

Point of Care Ultrasound: The Lung

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Consultant Paediatric Intensivist

Overview

- Why do lung ultrasound?
- Normal lung ultrasound appearances
- Abnormal lung ultrasound appearances
- How to scan the lungs
- Questions

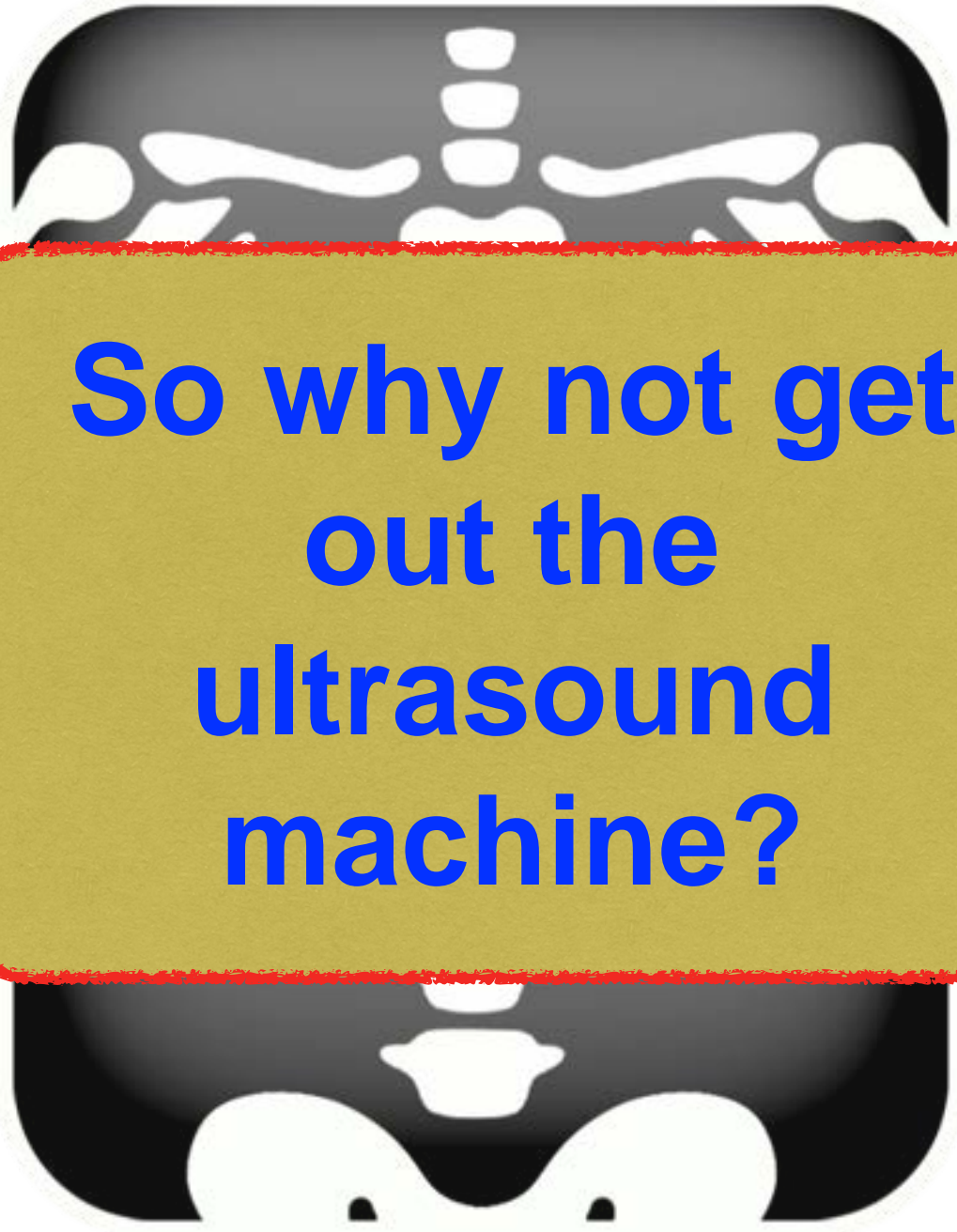
Why Do Lung Ultrasound?

Common Scenarios

- Respiratory distress
- Hypercapnia
- Hypoxia
- Shock
- Chest trauma
- Endobronchial intubation?
- Possible VAP
- Fluid balance vs. extubation...

Chest X-Ray

- Slow
- Radiation
- Lag time for some pathologies
- Lots of patient movement



**So why not get
out the
ultrasound
machine?**

CXR vs Lung POCUS

Pathology Diagnosis	Chest X-Ray		Lung POCUS	
	Sensitivity	Specificity	Sensitivity	Specificity
Pneumothorax ¹⁰	46%	100%	87%	99%
Pleural Effusion ¹¹	51%	99%	94%	98%
Consolidation ¹²⁻¹³	77-86%	91-96%	95-97%	90-96%
Pulmonary Oedema ¹⁴⁻¹⁵	50-68%	76-83%	97%	98%

Developing Lung POCUS Skills



Signs to Find

- Pleural Line (with Bat Wing Sign)
- A-Lines
- Lung Sliding (with Seashore Sign)
- Quad Sign (with the Lung Line)
- Sinusoid Sign
- PLAPS Point
- Tissue-Like Sign
- Shred-Sign
- C-Profile
- B-Lines
- Absent Lung Sliding (with Barcode Sign)
- Lung Point



Normal Lung Ultrasound Appearances

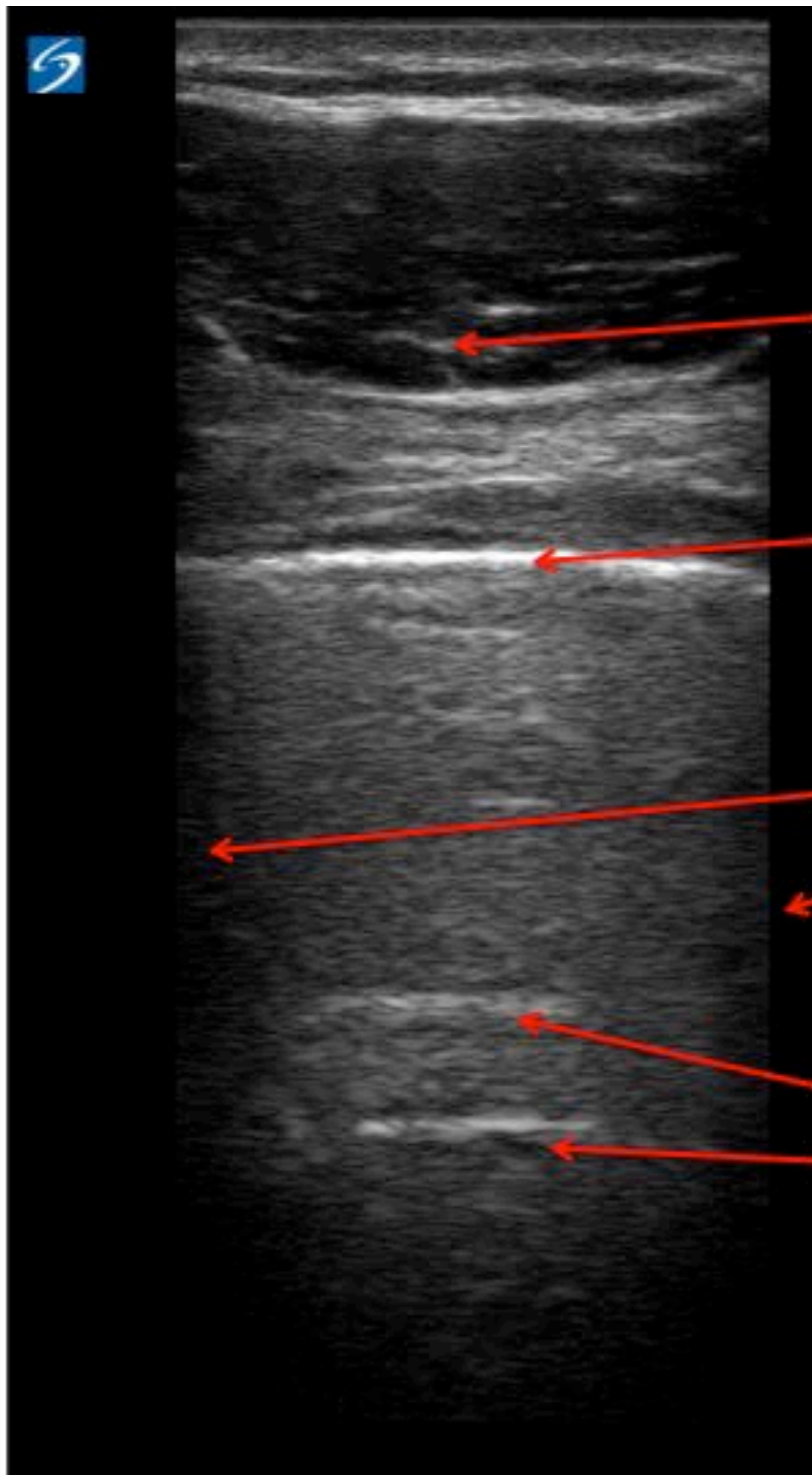
Signs to Find

- **Pleural Line (with Bat Wing Sign)**
- **A-Lines**
- **Lung Sliding (with Seashore Sign)**
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- PLAPS Point
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Normal Lung

Normal Lung Ultrasound: *Linear Probe*



Subcutaneous Tissue

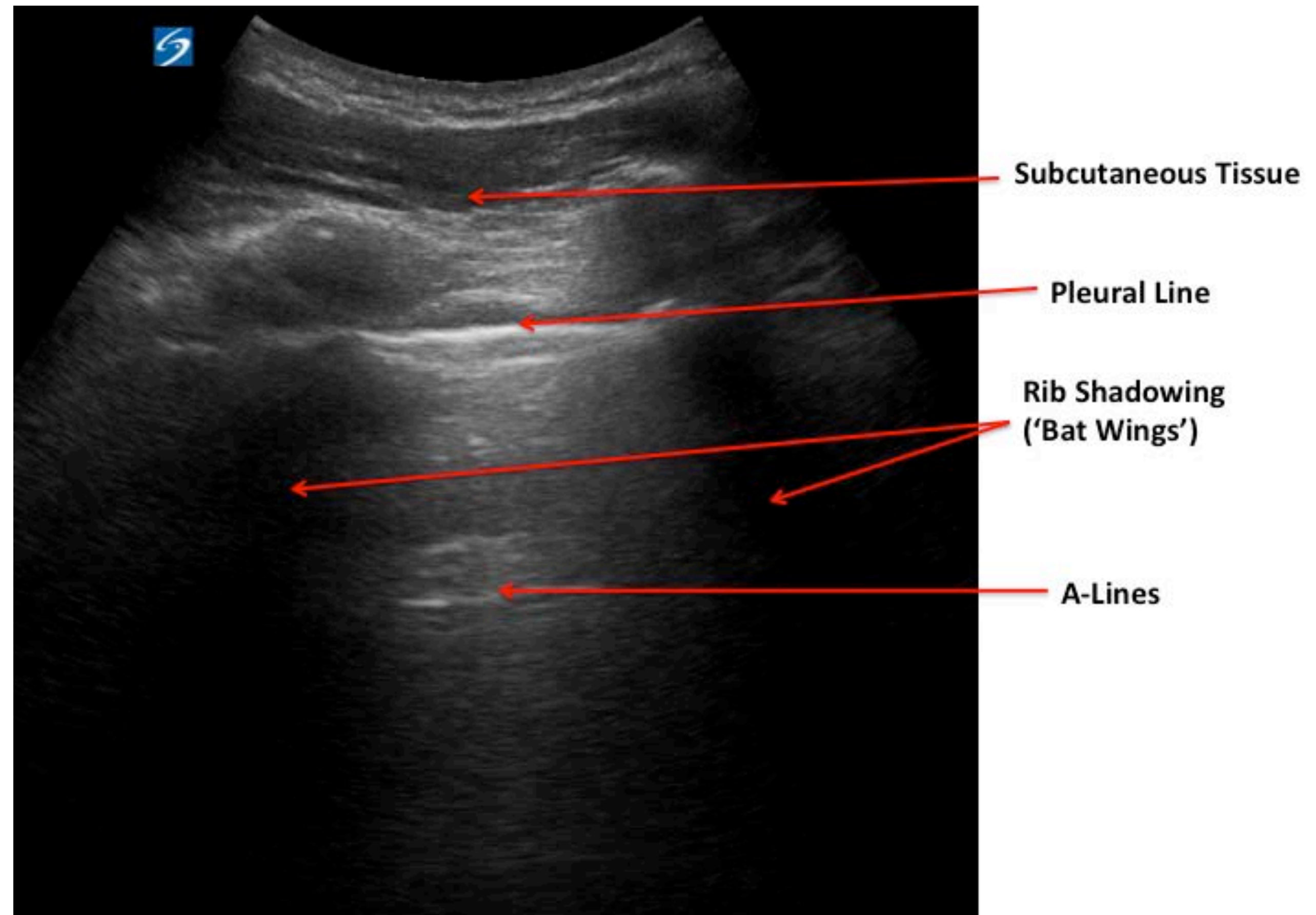
Pleural Line

Rib Shadowing with
drop out either
side of the image
(‘Bat Wings’)

A-Lines

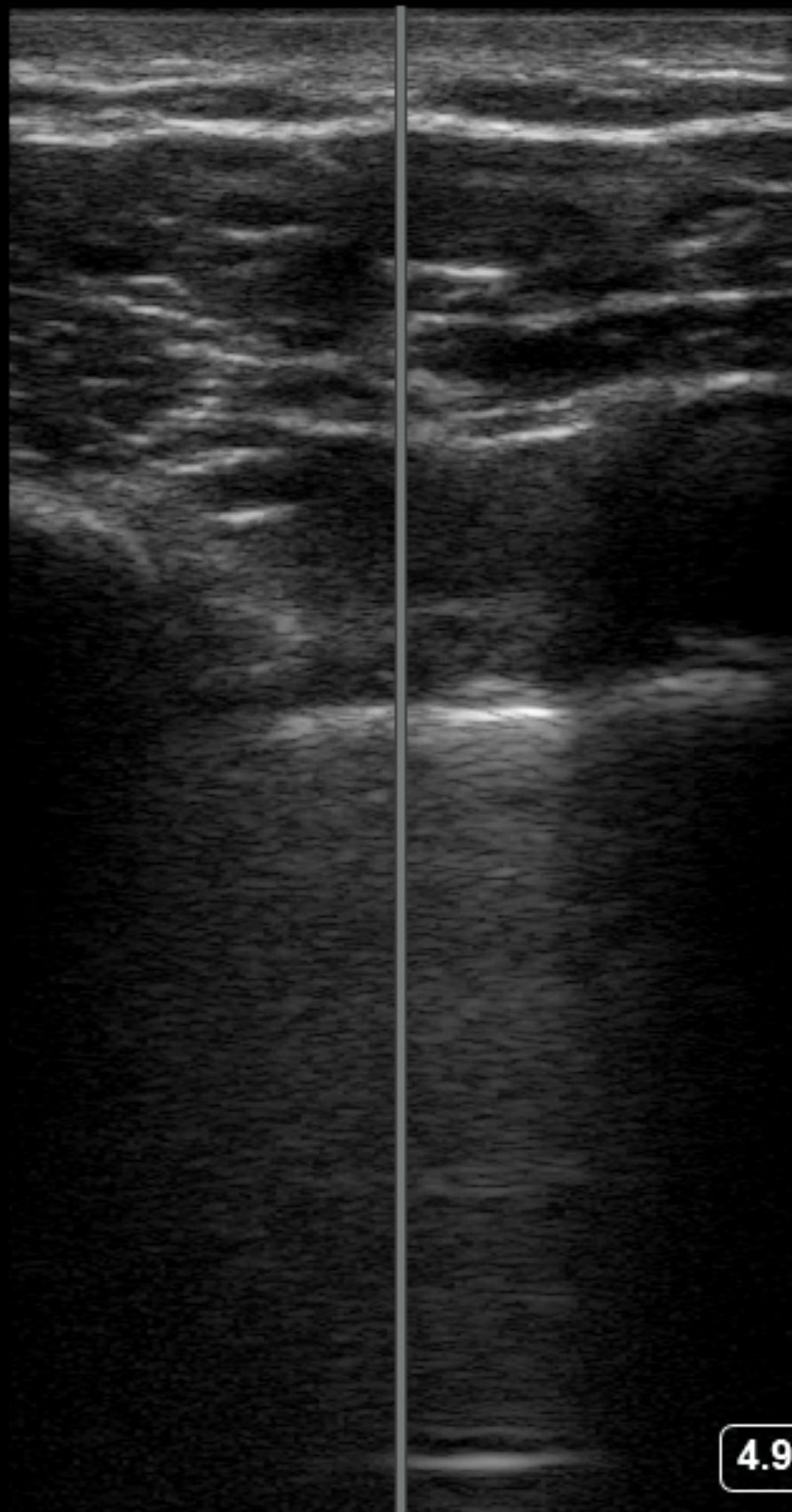


Normal Lung Ultrasound: *Curvilinear Probe*

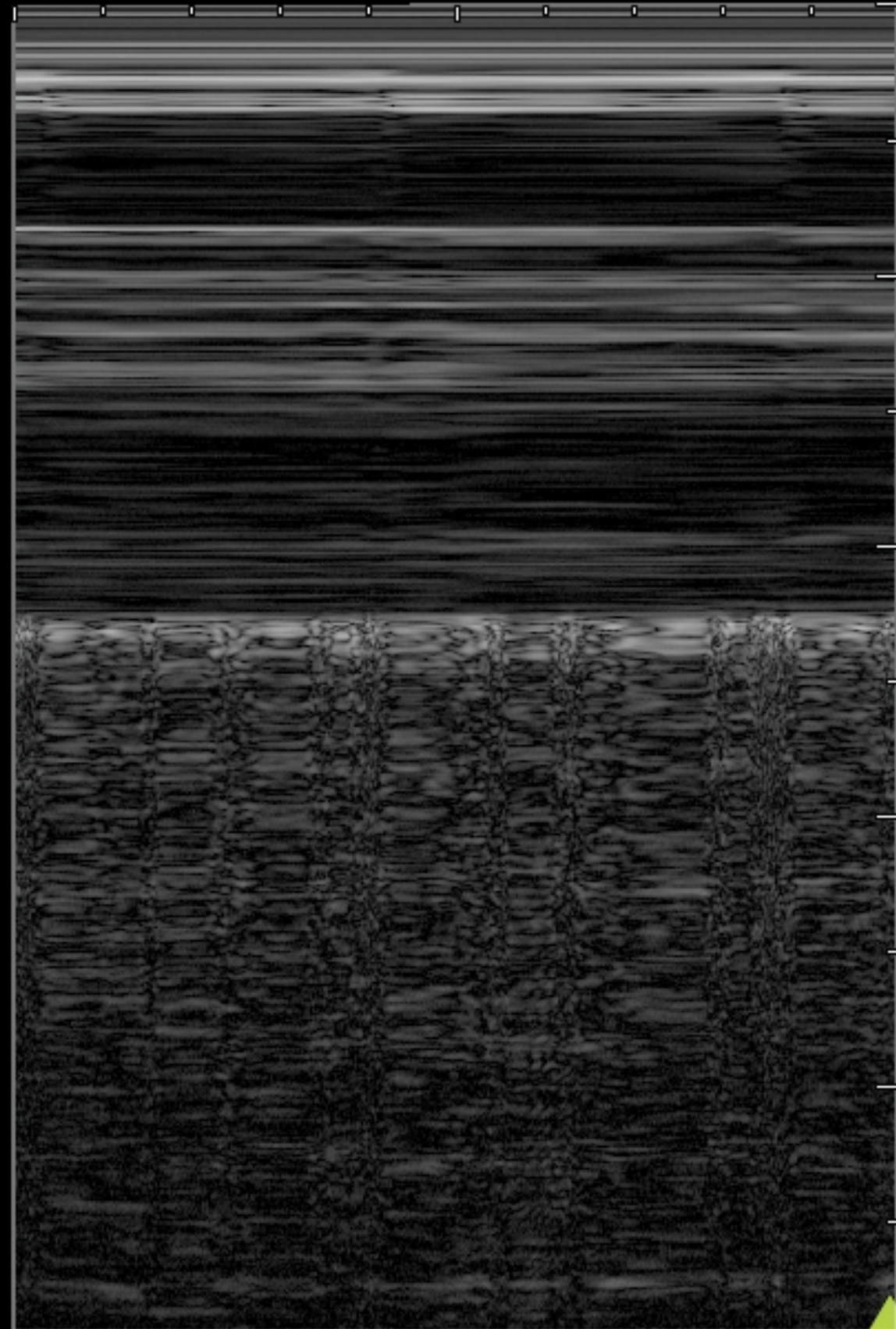


M-Mode

- Motion mode
- Used to measure movement of a given structure against time
- Helps confirm the presence of pleural sliding



