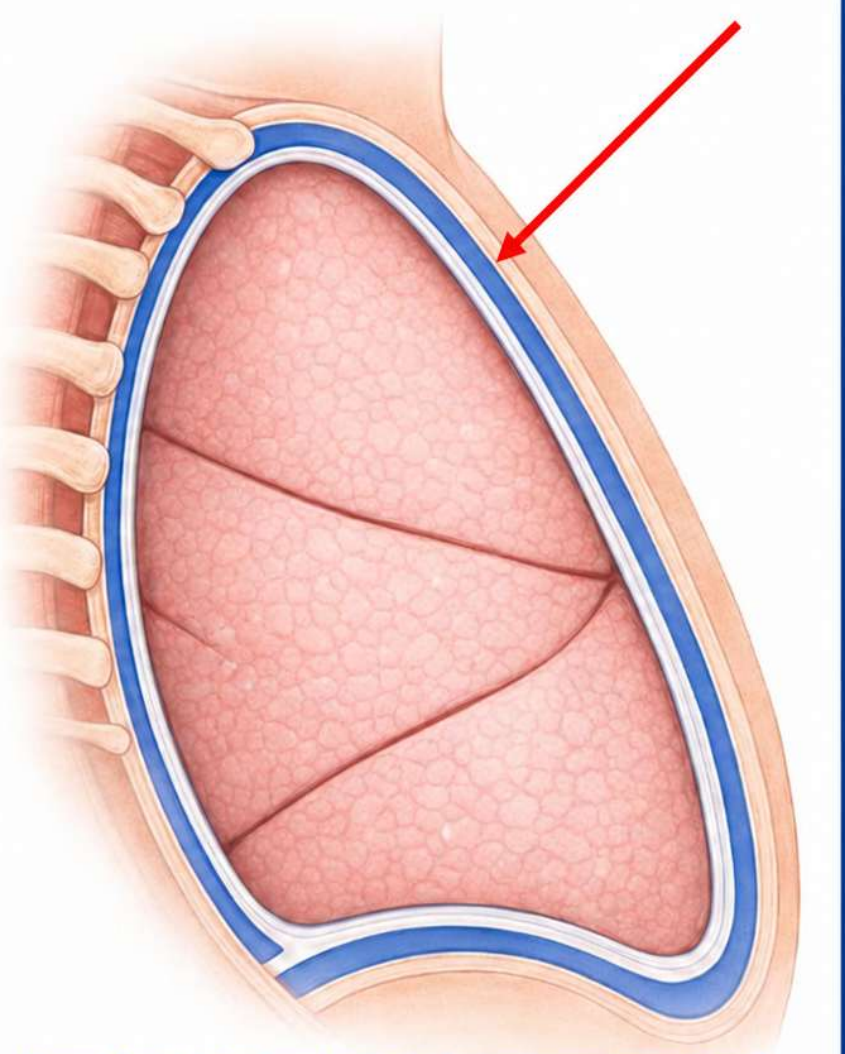
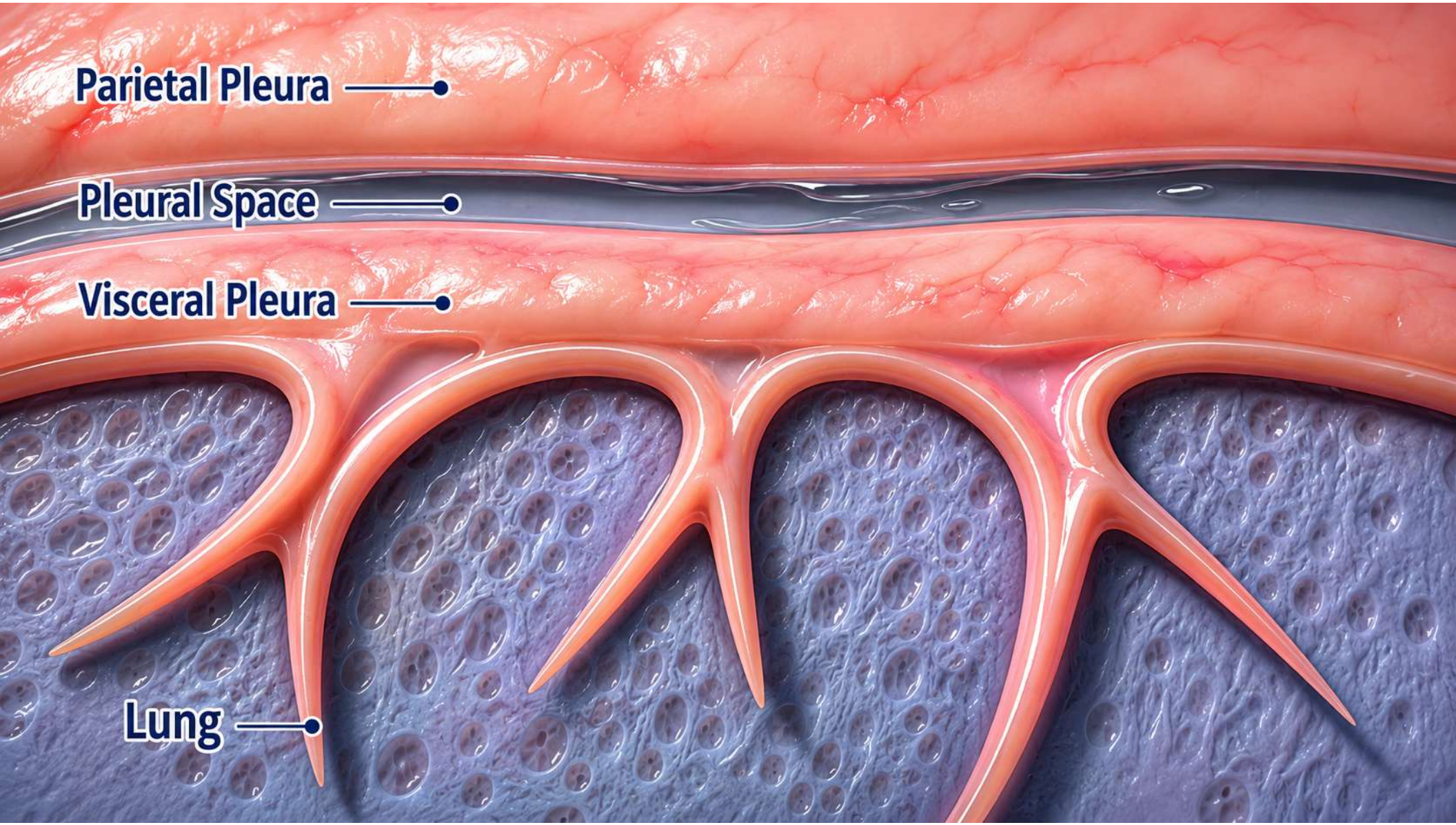


Microsoft Copilot. *Pleural Space Identified* [artificial intelligence–generated image]. Created March 22, 2026.

