

Chest Ultrasound

Anatomy and Abnormalities

Bronchoscopy and Pleural Boot Camp

Chat Box:

What's your ultrasound experience so far?

- No formal training
- On the job
- Formal curriculum
- Formal certification

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No Disclosures



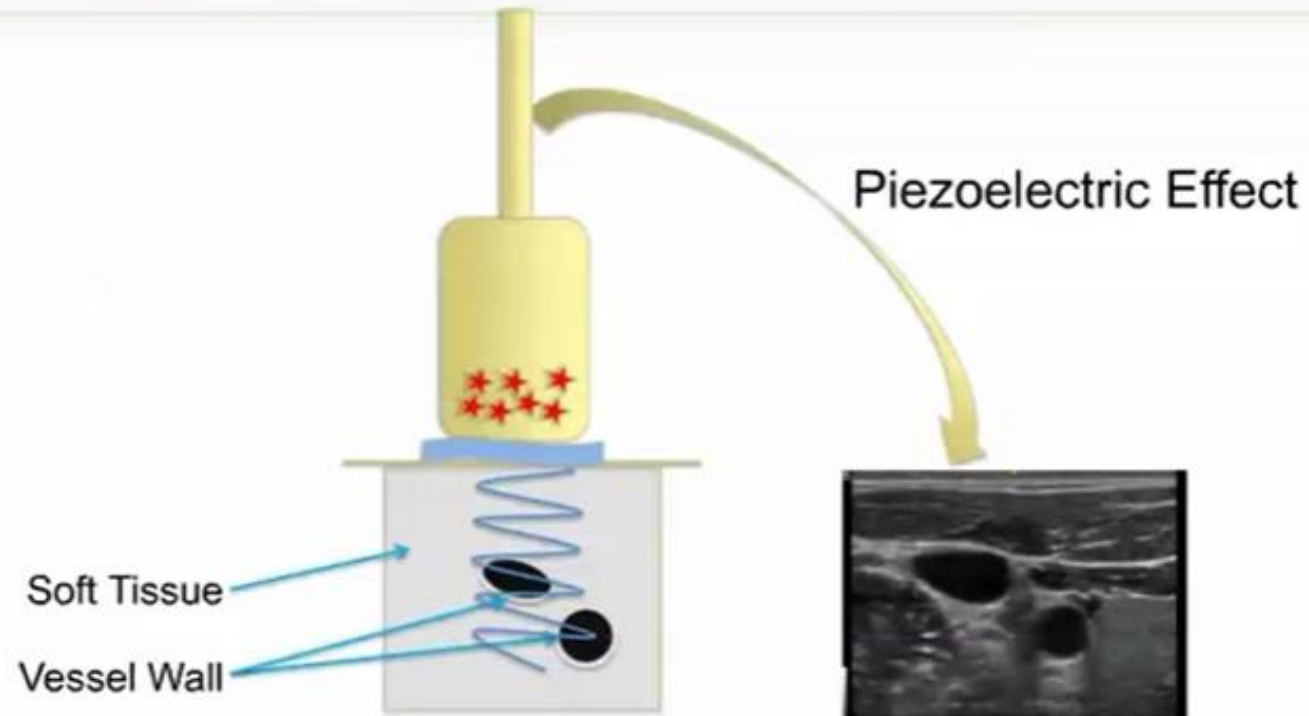
Goals

- Briefly review ultrasound basics
- Introduce lung ultrasound
- Define
 - Probe types for lung ultrasound
 - Scanning zones
 - Anatomy
 - Artifacts/Findings

Point of Care Questions:

1. Is the peripheral lung parenchyma normal?
2. Is there a pneumothorax?
3. Is there a pleural effusion?

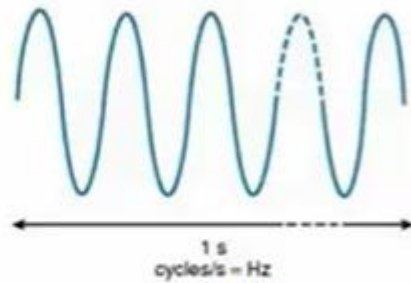
Physics of Ultrasound



Best of ATS video lecture series. US basics. Shailaja J Hatden MD, Amy Morris M.D. University of Washington

Physics of ultrasound

Physics of Ultrasound



FREQUENCY =
Number of cycles per second

Audible sound waves	20-20,000 Hz
Infrasound waves	<20 Hz
Ultrasound waves	>20,000 Hz
Medical ultrasound transducers	1-20 MHz



Introduction to Lung Ultrasound

- Much of lung US is determined on artifacts
- Normal aerated lung will scatter sound waves
- Can only detect pathology that reaches the lung periphery
- Superior to CXR

Lung ultrasound involves the interpretation of ultrasound artifacts

Before you scan

- Choose your probe
- Choose your exam present
- Orient yourself to the indicator
- Position your equipment and the patient
- Adjust your gain to make black structures (anechoic) structures look black
- Set depth





Which probe would you use?

Phased-array "cardiac" transducer

Lower frequency
Lower resolution / deeper penetration



Curvilinear "abdominal" transducer

Lower frequency
Lower resolution / deeper penetration

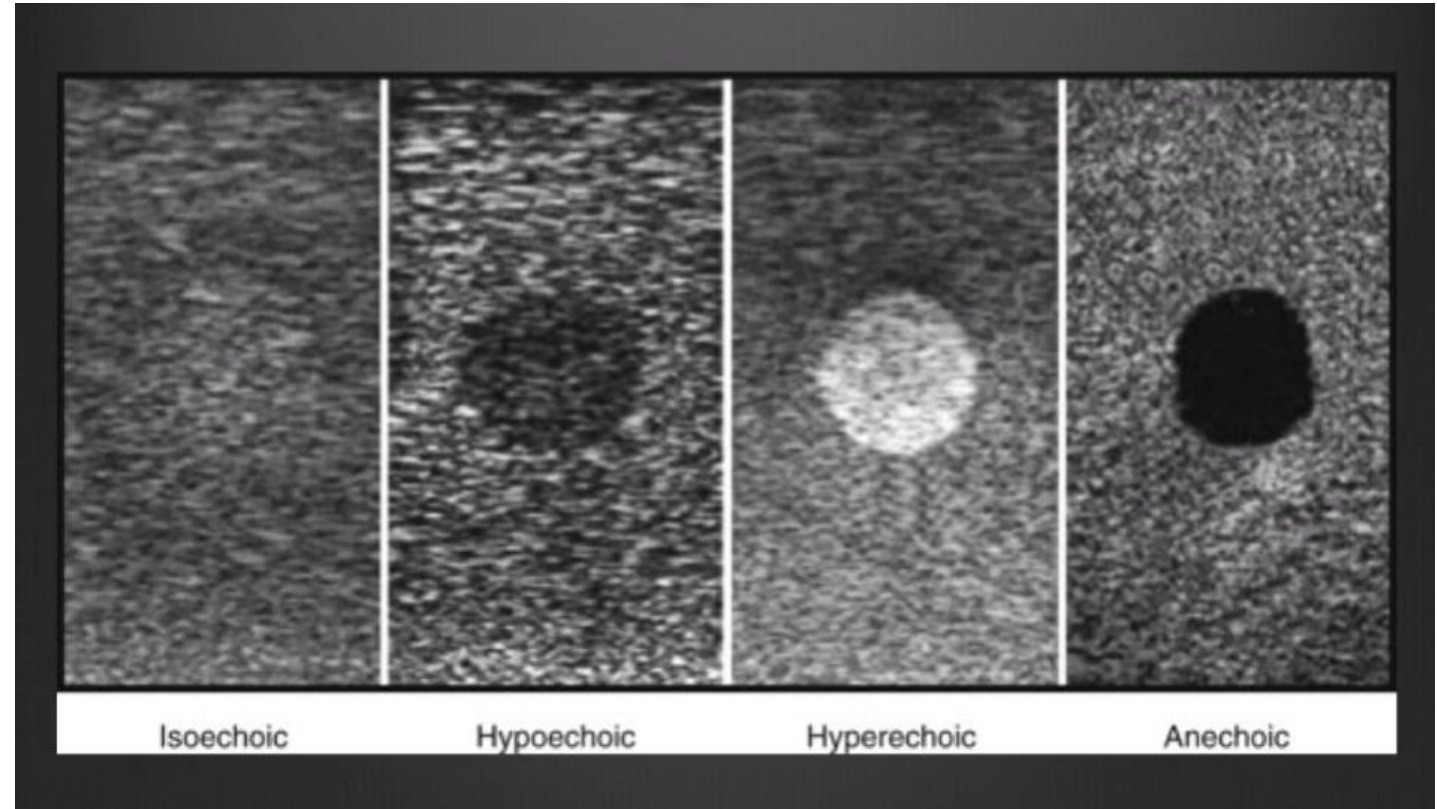


Linear "vascular" transducer

Higher frequency
Higher resolution / shallower penetration



Terminology



Modes

- 2D or B mode
- M mode (motion)
- Color/doppler

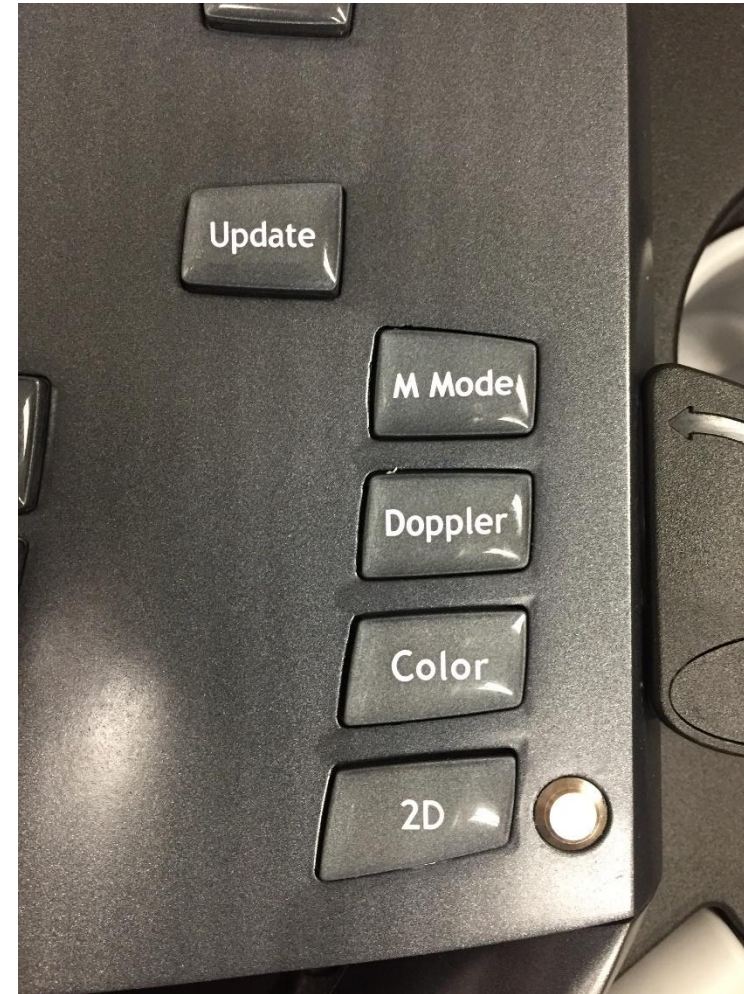
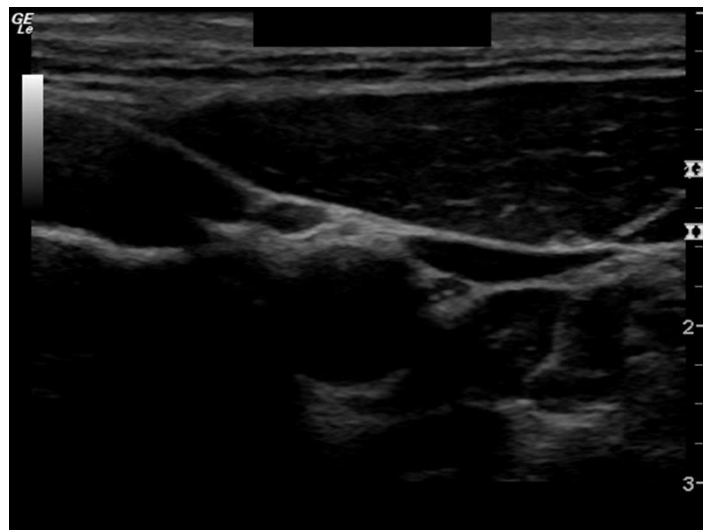


