



Pulmonary POC Ultrasound

By: Eyad Khattab, MD, MPH



Main Points

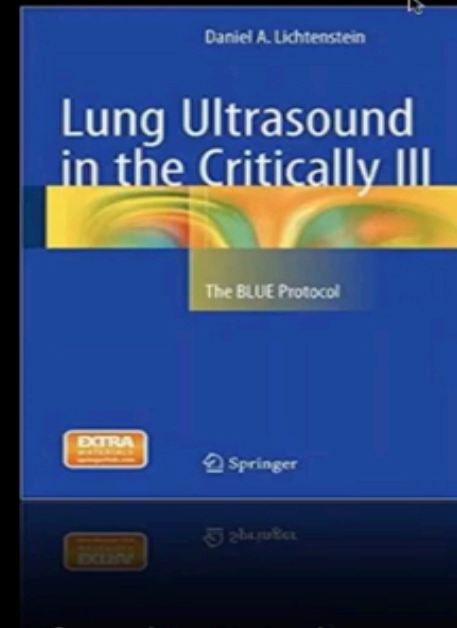
- Why pulmonary US is special
- Why we do it
- How to do it (Transducers & Technique)
- What to look for
 - 1- A-Lines
 - 2- Lung Sliding and Lung point
 - 3- B-Lines
 - 4- Pleural Effusions & Spine Sign
 - 5- C-Lines and Shred sign
 - 6- Air Bronchogram & Hepatization
- Evidence behind it

Why pulmonary US is special

- Reading pulmonary US is artifacts analysis



The Father of Lung Ultrasound



The study of an object, quality, event, or entity whose presence or occurrence indicates the probable presence or occurrence of something else.

Why Pulmonary US is Special



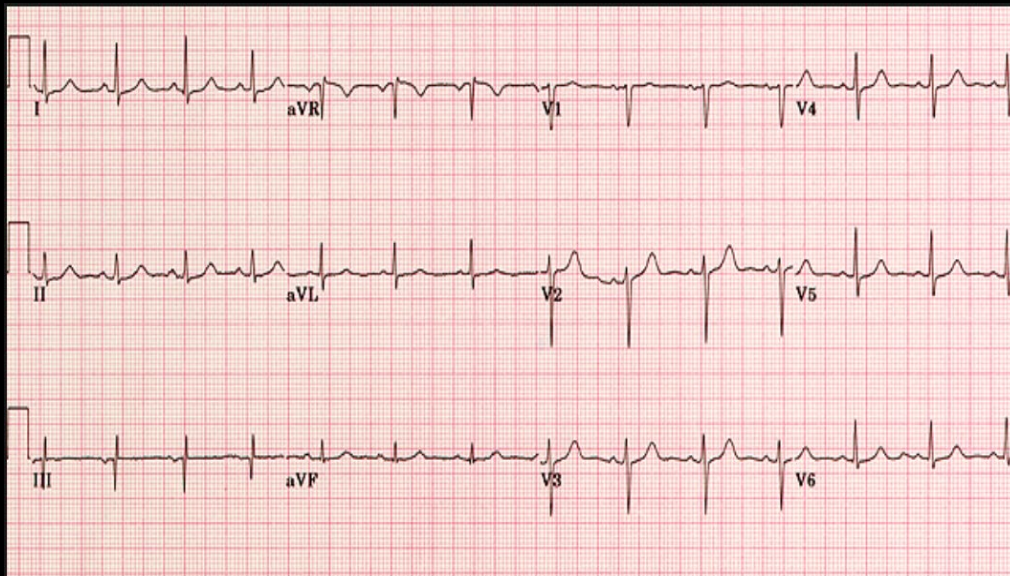
Lung is anechoic free space



Why pulmonary US is special

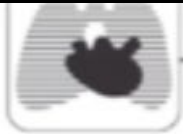


Getting 2ry information about the lung



- **Be careful about making the diagnosis according to lung ultrasound findings**

Why we do it



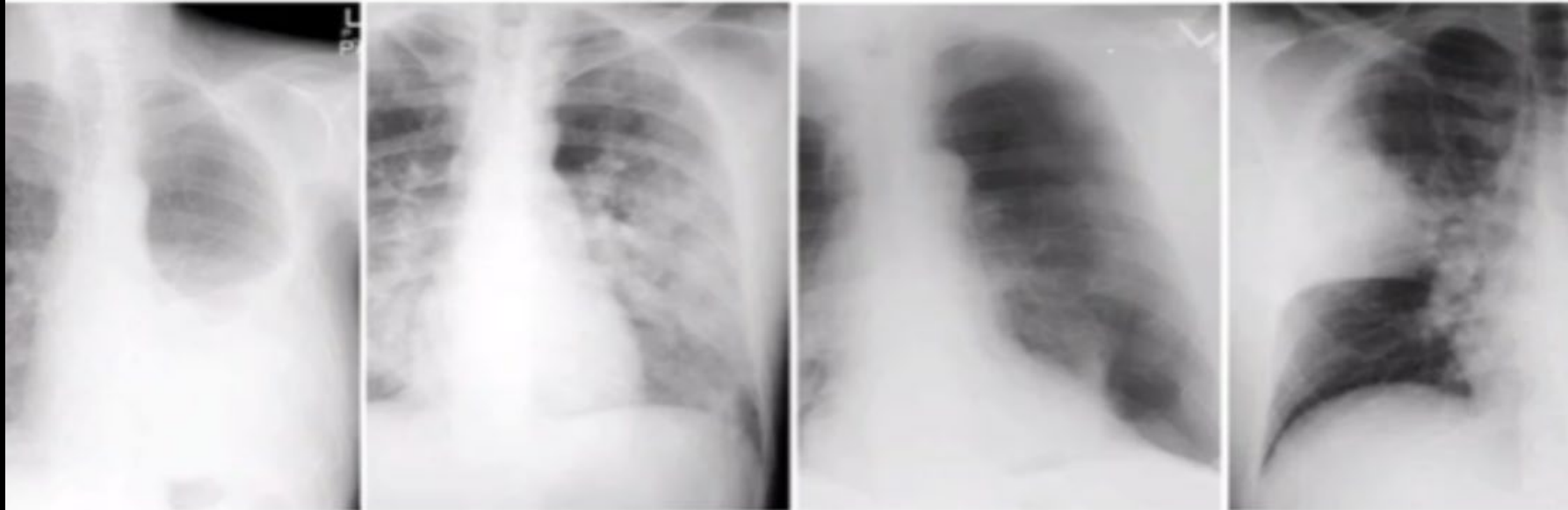
CHEST

Original Research

IMAGING

Can Chest Ultrasonography Replace Standard Chest Radiography for Evaluation of Acute Dyspnea in the ED?