A&P 101

- What is this?
- What is its purpose?
- How does it tie into lung ultrasound?


Parietal Pleura
Pleural Space
Visceral Pleura
Lung

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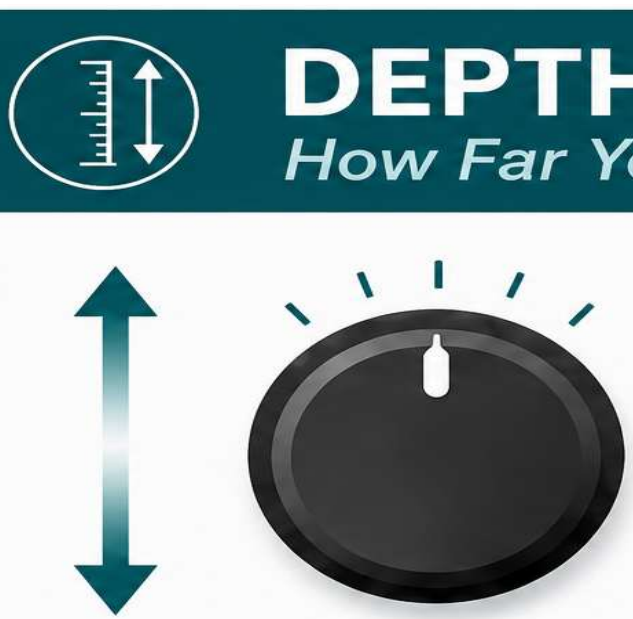
MHz

Key point: The smaller the MHz, the greater the depth.

BASIC KNOBology

DEPTH

How Far You See



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- Increase depth = view deeper (structures appear smaller)
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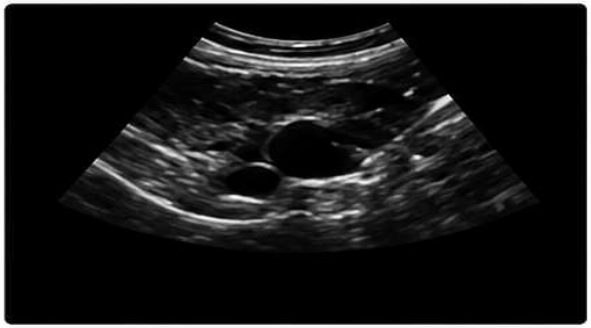
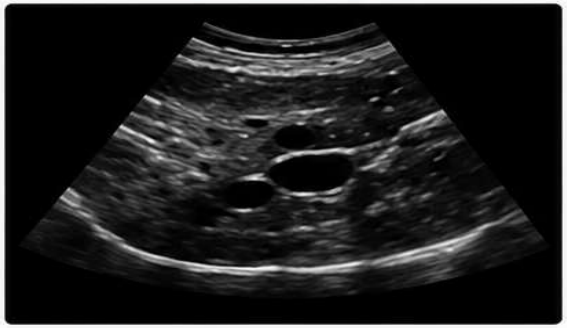
EXAMPLE

Shallow Depth



Optimal Depth



Deep Depth

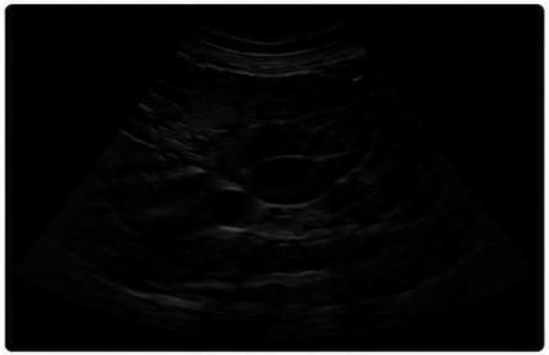
Shallower → **Deeper**

GAIN
BRIGHTNESS

- Adjusts the overall brightness (amplification) of returning echoes.
- Increase gain = brighter image (more noise)
- Decrease gain = darker image (less noise)

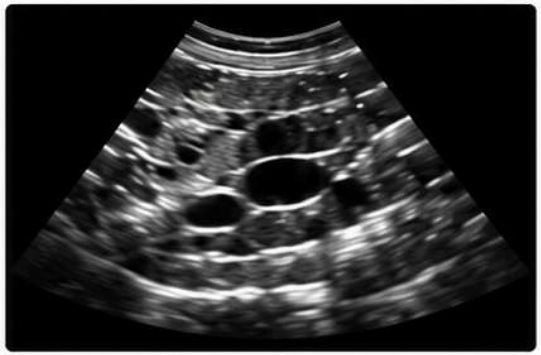
EXAMPLE

Low Gain



Optimal Gain

High Gain



Darker → **Brighter**

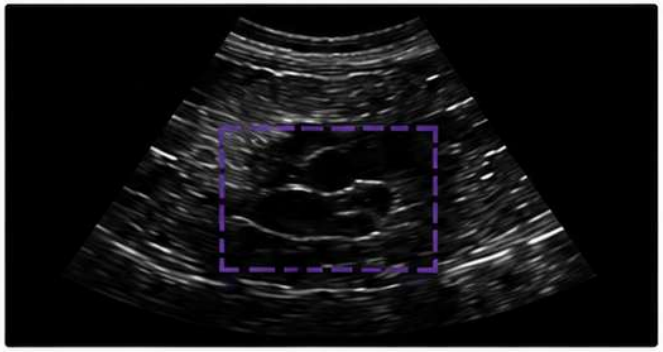
ZOOM

Magnify the Area

- Magnifies a specific area without changing depth.
- Improves detail and resolution of the area of interest.
- Move the box to the area you want to zoom.