Image optimization: Gain

Undergain



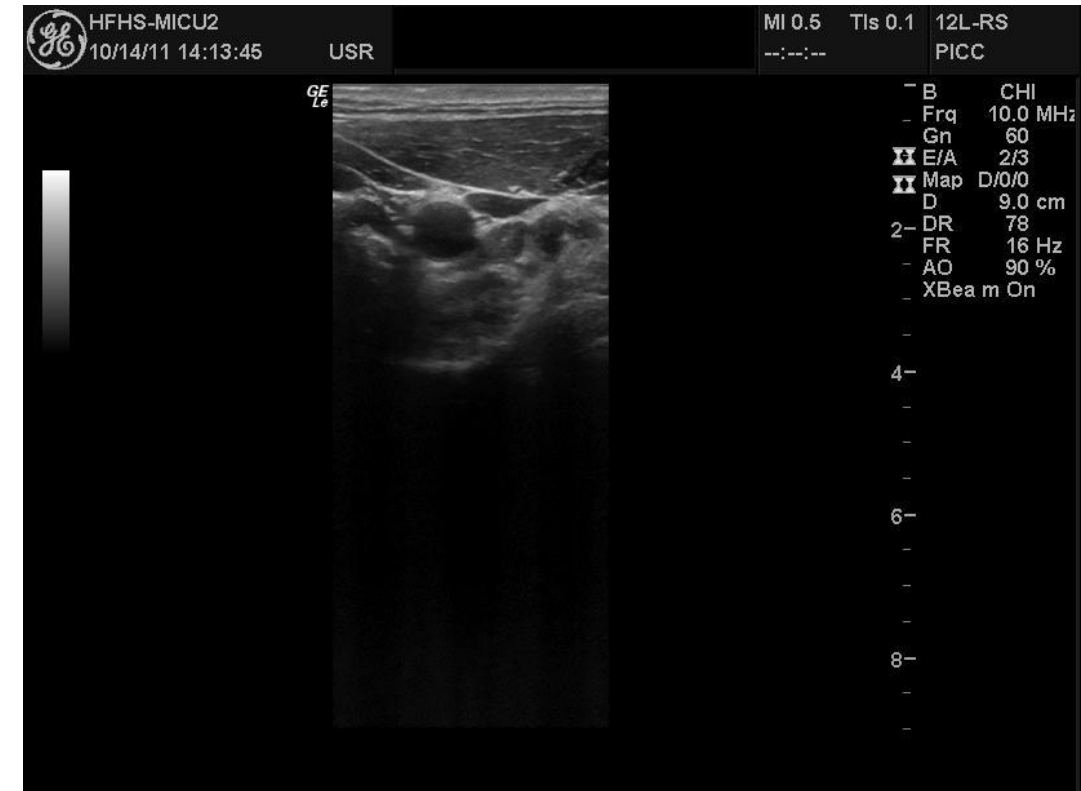
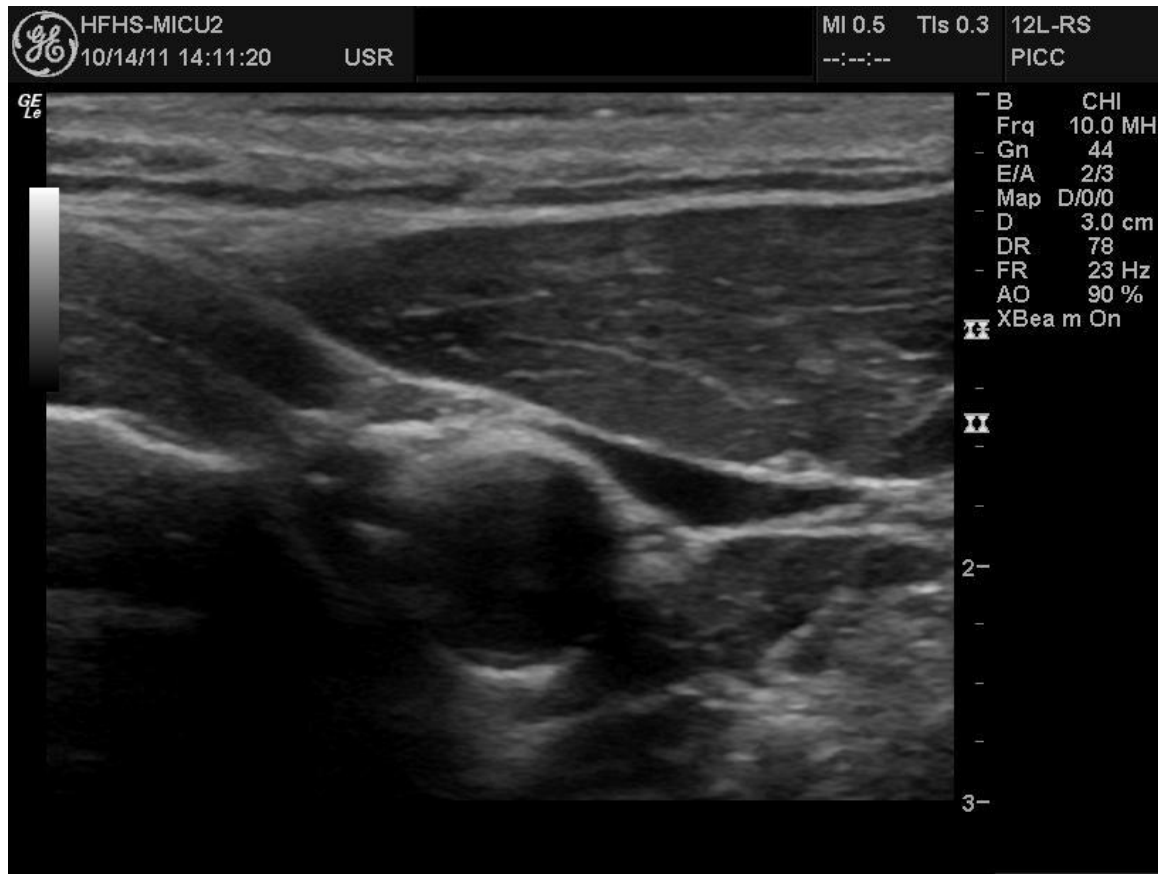
Just right



Overgain



Image Optimization - Depth

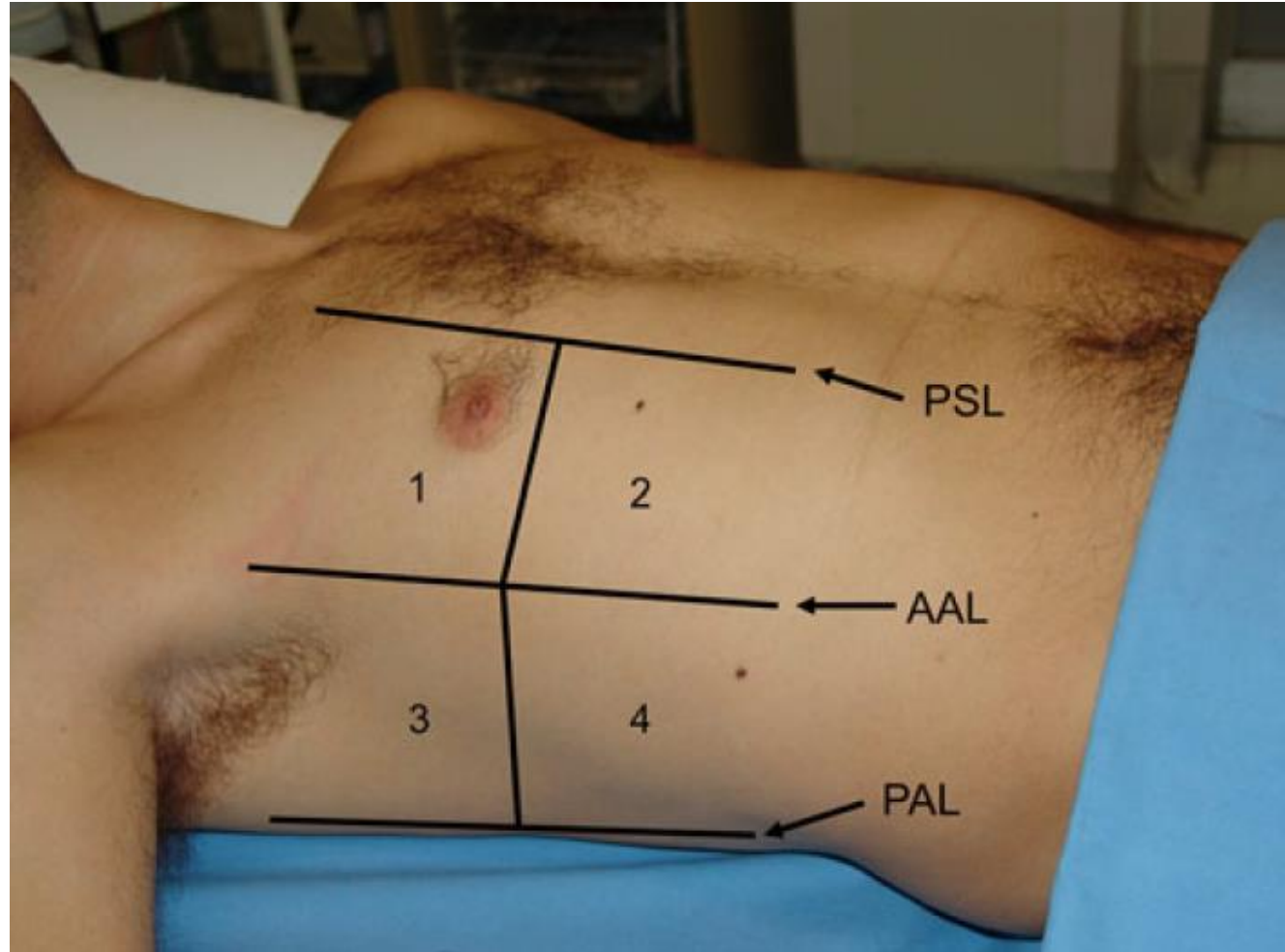


Holding the probe and identifying directions



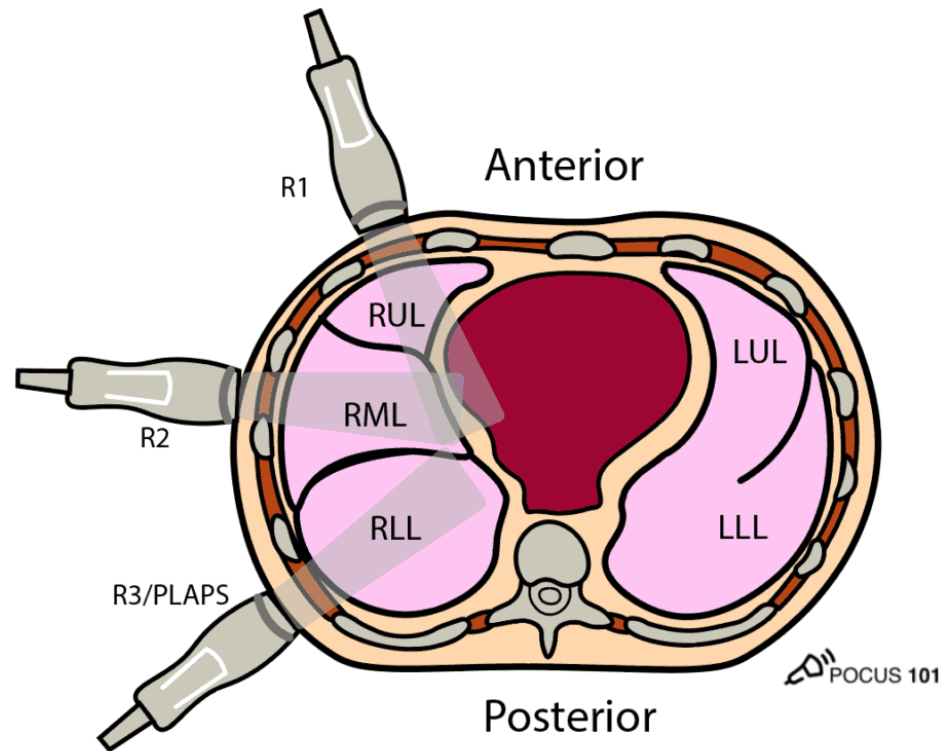
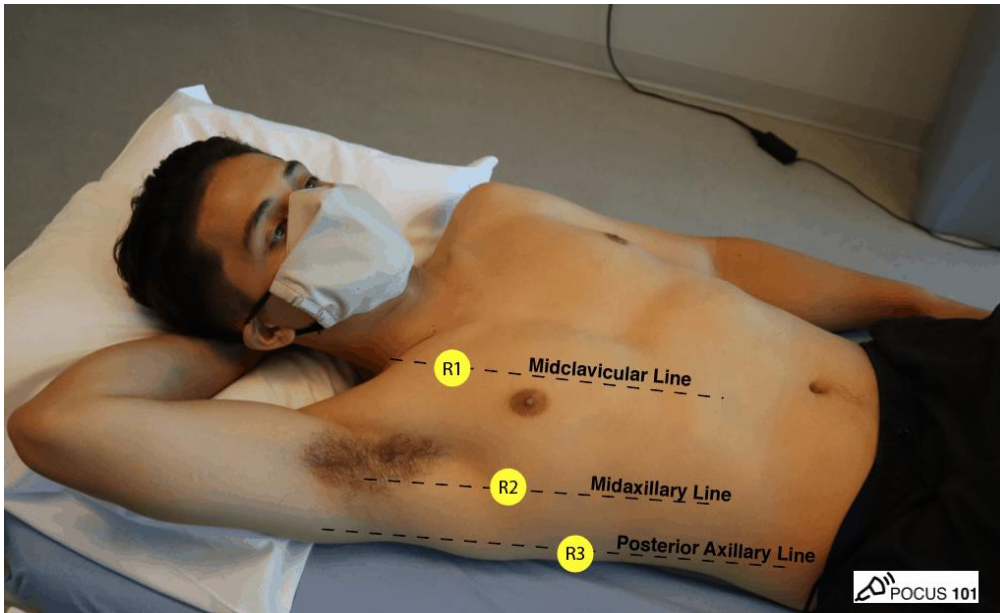
- **Rotate**
 - Clockwise or counterclockwise
- **Rock**
 - Forward/back
- **Tilt**
 - Right/Left