Maurizio Zanobetti, MD; Claudio Poggioni, MD; and Riccardo Pini, MD



Why we do it



- Pneumothorax
- COPD/Asthma
- Pulmonary Edema
- Pneumonia
- Pleural Effusion
- Pulmonary embolism
- Pulmonary Contusion/ARDS

- Verify Endotracheal Intubation
- Identify Right Main Stem Intubation

- *Chest Pain
- *Dyspnea
- *Hypoxia
- *Hypotension
- *Thoracic Trauma

- *Thoracentesis



• How to do it

• Probe Selection

Linear Probe (Pleural Line)

- 6 cm depth limit
- High frequency, Better resolution
- Look for-----



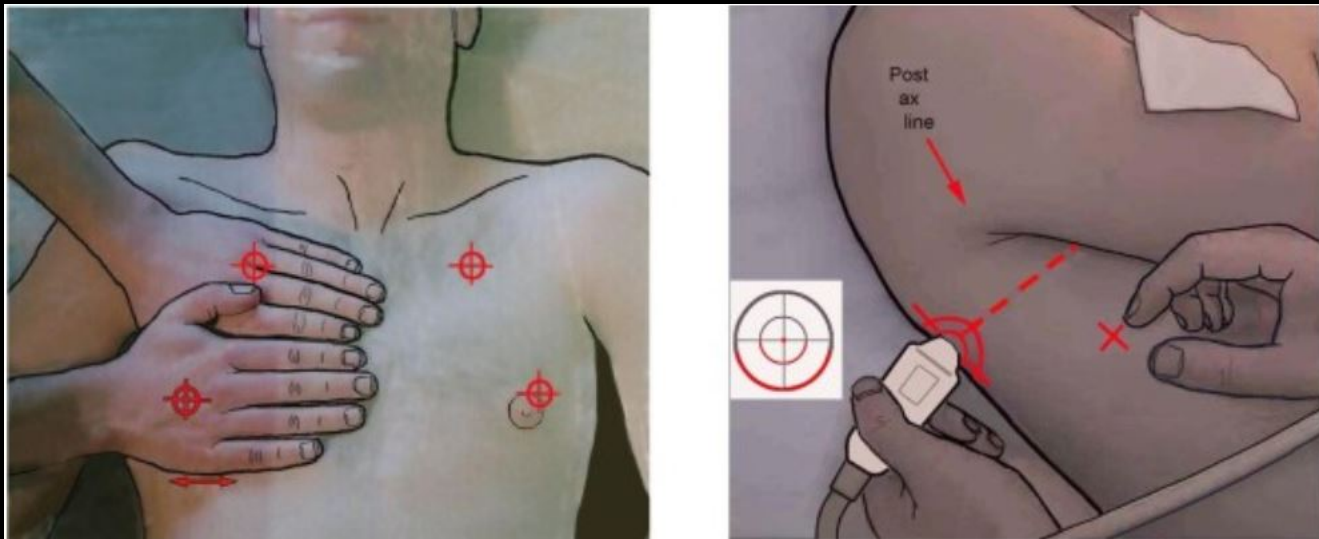
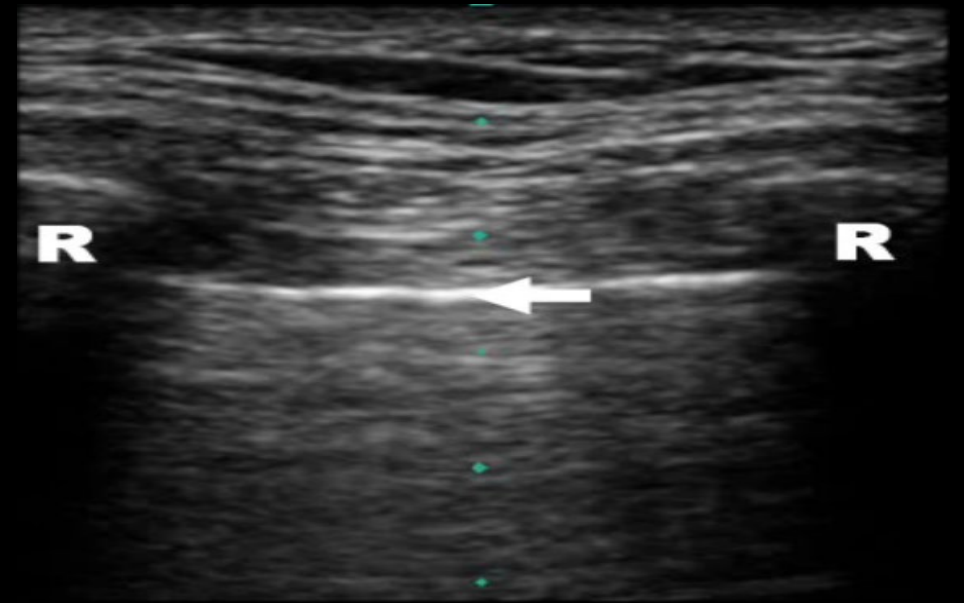
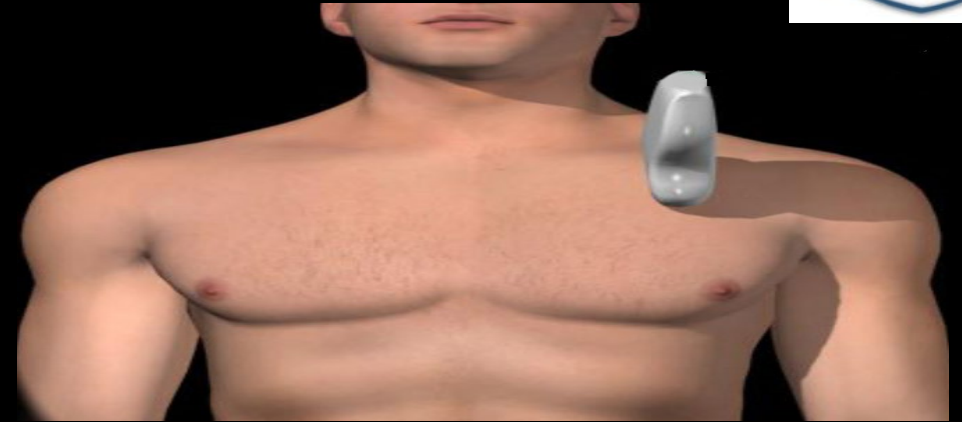
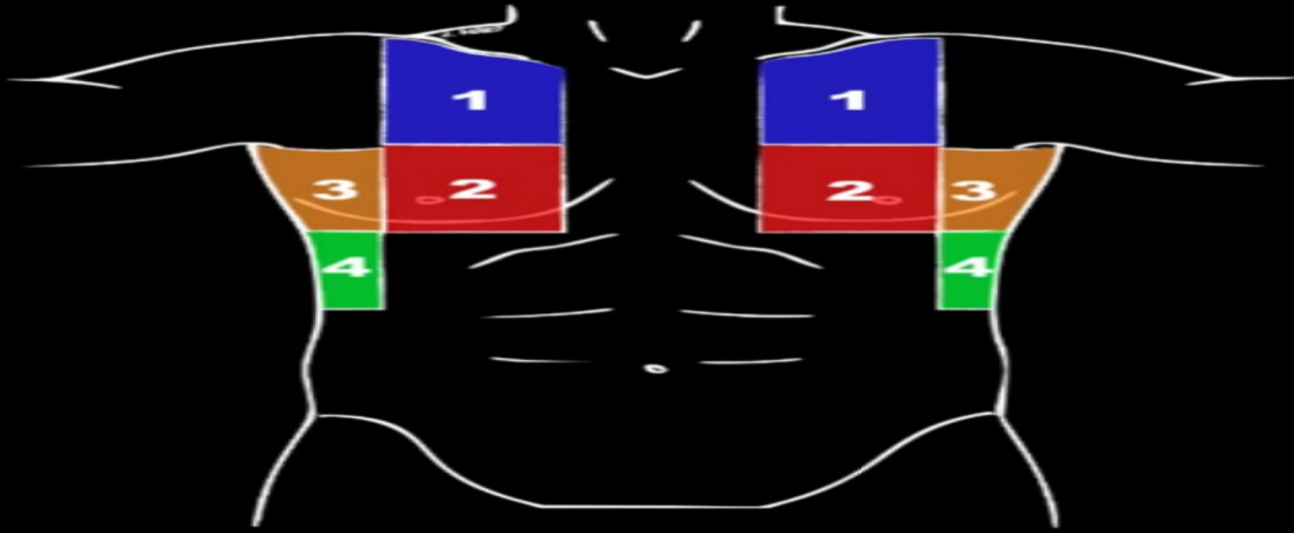
Curvilinear Probe (Deeper into the chest)