EXAMPLE

Zoom Off (Wide View)



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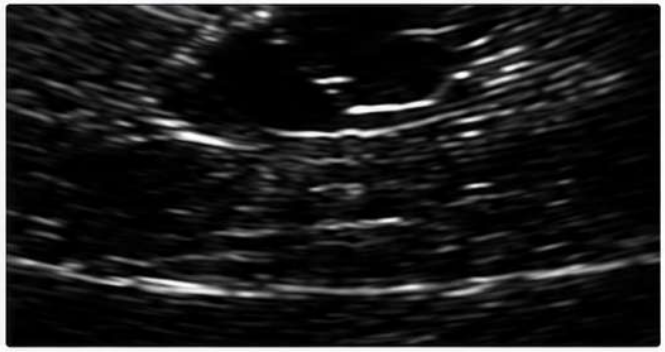
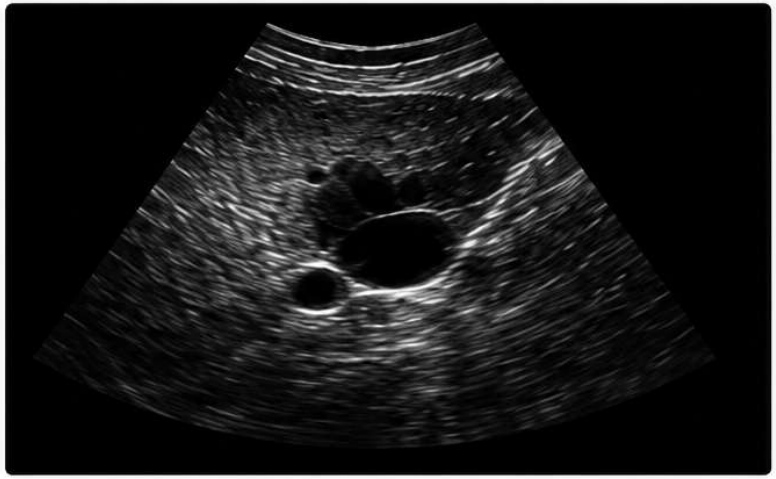


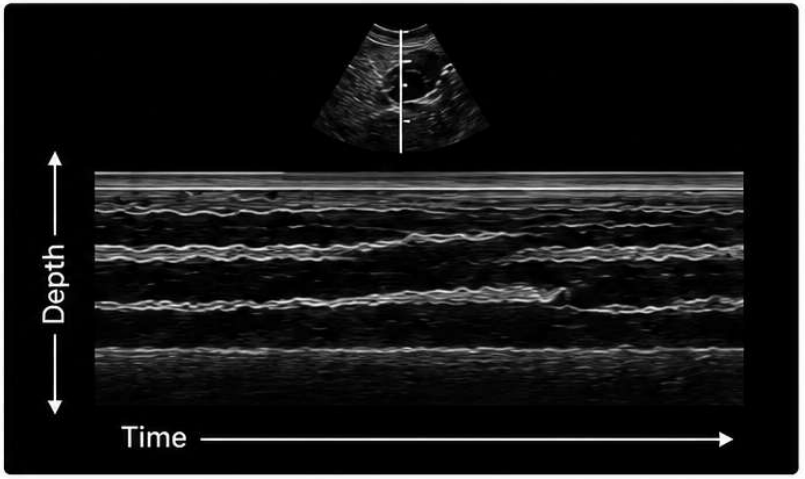
ULTRASOUND MODES

B-MODE (BRIGHTNESS MODE)
2D Grayscale Imaging



- Produces a two-dimensional image of anatomy.
- Different tissue densities create different shades of gray.
- Excellent for evaluating structure, size, shape, and pathology.
- Most commonly used mode in clinical practice.

M-MODE (MOTION MODE)
One-Dimensional Motion Imaging



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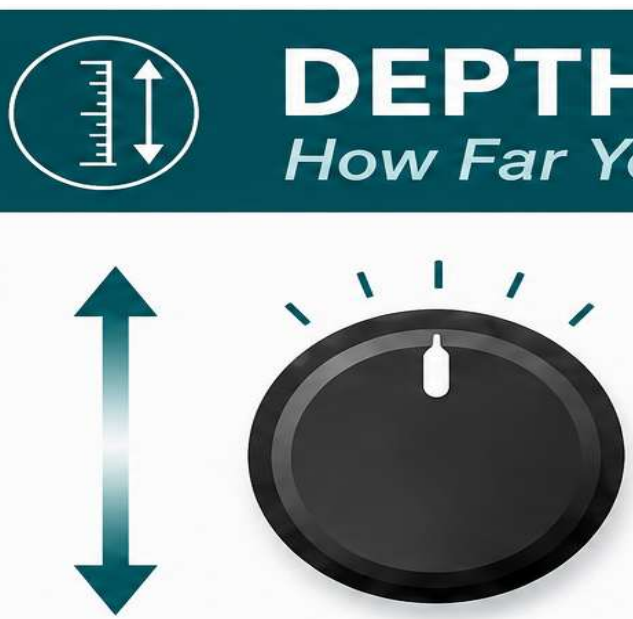

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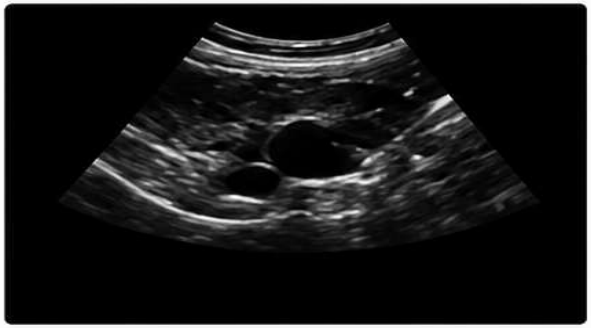

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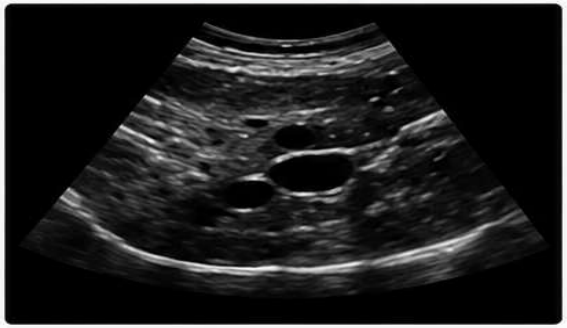

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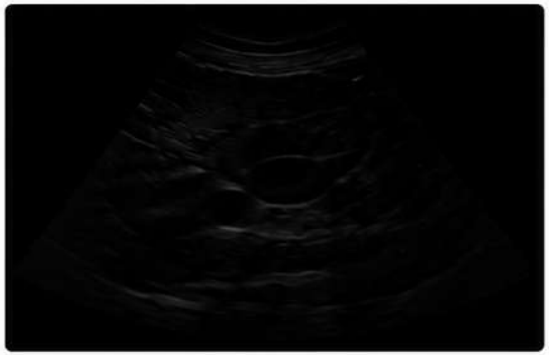