Scanning Zones –Volpicelli’s zones

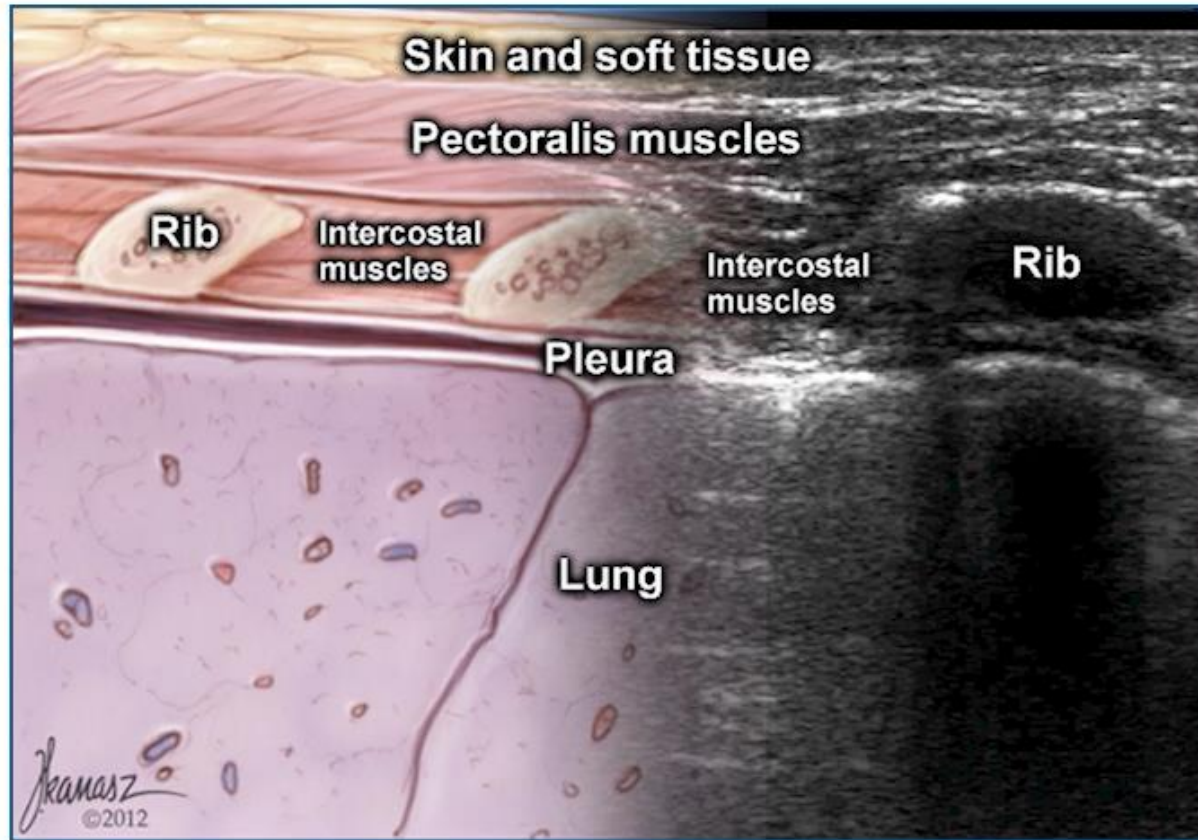


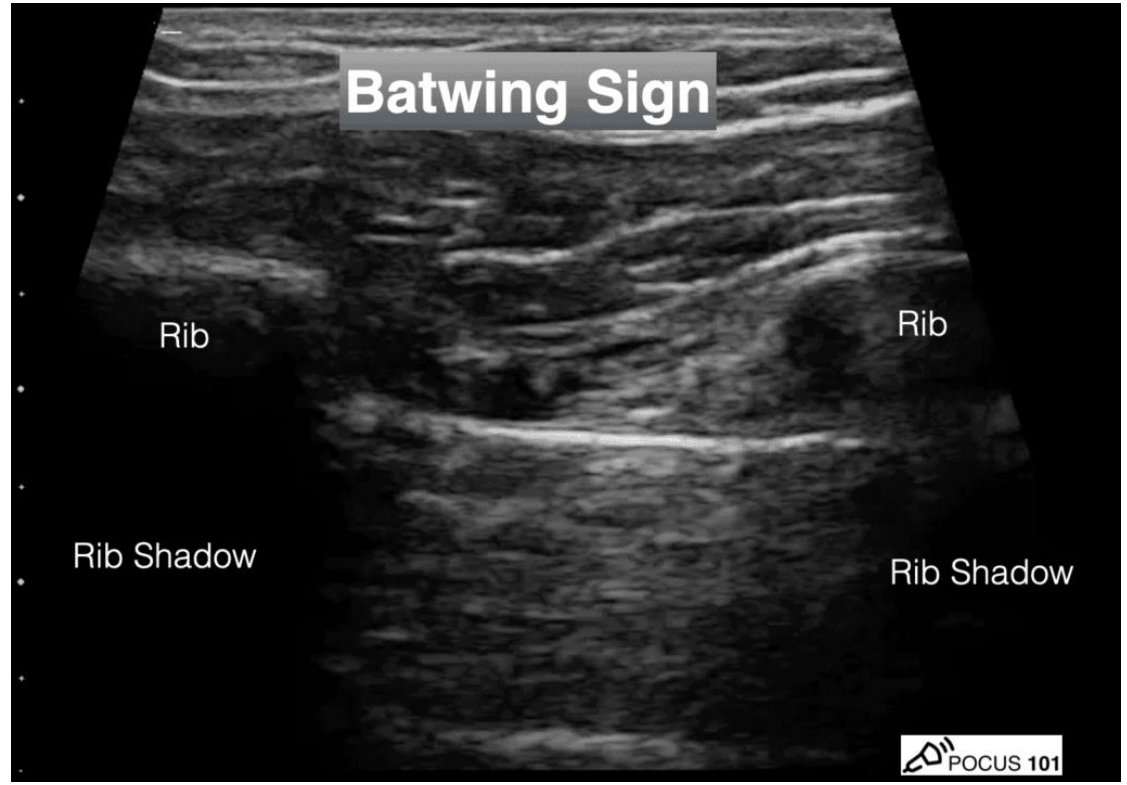
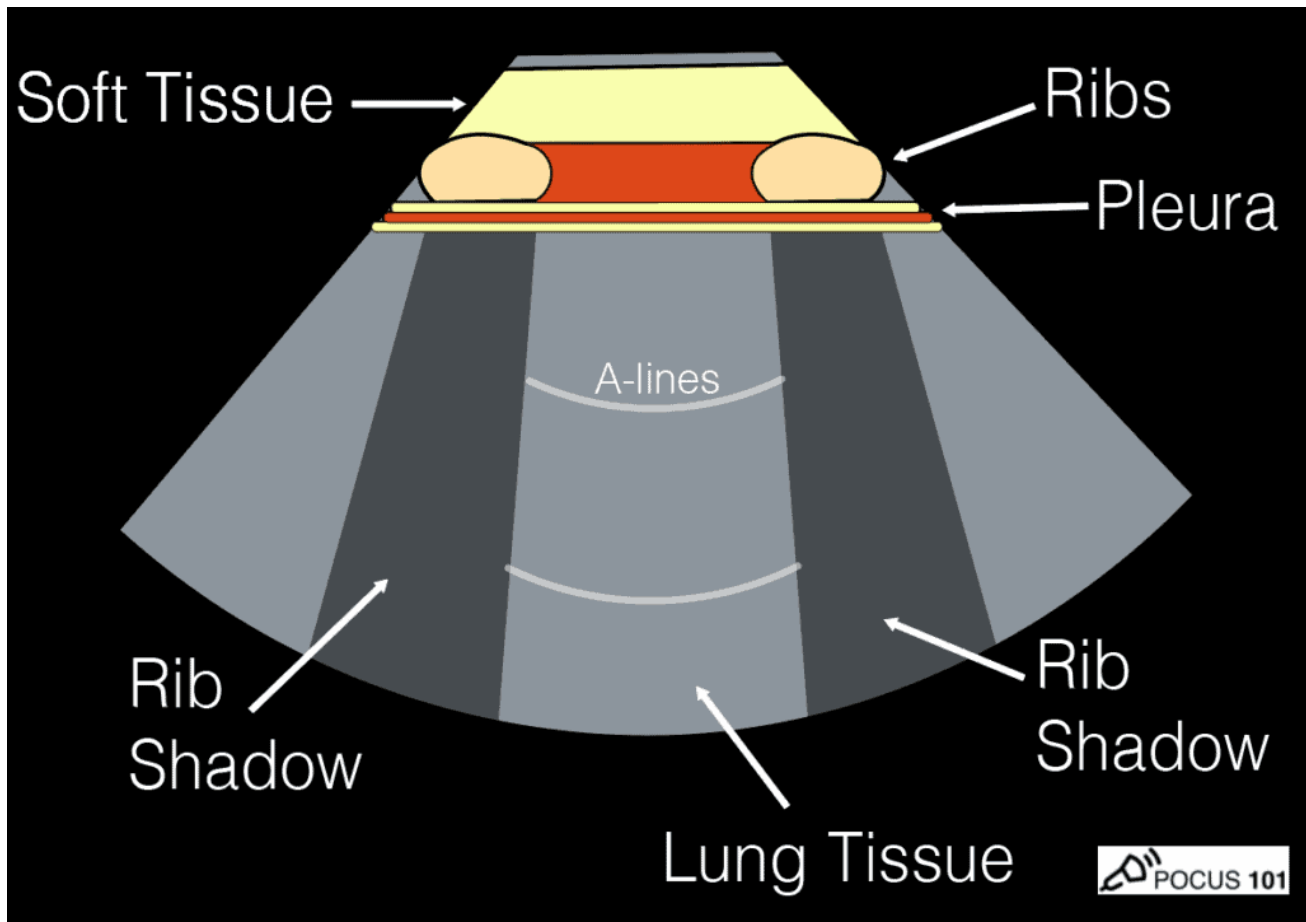
PSL –parasternal
line
AAL-anterior
axillary line
PAL- posterior
axillary line