- Can images multiple rib spaces
- Large footprint
- Low frequency, Good resolution
- Look for -----



How to do it

- Basic Sonographic Windows





Normal findings on lung US

Bat sign

Seashore sign

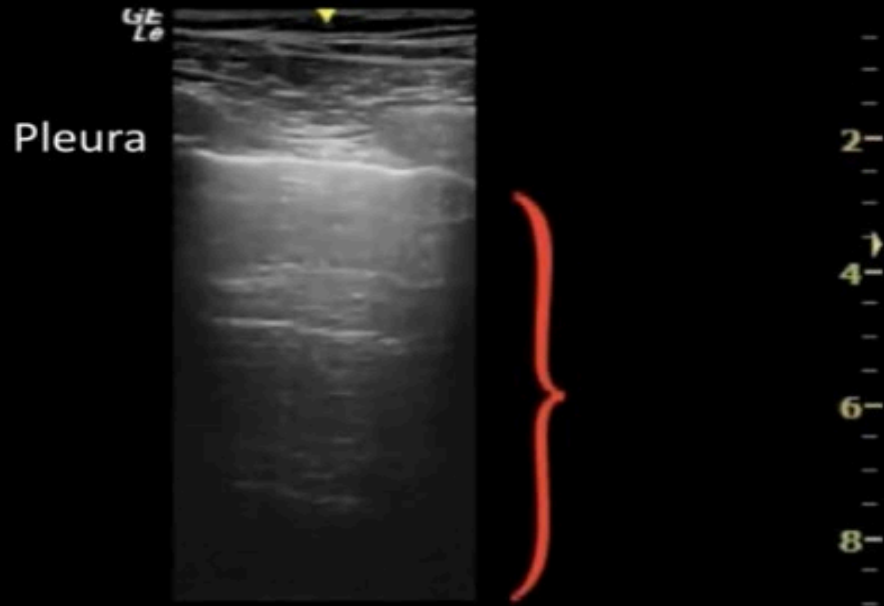
A-lines

Lung sliding

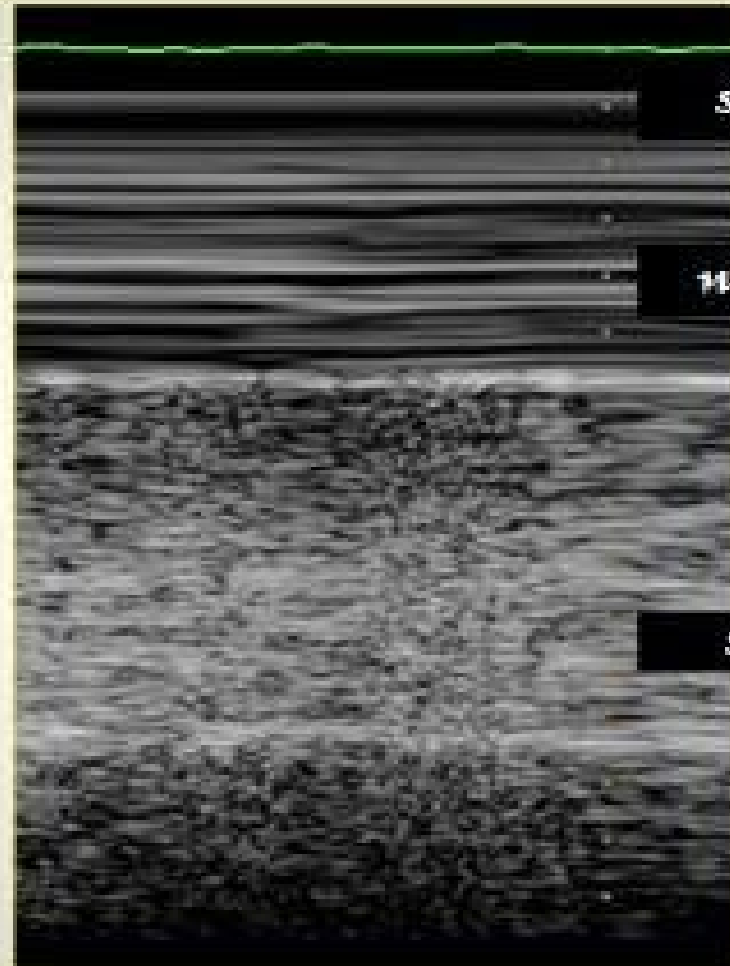
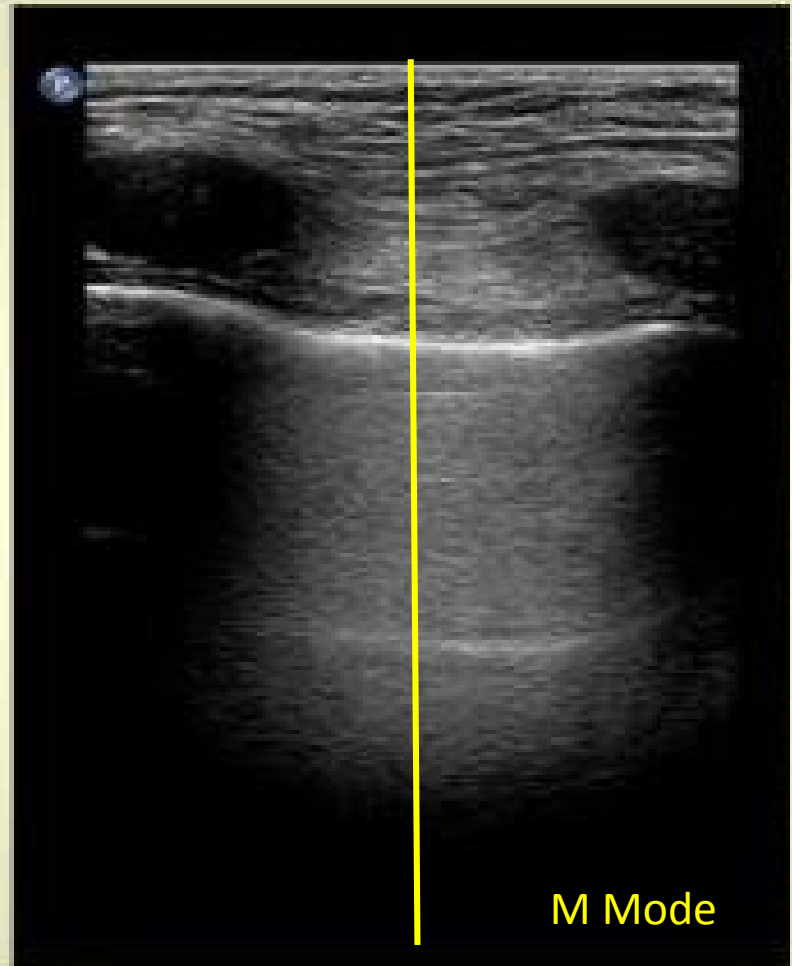
Mirror image artifact

