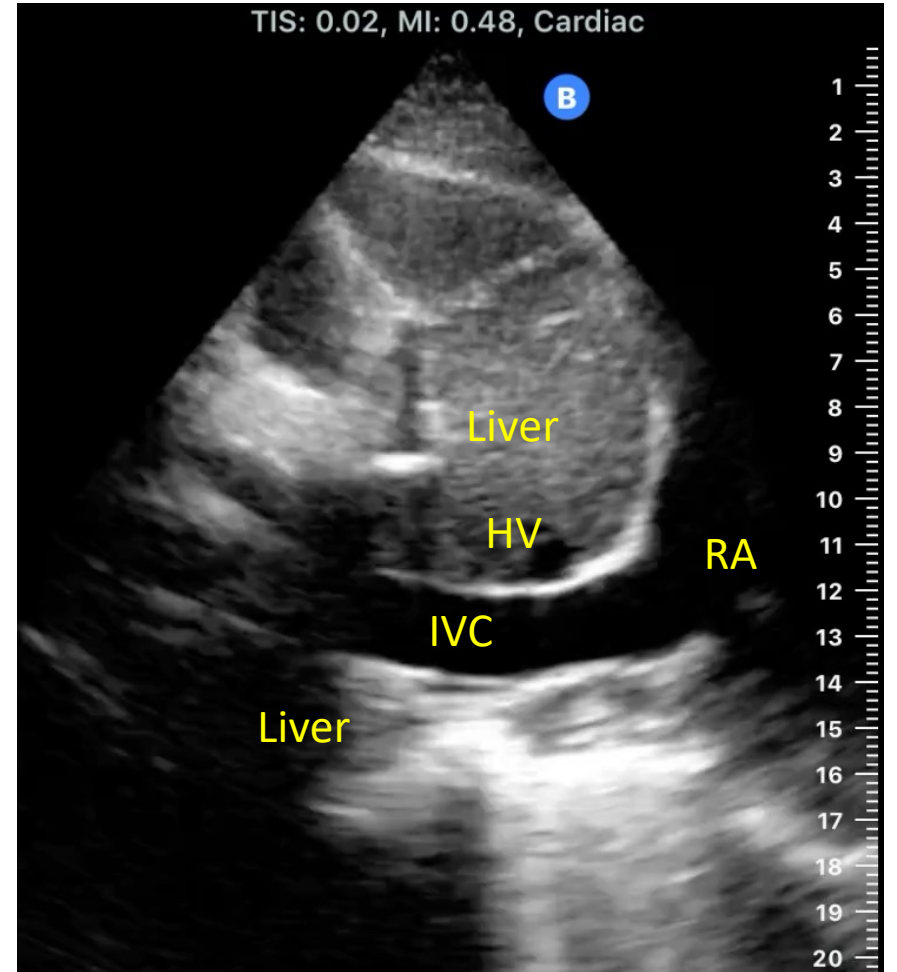
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