Scanning Zones 6 point Lichtenstein 2014



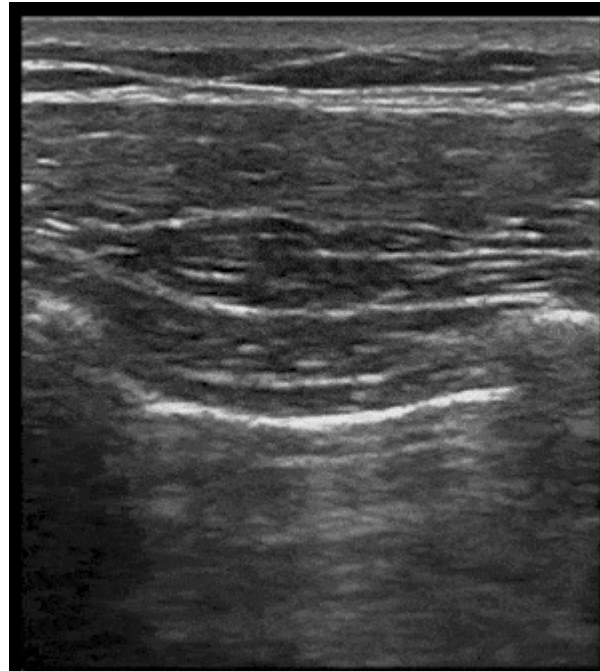
Anatomy



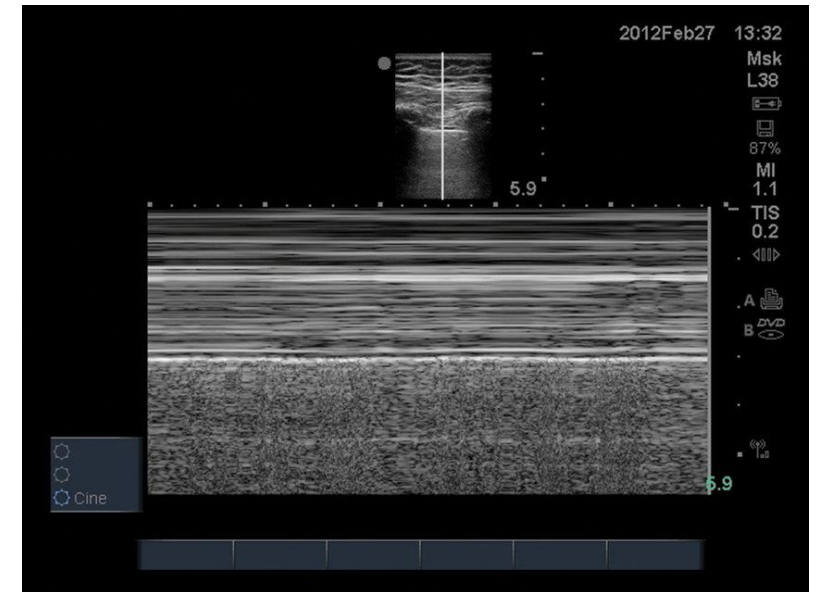


Lung sliding

- Hyperechoic pleural line moves with lung movement
- “Ants marching”
- Rules out a pneumothorax in the scanned area 100%
- M-Mode “seashore sign”



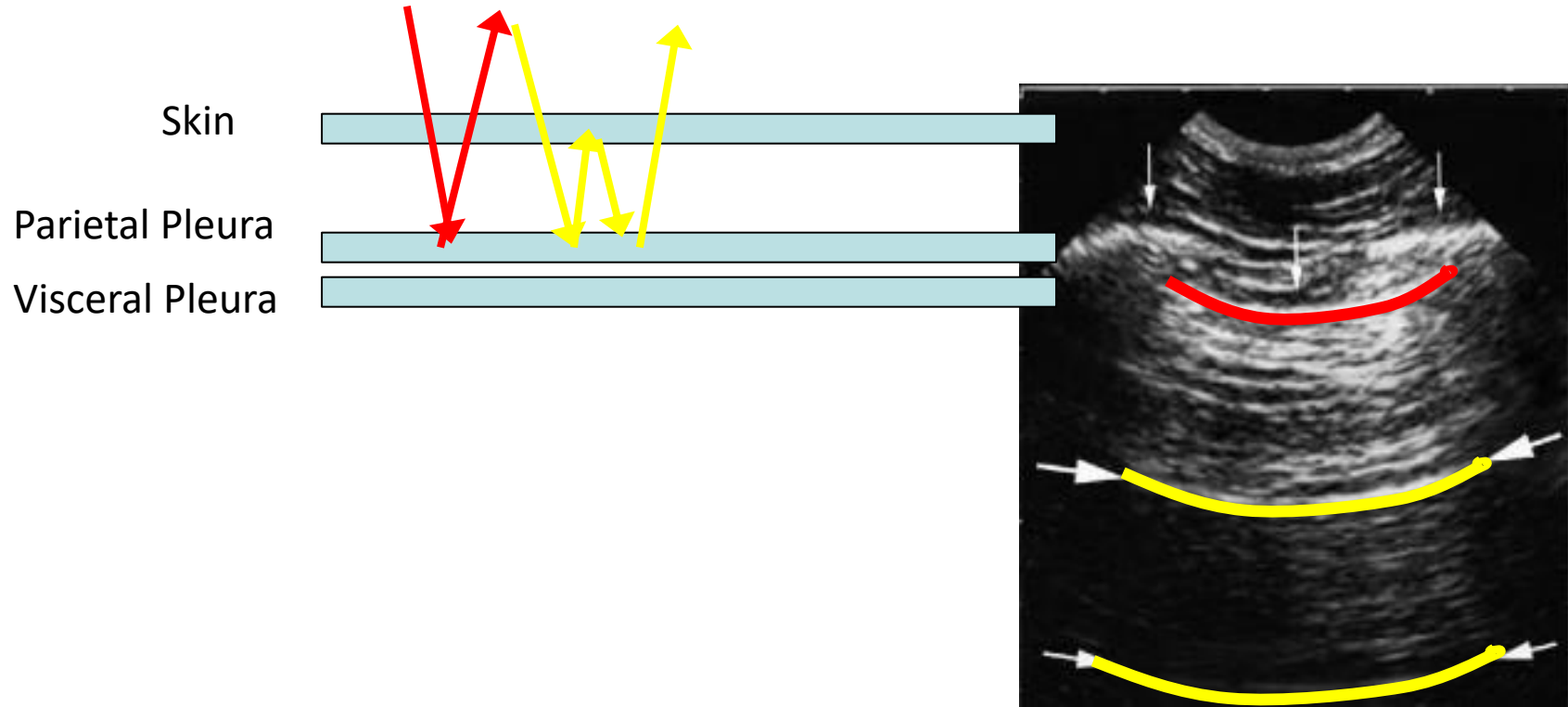
M-Mode



Mosier, Jarrod & Martin, J.A. & Andrus, Phillip & Clinton, MD & Demla, Vishal & Dinh, MD & Saul, MD & RDMS, Christopher &

A-line

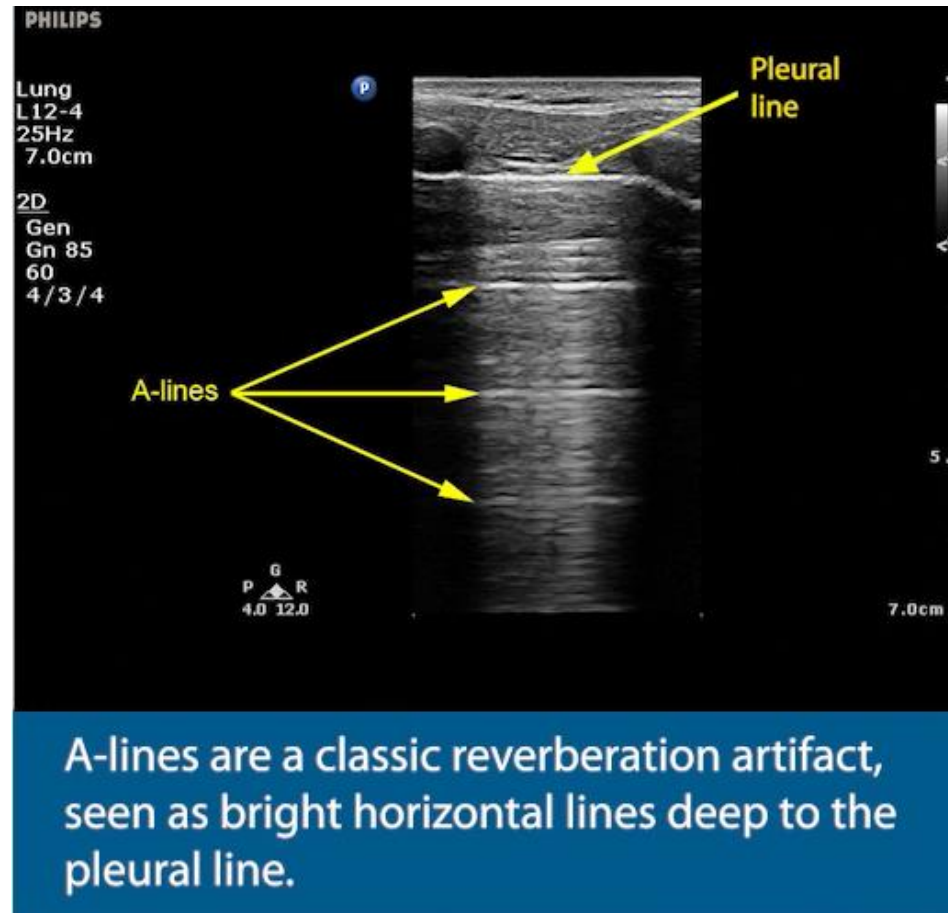
Seen in normally aerated lung or pneumothorax



A lines

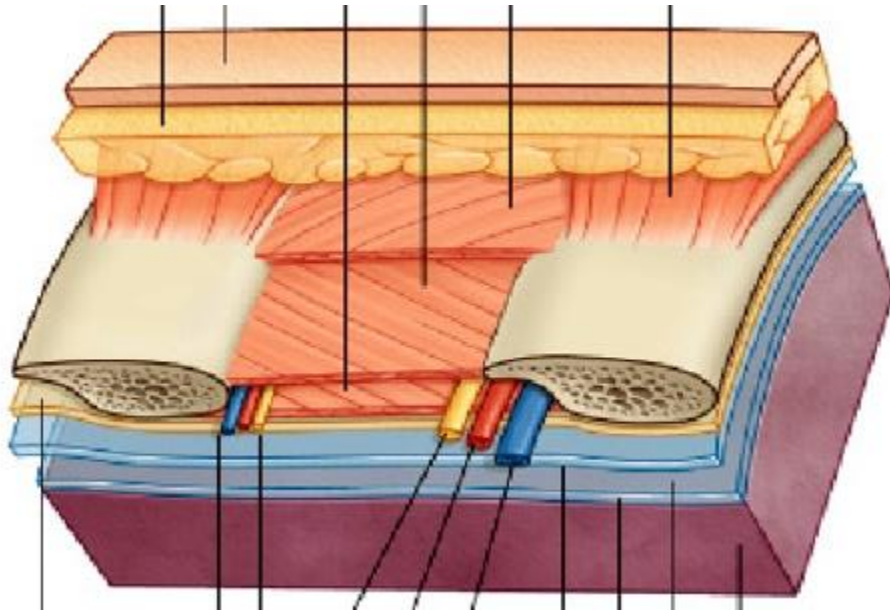
Horizontal

A lines
throughout-
normal CXR



Normal Lung

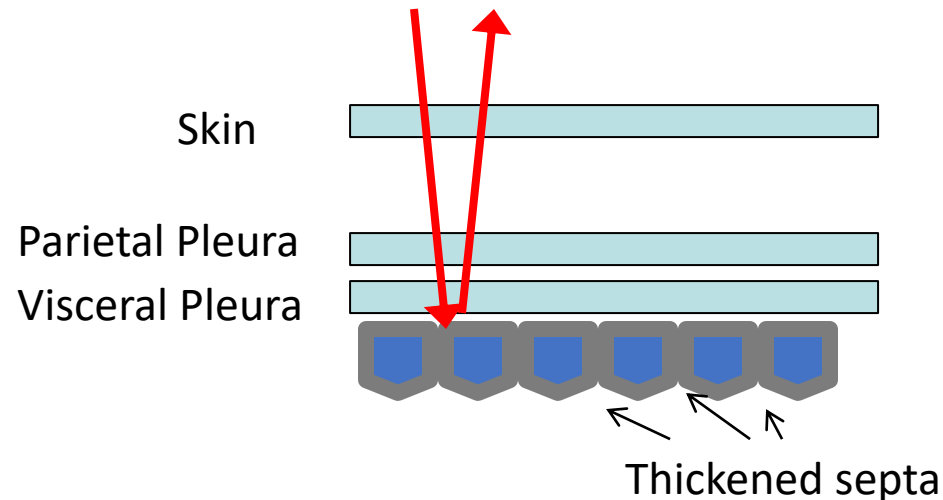
Anatomy



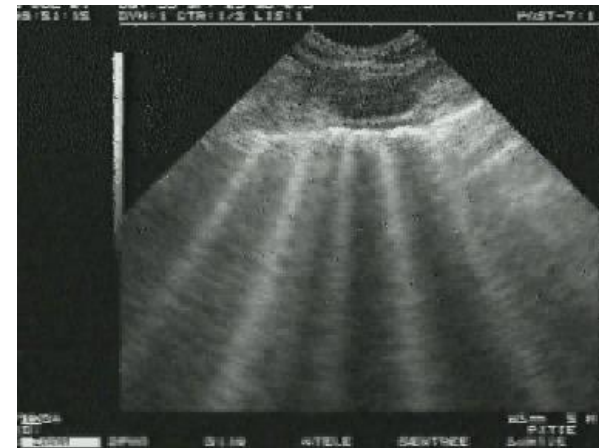
Lung pulse

- Synchronous movement with cardiac cycle
- Equivalent to lung sliding
- Could see this sign in a mainstem intubation