Curtain sign

Batwing Sign



*Once ultrasound encounters air,
nothing beyond that point is real...*

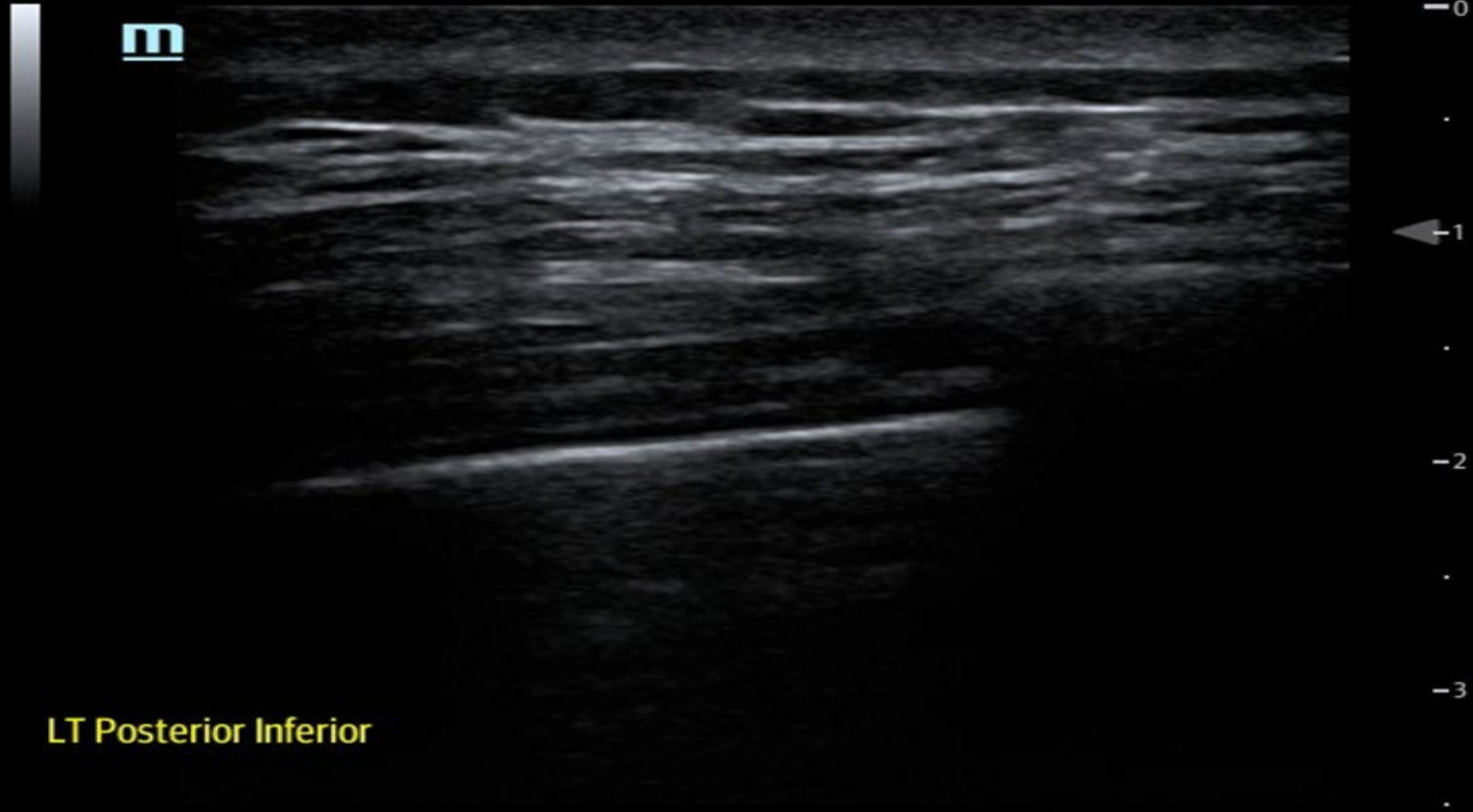