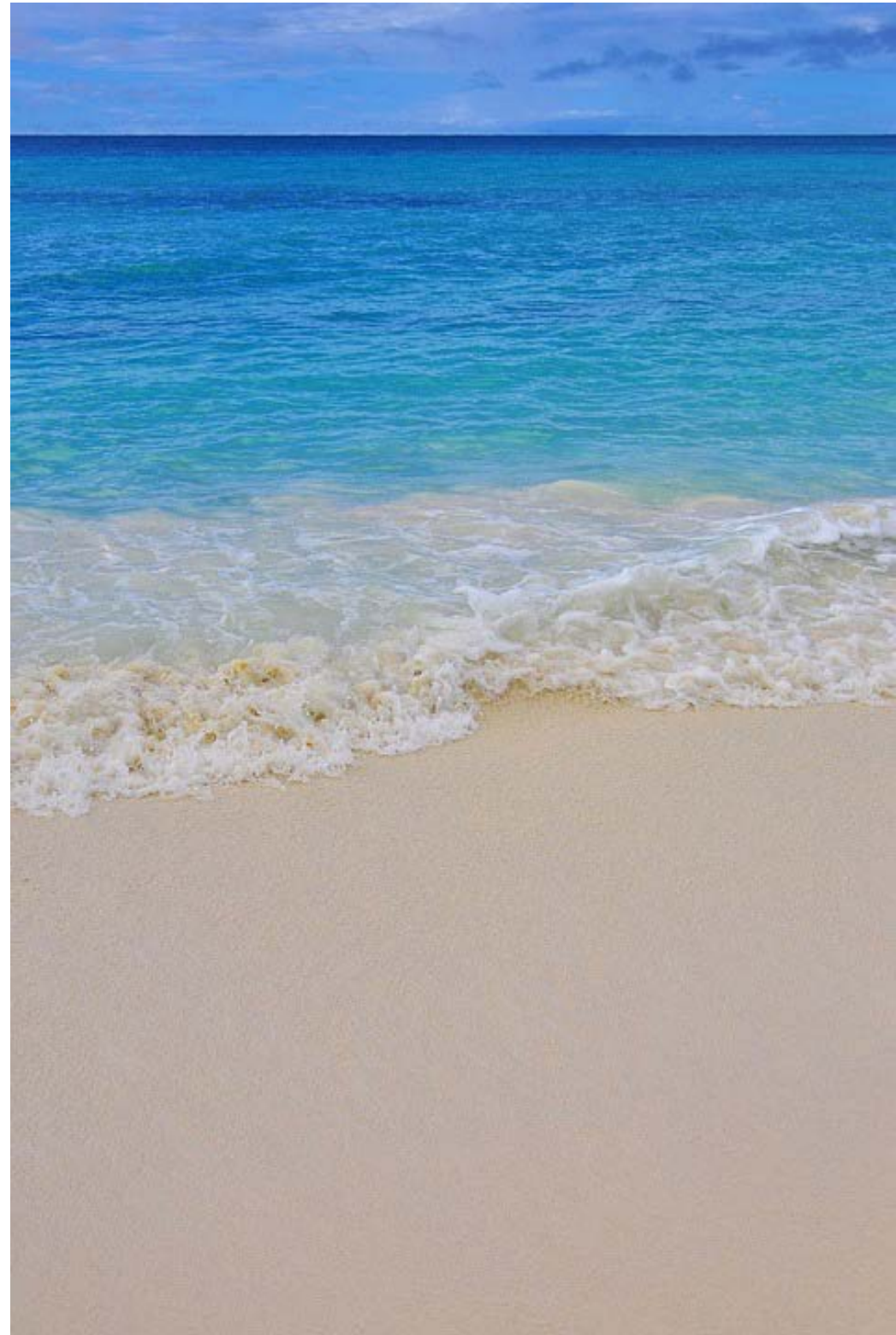
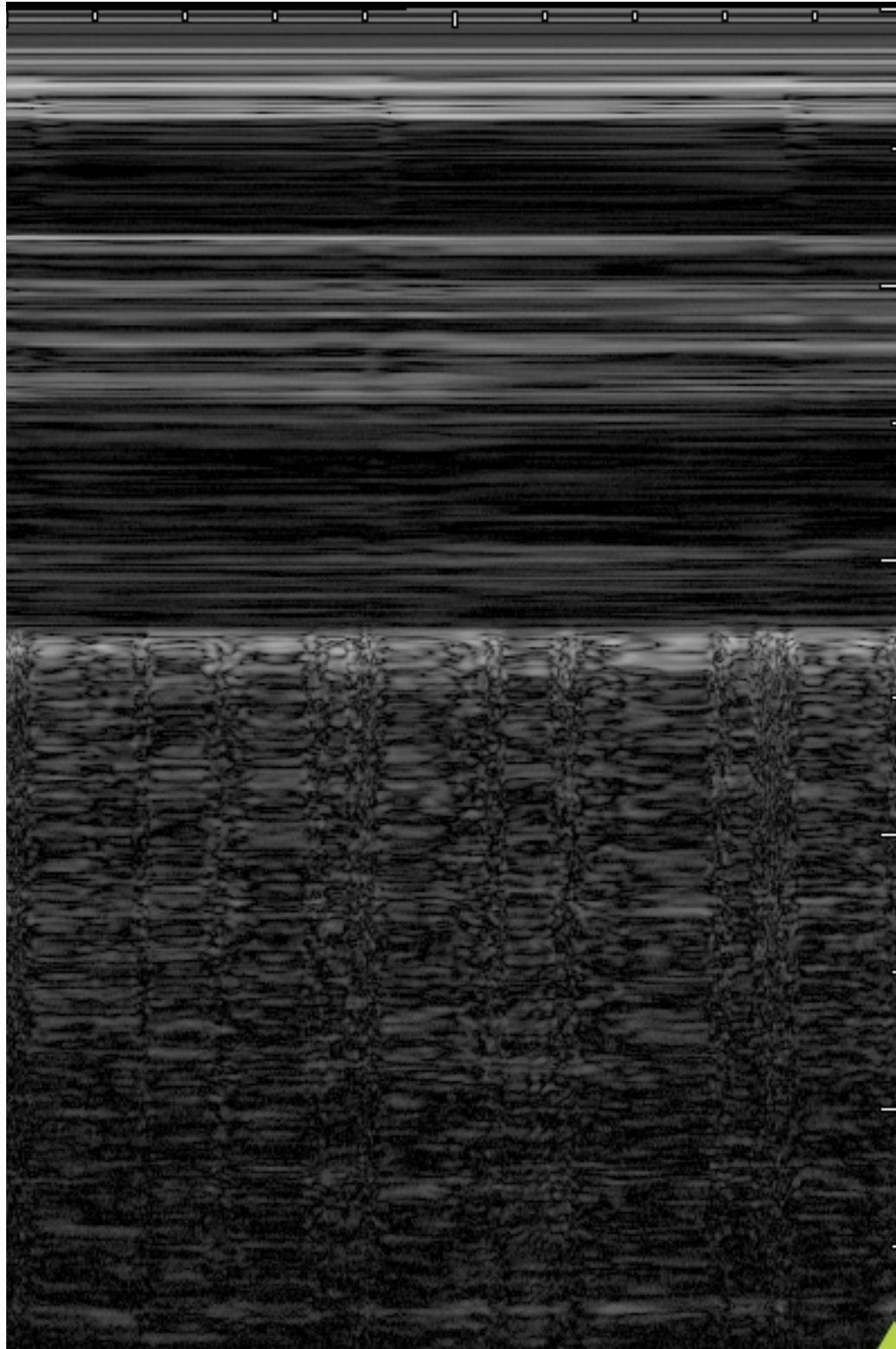
4.9 cm



SonoSite
HSL25xp/13-6 Lung
MI: 0.8 TIS: 0.3

M: G: 53 **2D:** G: 53
Res DR: 0

Normal Pleural Sliding: *Sea-Shore Sign*



LEFT

Z

Abd/General
C6-2/5.0MHz
-DR60/M3/P2
G50/E1/100%
MI0.7 TIs0.2
6.0 cm
Cine
ZSI 0

0.0 17.1

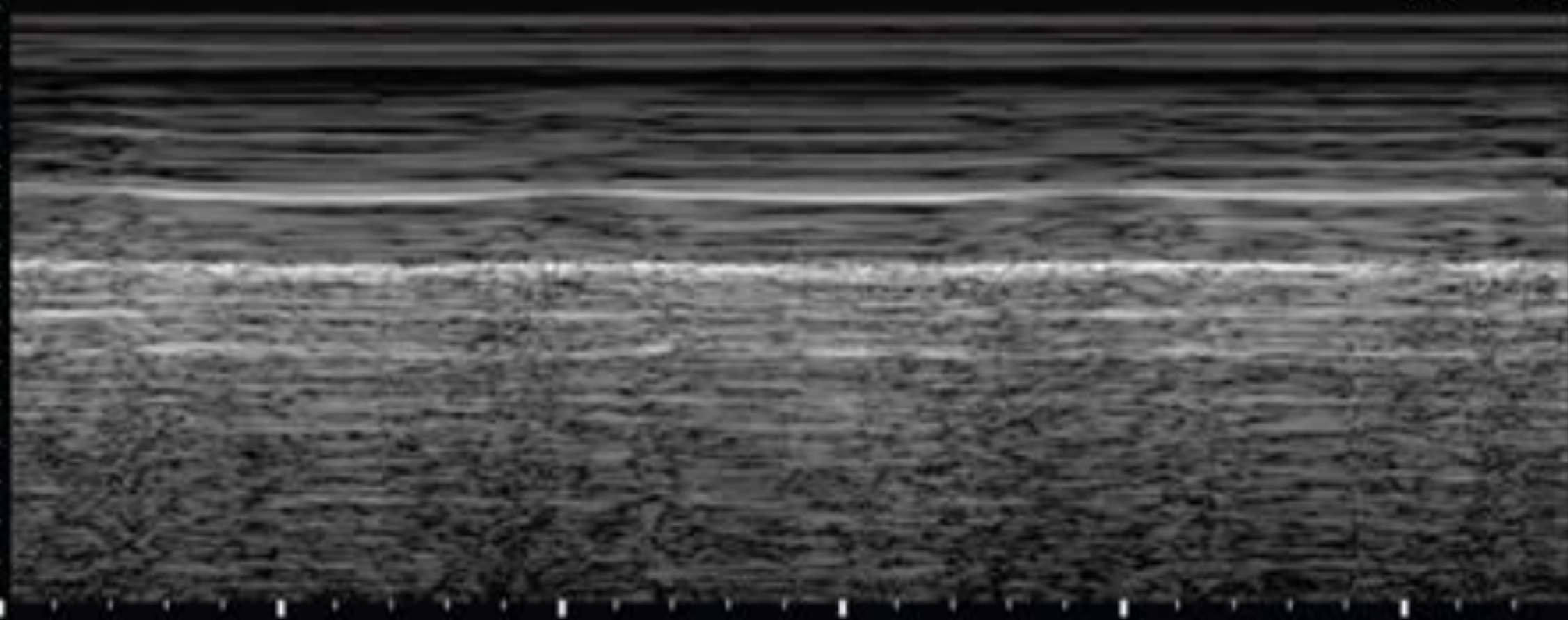
G44
Med
M2
DR65
P0

0.0

2.0

4.0

6.0
cm



Normal Key Signs to Find



Normal Lung

- **Pleural Line (with Bat Wing Sign)**
- **A-Lines**
- **Lung Sliding (with Seashore Sign)**

Abnormal Lung Ultrasound Appearances

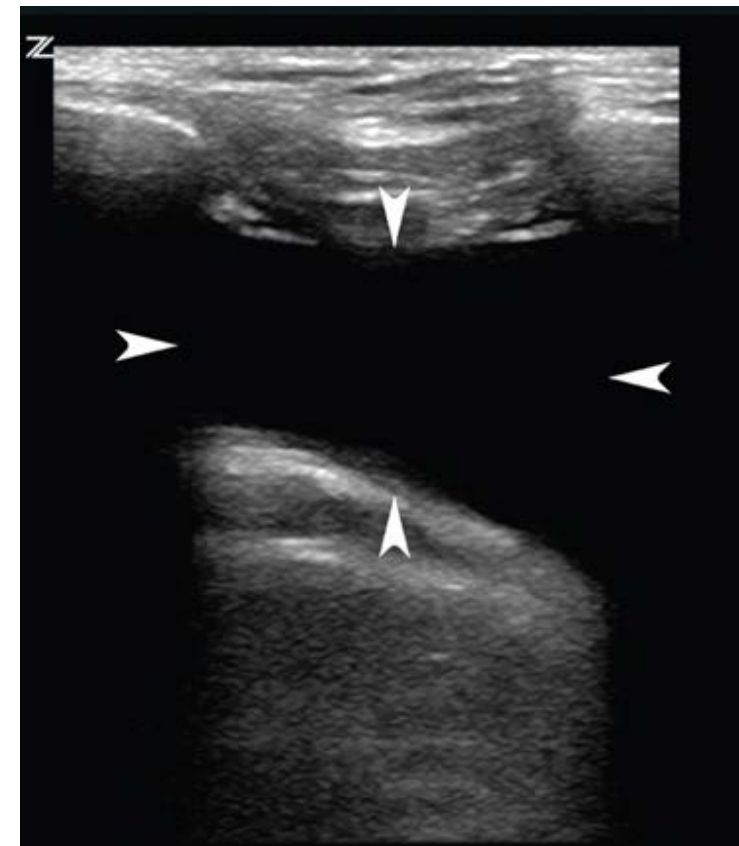
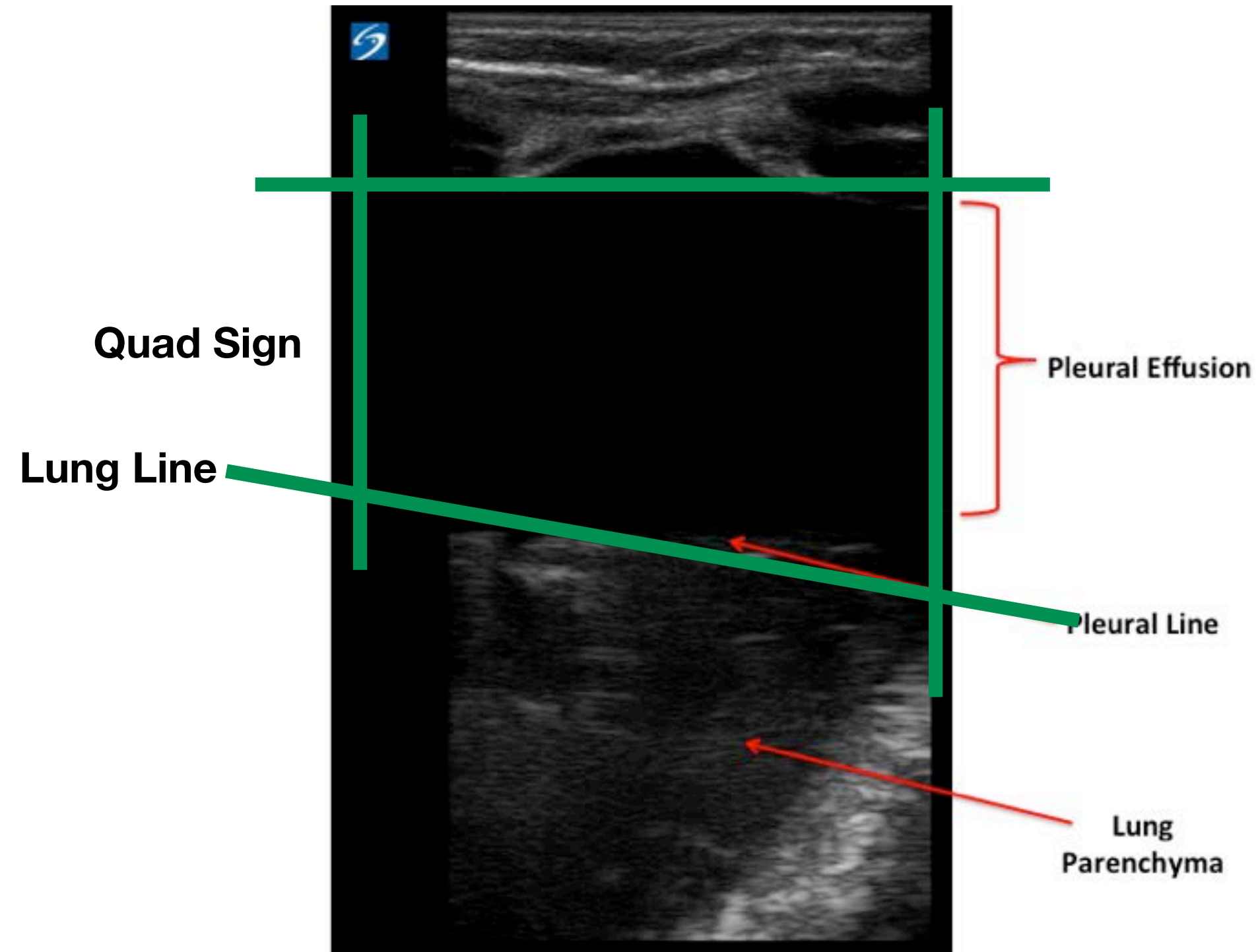
Signs to Find

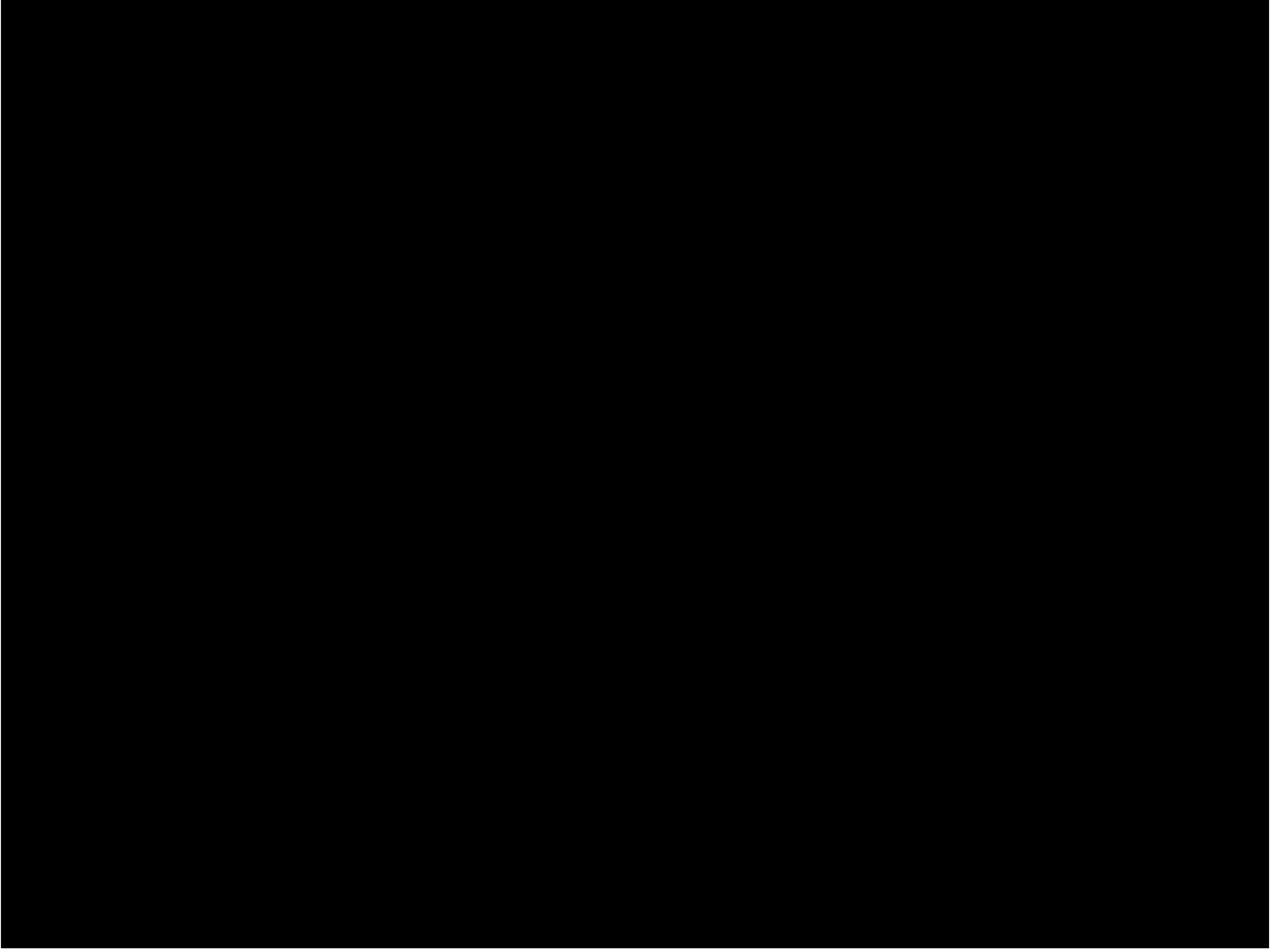
- Pleural Line (with Bat Wing Sign)
- A-Lines
- Lung Sliding (with Seashore Sign)
- **Quad Sign (with the Lung Line)**
- **Sinusoid Sign**
- **PLAPS Point**
- Tissue-Like Sign
- Shred-Sign
- C-Profile
- B-Lines
- Absent Lung Sliding (with Barcode Sign)
- Lung Point