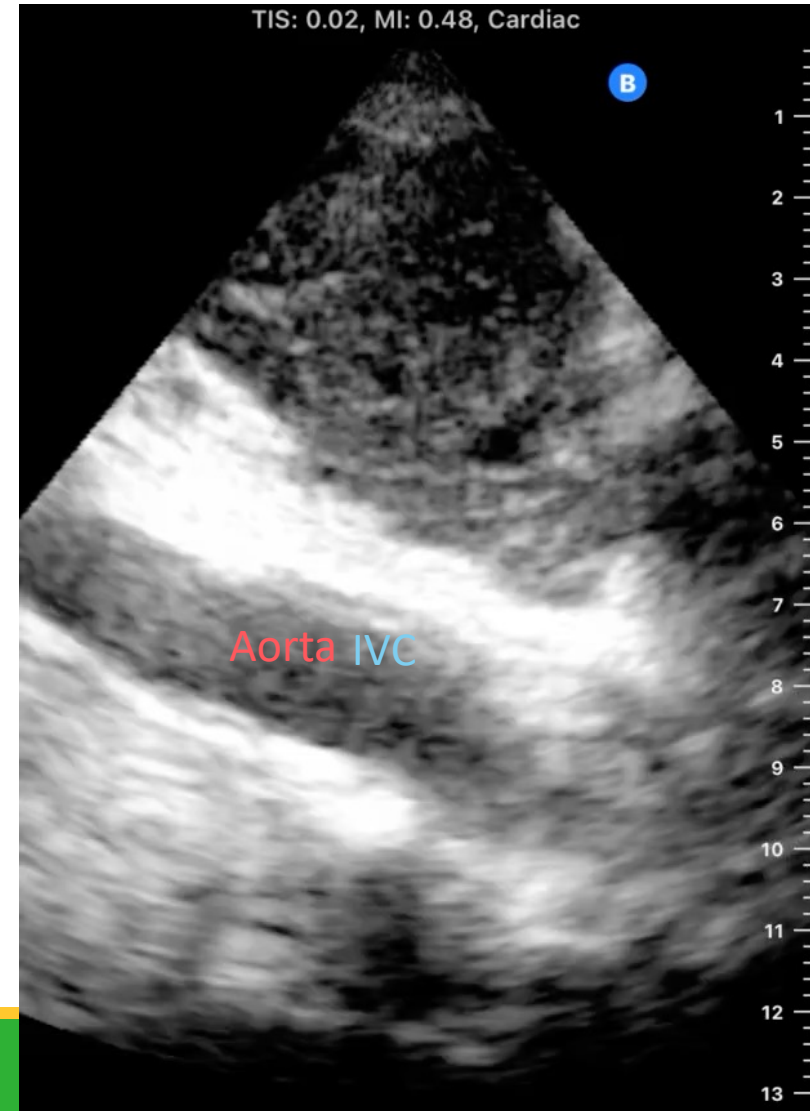
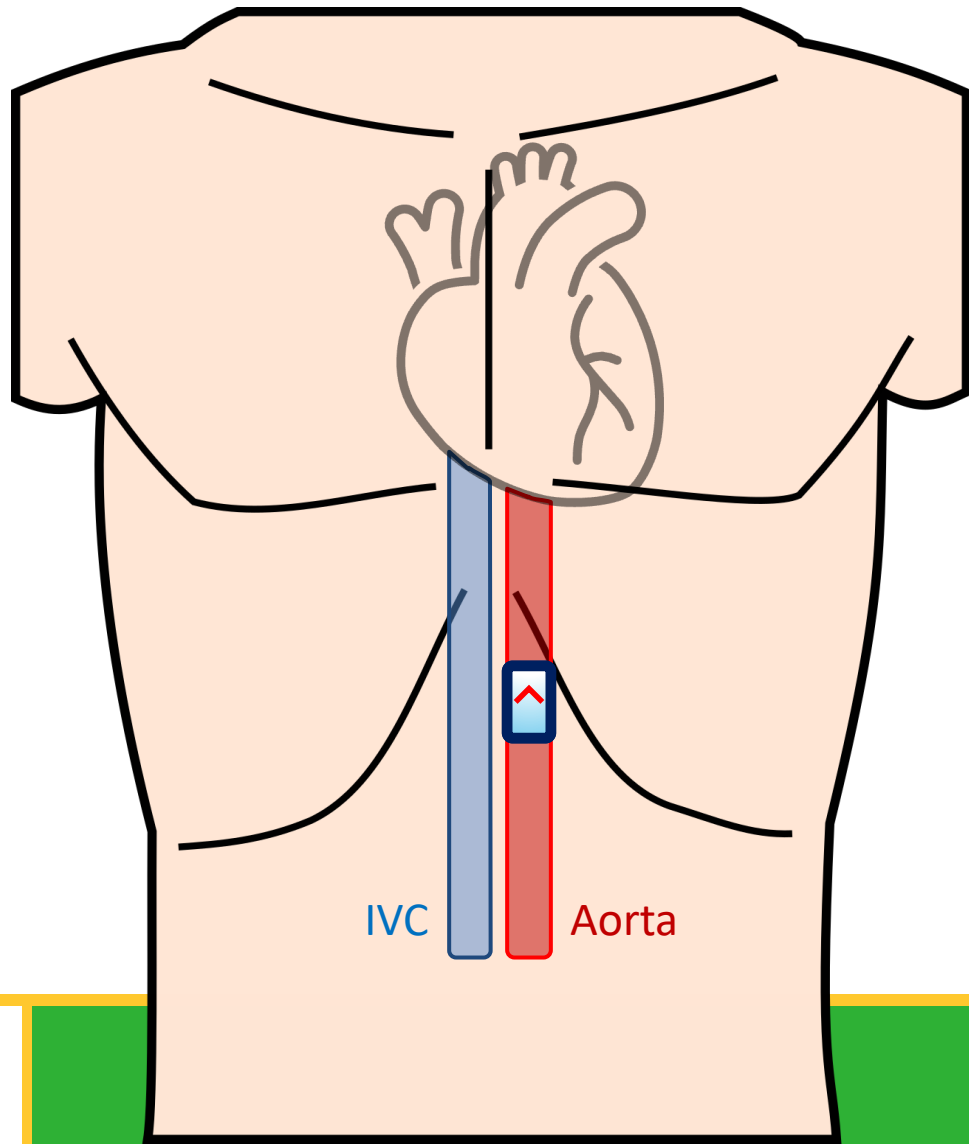
Subcostal Inferior Vena Cava