sky

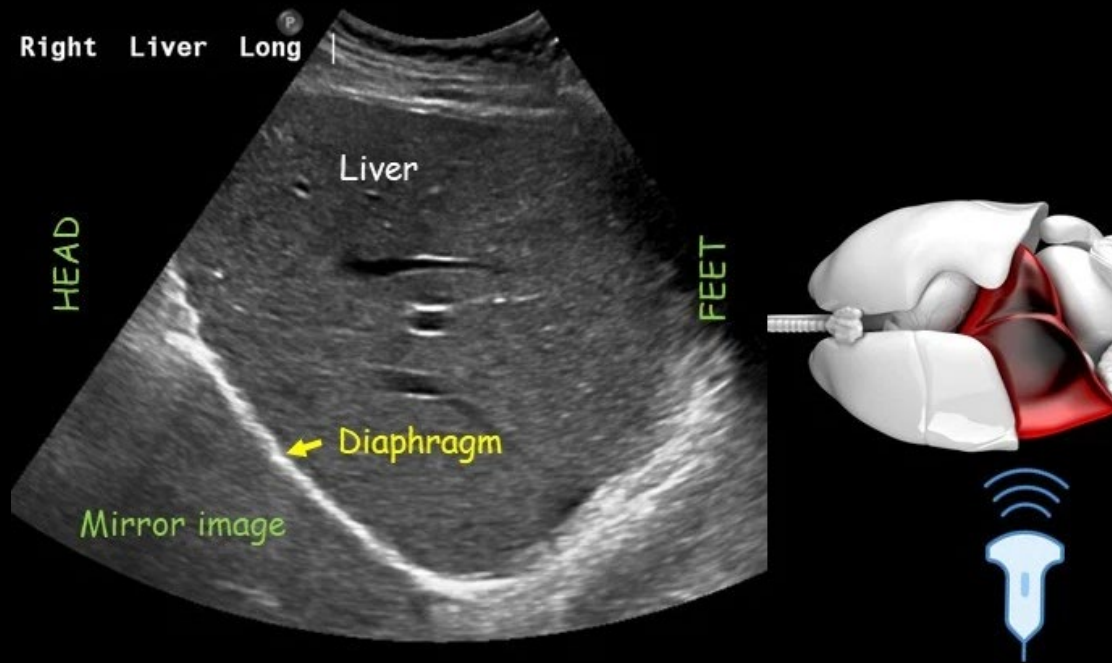
waves

sand

What to look for

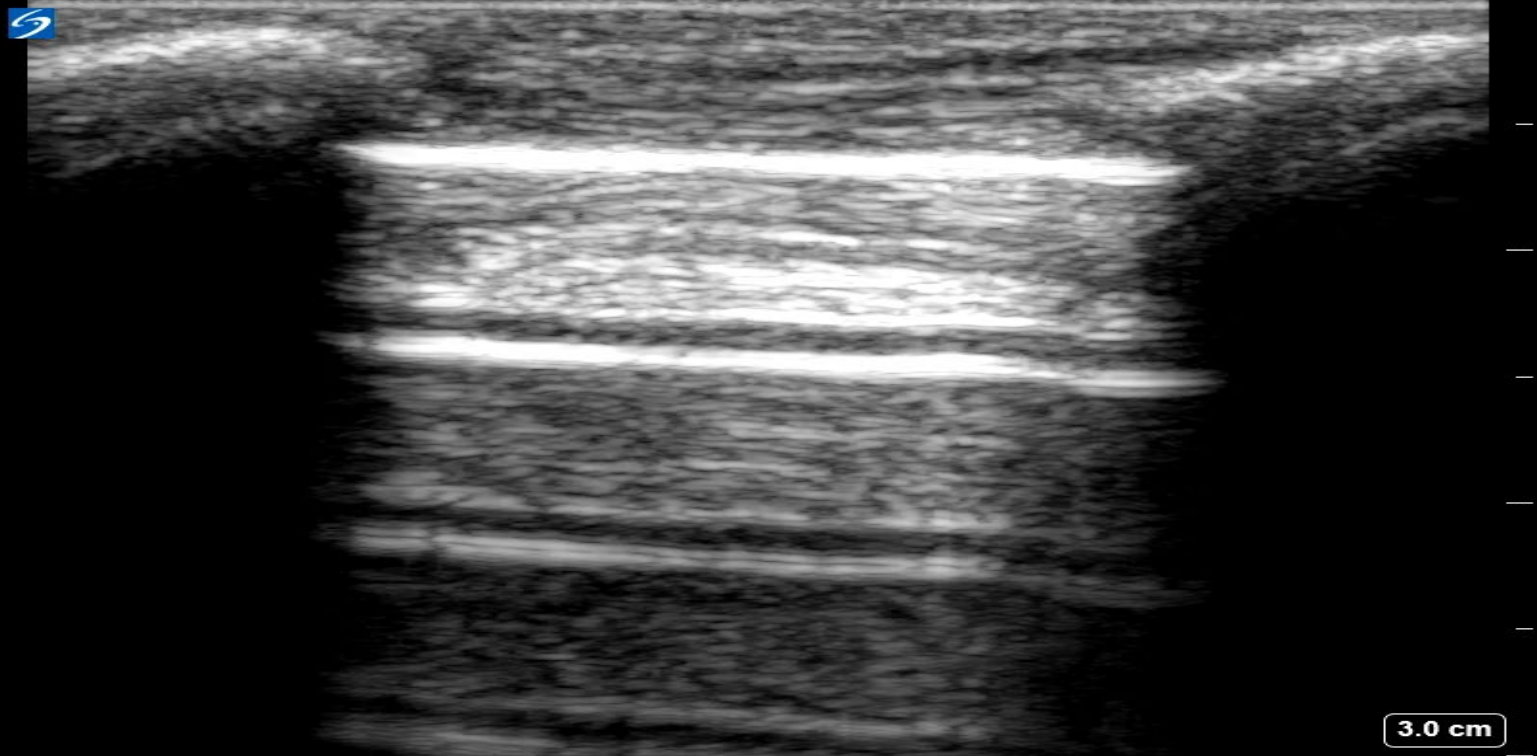