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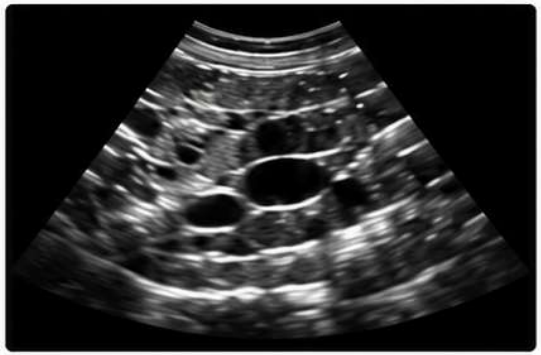

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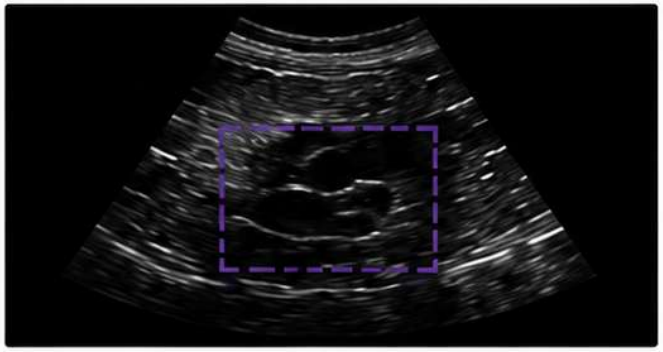

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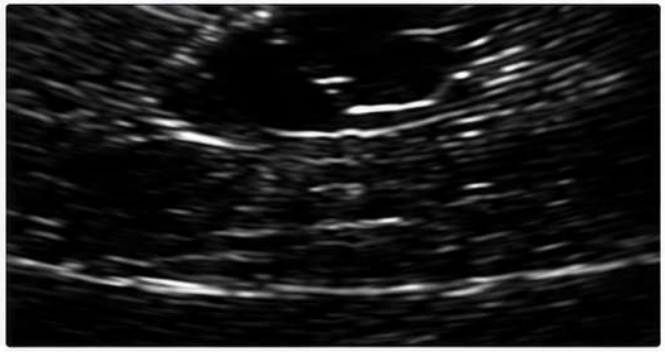

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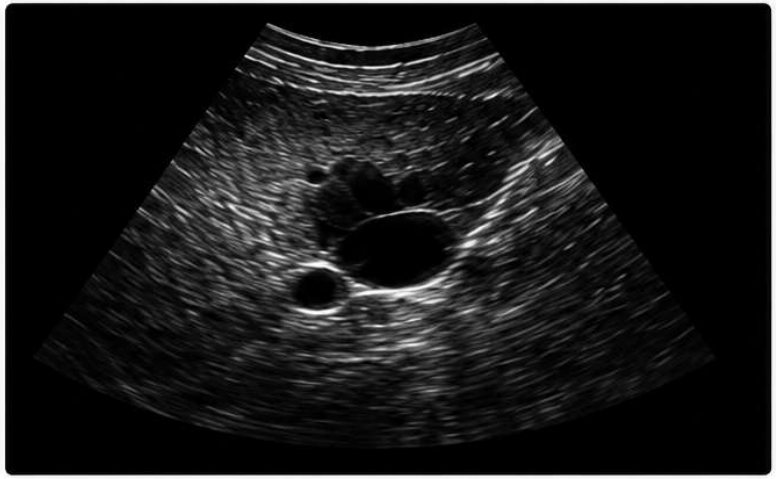

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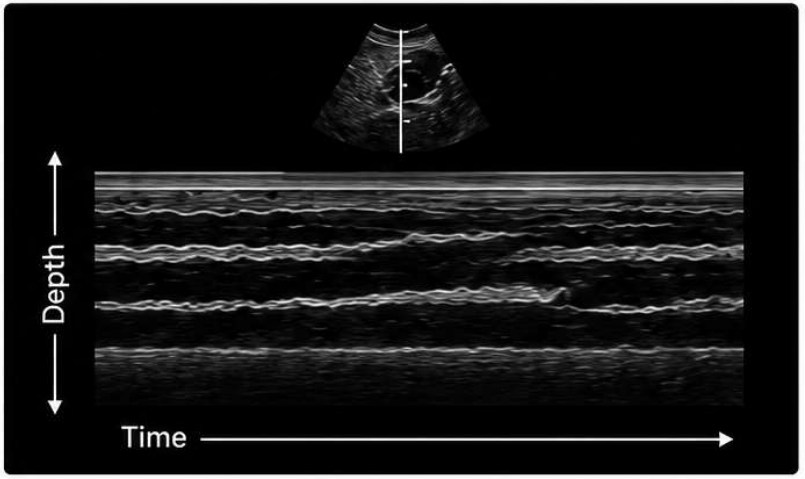

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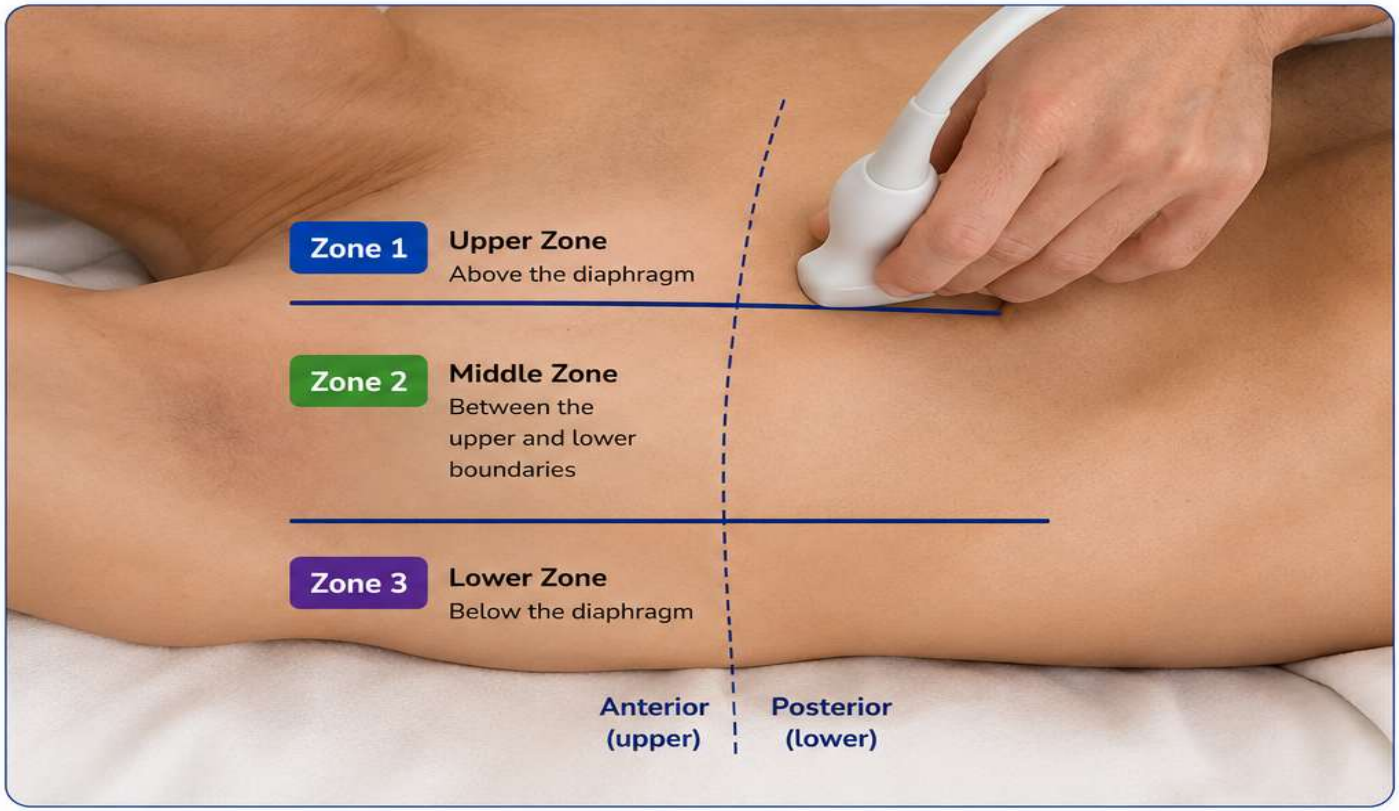
Application of Lung Ultrasound (LUS)