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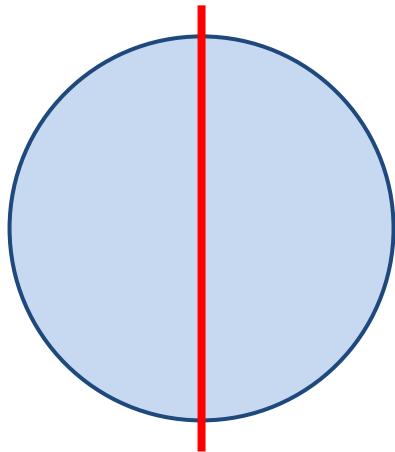


Watch Out for the Aorta!

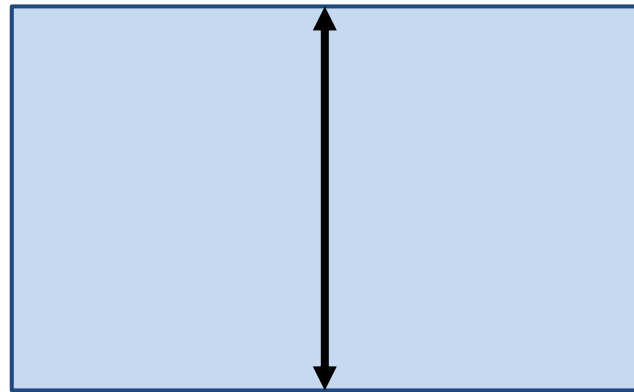


Subcostal Inferior Vena Cava

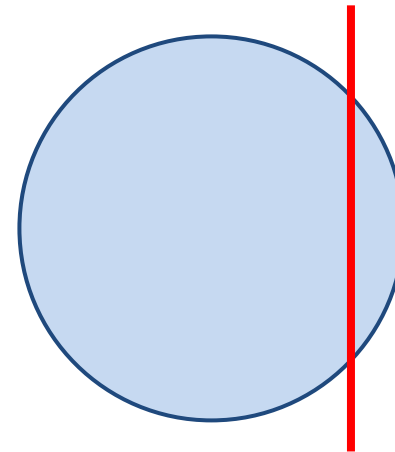
- Identify by landmarks: Right atrium, hepatic vein, liver
- Estimate the diameter 1-2cm from the right atrial junction
- Off axis imaging can significantly alter the IVC diameter