LT Posterior Inferior



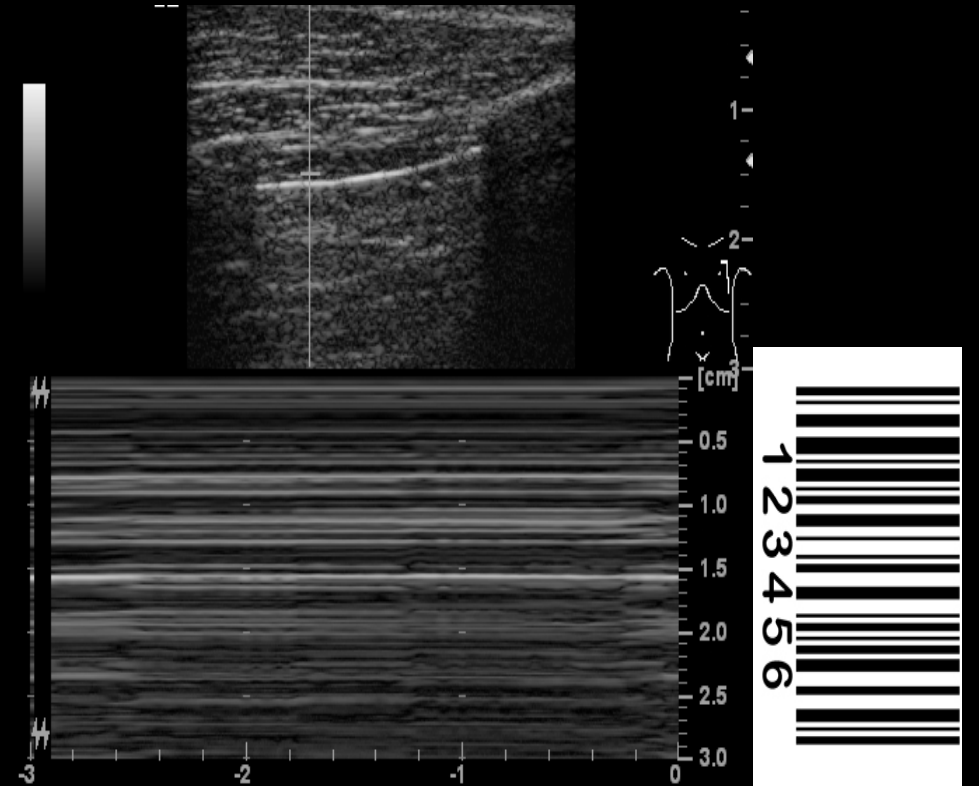
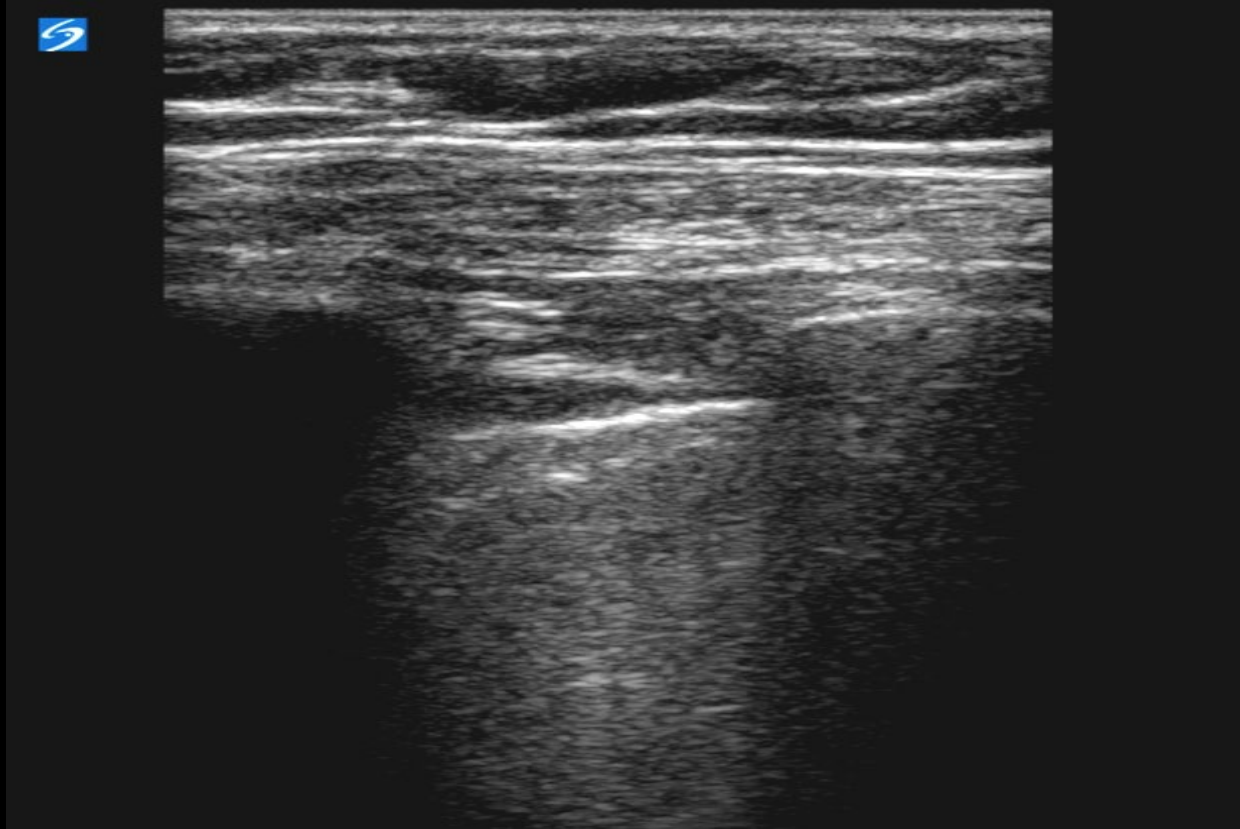