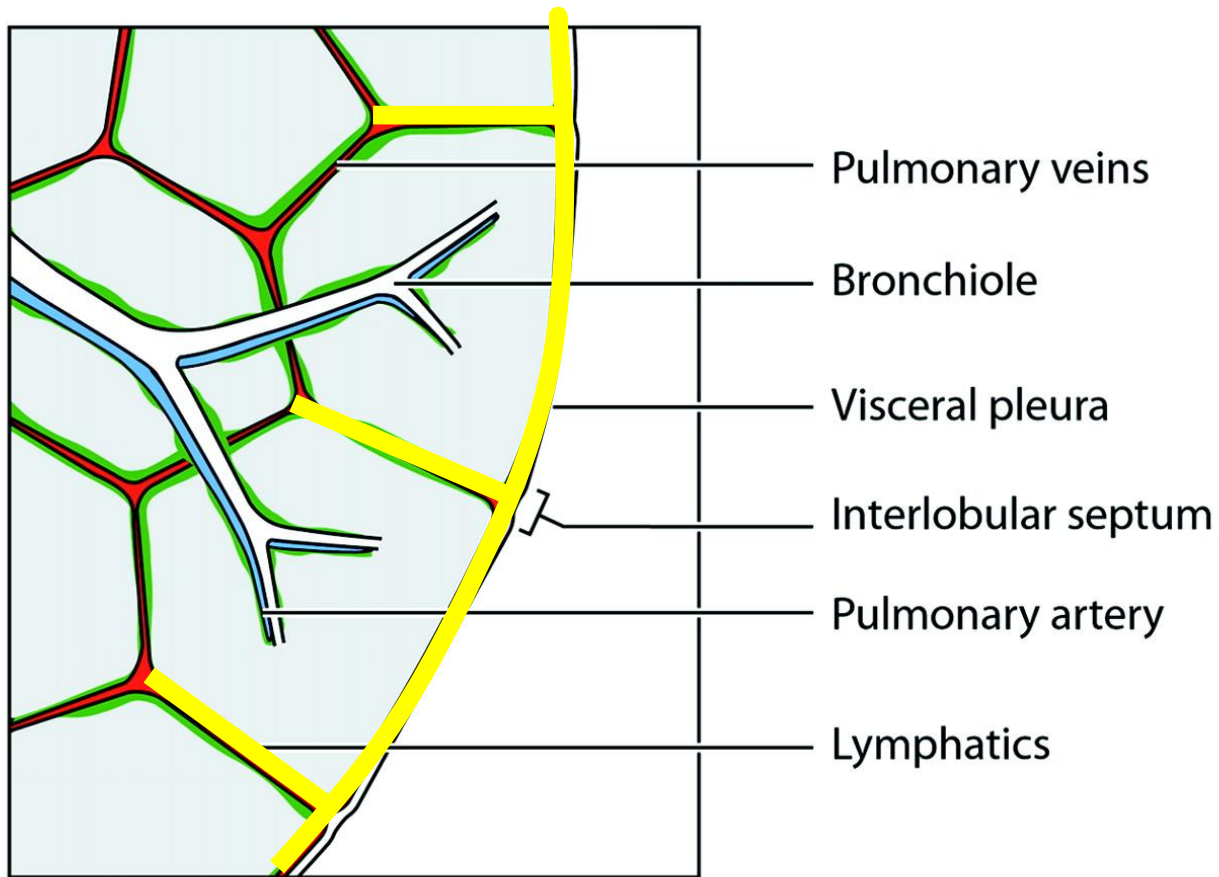
B-lines



- Suggests pathology (interstitial syndrome)
- < 3 per scanning field normal
- Move with lung sliding
- Absent in pneumothorax
- “Lung Rockets”
- Ring down artifact
- Start at pleural line
- Move with respiration



Anatomy



B- Lines and confluent lines



LITFL ultrasound library

Do not confuse with Z-lines

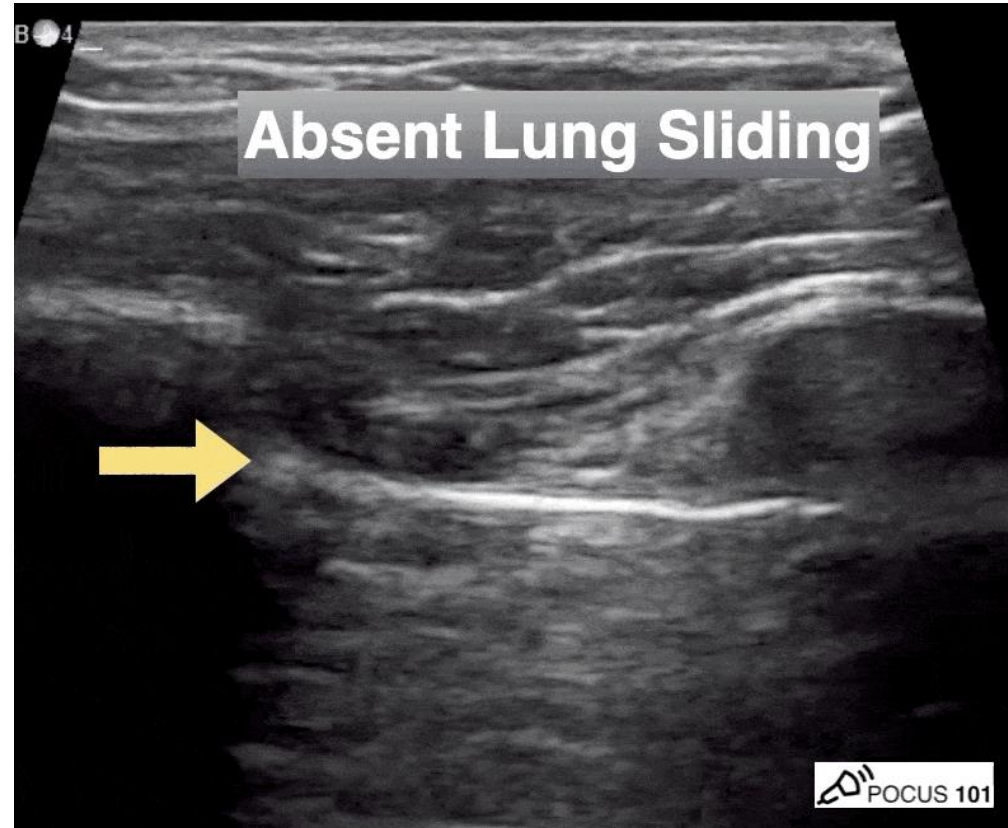
- Not B- Lines
- Normal finding
- Do not obliterate A lines
- Taper
- Arise from the pleural line
- Only 2-4 cm in depth
- No movement with lung sliding

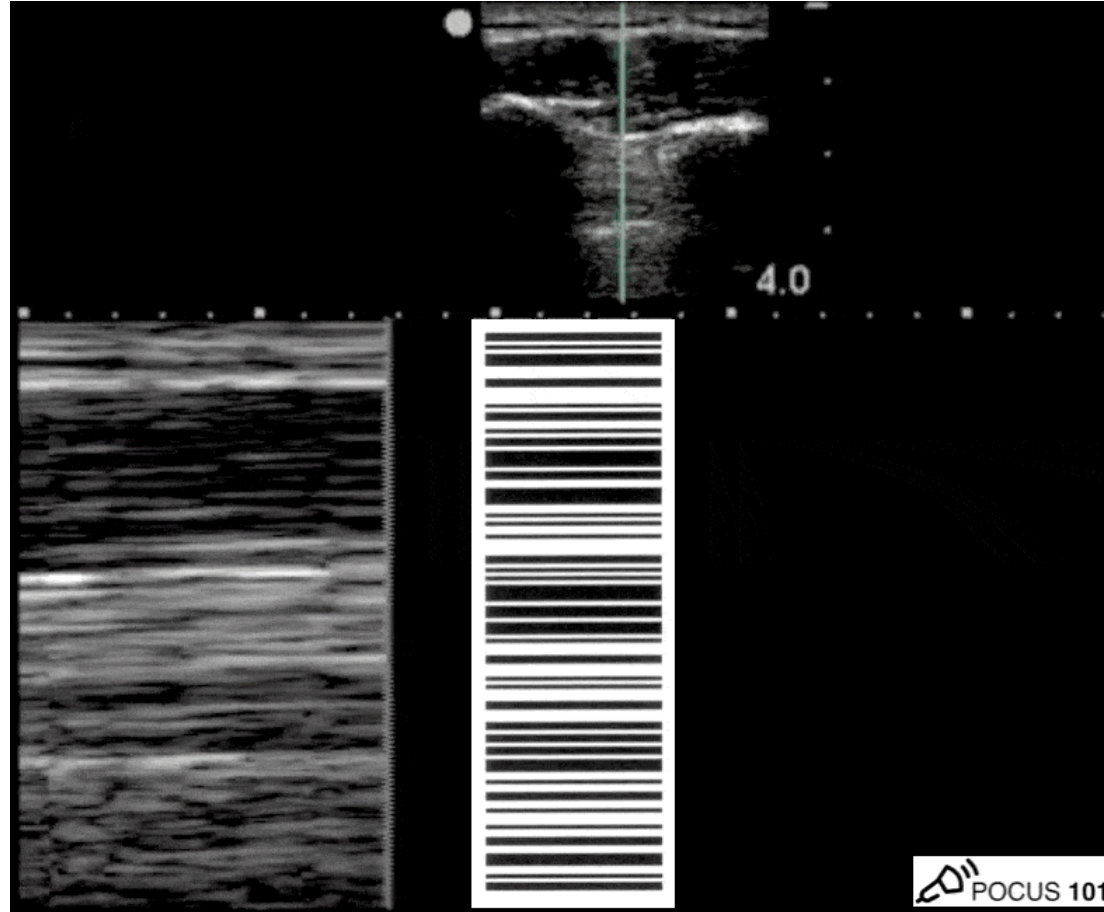


Absence of lung sliding

Chat box:

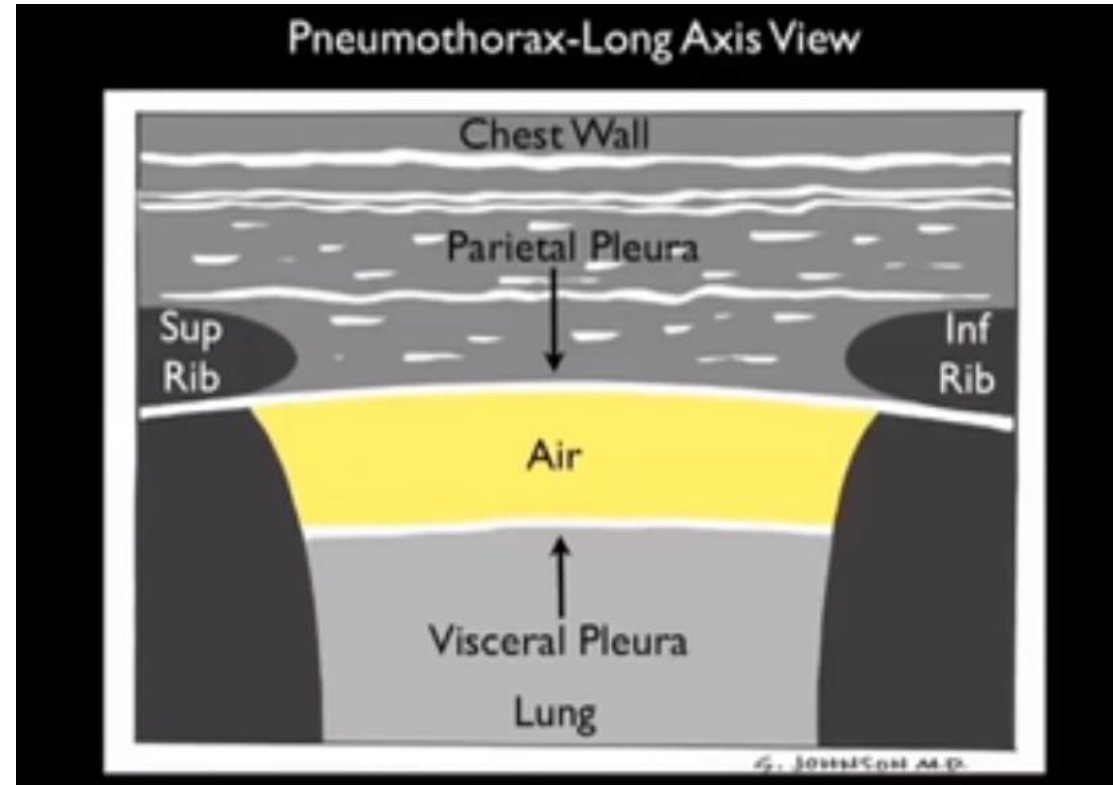
What might this represent?