The hemithorax is divided into 3 zones in the longitudinal orientation.



Zone 1 – Upper Zone

- From the lung apex to the upper boundary of the diaphragm.
- Includes the upper anterior and posterior areas.

Zone 2 – Middle Zone

- Between the upper and lower boundaries.
- Includes the lateral thoracic wall.

Zone 3 – Lower Zone

- From the lower boundary of the diaphragm to the costophrenic angle.
- Includes the lower anterior and posterior areas.

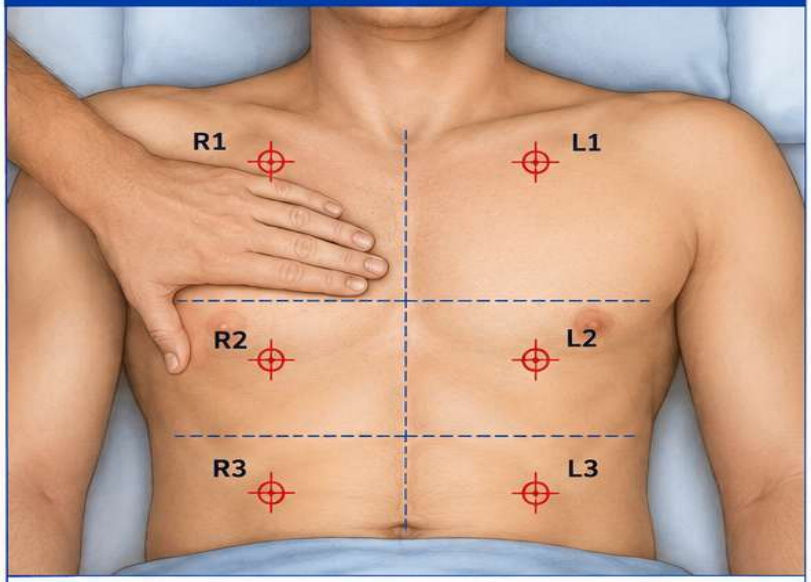
Tip: Systematic scanning of all 3 zones on each hemithorax helps detect and monitor pulmonary pathology effectively.

Lichtenstein D, Curr Opin Crit Care 2014;20:315-322

Lung Ultrasound (LUS) – Probe Placement

Systematic scanning of key points on the anterior and lateral chest.

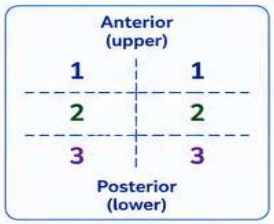
1. ANTERIOR CHEST – 6 ZONES



R1/L1 **Upper Zone**
Above the diaphragm

R2/L2 **Middle Zone**
Between the upper and lower boundaries

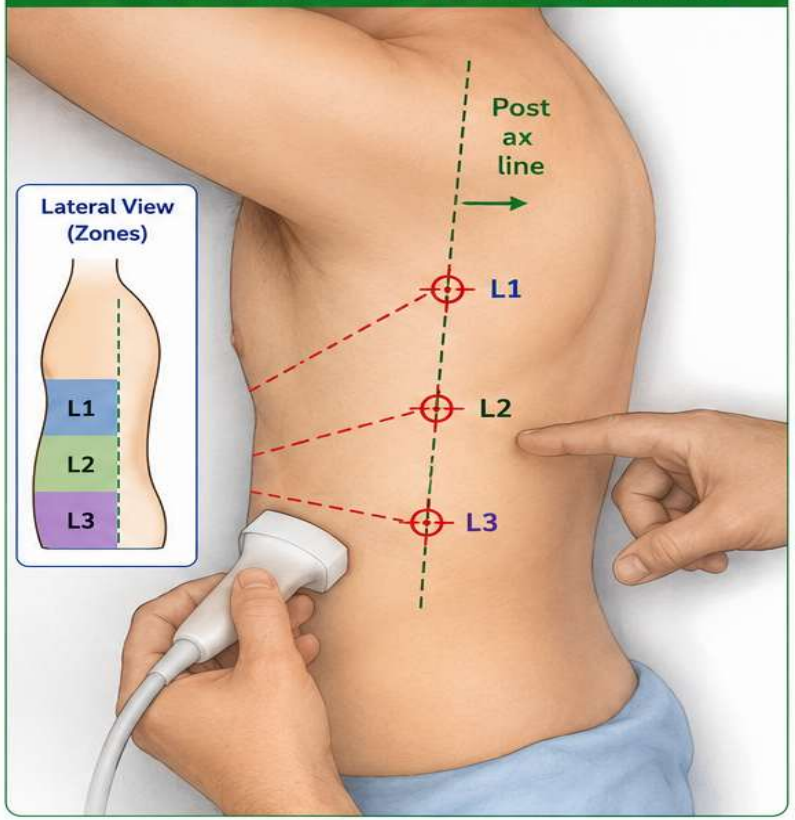
R3/L3 **Lower Zone**
Below the diaphragm



Key Points

- Scan each zone systematically bilaterally.
- Compare symmetry between right and left hemithorax.
- Use a systematic approach to avoid missing pathology.