8 Feb 2020 / 22:25



SonoSite
L38xp/10-5 Lung
MI: 1.1 TIS: 0.5

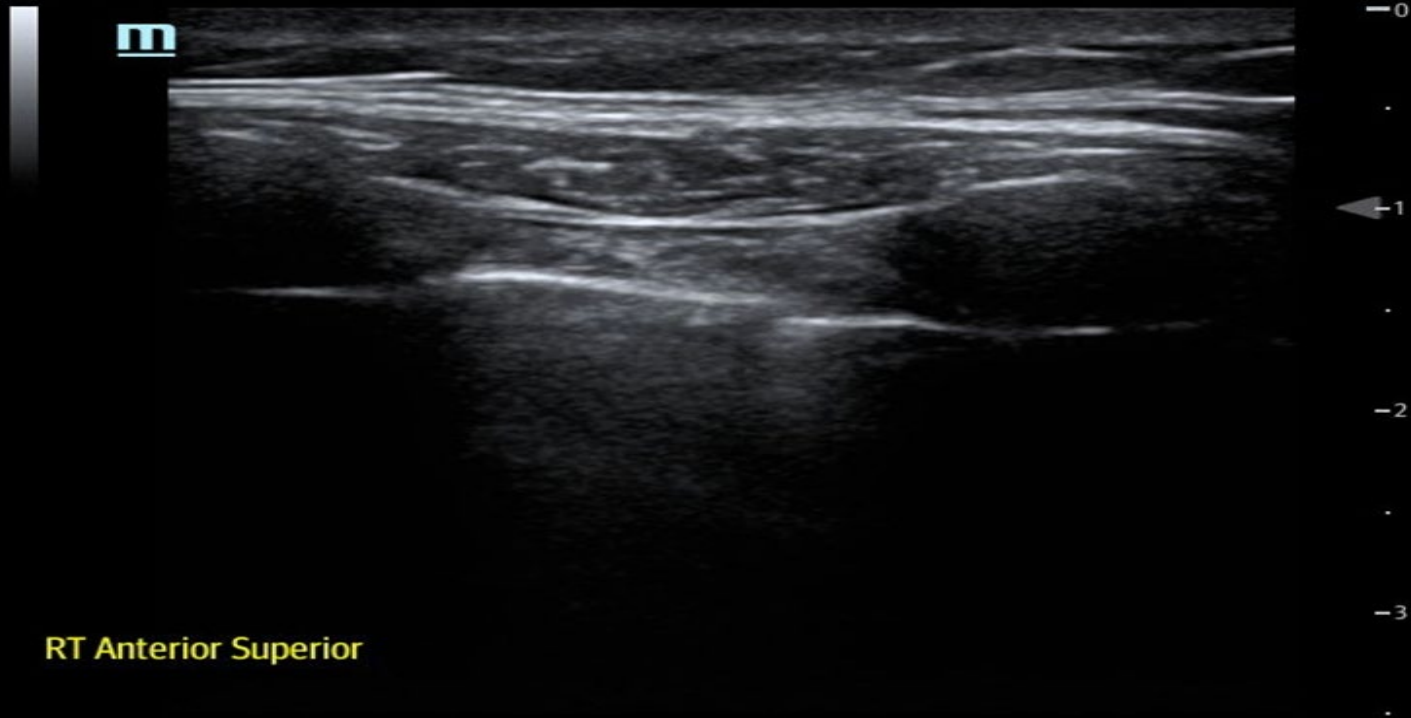
3.0 cm
2D: G: 80
Gen DR: 0



What to look for



A-Lines(Reverberation), Lung Sliding and Lung Point