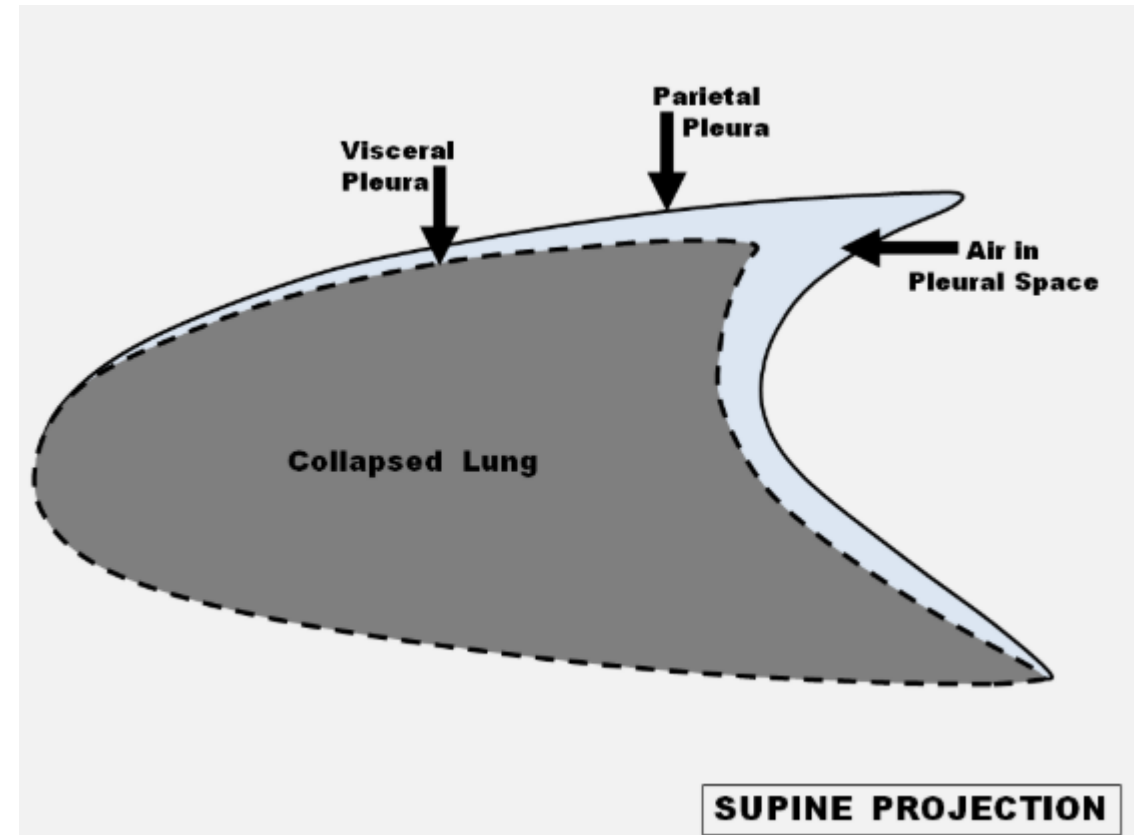
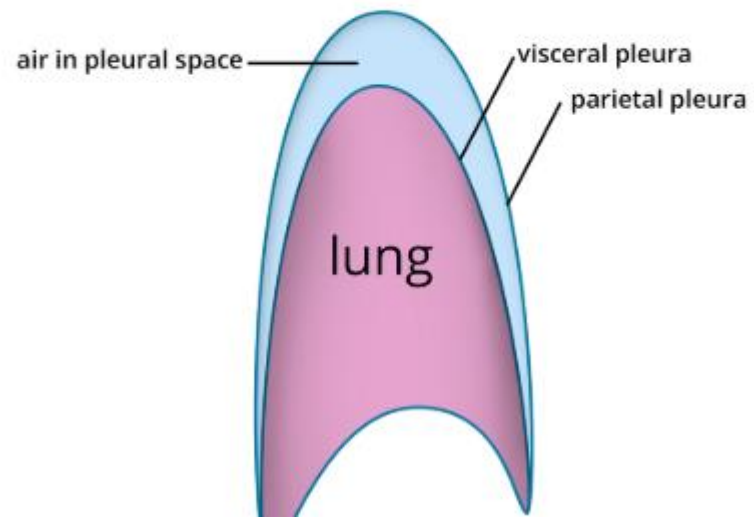
Pneumothorax

- US is primarily a rule out test (lung sliding present) parietal and visceral pleural apposition
- A lines **do not** rule out a pneumothorax
- B lines **do** rule out a pneumothorax. Must have apposition for B lines
- Lung pulse rules out a pneumothorax (apposition)
- Lung point – **rules in** a **pneumothorax** if can be found

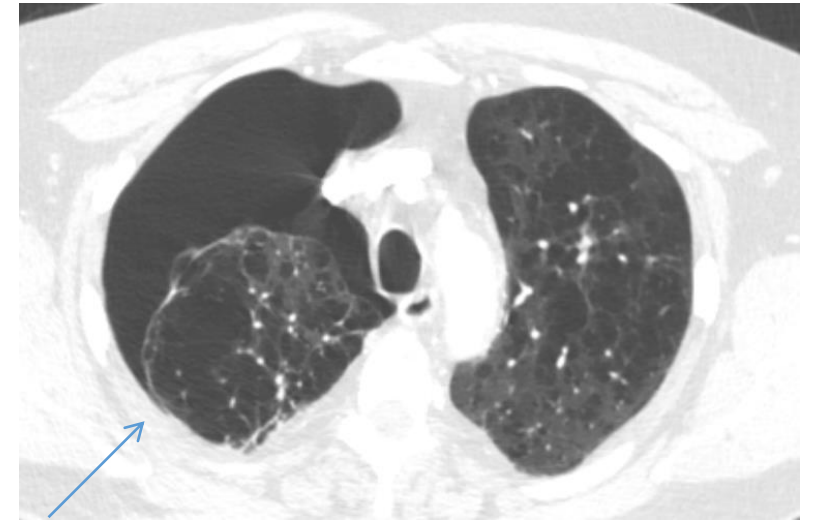
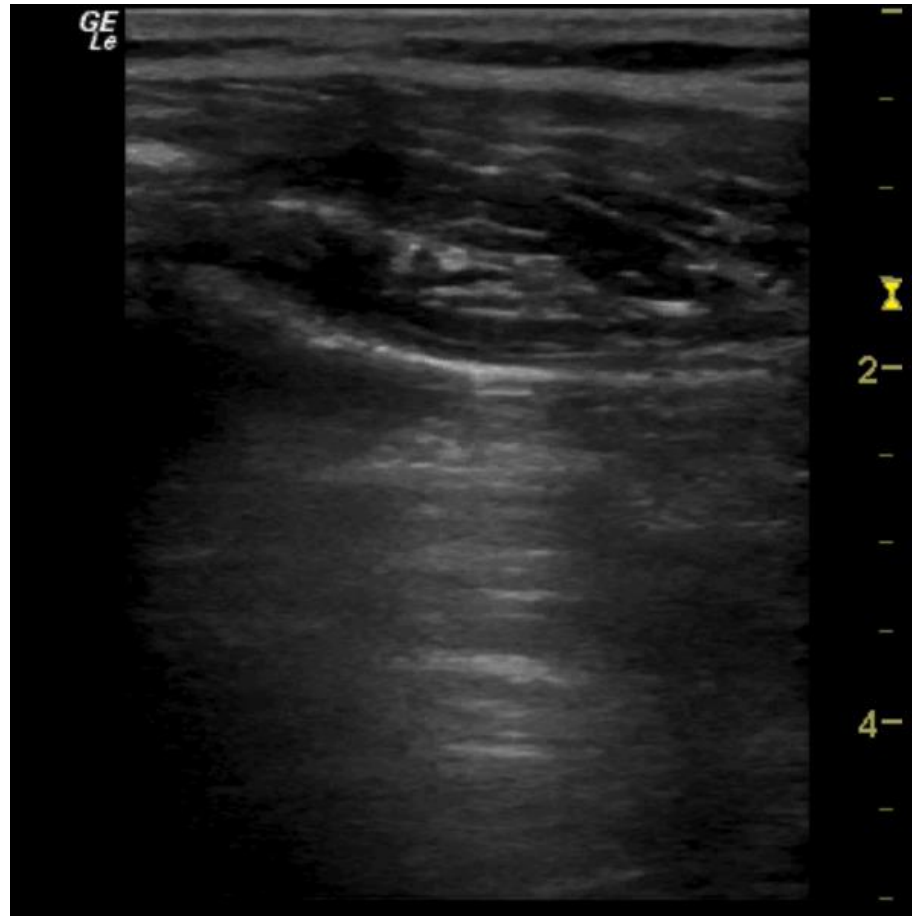
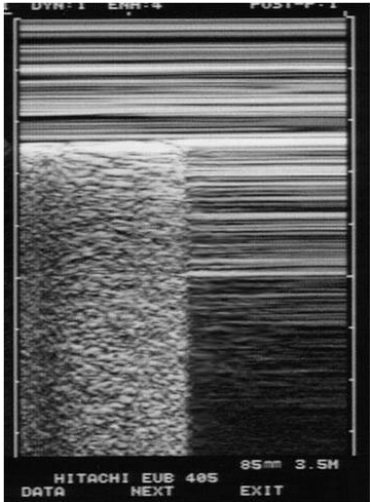


Pneumothorax

Pneumothorax distribution Erect



Lung point



Lung Pt

Moreno-Aguilar, German, and Daniel Lichtenstein. 'Lung Ultrasound In The Critically Ill (LUCI) And The Lung Point: A Sign Specific To Pneumothorax Which Cannot Be Mimicked'. *Critical Care* 19.1 (2015): n. pag. Web.

Case courtesy of Dr Andrew Dixon, Radiopaedia.org, rID: 45149

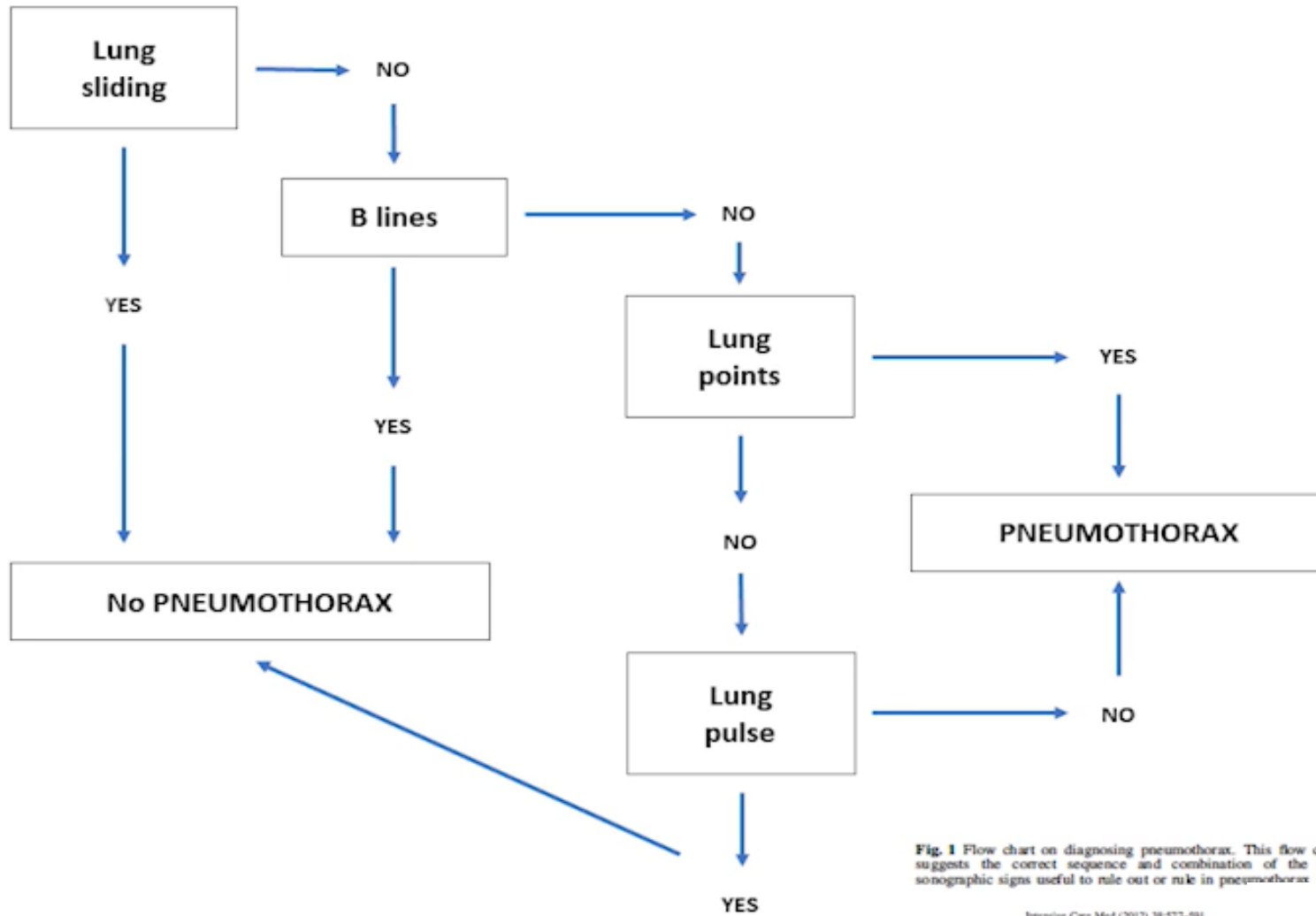


Fig. 1 Flow chart on diagnosing pneumothorax. This flow chart suggests the correct sequence and combination of the four sonographic signs useful to rule out or rule in pneumothorax.