2. LATERAL CHEST – POSTERIOR AXILLARY LINE



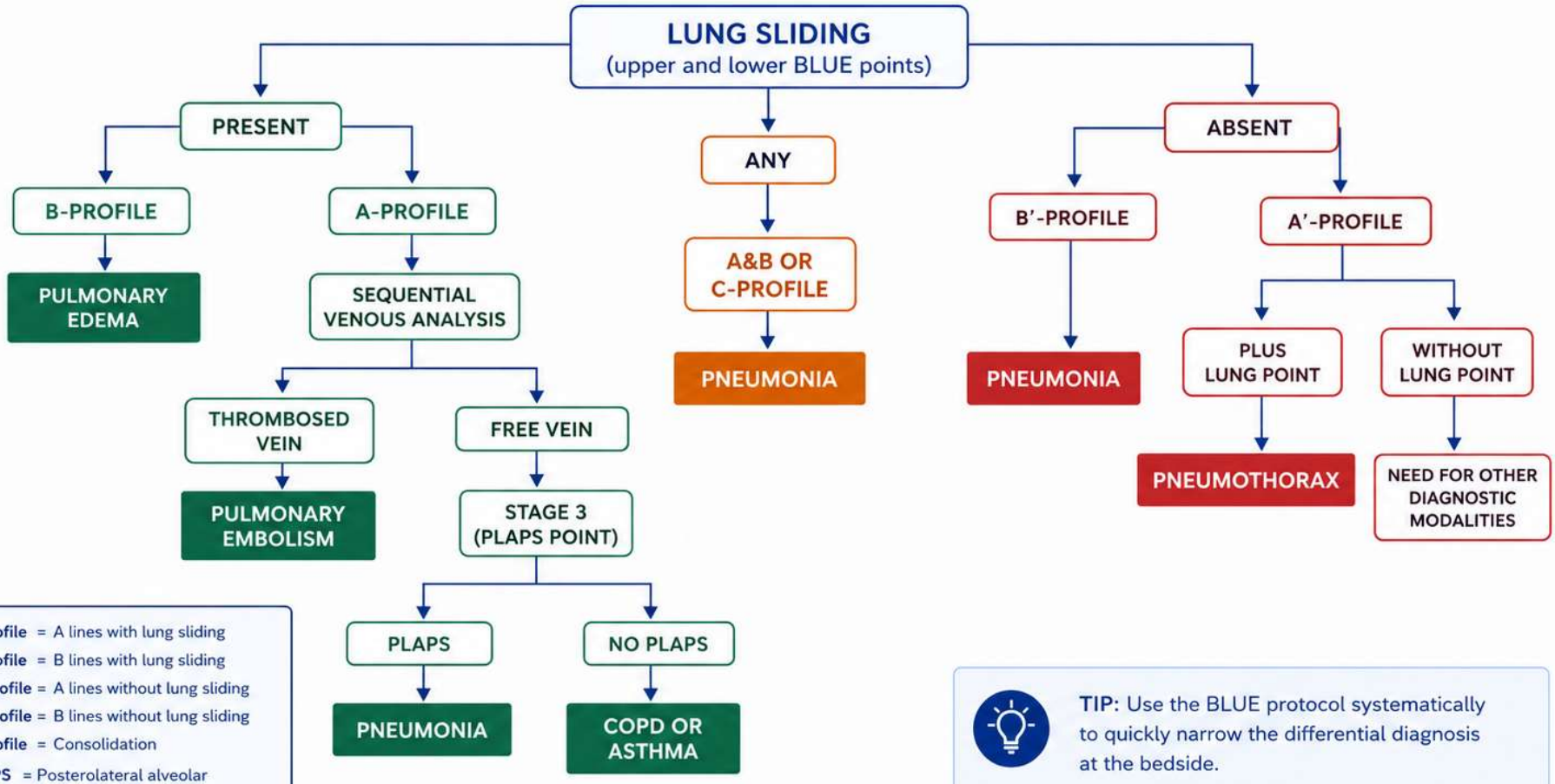
Tip: Use a systematic approach and scan all 6 anterior zones and 3 lateral zones on each hemithorax for a complete evaluation.

Lichtenstein D, Curr Opin Crir Care 2014:20:315-322

The BLUE Protocol

Bedside Lung Ultrasound in Emergency (Lung Sliding + Upper and Lower BLUE Points)

NephroPOCUS



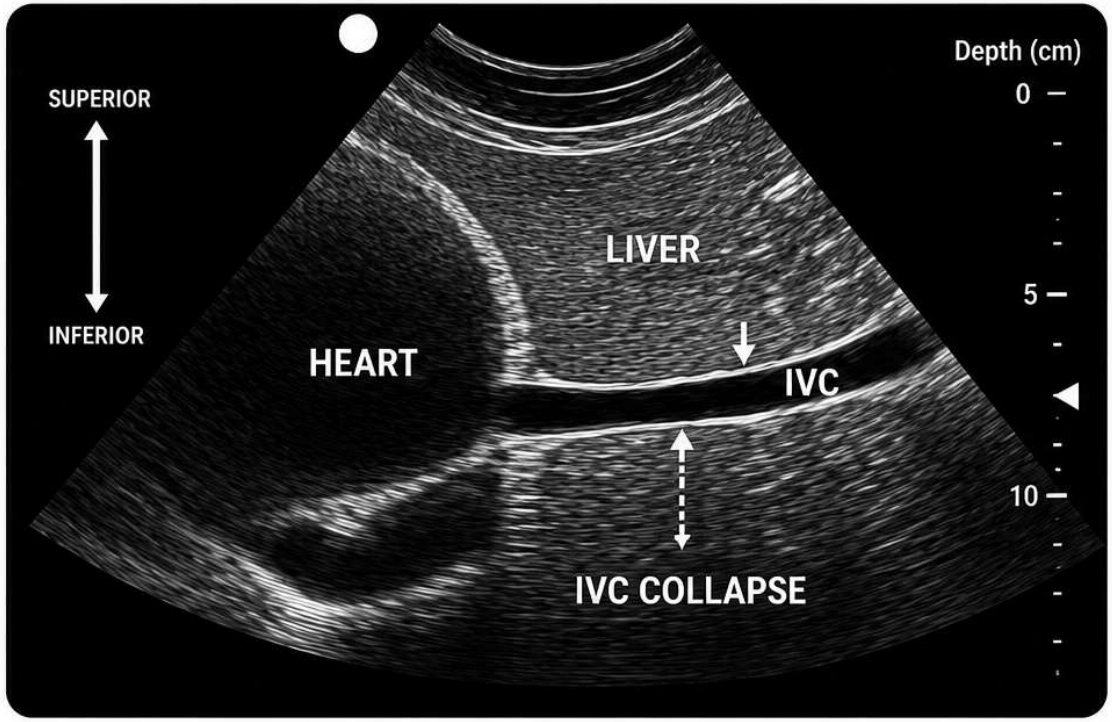
A-profile = A lines with lung sliding
B-profile = B lines with lung sliding
A'-profile = A lines without lung sliding
B'-profile = B lines without lung sliding
C-profile = Consolidation
PLAPS = Posterolateral alveolar and/or pleural syndrome

TIP: Use the BLUE protocol systematically to quickly narrow the differential diagnosis at the bedside.