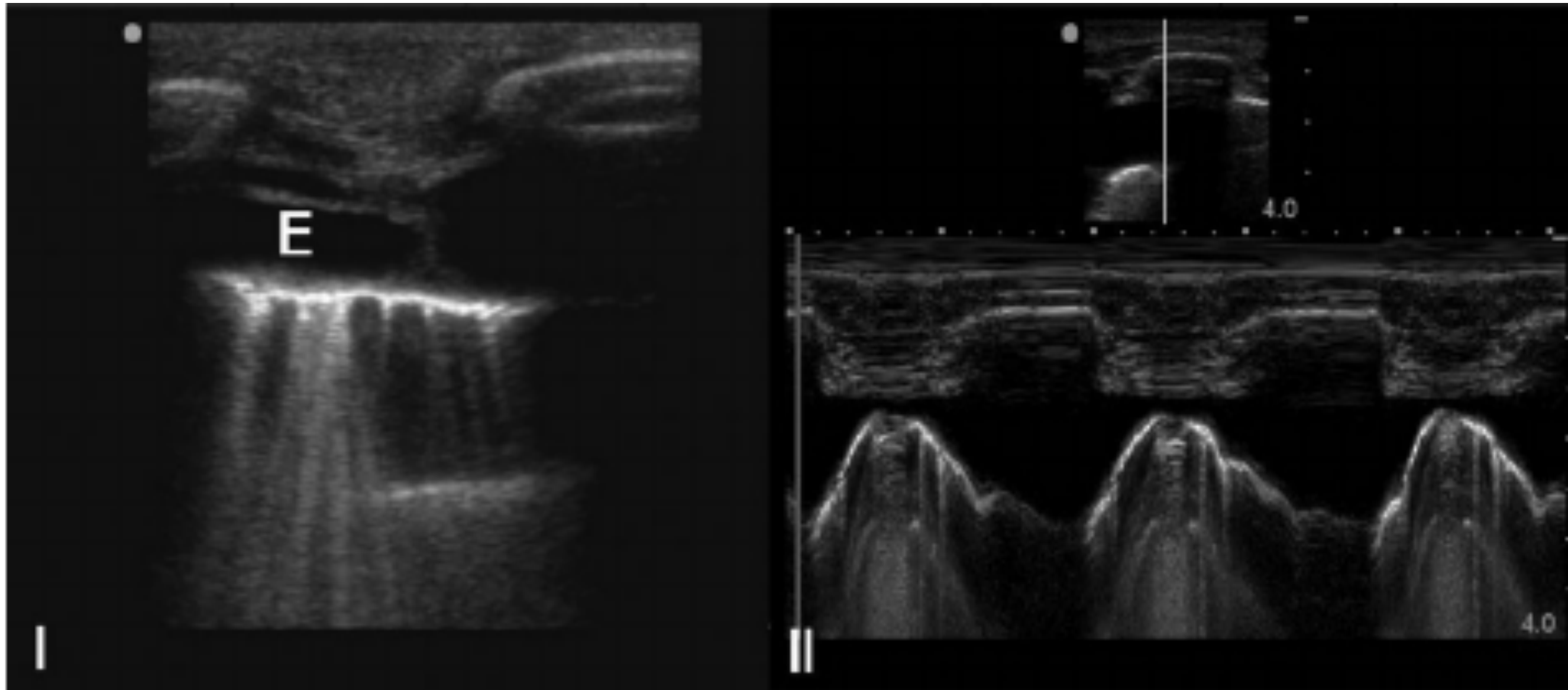
Pleural Effusion

Quad Sign & Lung Line

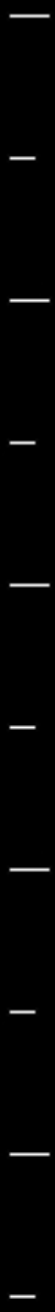




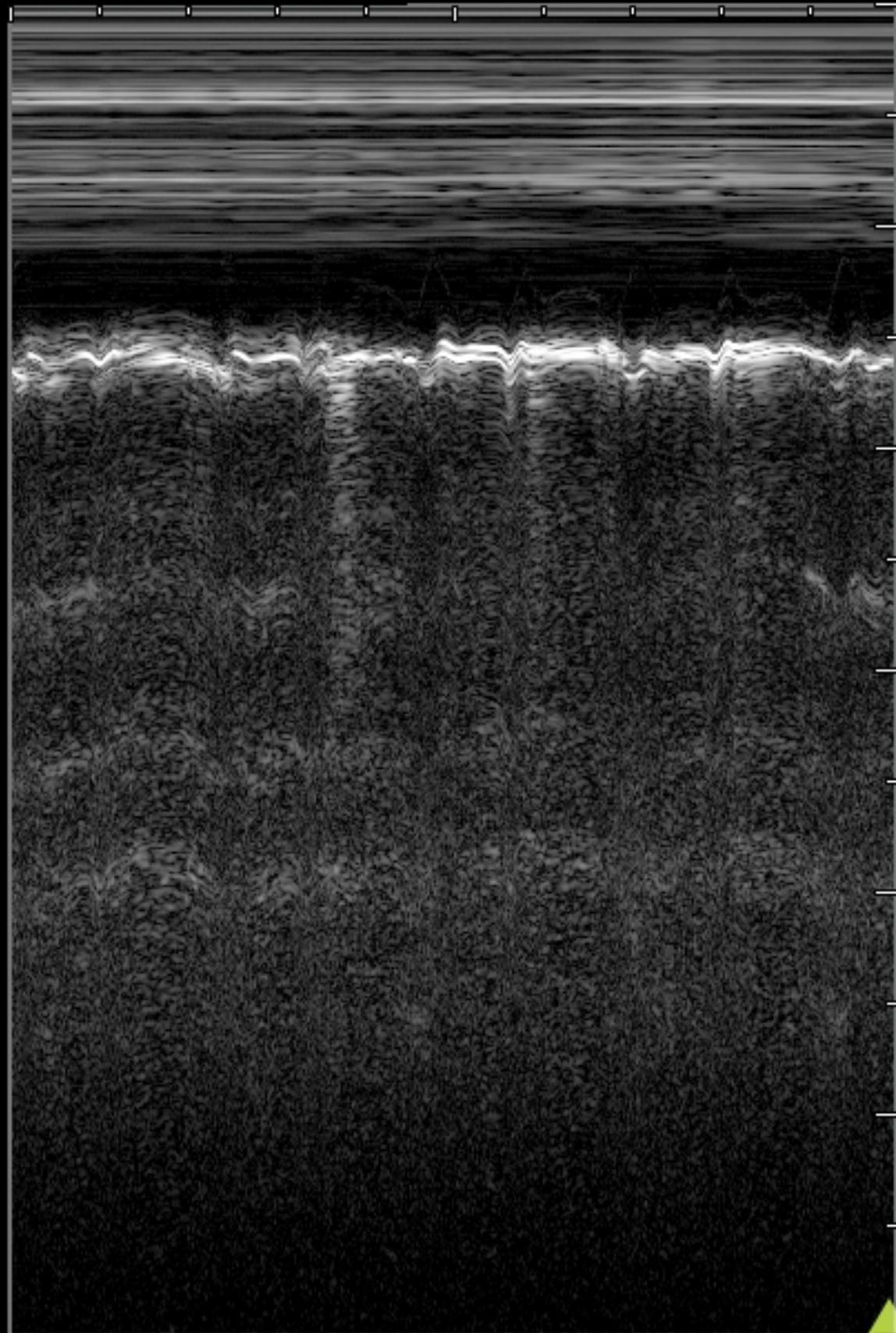
Sinusoid Sign



Lung
LMID



6.0 cm



AT

PICU

SonoSite

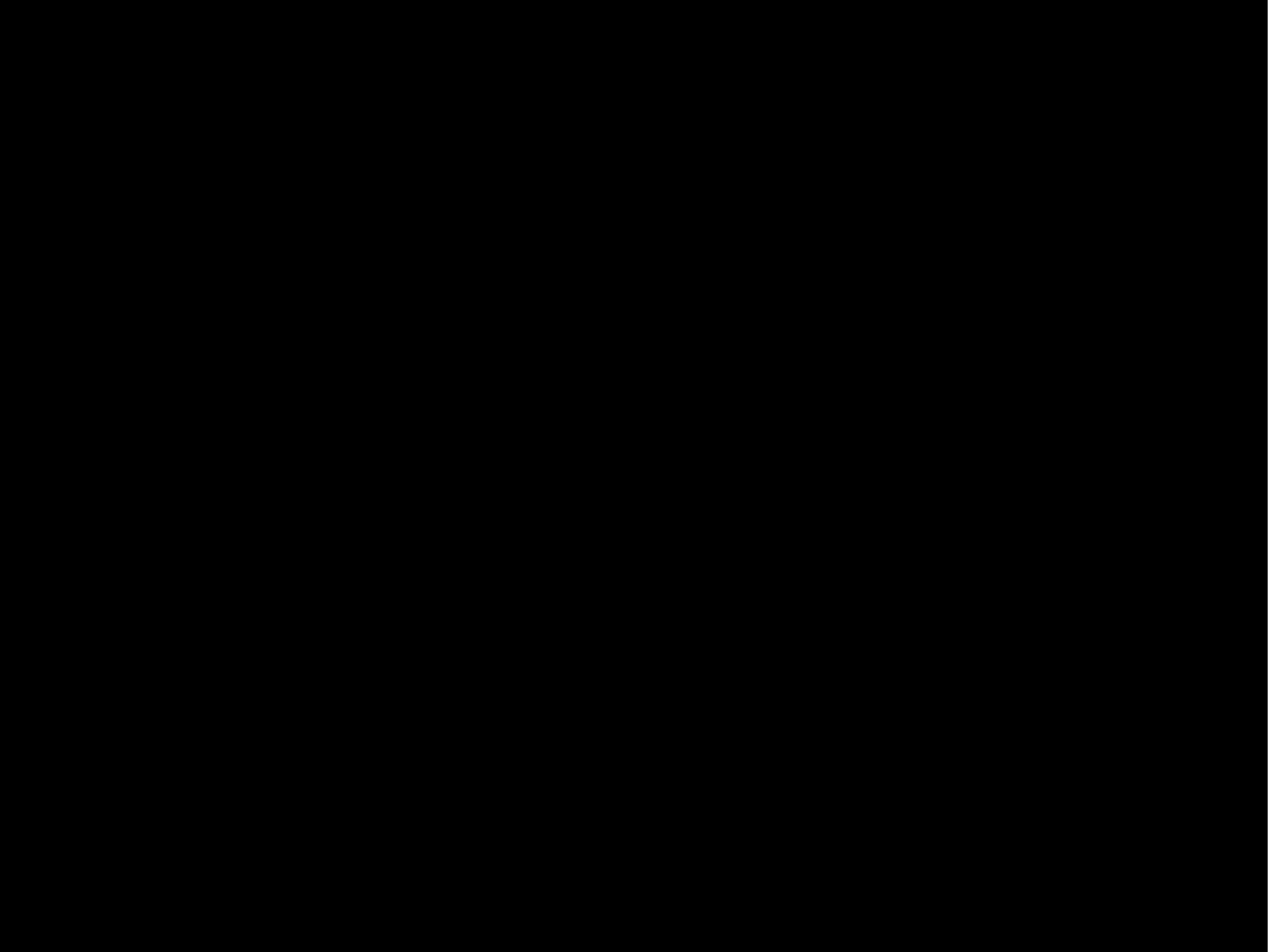
HSL25xp/13-6 Lung
MI: 0.6 TIS: 0.3

M: G: 50 2D: G: 50
Res DR: 0

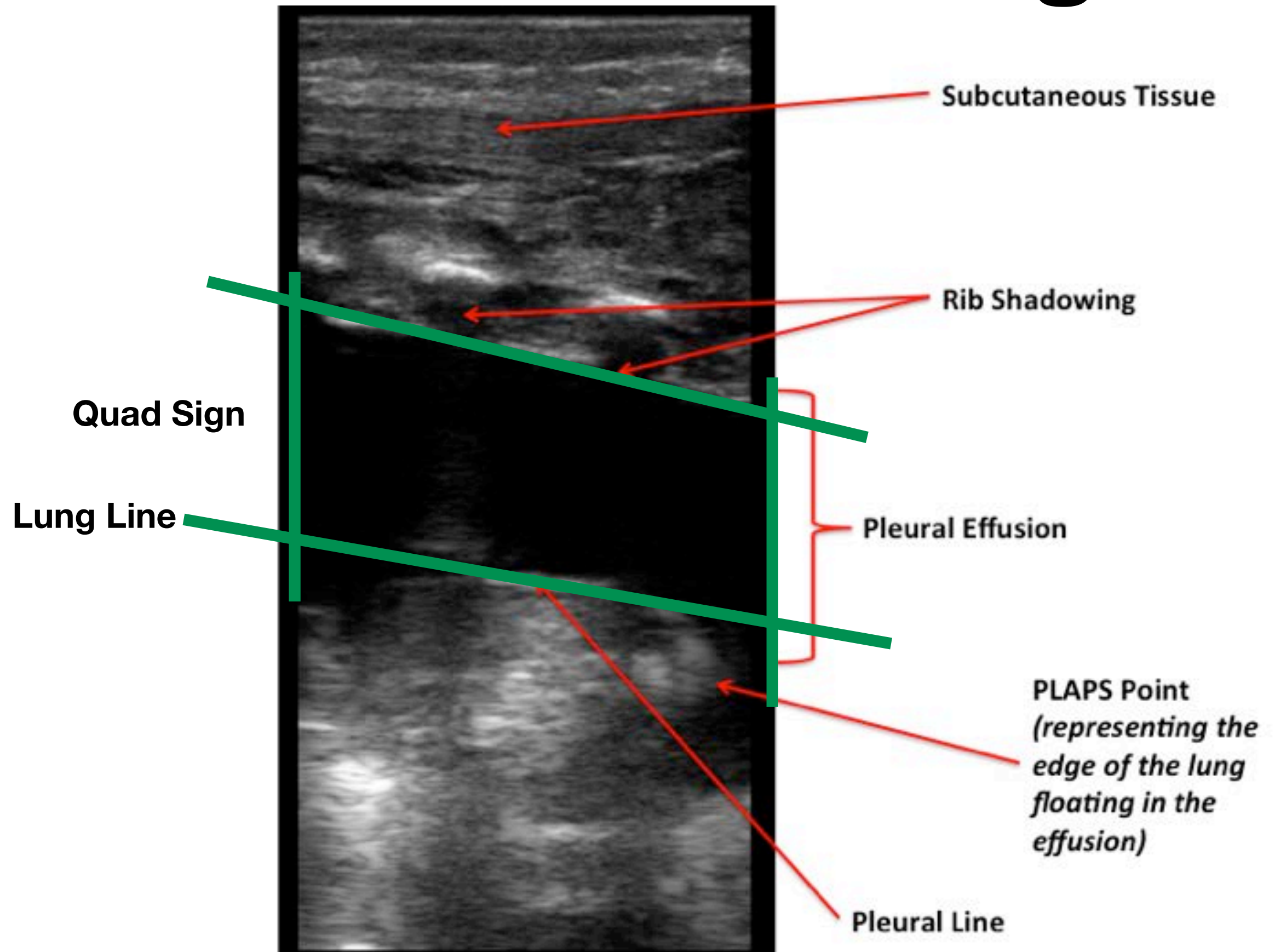
PLAPS Point







Pleural Effusion Signs



Signs to Find in Pleural Effusion



Pleural Effusion

- Quad Sign (with the Lung Line)
- Sinusoid Sign
- PLAPS Point

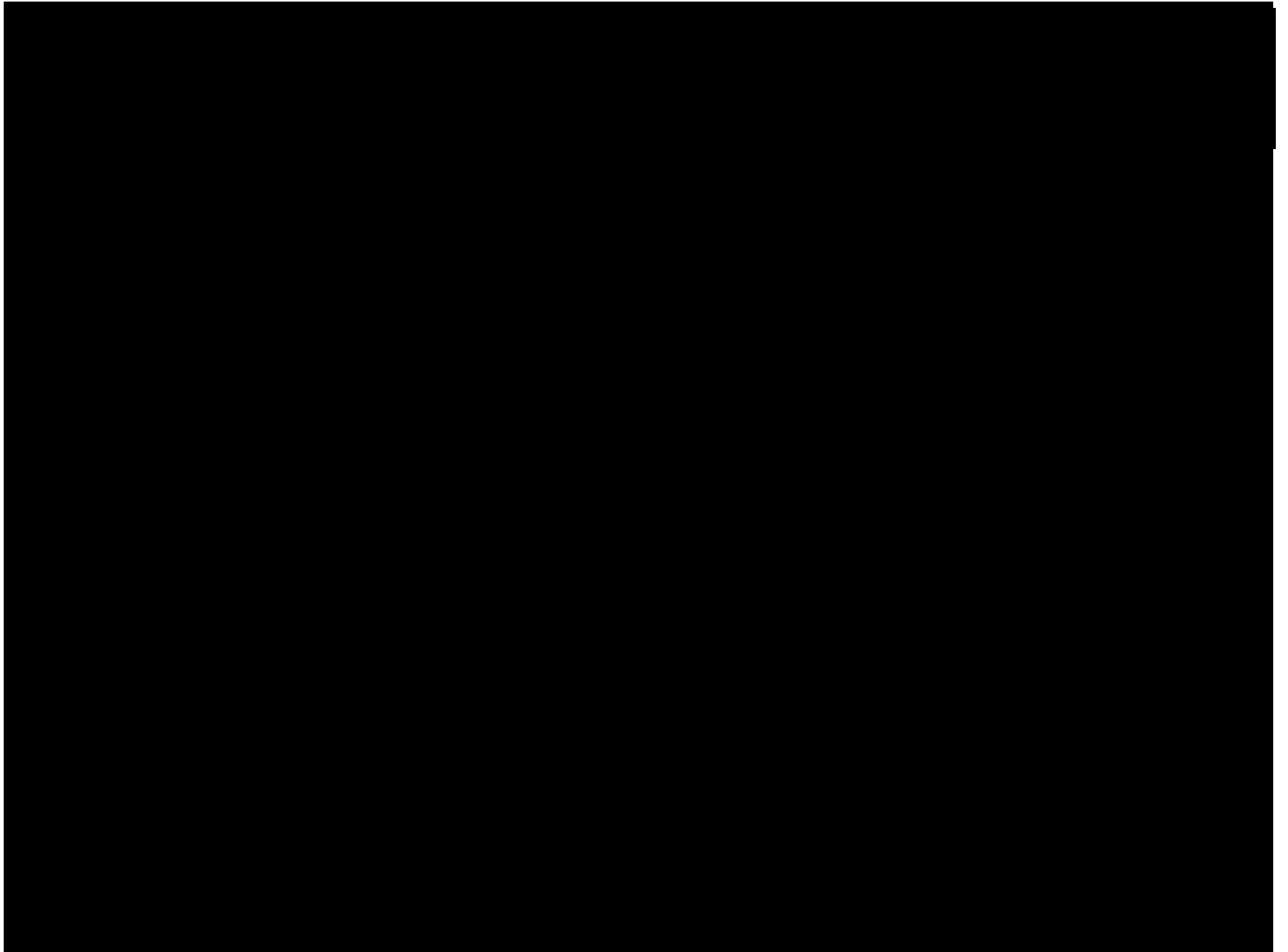
Signs to Find

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- Lung Sliding (with Seashore Sign)
- Quad Sign (with the Lung Line)
- Sinusoid Sign
- PLAPS Point
- **Tissue-Like Sign**
- **Shred-Sign**
- **C-Profile**
- B-Lines
- Absent Lung Sliding (with Barcode Sign)
- Lung Point