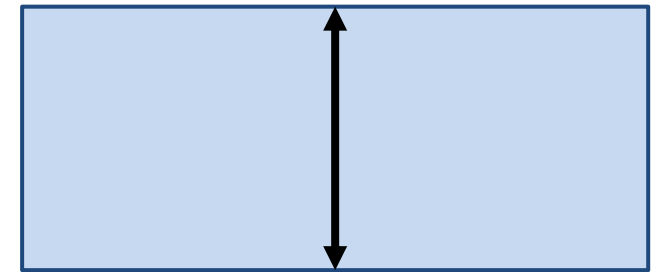
On axis



Accurate Diameter



Off axis

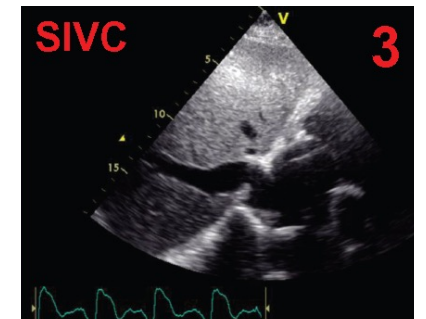


False Diameter

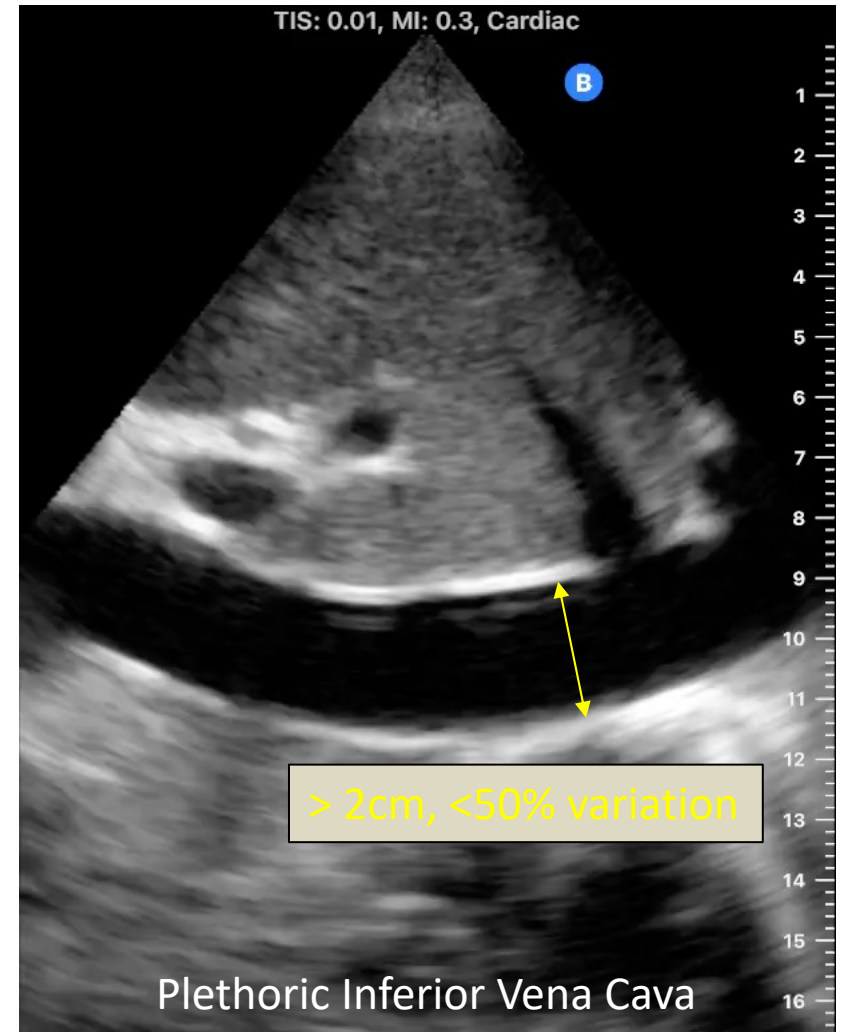
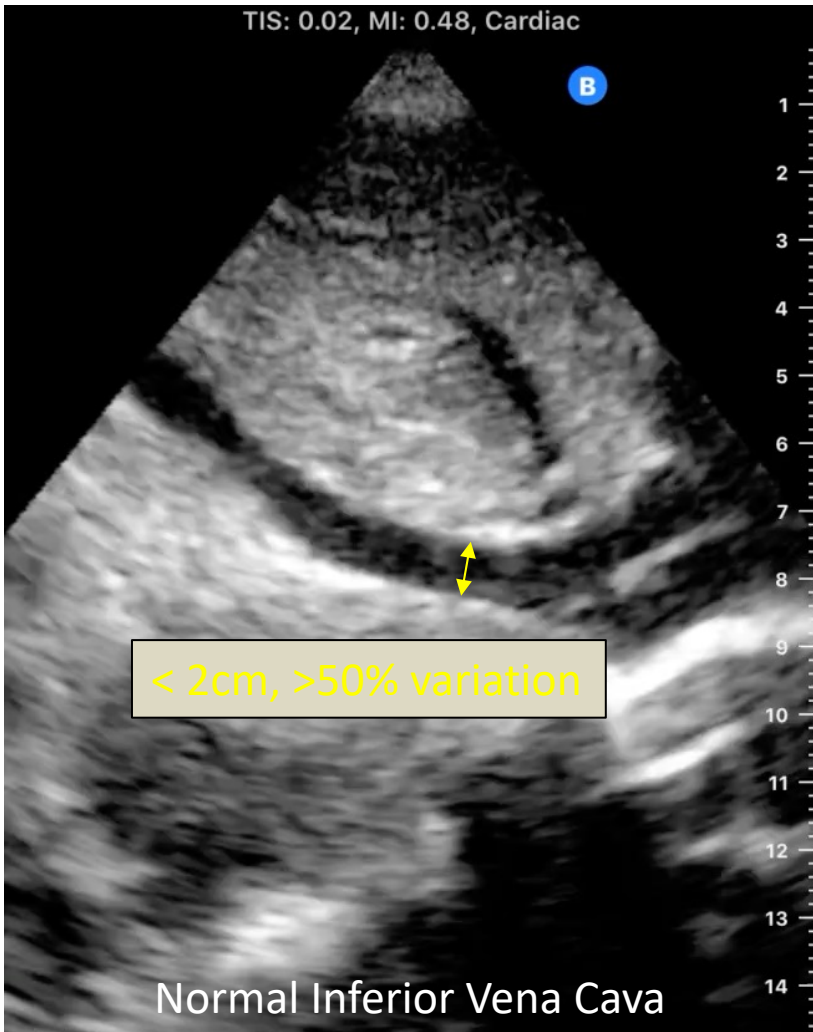
Subcostal Inferior Vena Cava