Invasive Care Med (2012) 38:577–591
 DOI 10.1007/s00134-012-2513-4



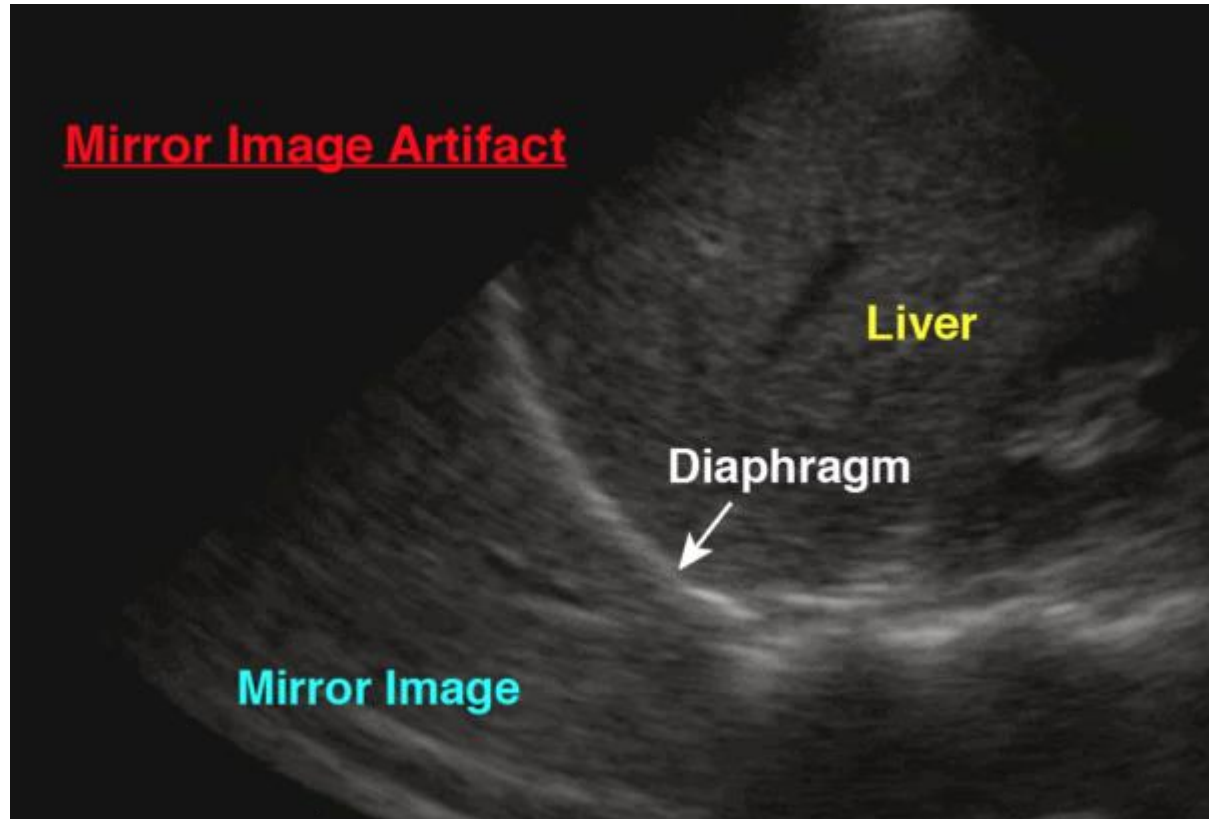
Mirror image artifact

Normal finding

Rules out a pleural effusion

Will not be able to see the spine

US waves encounter a highly reflective surface that is adjacent to air

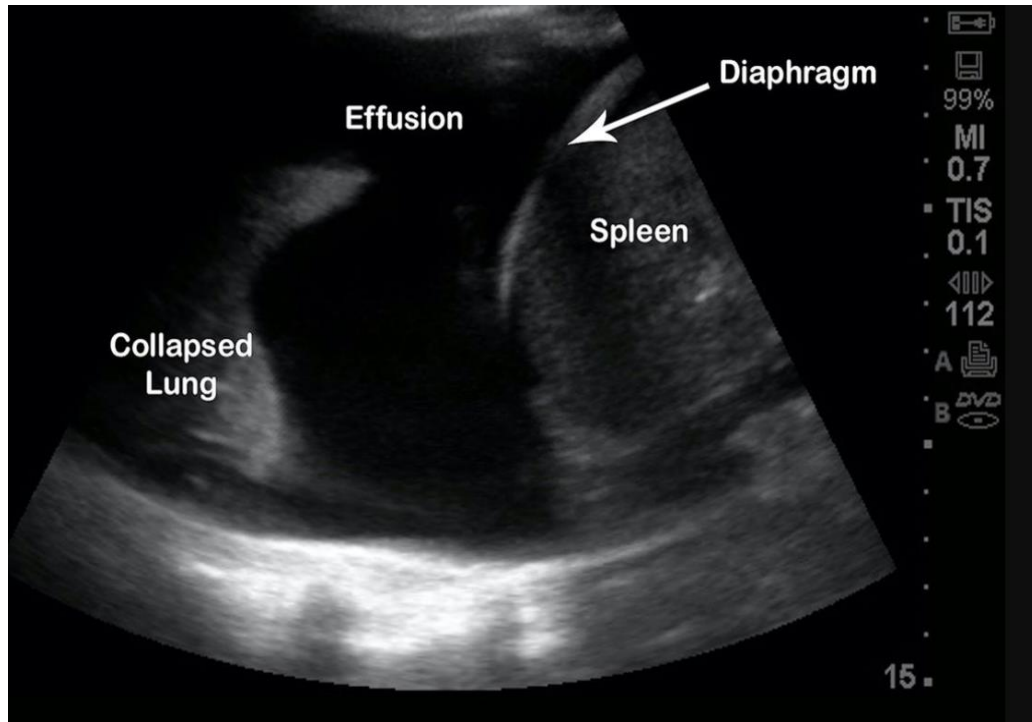


Lung Consolidation

- Hepatization
- Dynamic airbronchograms
- Static airbronchograms



Pleural effusions

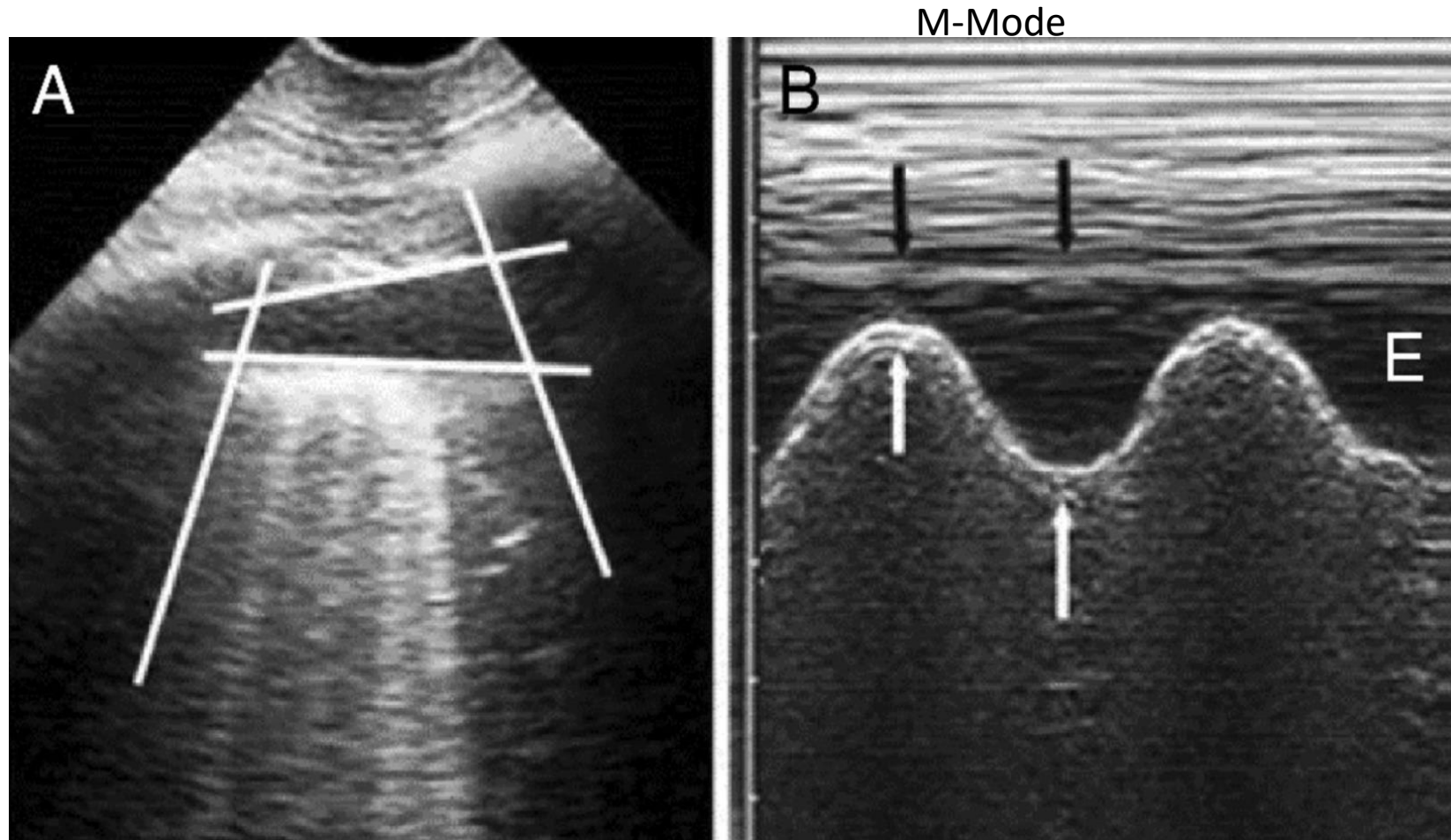


emj.bmj.com



Ultrasound.guide
Aorta Spine Sign