Flowchart from: *Intensive Care Med.* 2019; doi: 10.1007/s00134-019-05725-8

INFERIOR VENA CAVA (IVC) – NORMAL

Normal IVC with >50% Inspiratory Collapse



NORMAL VOLUME STATUS

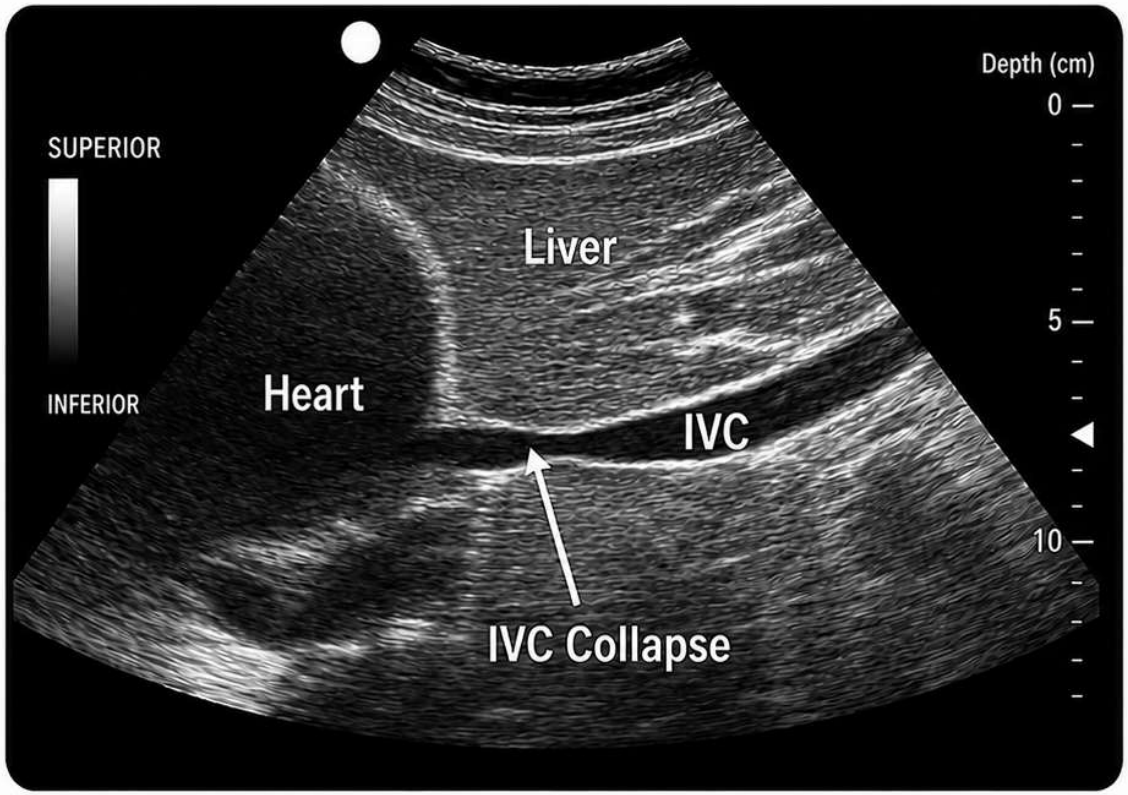
- IVC diameter < 2.1 cm
- > 50% inspiratory collapse

Estimated CVP: 0 – 5 mmHg

CLINICAL PEARLS: A normal IVC suggests normal intravascular volume and right atrial pressure. IVC ultrasound should always be interpreted within the patient's overall clinical picture. Mechanical ventilation, elevated intra-abdominal pressure, and right heart disease can alter IVC measurements and reduce diagnostic accuracy.