IVC Diameter and Respiratory Variation	Qualitative Interpretation	Estimated CVP (mmHg)
≤ 2.1 cm and > 50 %	Normal	0 - 5 (3)
≤ 2.1 cm and < 50 % or > 2.1 cm and > 50 %	Intermediate	5 - 10 (8)
> 2.1 cm and < 50 %	High	10 - 20 (15)

Adapted from Point of Care Ultrasound 2nd edition. N. Soni



Subcostal Inferior Vena Cava



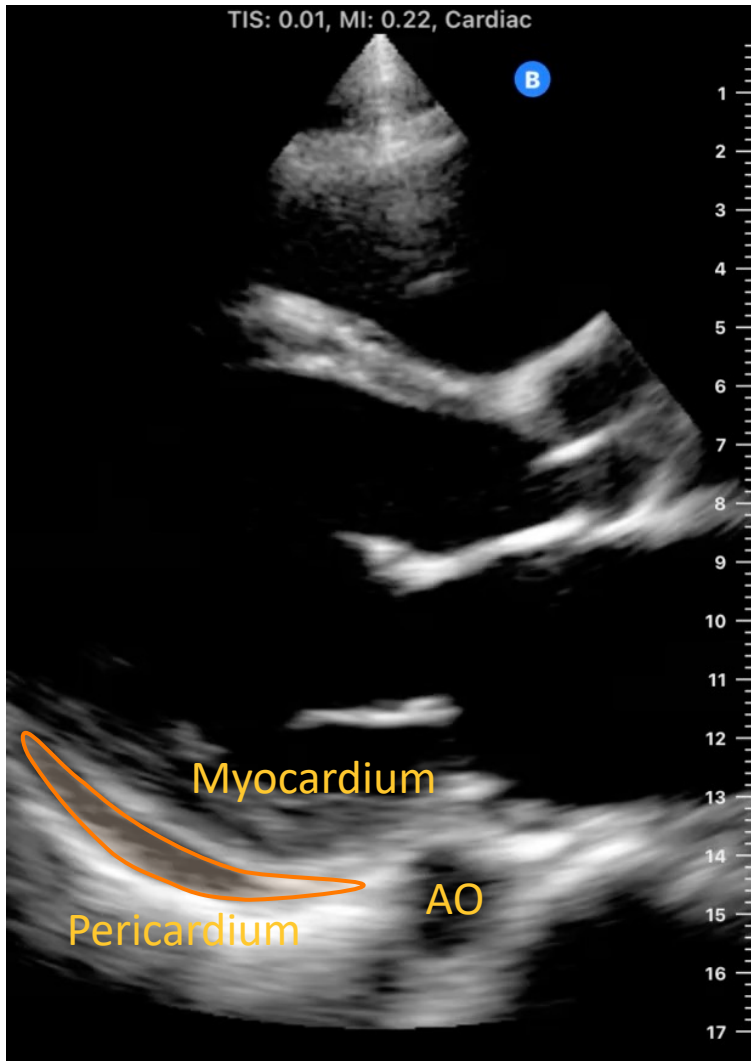
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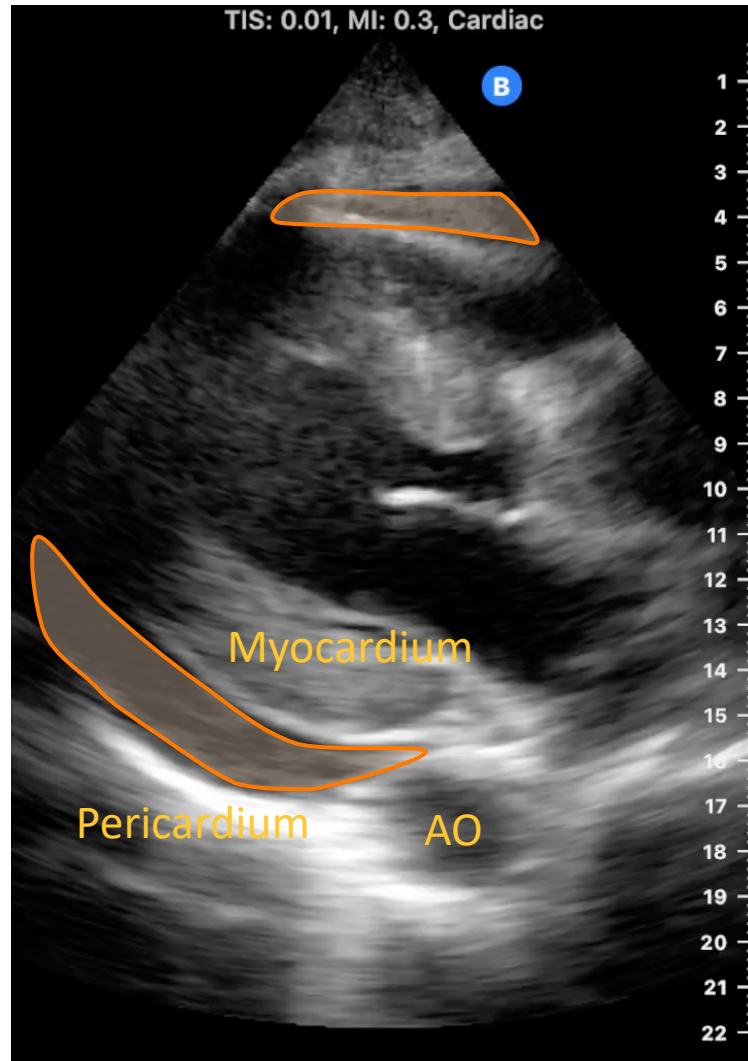
Pericardial Effusion