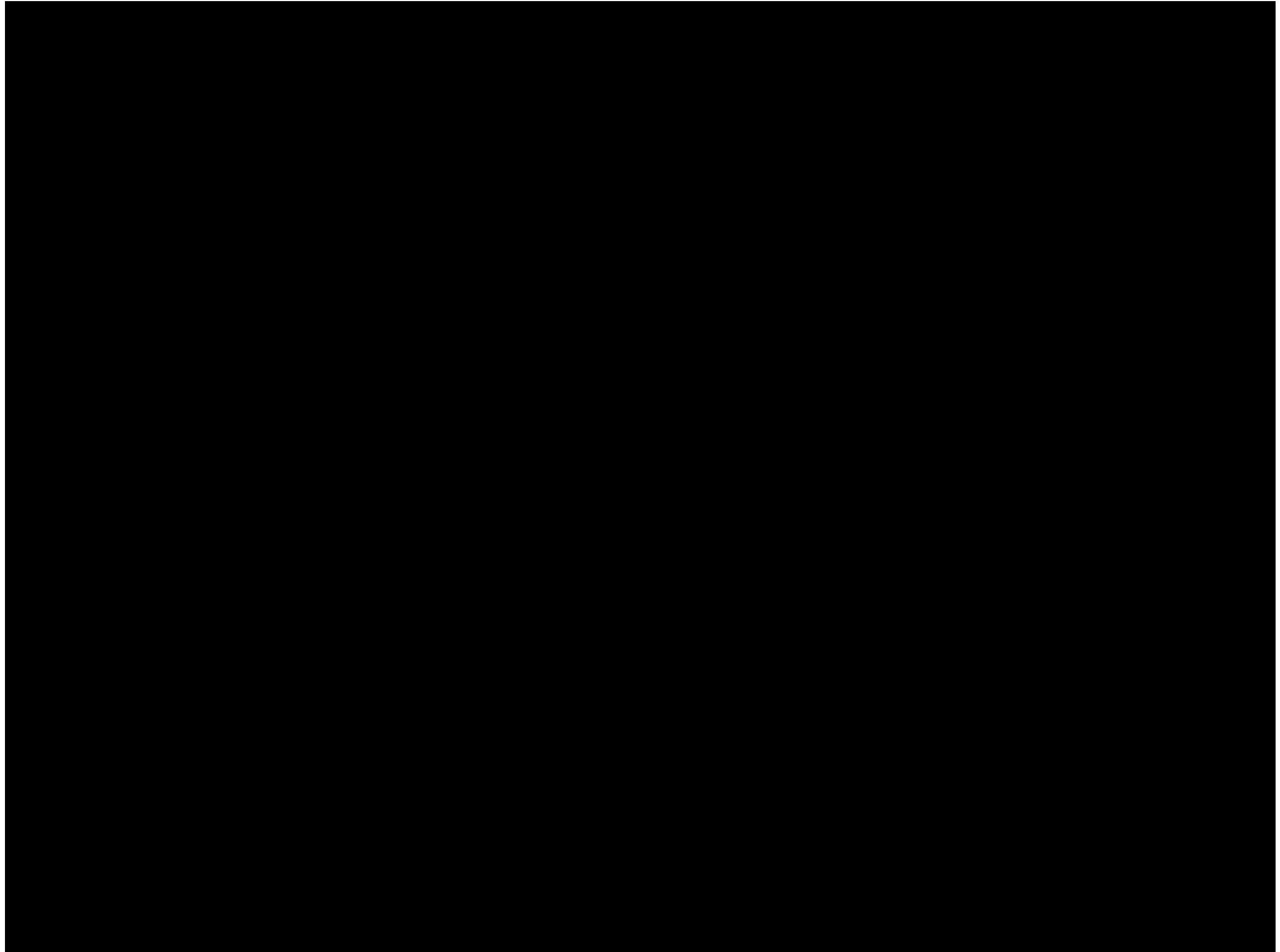


Consolidation

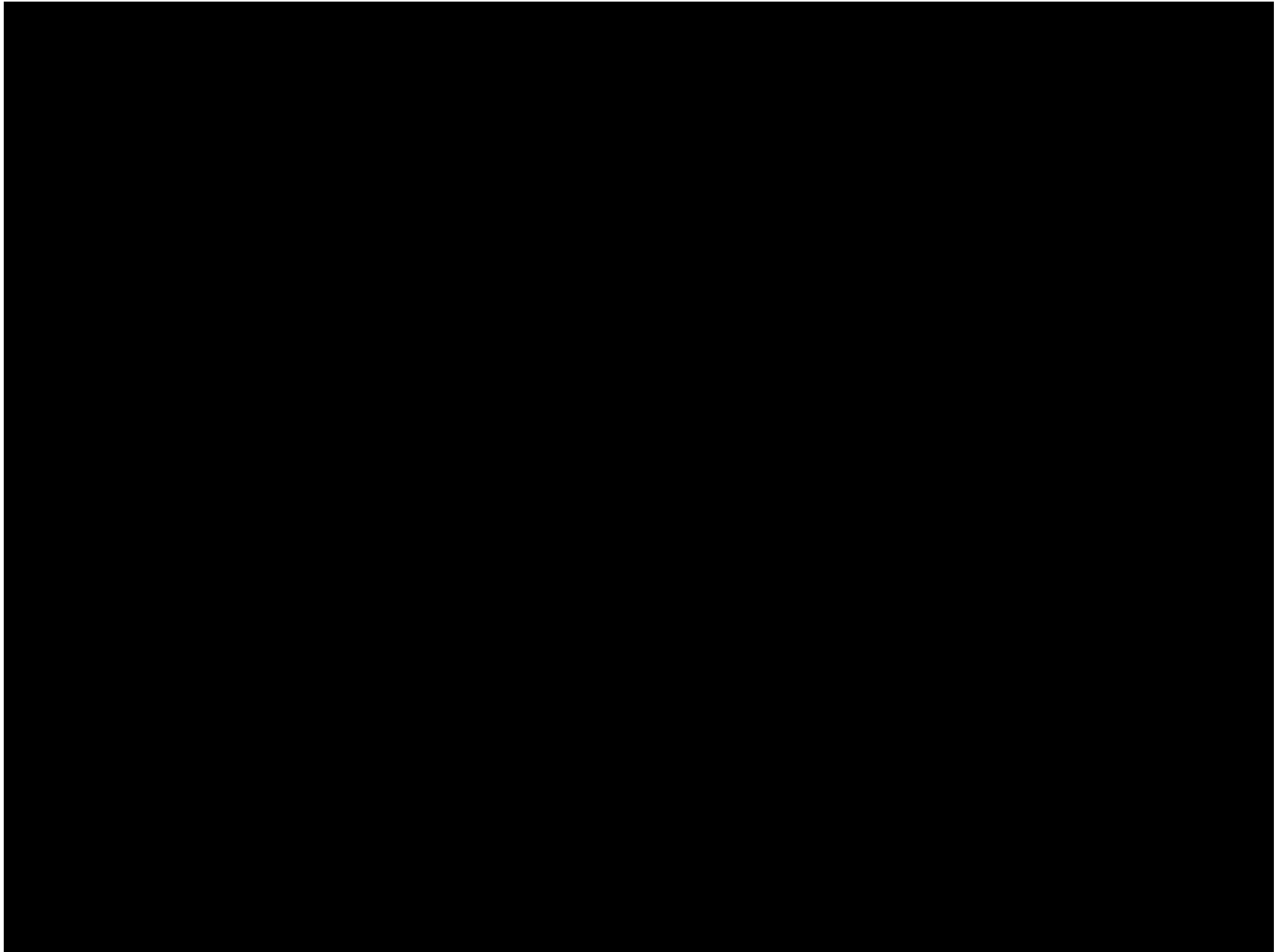
Consolidation



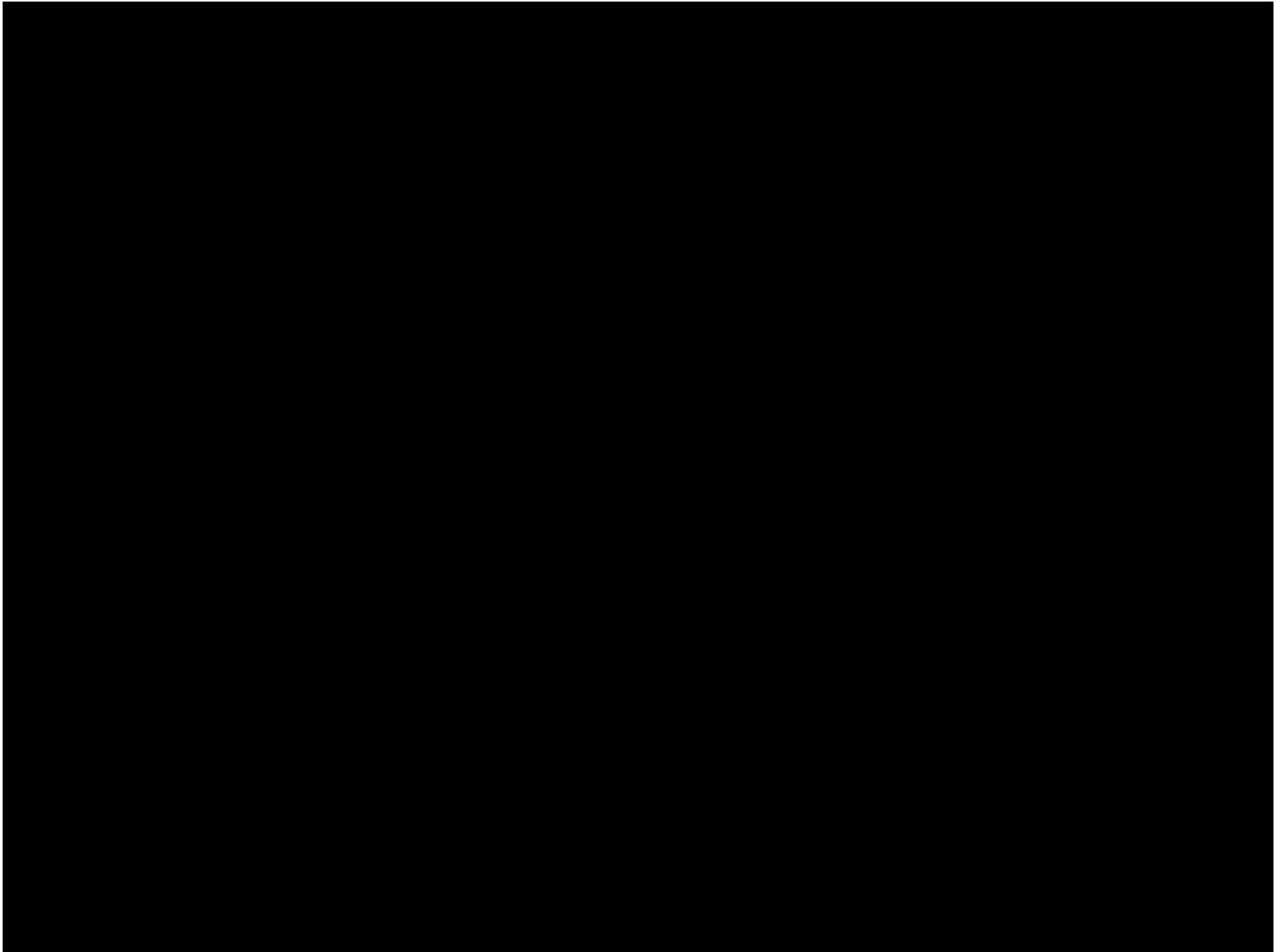
Consolidation



Consolidation



Consolidation



Signs to Find in Consolidation



Consolidation

- Tissue-Like Sign
- Shred-Sign
- C-Profile

Signs to Find

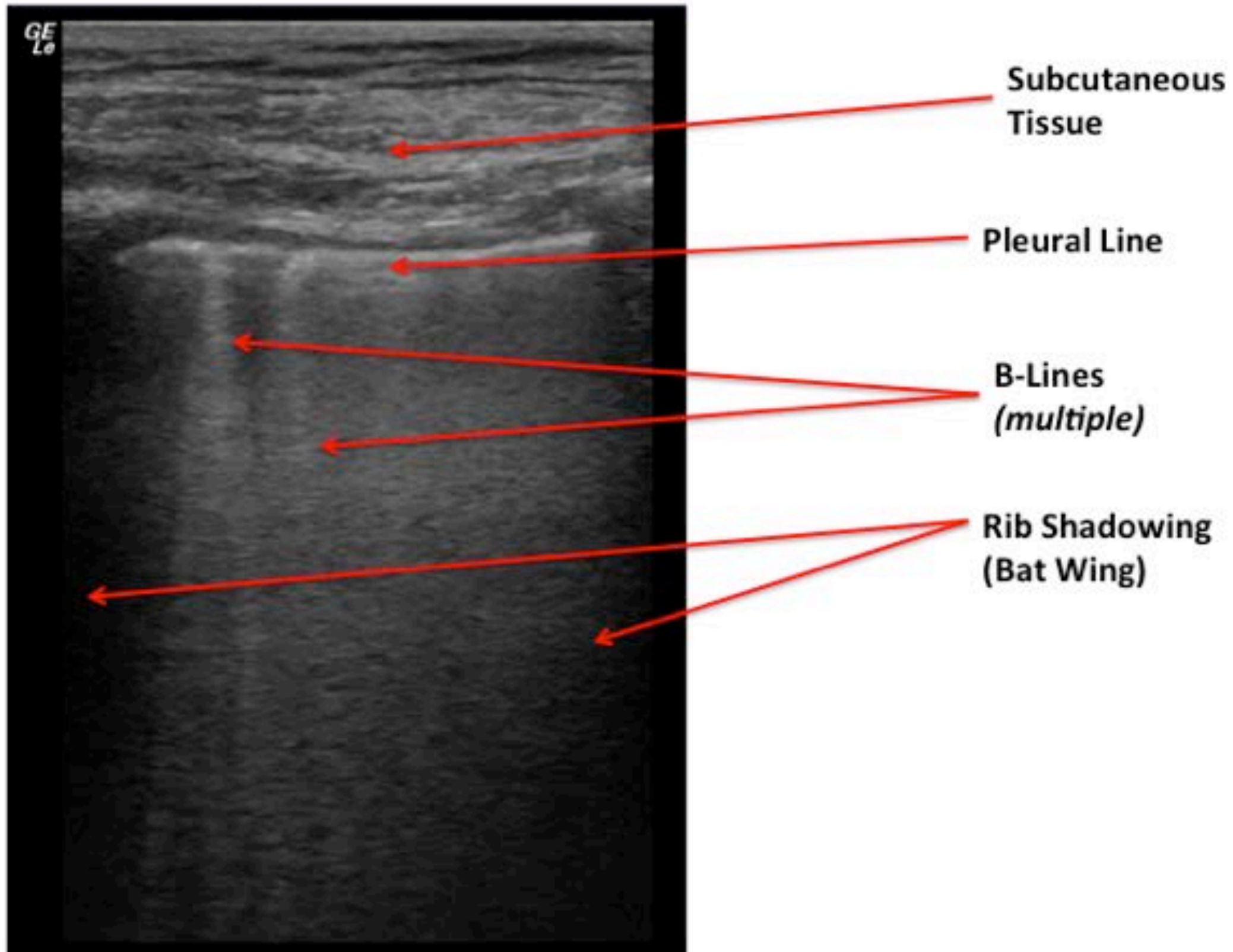
- Pleural Line (with Bat Wing Sign)
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- C-Profile
- **B-Lines**
- Absent Lung Sliding (with Barcode Sign)
- Lung Point

◀ **Interstitial Syndrome**

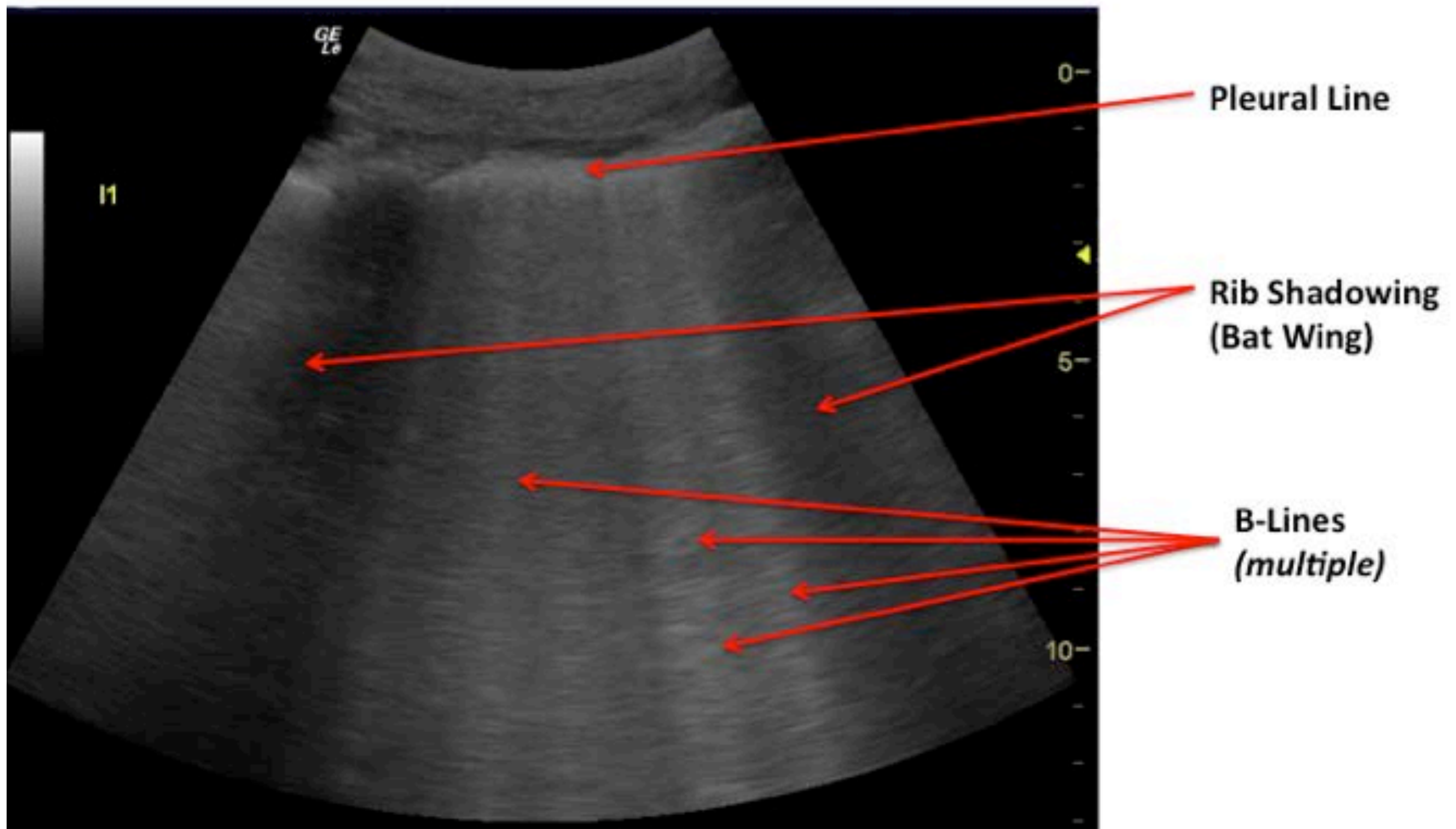
B Lines

- Dense white lines arising from the pleura and extending down towards the end of the screen
- Often erase the A-lines
- Can represent:
 - ✱ Alveolar (pulmonary) oedema
 - ✱ Alveolar consolidation
 - ✱ Pulmonary fibrosis
- Correlated with severity of the oedema
- Real-time resolution

B-Lines



B-Lines



Quantity of B Lines

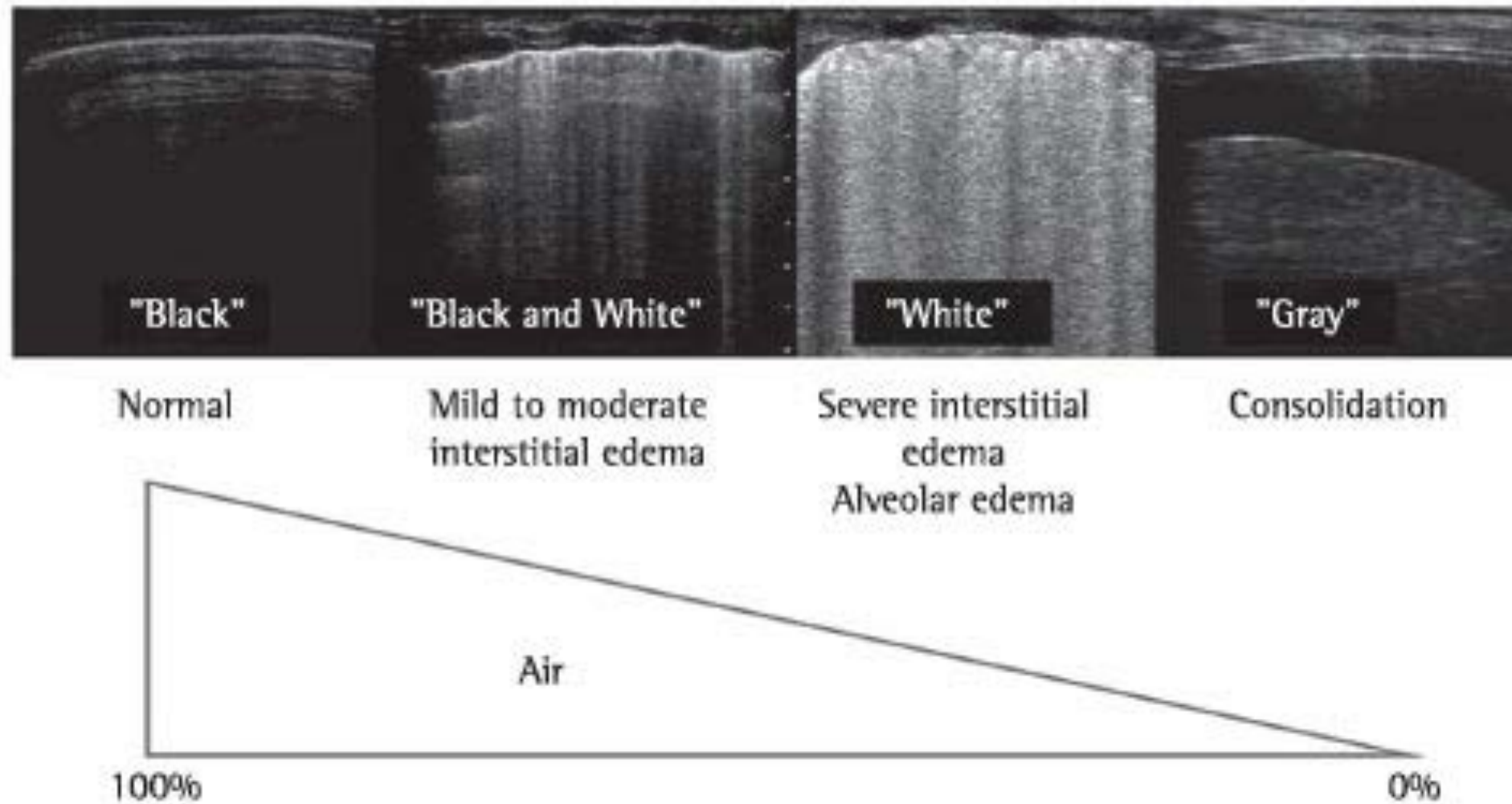
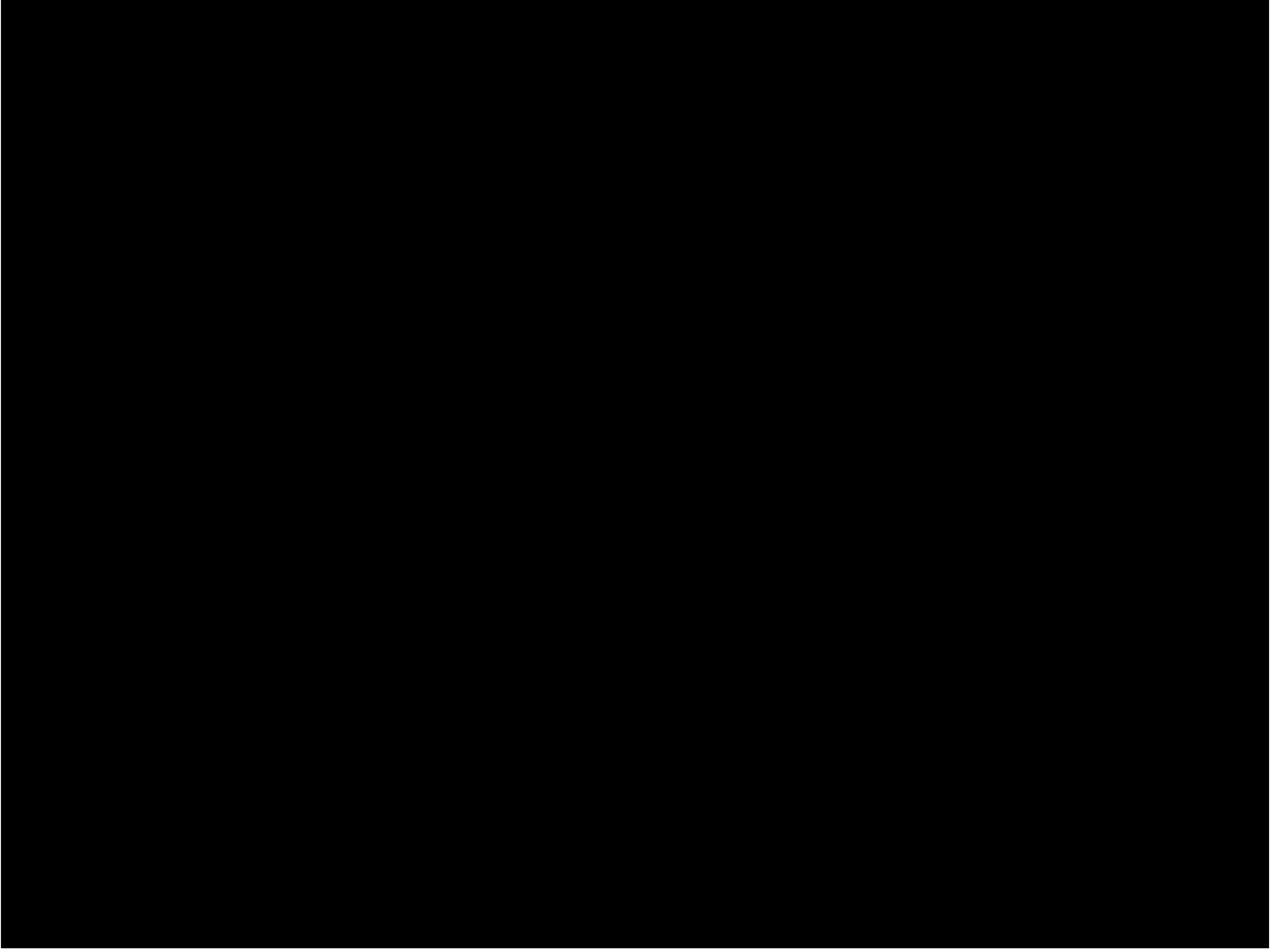


Figure 1 – Physical principles of lung ultrasound. A less aerated lung translates to easier detection of abnormalities by the method. Adapted from Gargani,⁽²⁾ with the permission of the author.