INFERIOR VENA CAVA (IVC) ASSESSMENT

Estimating Intravascular Volume Status

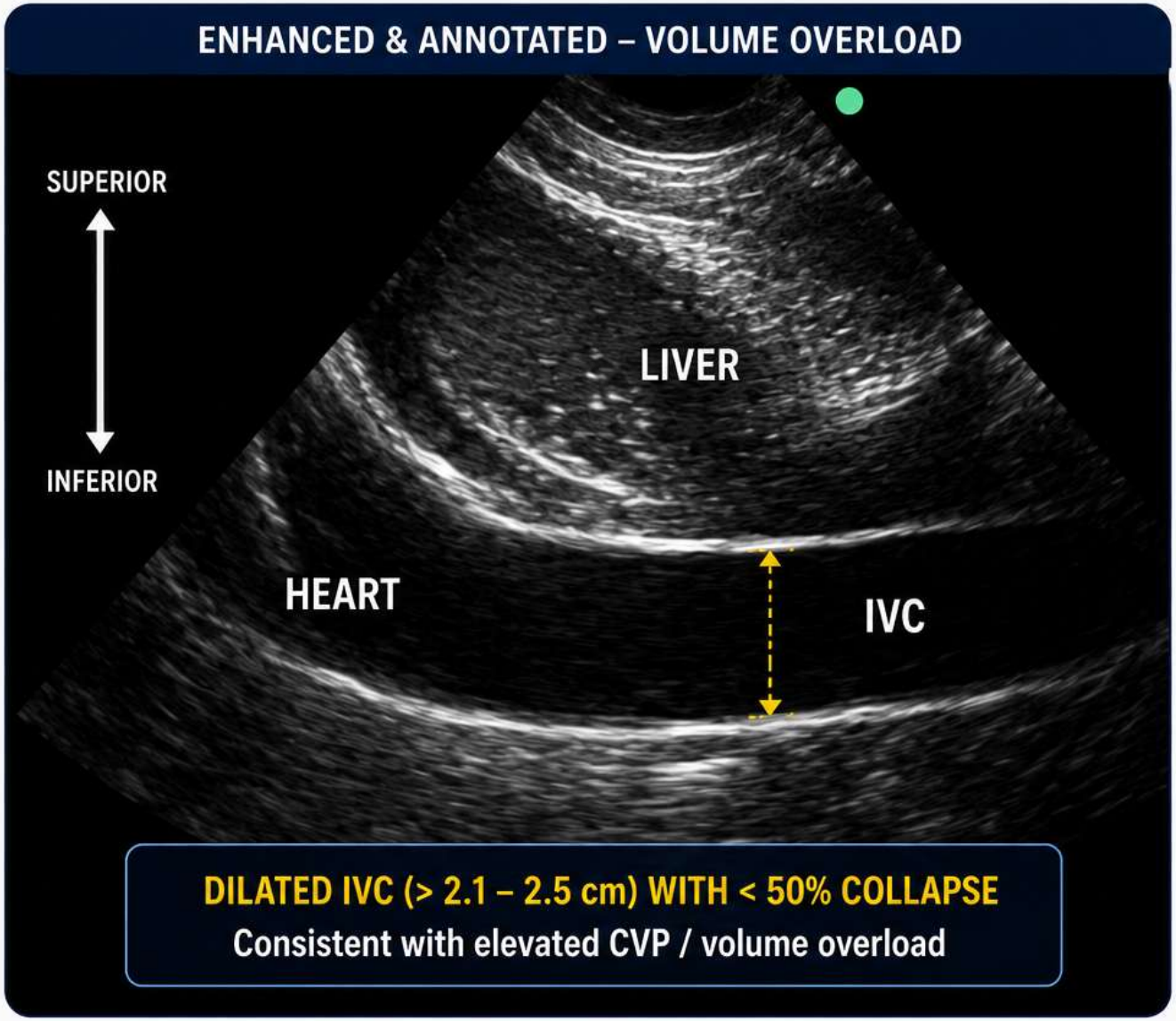


VOLUME DEPLETION (HYPOVOLEMIA)

- Small IVC (< 1.5 – 2.0 cm)
- > 50% inspiratory collapse
- Suggests low right atrial pressure / low preload
- Common findings:
  - Tachycardia
  - Hypotension
  - Poor tissue perfusion

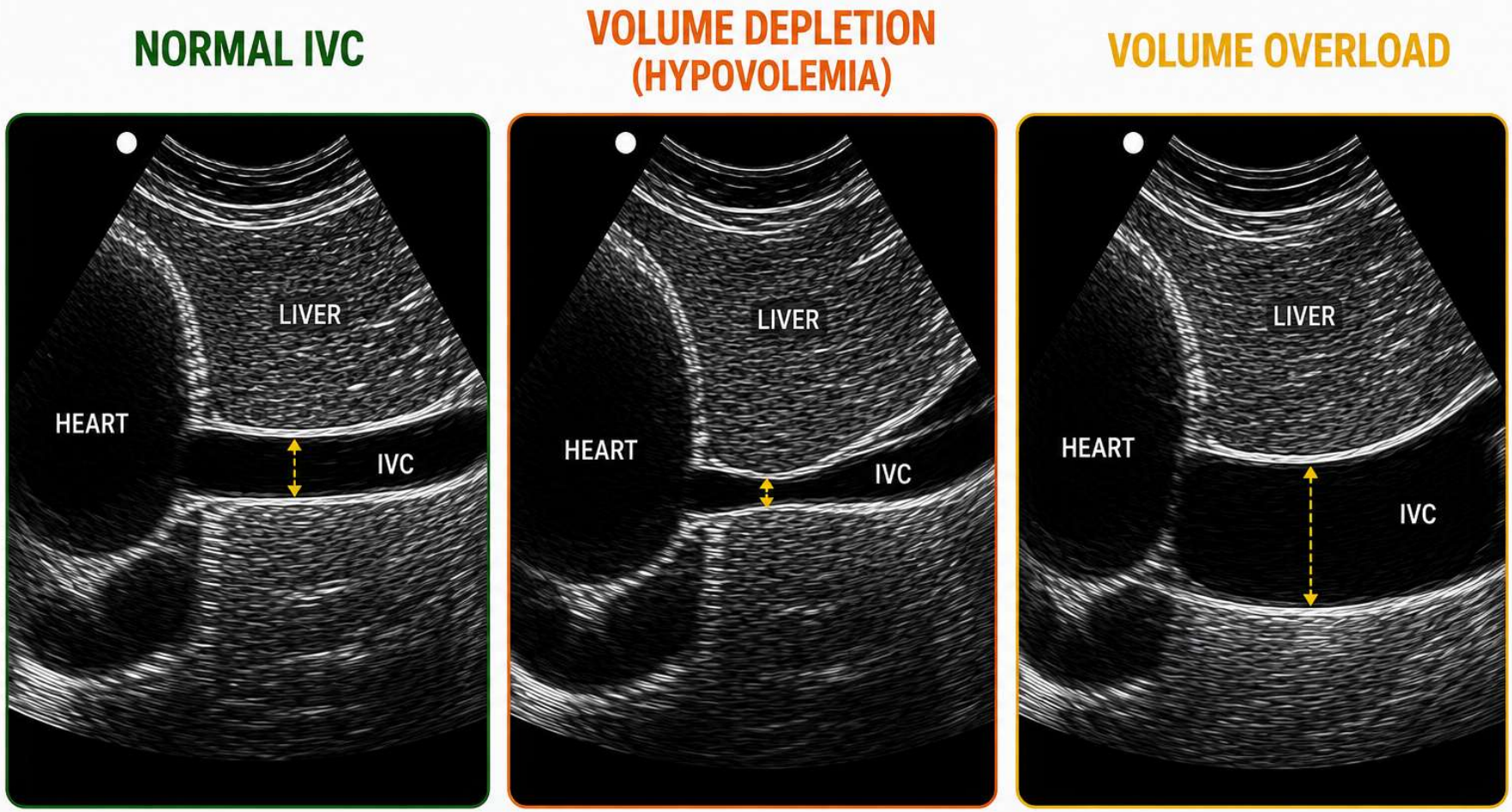
Estimated CVP: < 5 mmHg

CLINICAL PEARL: *IVC ultrasound should always be interpreted within the patient's overall clinical picture.* Mechanical ventilation, elevated intra-abdominal pressure, and right heart disease can alter IVC measurements and reduce diagnostic accuracy.



VOLUME OVERLOAD

- Dilated IVC
  > 2.1 – 2.5 cm
- < 50%
  inspiratory collapse
- Suggests elevated
  right-sided
  filling pressures
- Estimated CVP:
  10 – 20 mmHg


NORMAL IVC
LIVER
HEART
IVC
VOLUME DEPLETION
(HYPOVOLEMIA)
LIVER
HEART
IVC
VOLUME OVERLOAD
LIVER
HEART
IVC