- Fluid accumulates between the parietal pericardium and myocardium
- Layers anterior to the descending thoracic aorta
- Sensitivity: 96%, specificity 98%
- Estimate size in end diastole: Small (< 1cm), Moderate (1 - 2cm), Large (> 2cm)

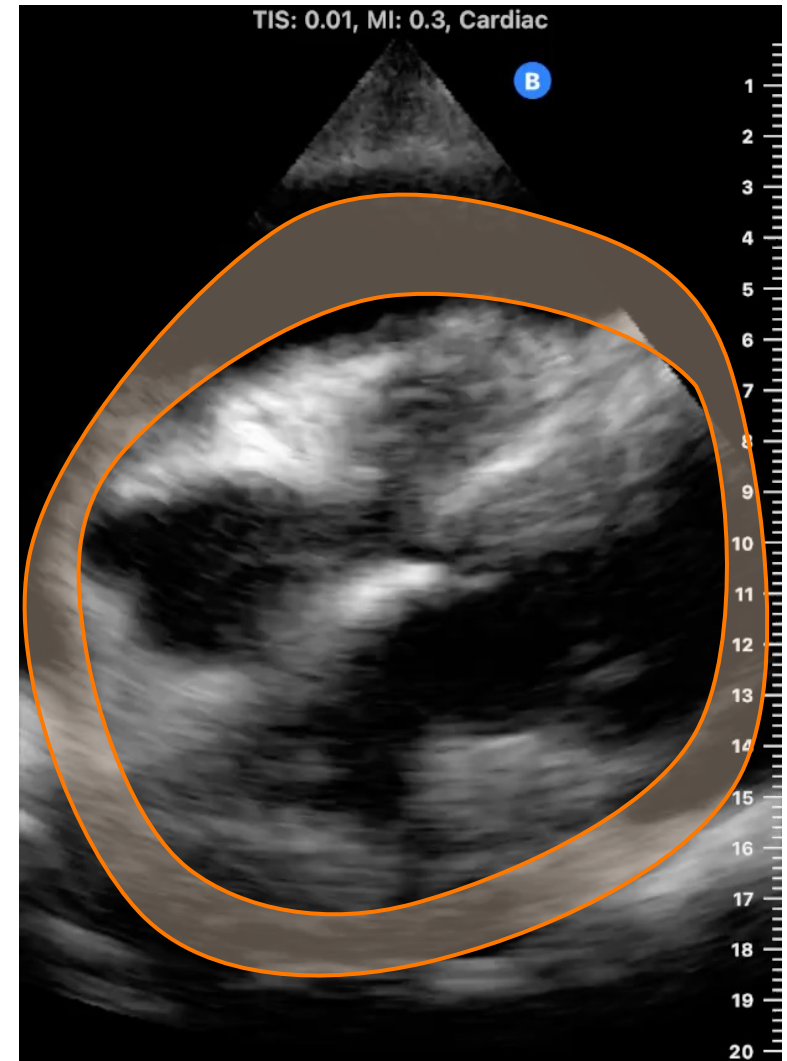