Signs to Find in Interstitial Syndrome

◀ Interstitial Syndrome

- **B-Lines**
- **(Plus cardiac POCUS signs.....)**

Signs to Find

- Pleural Line (with Bat Wing Sign)
- A-Lines
- Lung Sliding (with Seashore Sign)
- Quad Sign (with the Lung Line)
- Sinusoid Sign
- PLAPS Point
- Tissue-Like Sign
- Shred-Sign
- C-Profile
- B-Lines
- **Absent Lung Sliding (with Barcode Sign)**
- **Lung Point**

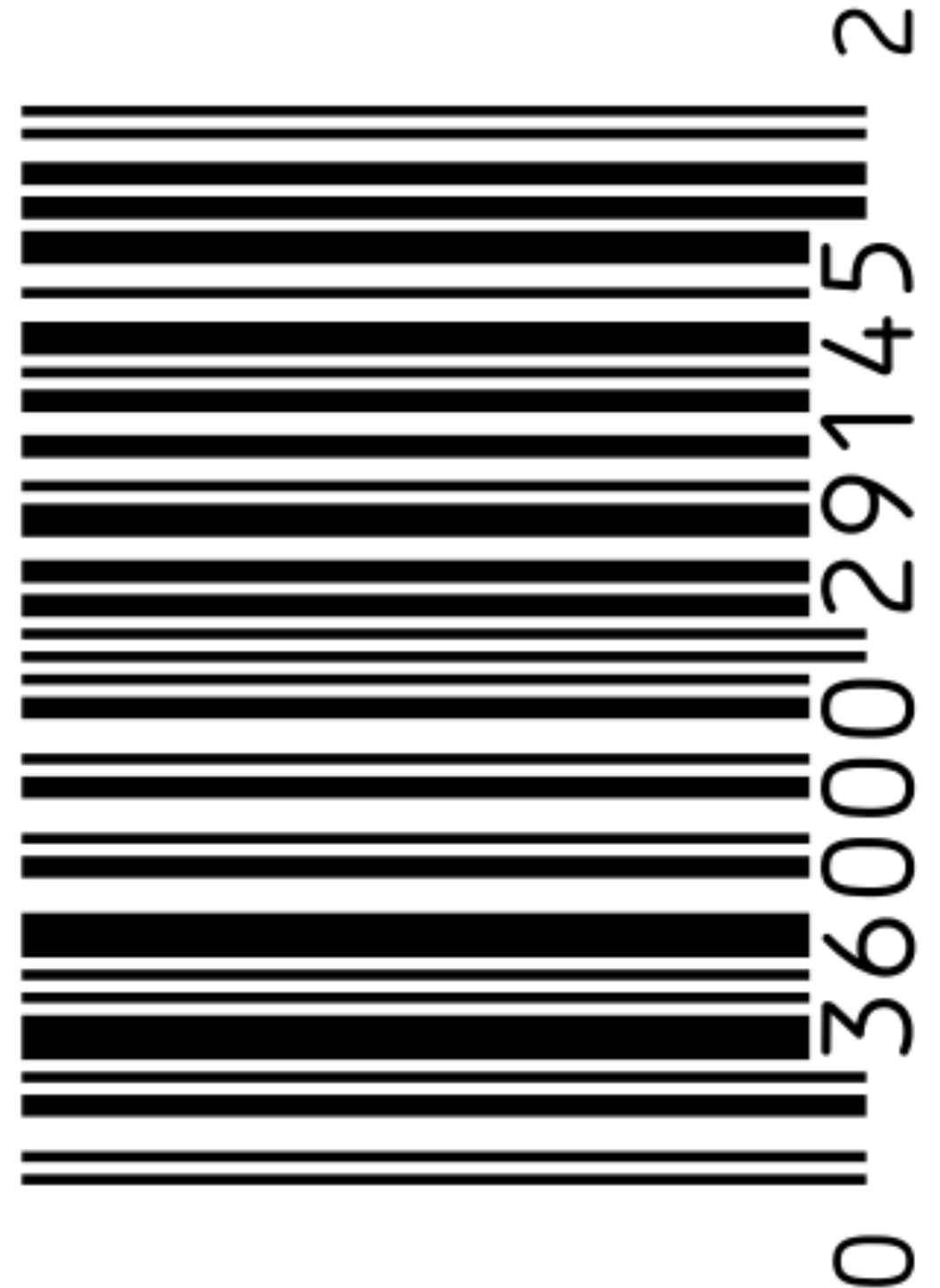
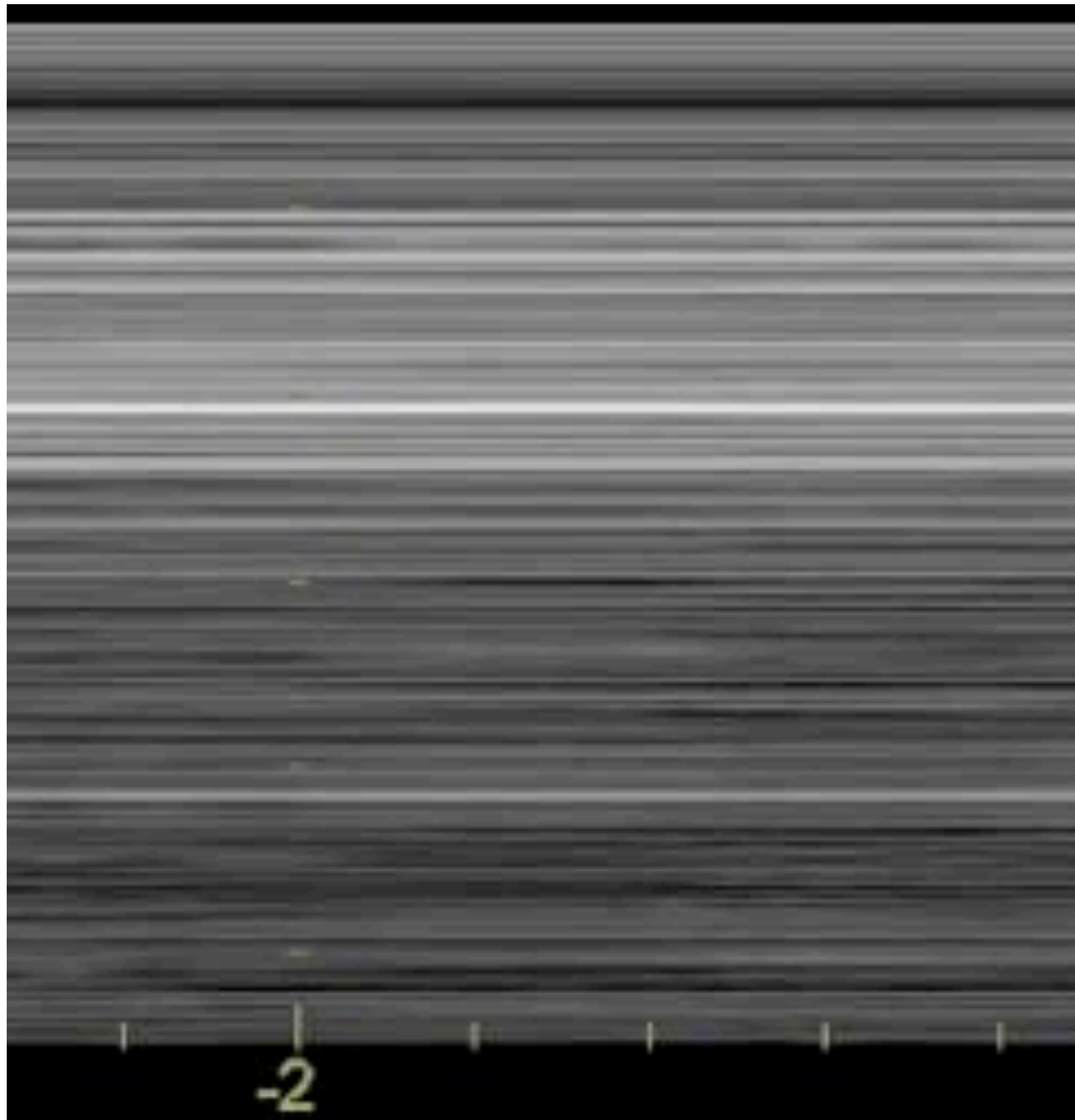


Pneumothorax

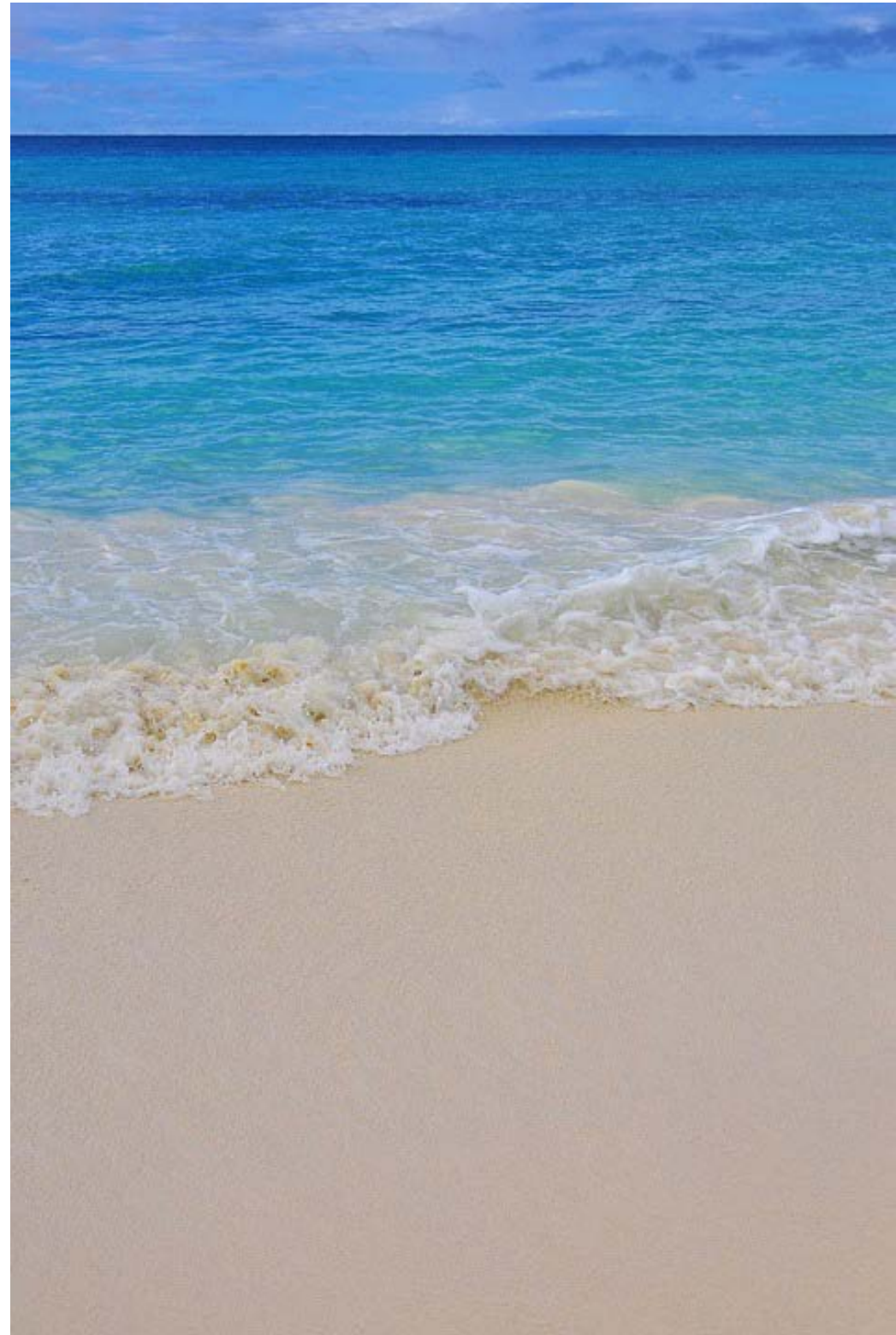
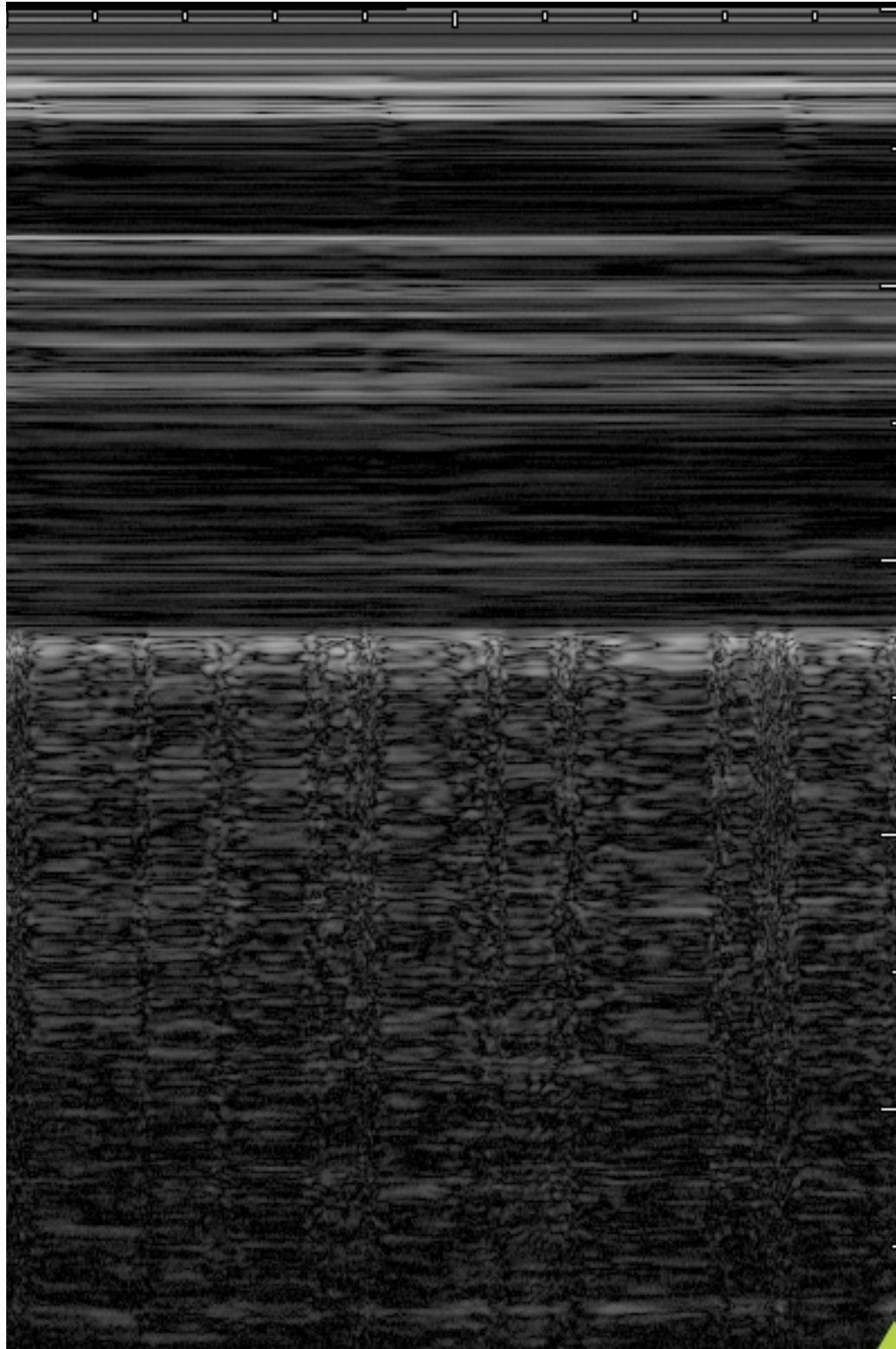
Right Lung

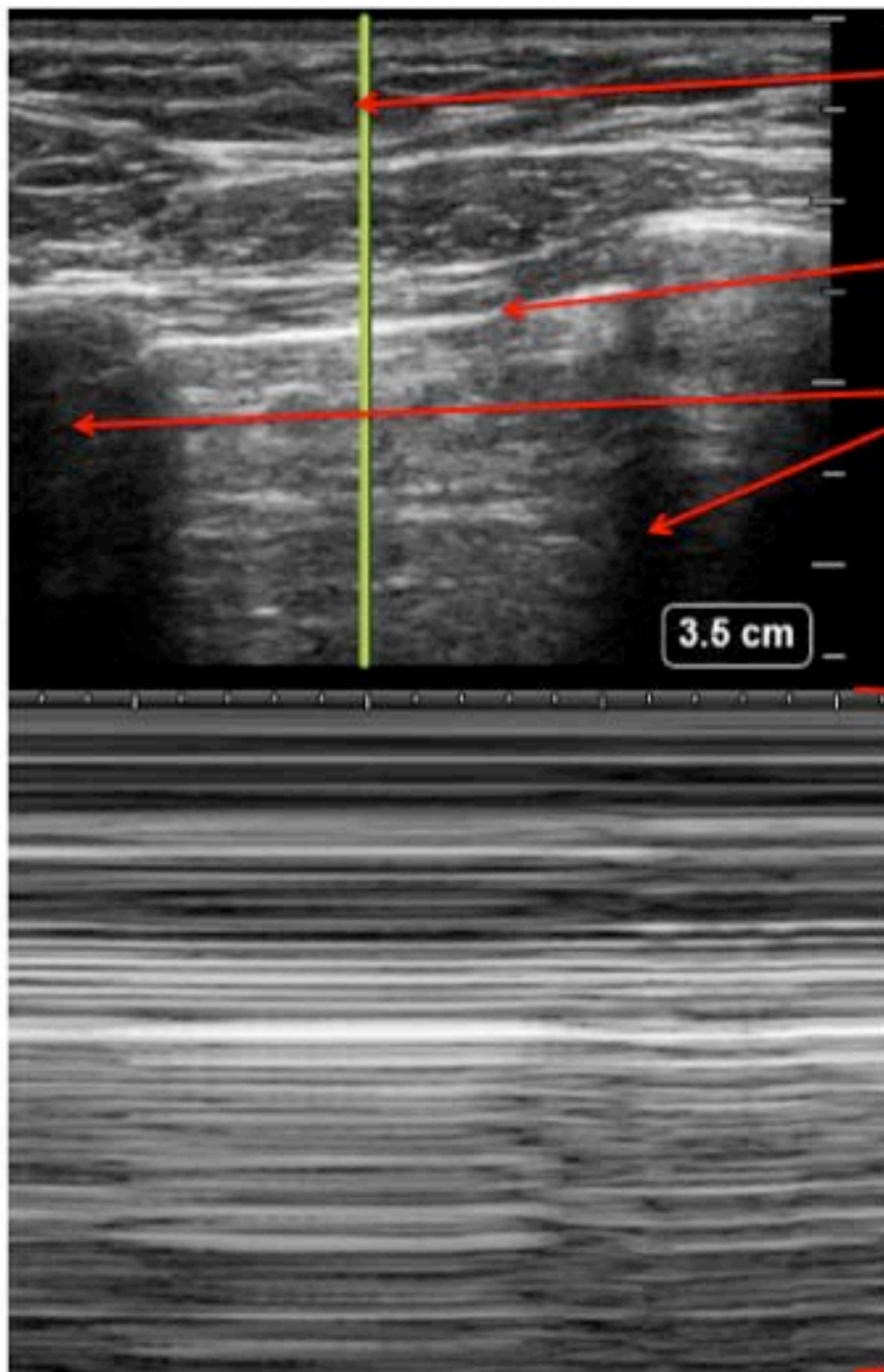
Left Lung

Absent Pleural Sliding: *Barcode Sign*



Normal Pleural Sliding: *Sea-Shore Sign*





M-Mode
Cursor

Pleural Line

Rib Shadowing
(\'Bat Wings\')

3.5 cm

M-Mode Trace:

*Uniform tracing
due to lack of
pleural movement*

*Barcode" or
'Stratosphere"
Sign*

*Compare to the
normal in Fig 6*

GE
L₀

0-

M-Mode
Cursor

Pleural Line

5-

Rib Shadowing
(‘Bat Wings’)

10-

[cm]

M-Mode Trace:

*Uniform tracing
due to lack of
pleural movement*

*“Barcode” or
‘Stratosphere’
Sign*

*Compare to the
normal in Fig 6*

2

4

6

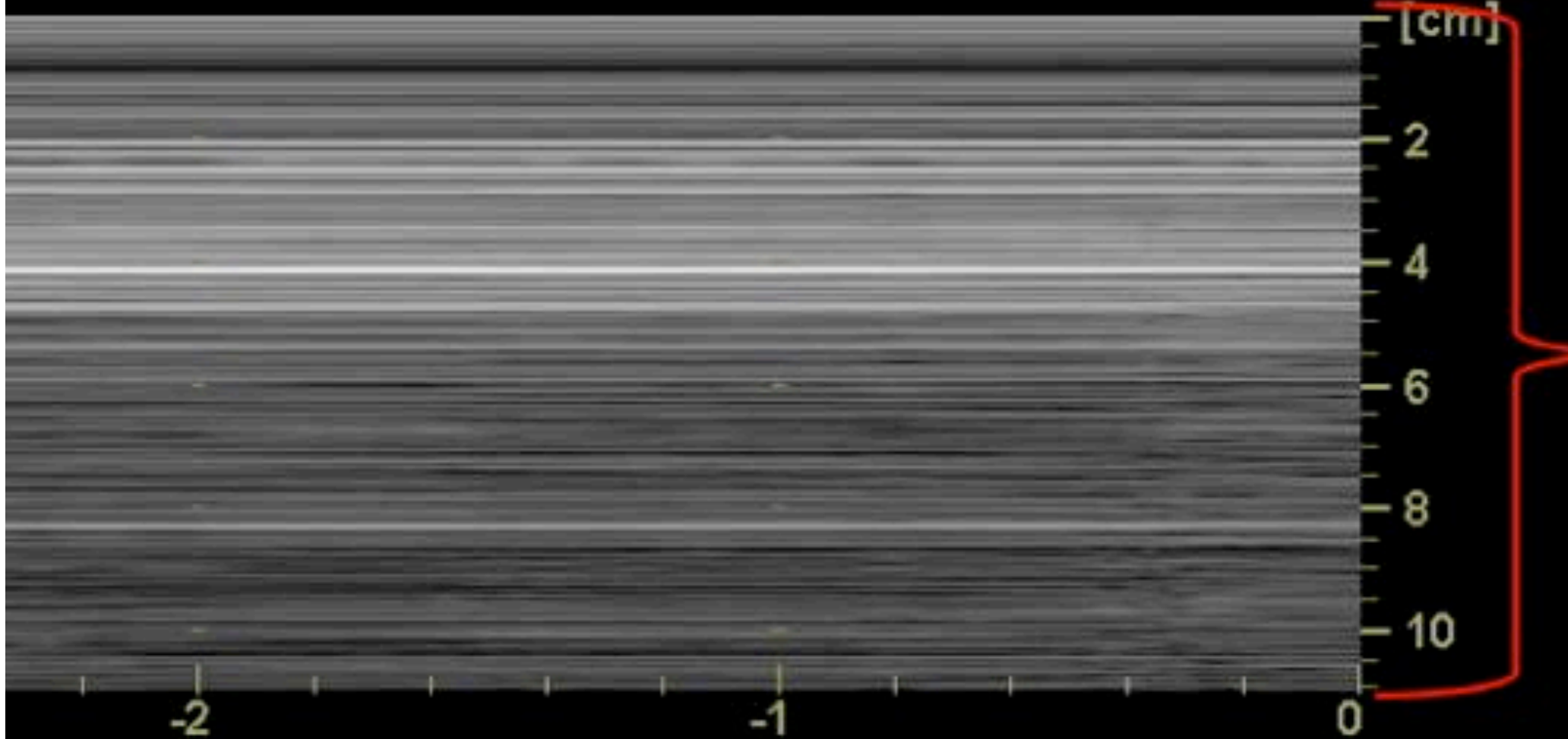
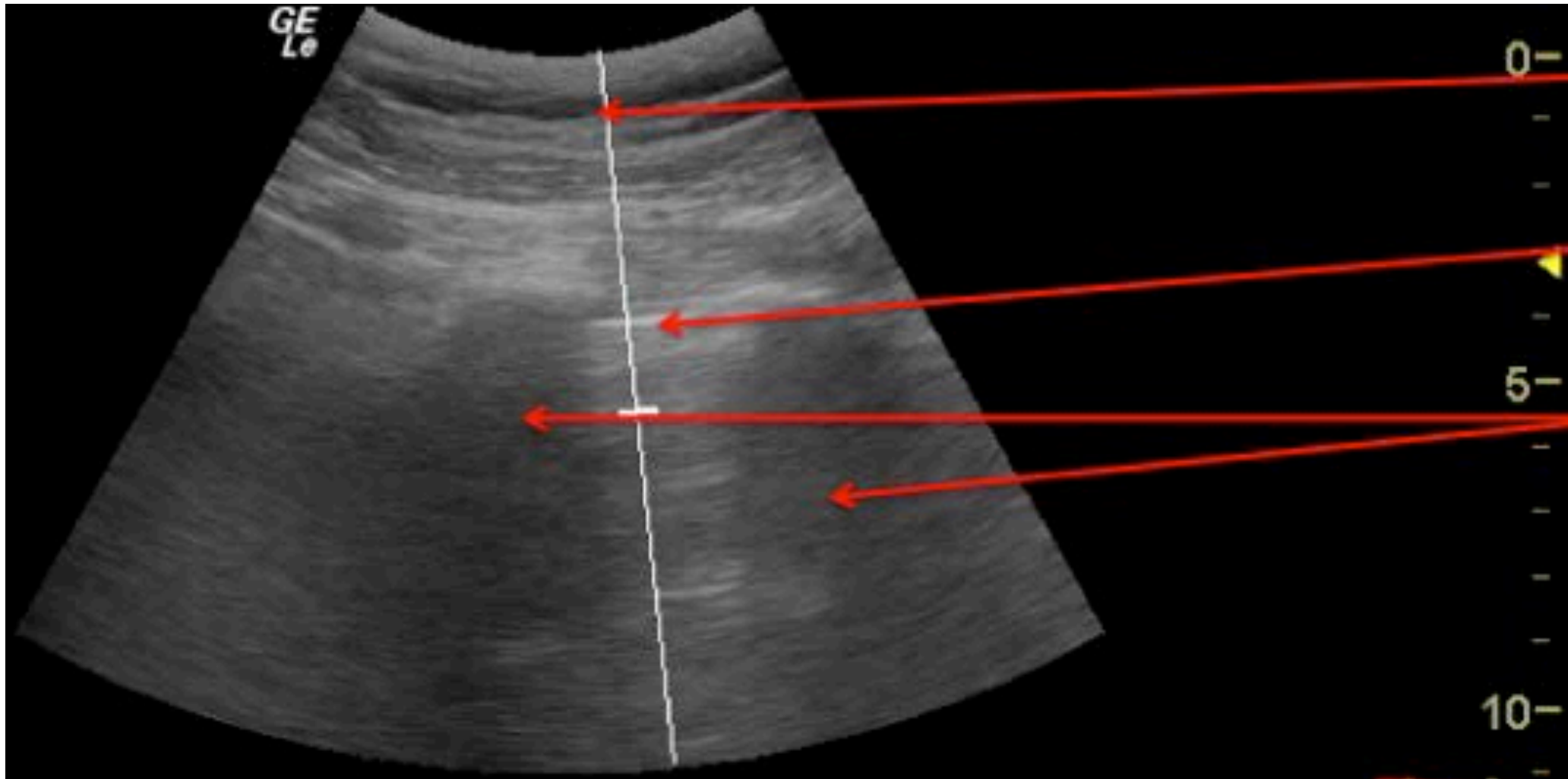
8