Pleural effusions Quad and Sinusoid sign



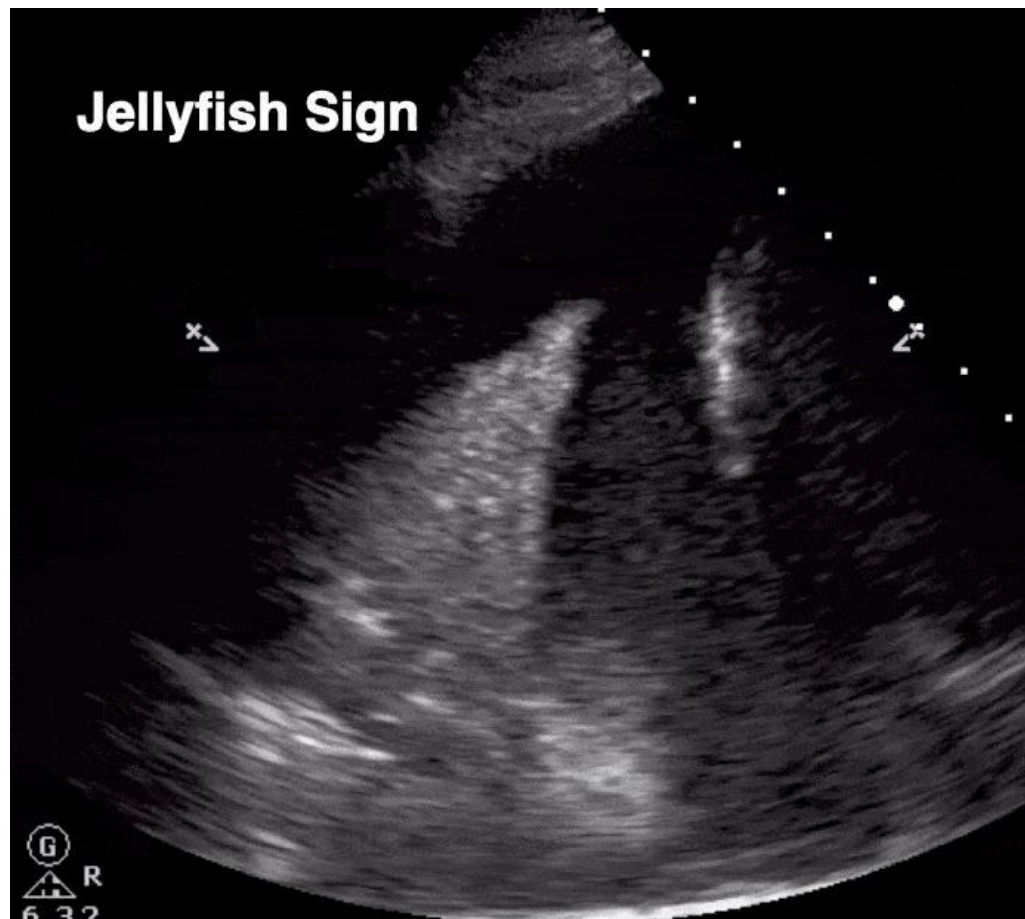
Curtain sign

Normal finding

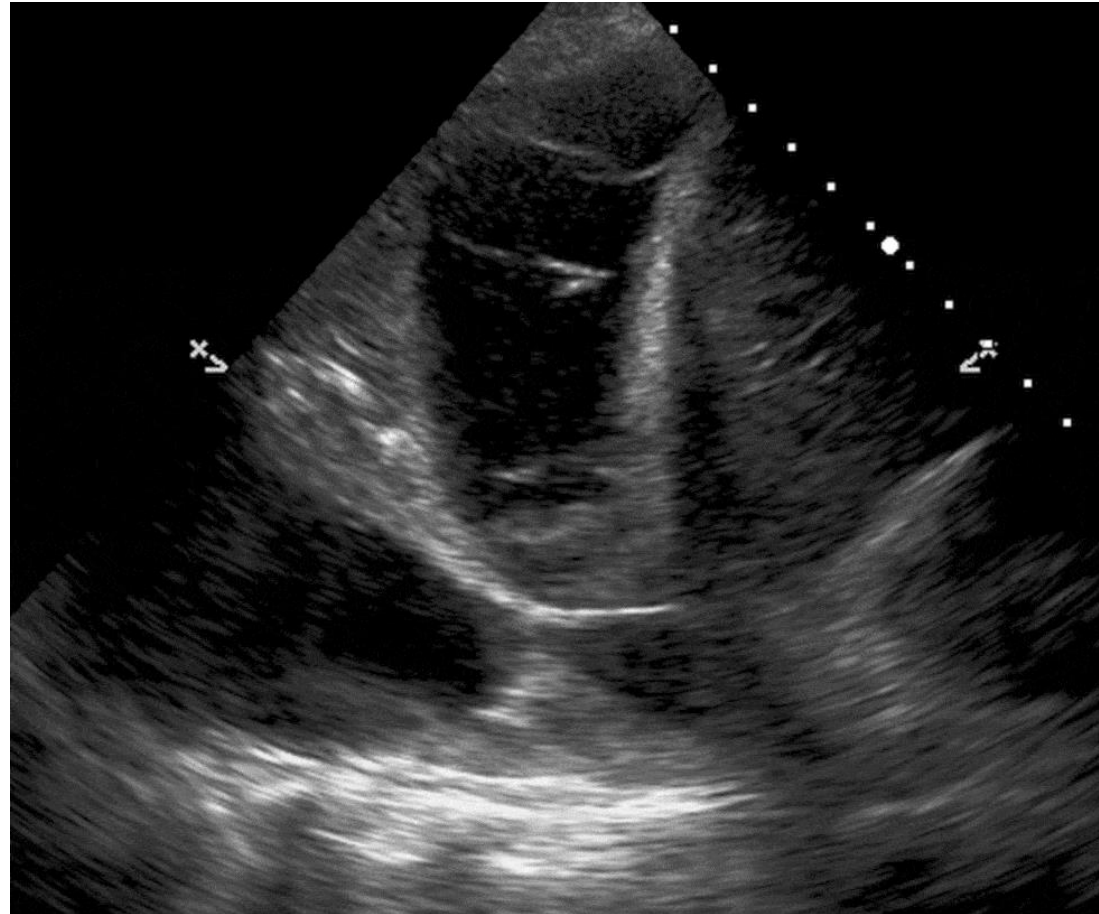
No pleural effusion



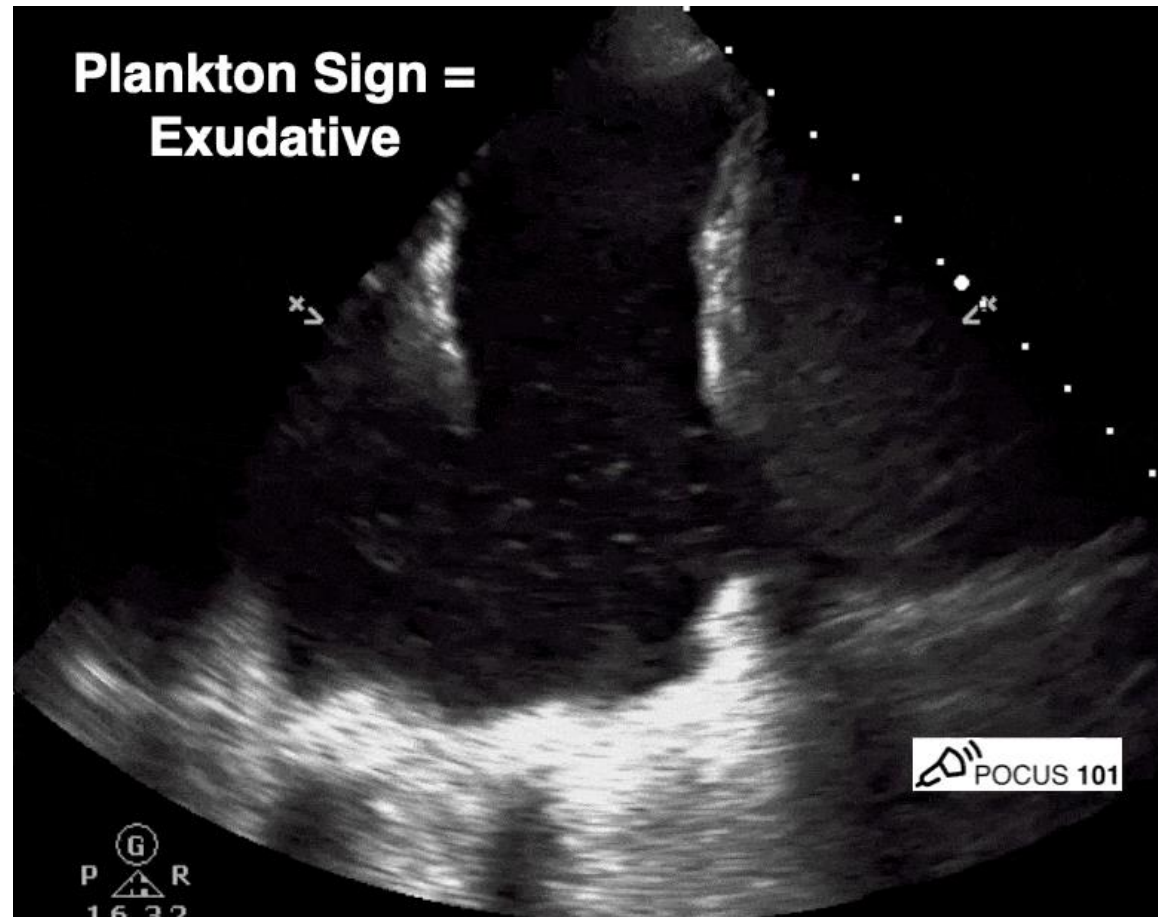
Jelly fish sign



Loculated pleural effusion



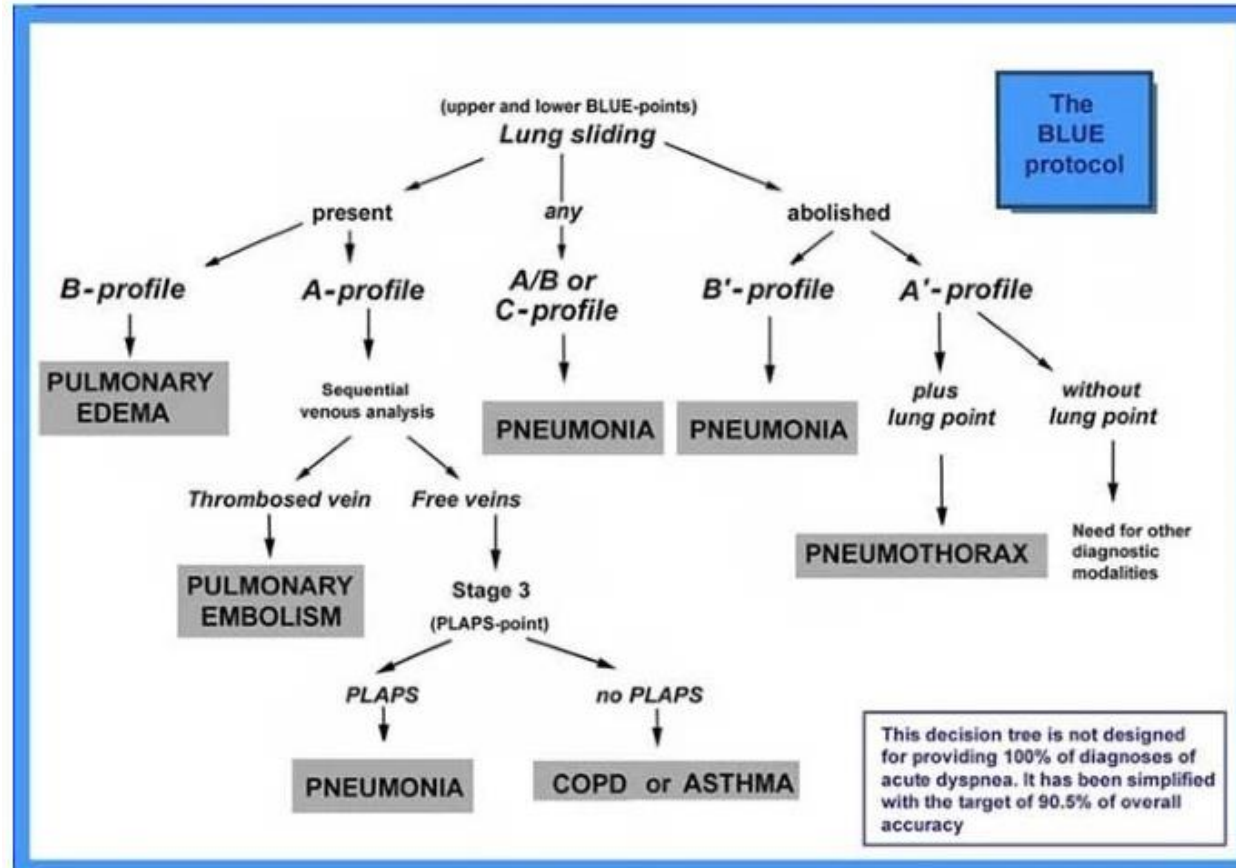
Plankton sign



Shred sign



BLUE-protocol – immediate diagnosis of the main causes of acute respiratory failure



Chest 2008;134:117-125

Thank you!



Supplement

- Instructional videos
- Suggested reading
- Common signs and terminology quick sheet