Pericardial Effusion



Parasternal Long



Parasternal Long

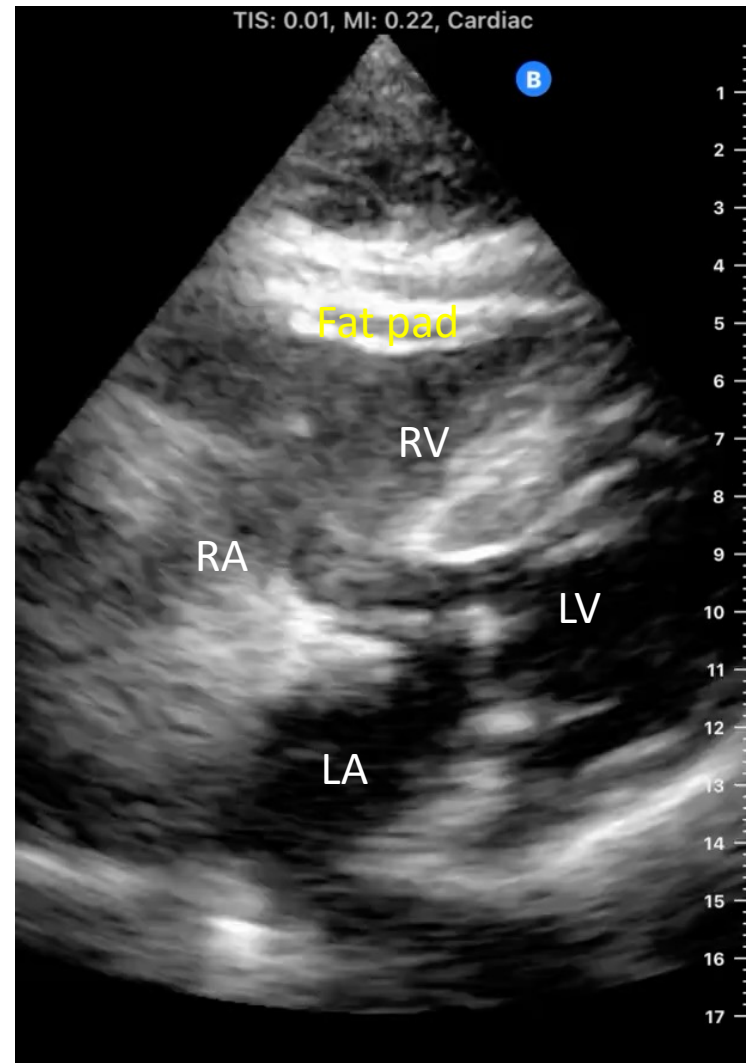


Subcostal Four

Pericardial Effusion Mimickers

1. Epicardial fat pad

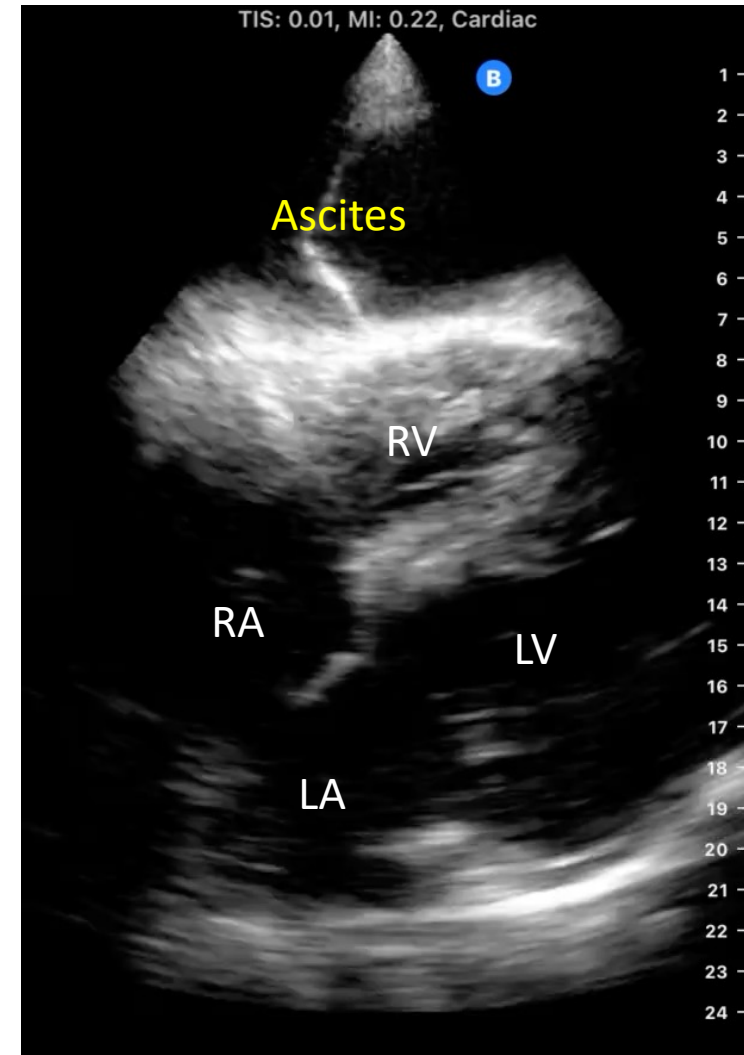
- Located along the right ventricular free wall
- Some echogenicity is present