10

-2

-1

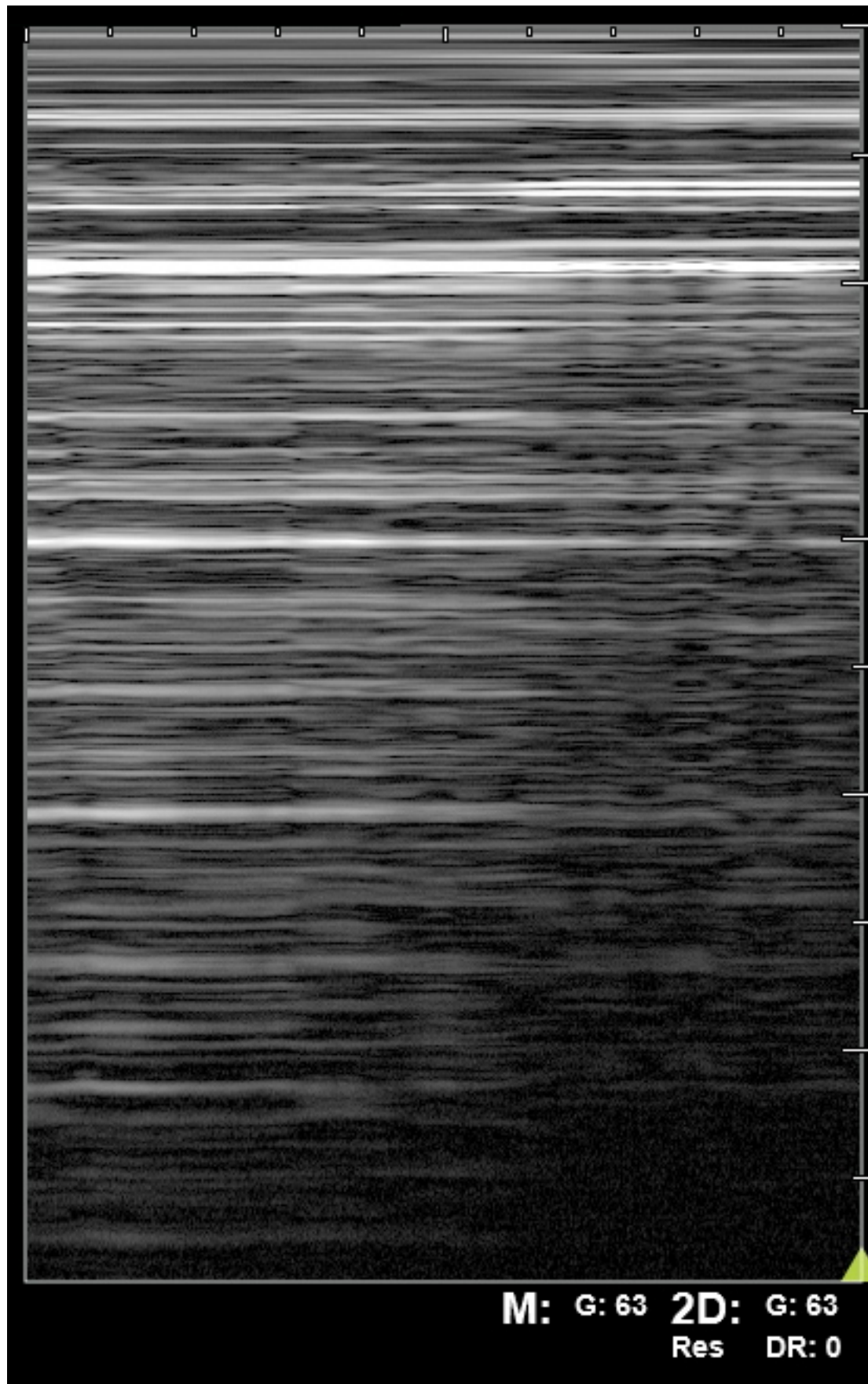
0



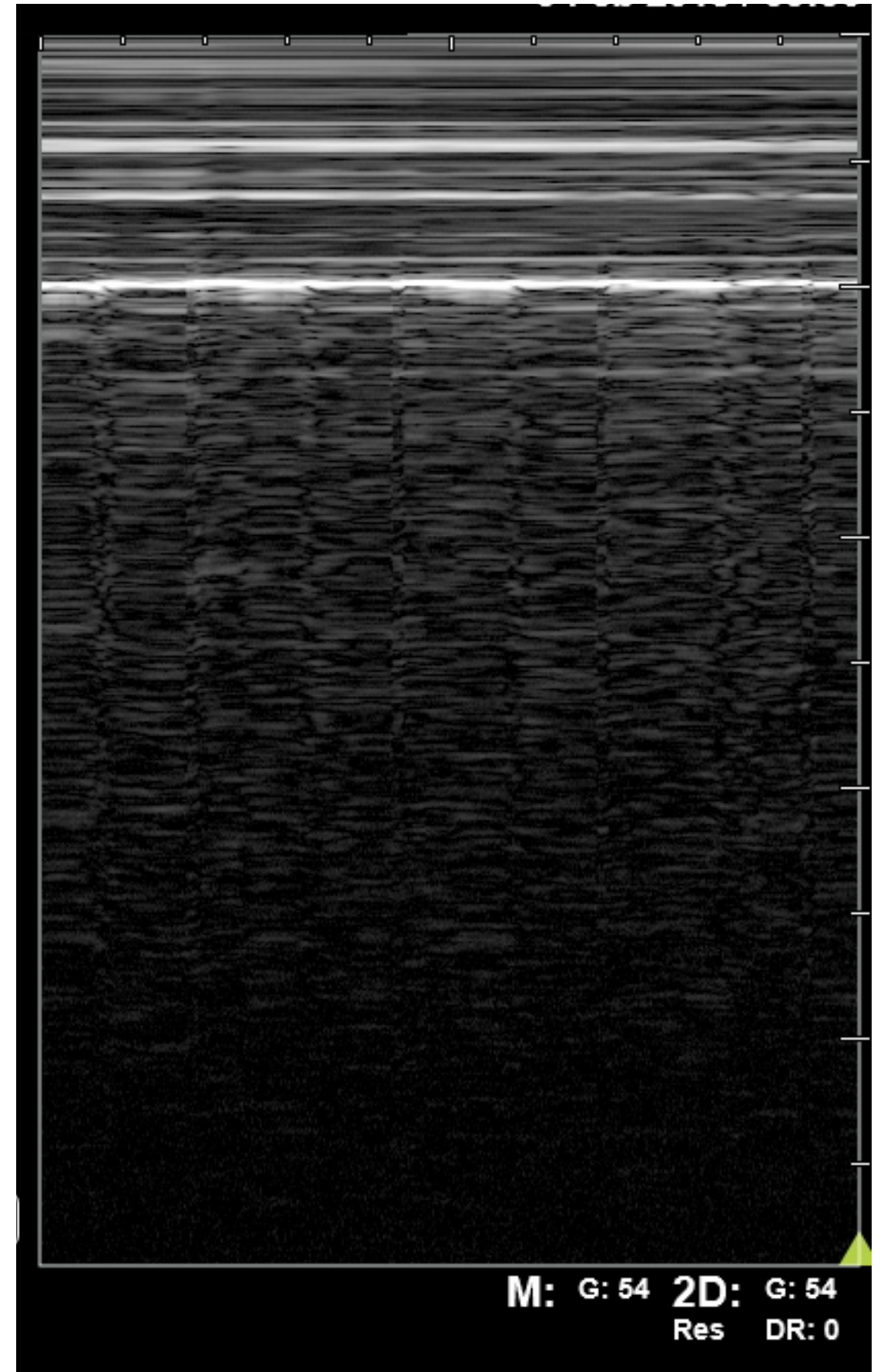
Right Lung

Left Lung

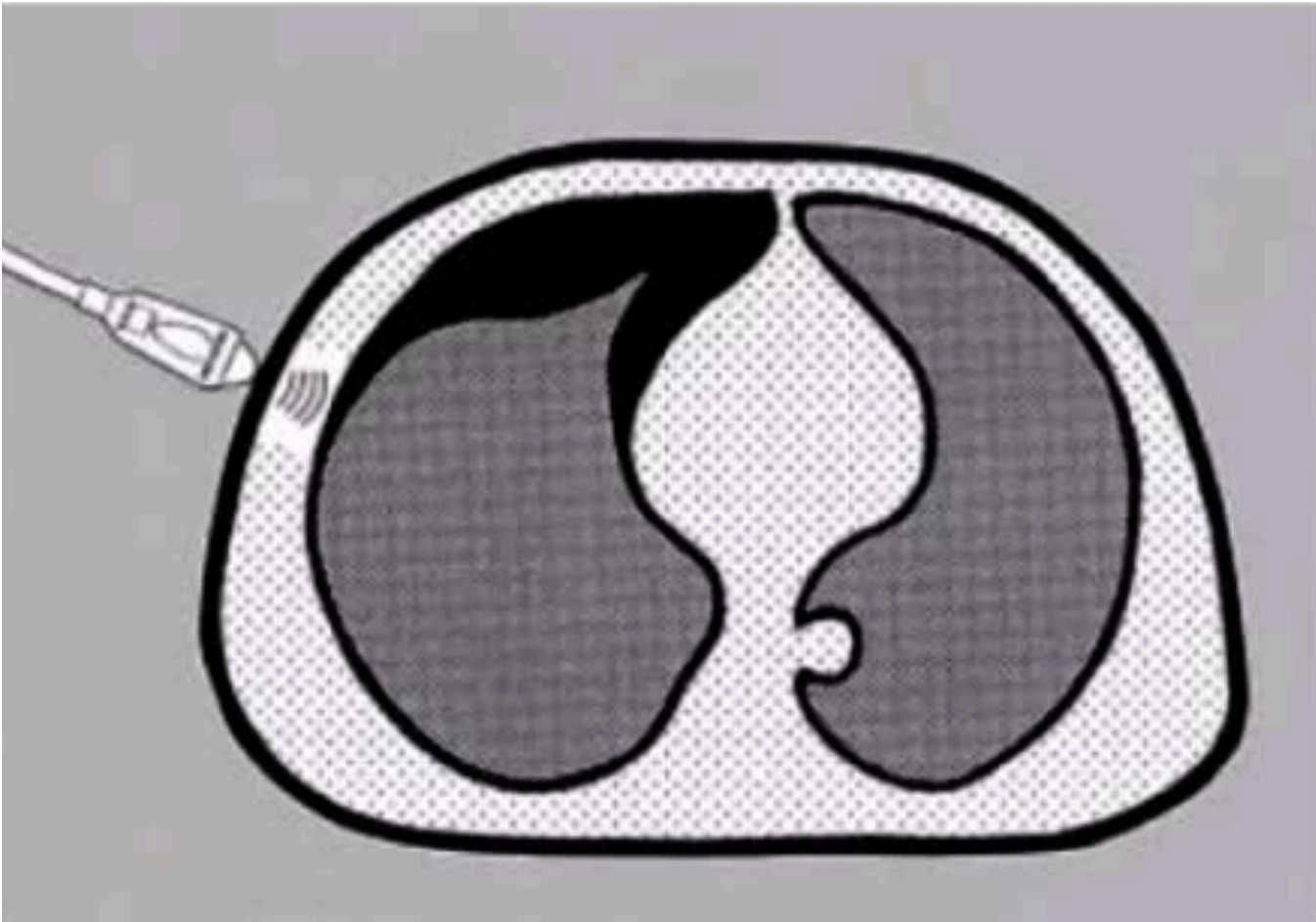
Right Lung



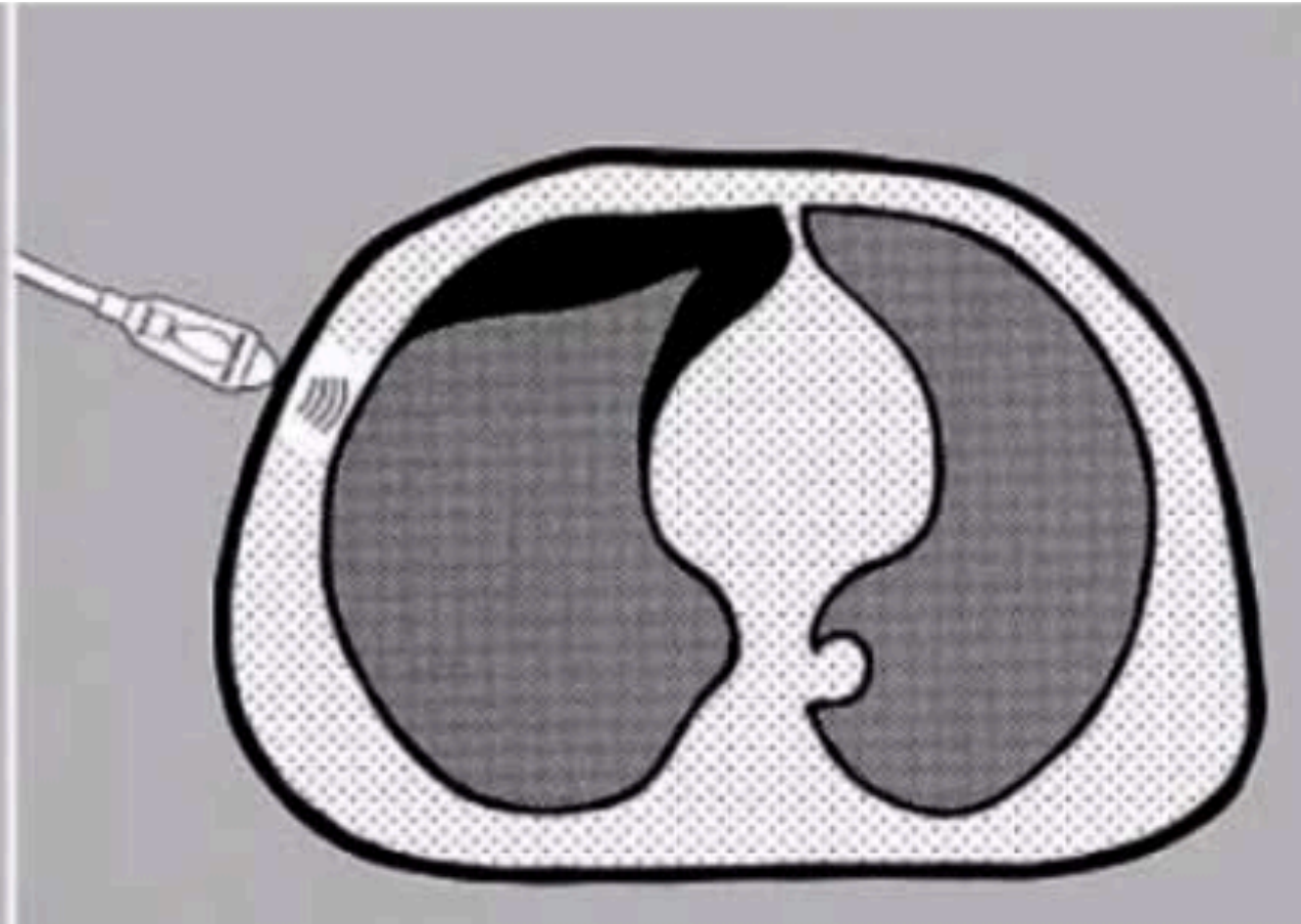
Left Lung



Lung Point

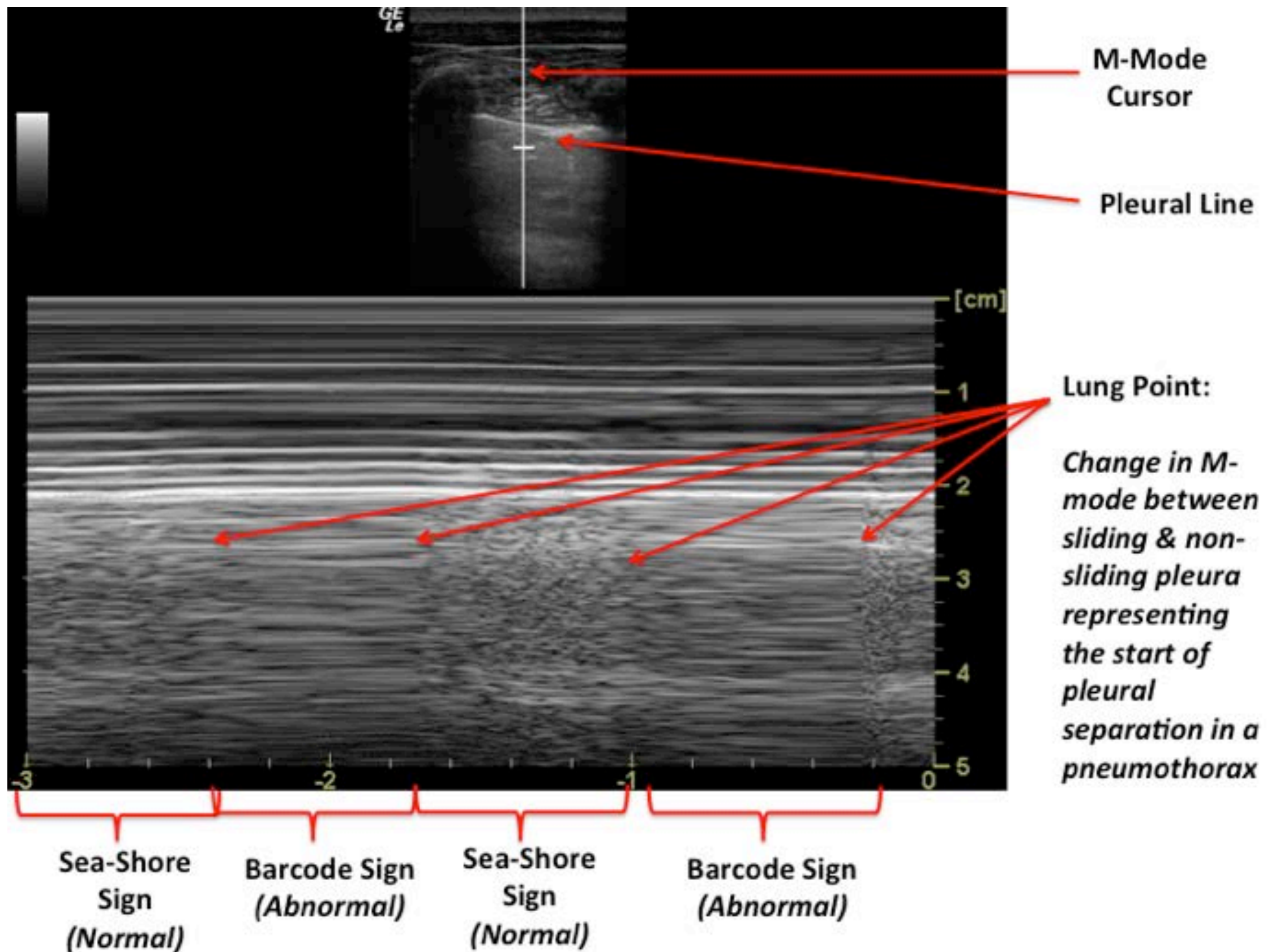


EXPIRATION

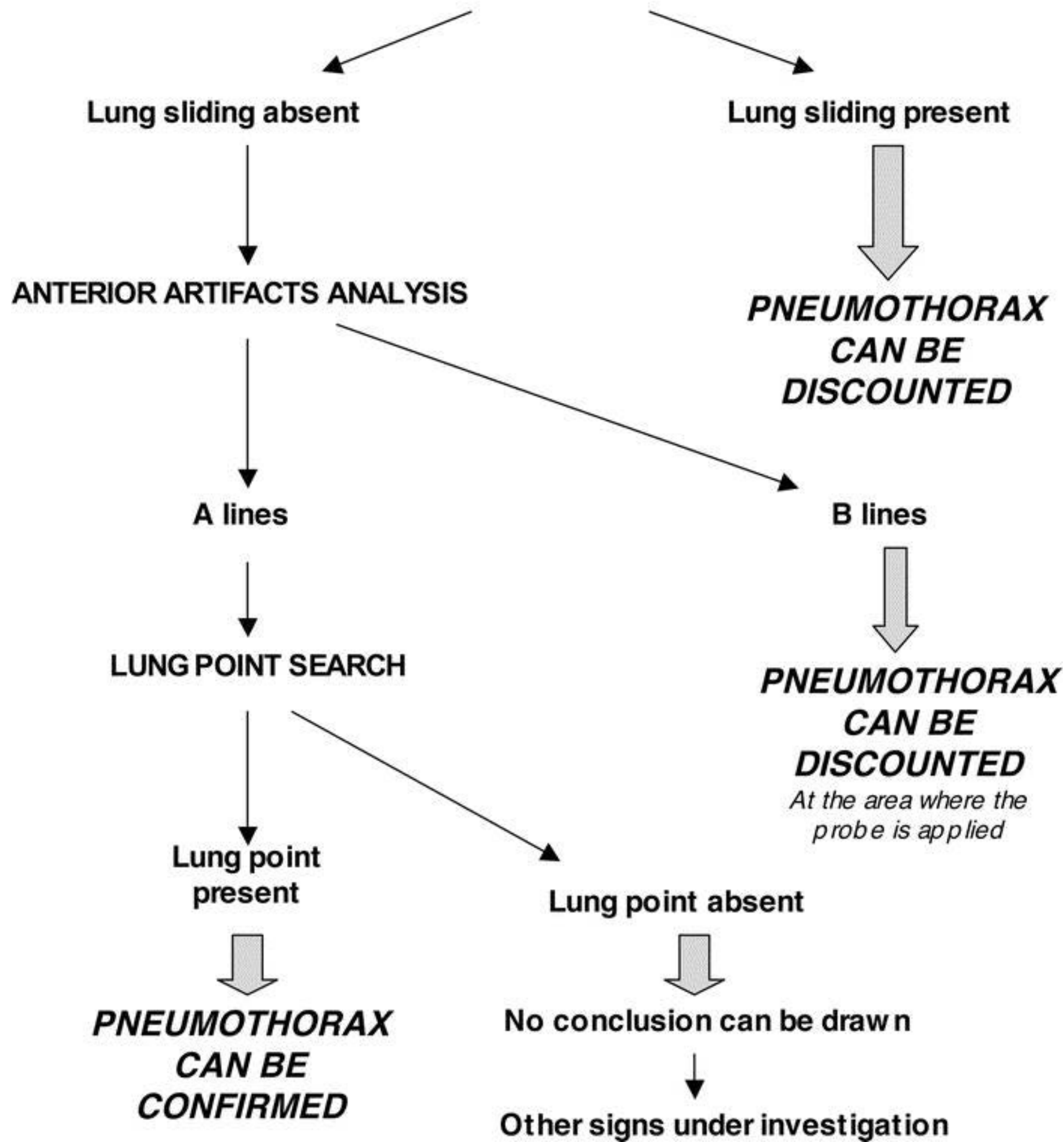


INSPIRATION

Lung Point



ANTERIOR LUNG SLIDING ANALYSIS



Signs to Find in a Pneumothorax



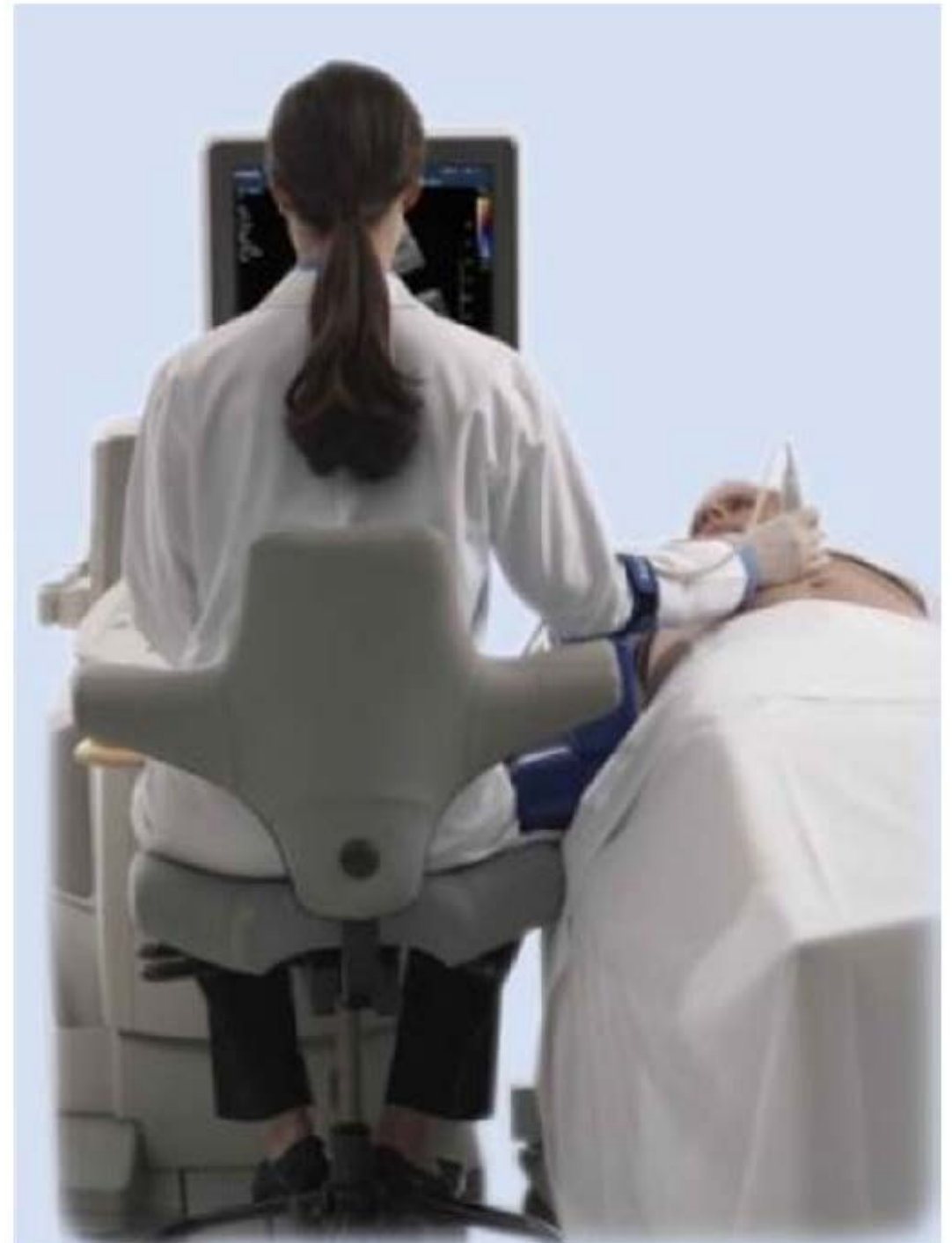
Pneumothorax

- Absent Lung Sliding (with Barcode Sign)
- Lung Point
- (Plus no anterior artefacts)

How to Scan the Lungs

Optimise Positioning!




- Positioning of machine
- Positioning of patient
- Positioning of you
- Temperature control



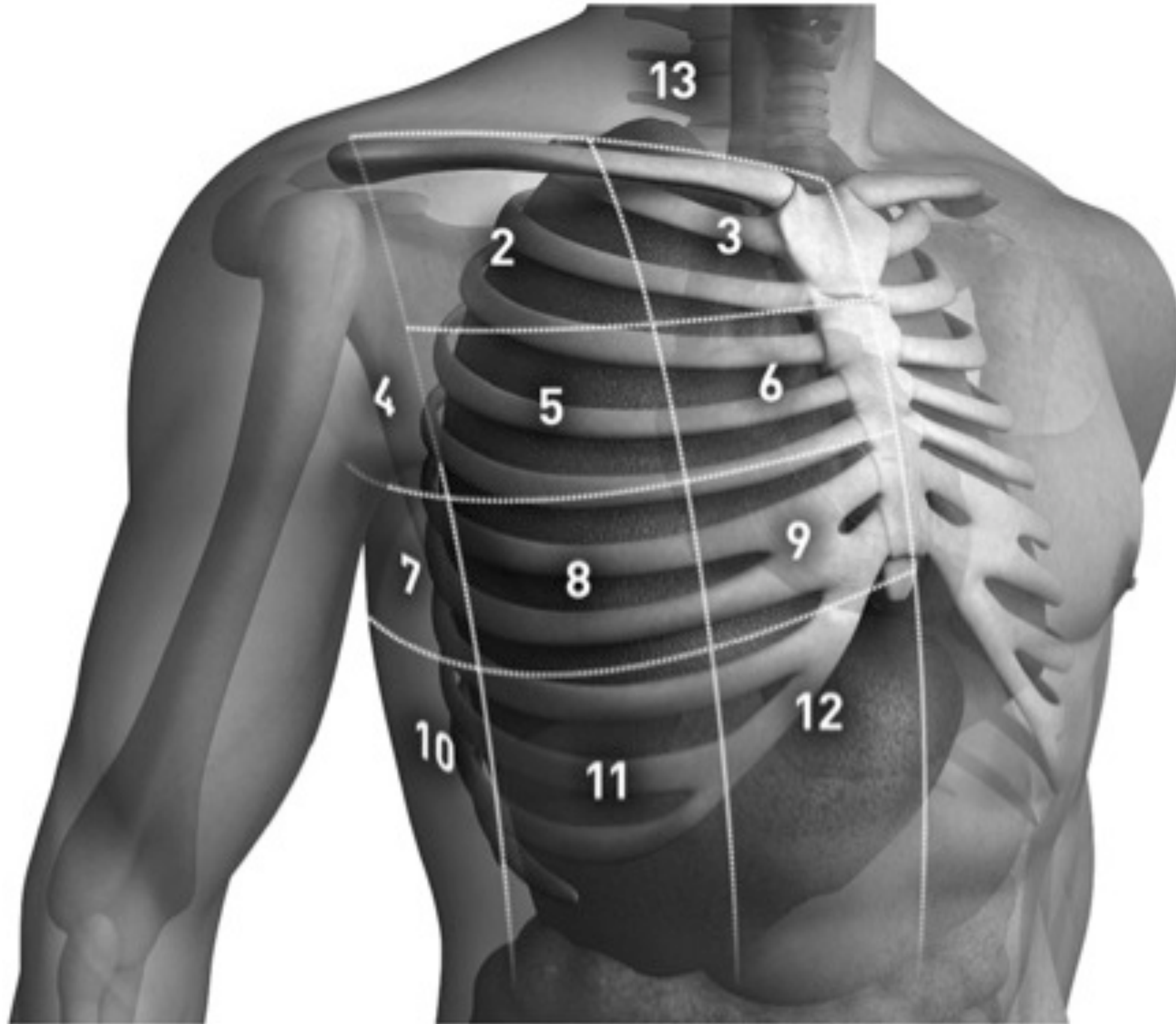
Optimise the Machine

- Correct pre-set
- Patient details
- Correct probe
- Ultrasound gel
- Depth
- Gain

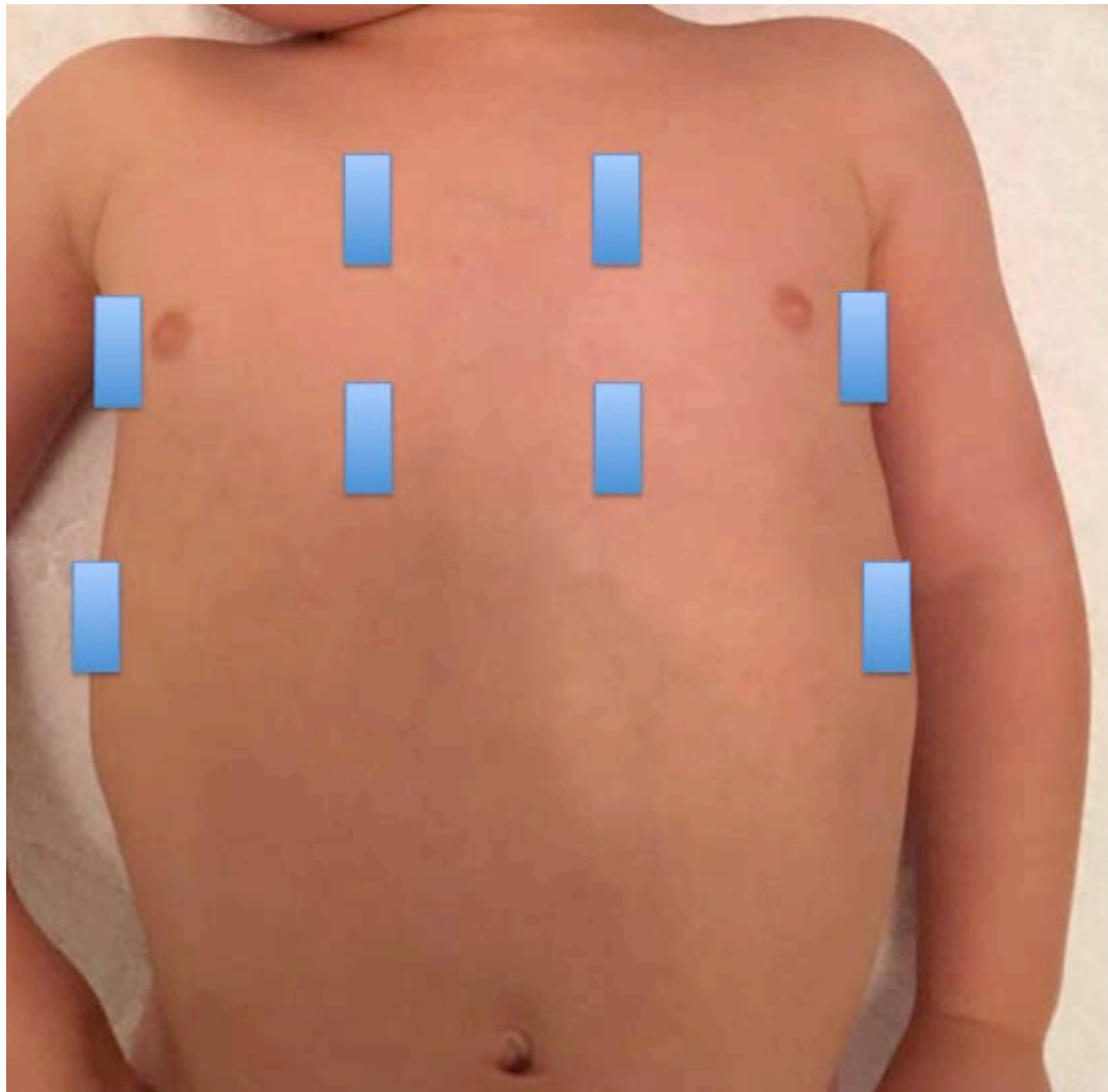


Probe Description	Probe Appearance	Good For:
Phased Array		Cardiac POCUS Neonatal Head
Linear		Superficial Structures Vascular Lungs in infants/neonates
Curved-Linear		Deep structures Lungs in older humans Abdominal POCUS