Pericardial Effusion Mimickers

2. Ascites

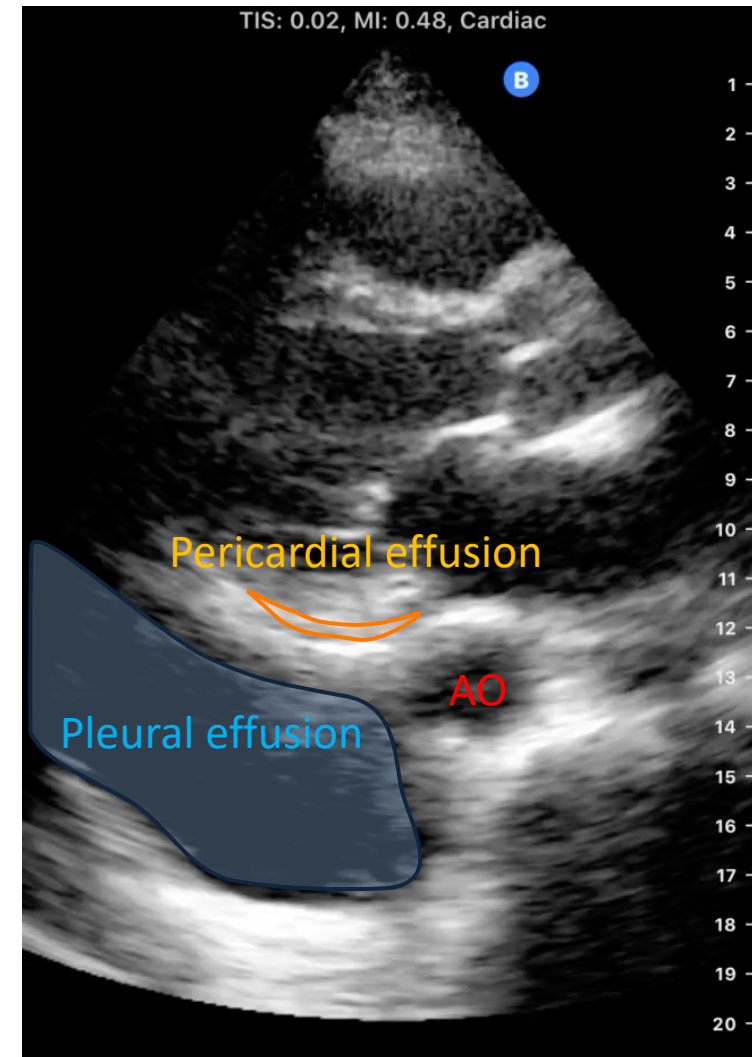
- Visualized in the subcostal four chamber view
- Falciform ligament may be seen



Pericardial Effusion Mimickers

3. Pleural effusion

- Best seen in the parasternal long axis view
- Layers posterior to the descending thoracic aorta



Take Home Points

- Use phased-array transducers in cardiac convention
- Estimate left ventricular function with 1) endocardial excursion, 2) myocardial wall thickening and 3) anterior mitral valve motion
- Use inferior vena cava to assist in evaluating volume status
- Pericardial effusion layers anterior to the descending thoracic aorta while pleural effusions layer posterior to it

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Q&A

Thank You!