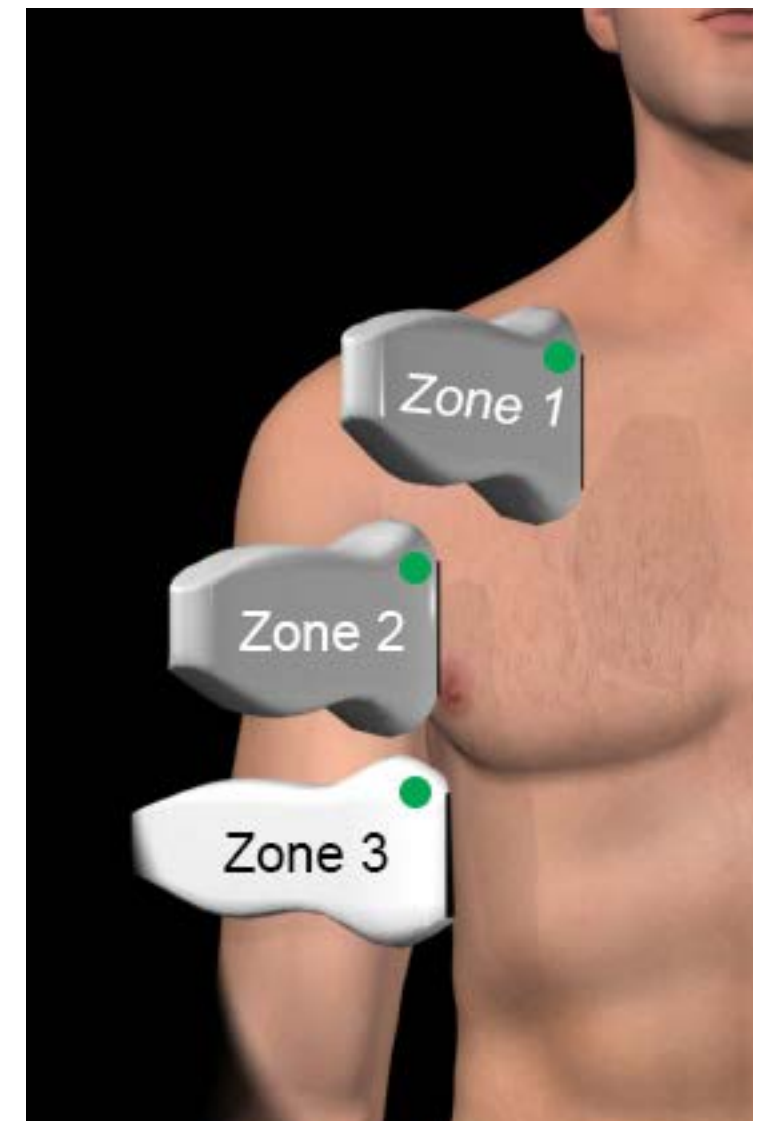
Sequential Scanning



Sequential Scanning



■ Ultrasound
Probe
Position &
locations



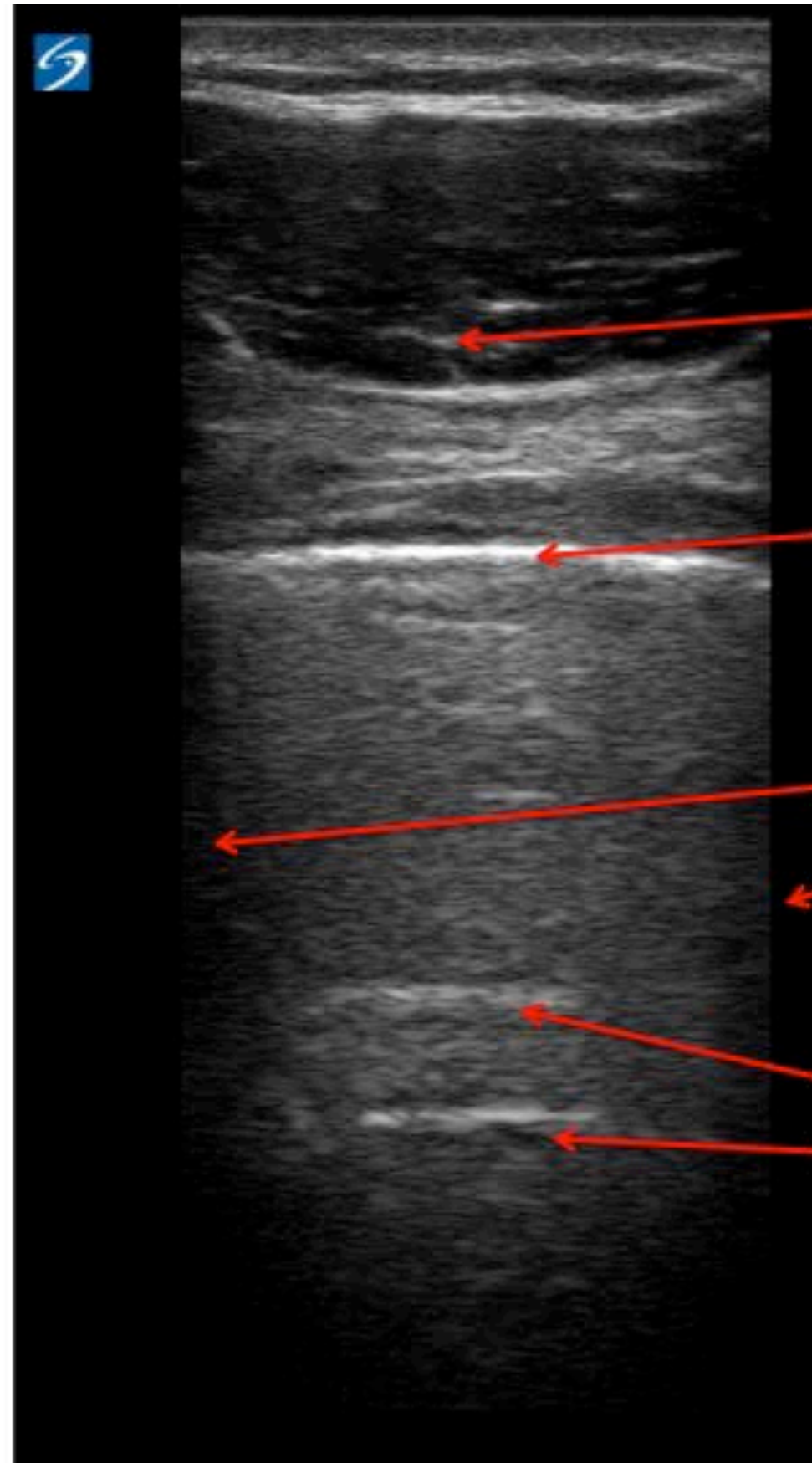
Probe Orientation

- Ultrasound placed longitudinally
- Held perpendicular to skin
- Marker represents patient head
- Same for all zones
- Hold probe stationary



Interpret the Scan

Normal Lung Ultrasound



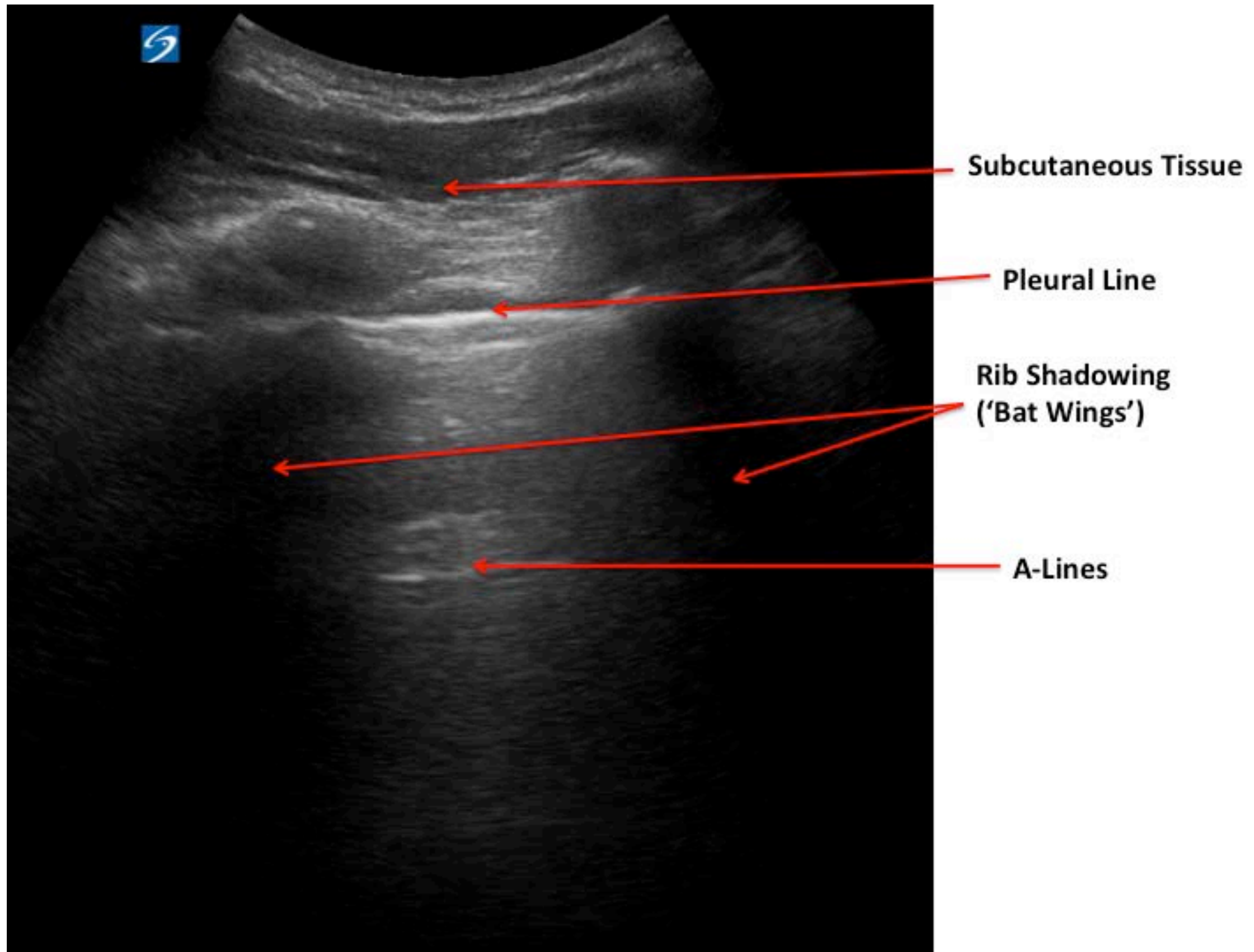
Subcutaneous Tissue

Pleural Line

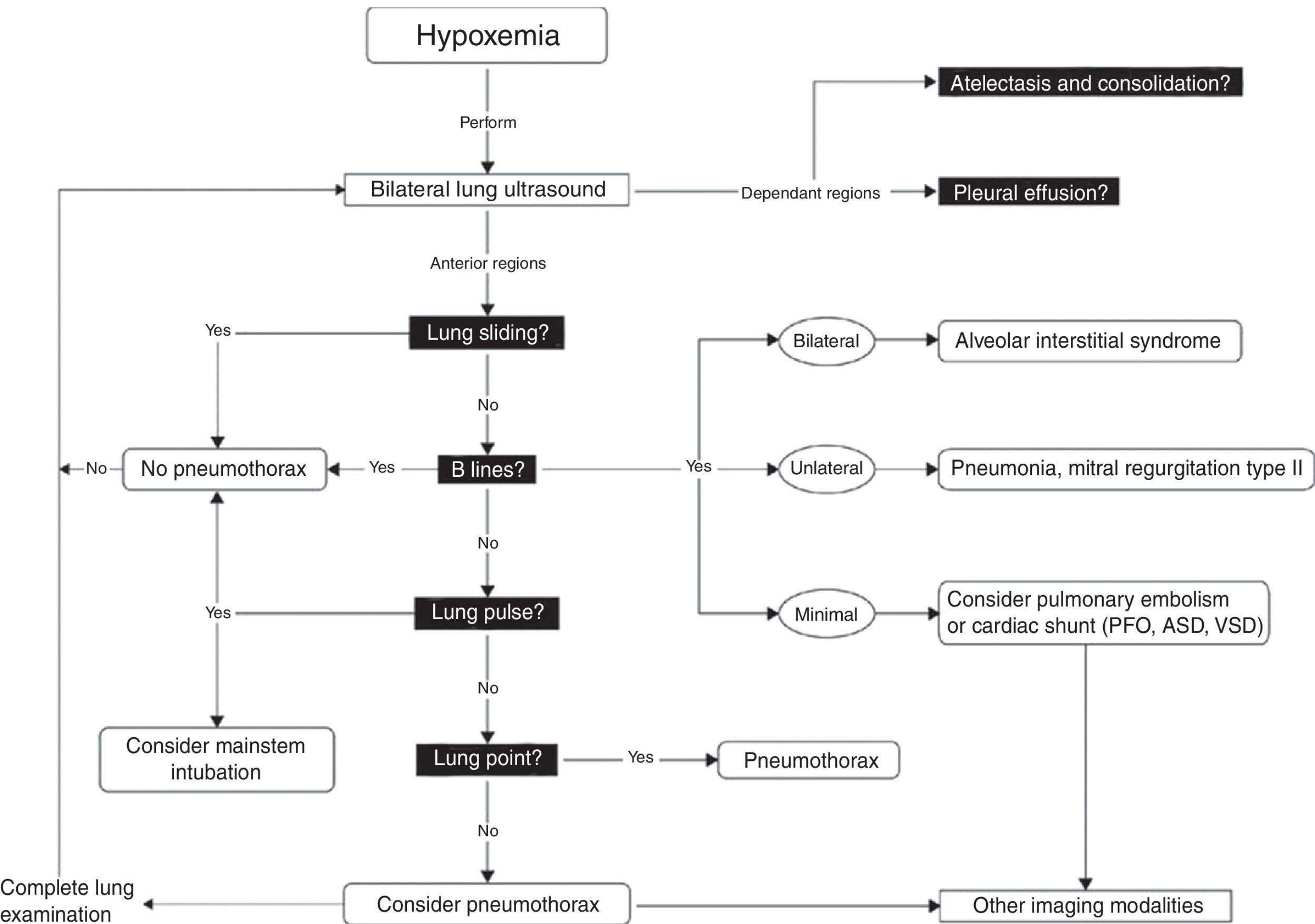
Rib Shadowing with
drop out either
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(‘Bat Wings’)

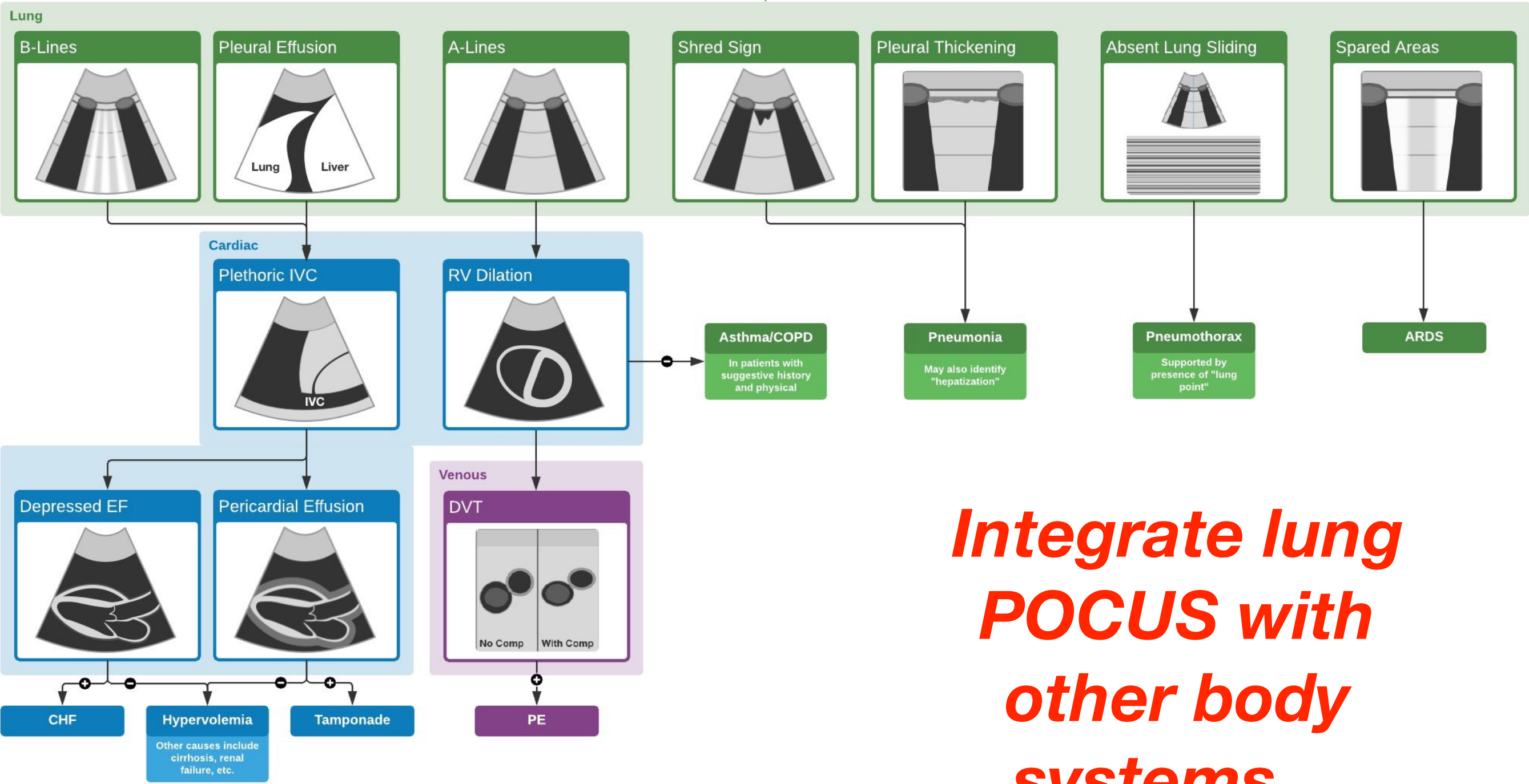
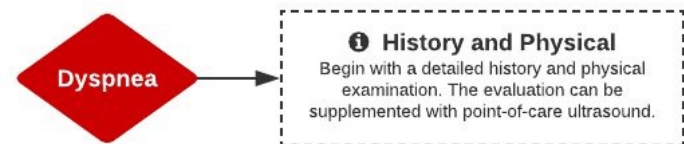
A-Lines

Normal Lung Ultrasound



Summary





***Integrate lung
POCUS with
other body
systems...***

Summary of Key Signs

- Pleural Line (with Bat Wing Sign)
- A-Lines
- Lung Sliding (with Seashore Sign)
- Quad Sign (with the Lung Line)
- Sinusoid Sign
- PLAPS Point
- Tissue-Like Sign
- Shred-Sign
- C-Profile
- B-Lines
- No Lung Sliding (with Barcode Sign)
- Lung Point

Normal Lung

Pleural Effusion

Consolidation

Interstitial Syndrome

Pneumothorax

Take Home Messages

- Lung POCUS has many advantages over the chest x-ray
- Consider this the 'visual stethoscope' and place the probe longitudinally in the same position
- Identify the normal features of the pleural line (with sliding), the bat wings sign and A lines
- Additional signs (B lines, C profile, absent pleural sliding, PLAPS points) suggest a disease process

Any Questions?




Thank you!

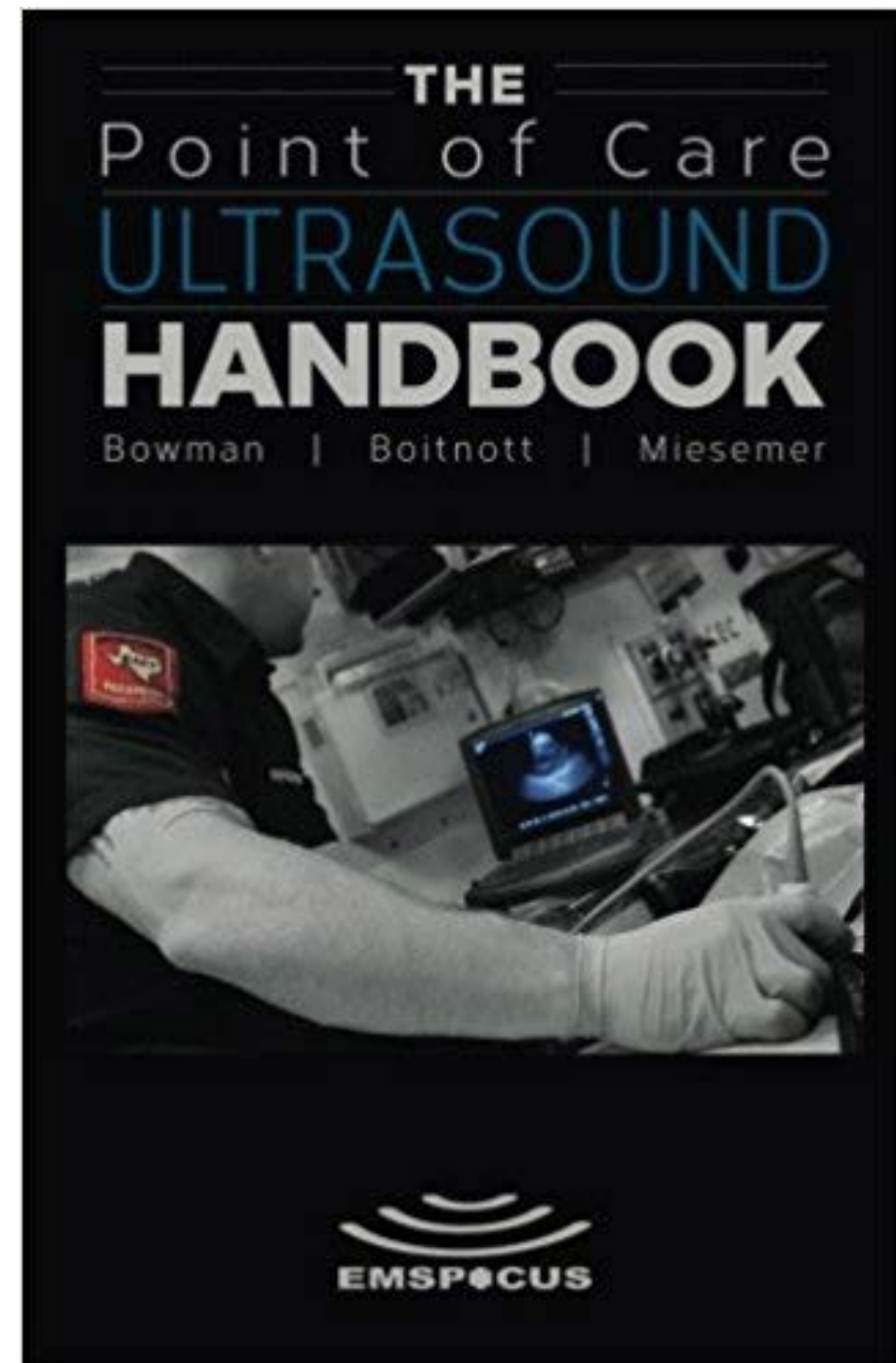
Michael.Griksaitis@uhs.nhs.uk



@MJGriksaitis

Resources

- Twitter: 
- #POCUS
- @UTS_Australia
- @emuss_uk



Resources

BEST PRACTICE

15-minute consultation: Using point of care ultrasound to assess children with respiratory failure

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HLO and MJG contributed equally.

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ABSTRACT

Point of care ultrasound (POCUS) is well established in adult emergency medicine and critical care. It is used for immediate diagnosis and evaluation of the impact of bedside interventions in the acutely unwell child. This article highlights how ultrasound can be helpful in paediatric practice when dealing with the neonate, infant or older child with undifferentiated respiratory distress, respiratory failure or ventilation problems. It highlights indications for use, key diagnostic features of common pathology and outlines the benefits of POCUS in everyday practice.

WHAT IS POINT OF CARE

is ultrasound guided, compared with the anatomical landmark technique, but it offers much more than support for practical procedures.^{1 2}

It was first applied as Focused Assessment by Sonography in Trauma (FAST) scanning in emergency departments. It aided both diagnosis and management of life-threatening injuries in patients without the need for transportation to a CT scanner. The aim of the FAST scan is to identify fluid in the pelvis and abdomen, which may require immediate intervention.

This has been 'extended' to the 'eFAST' scan, which includes assessment of the lungs for pneumothorax and/