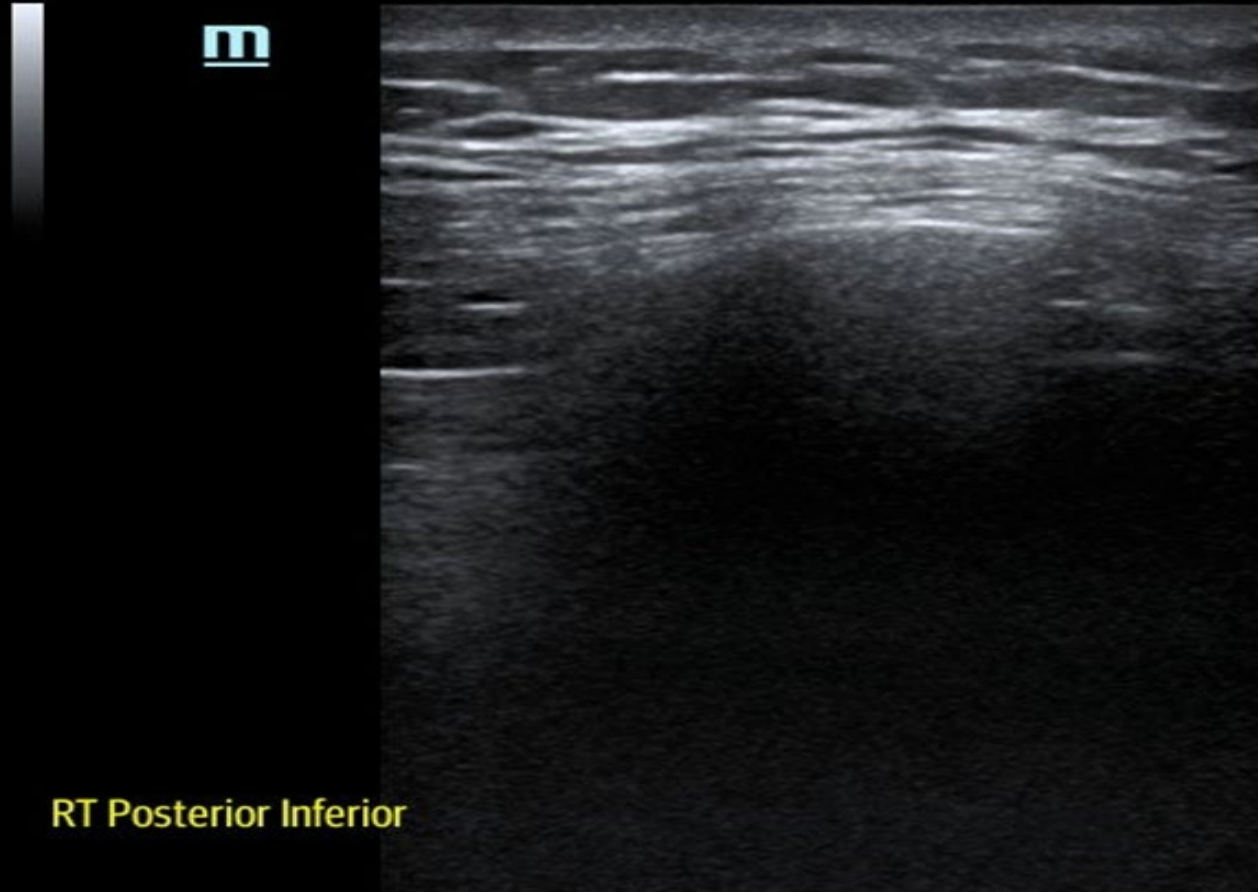
What to look for

4- Spine sign

5- C-Lines and Shred sign

6- Air Bronchogram & Hepatization

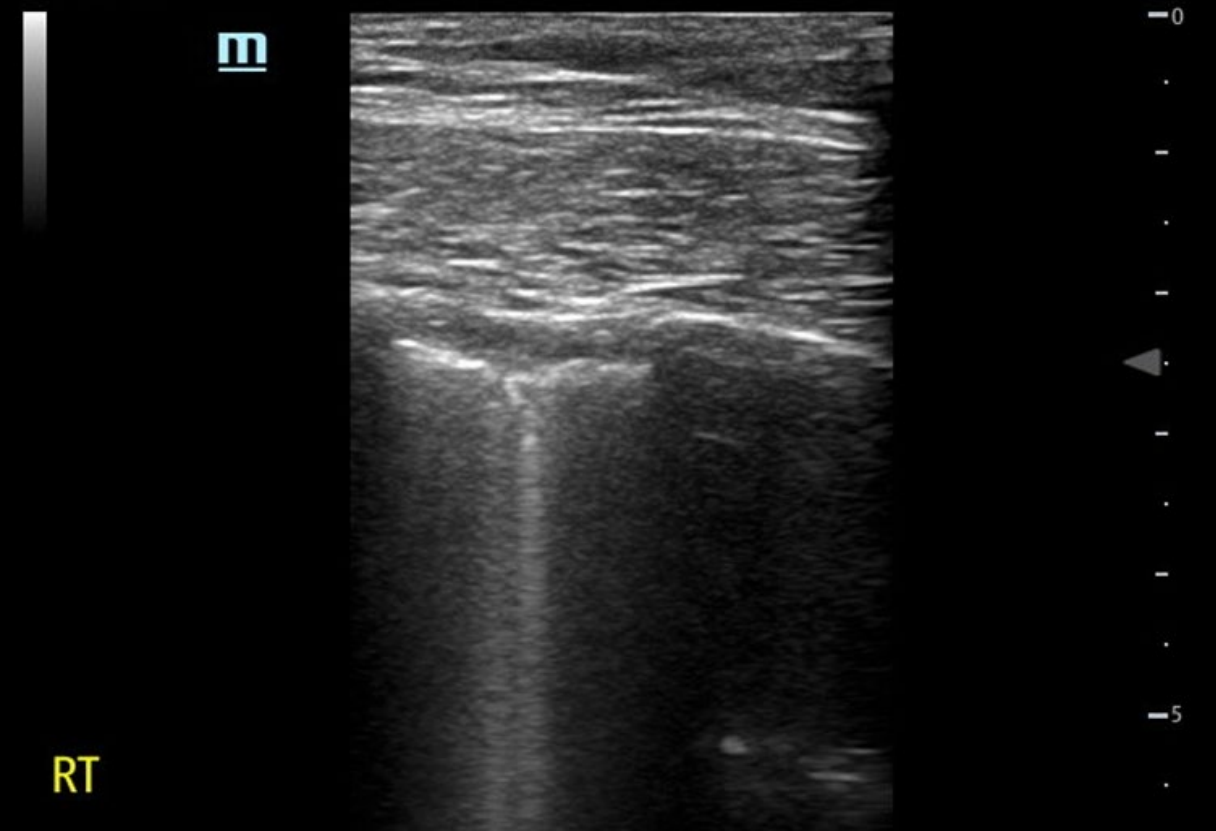
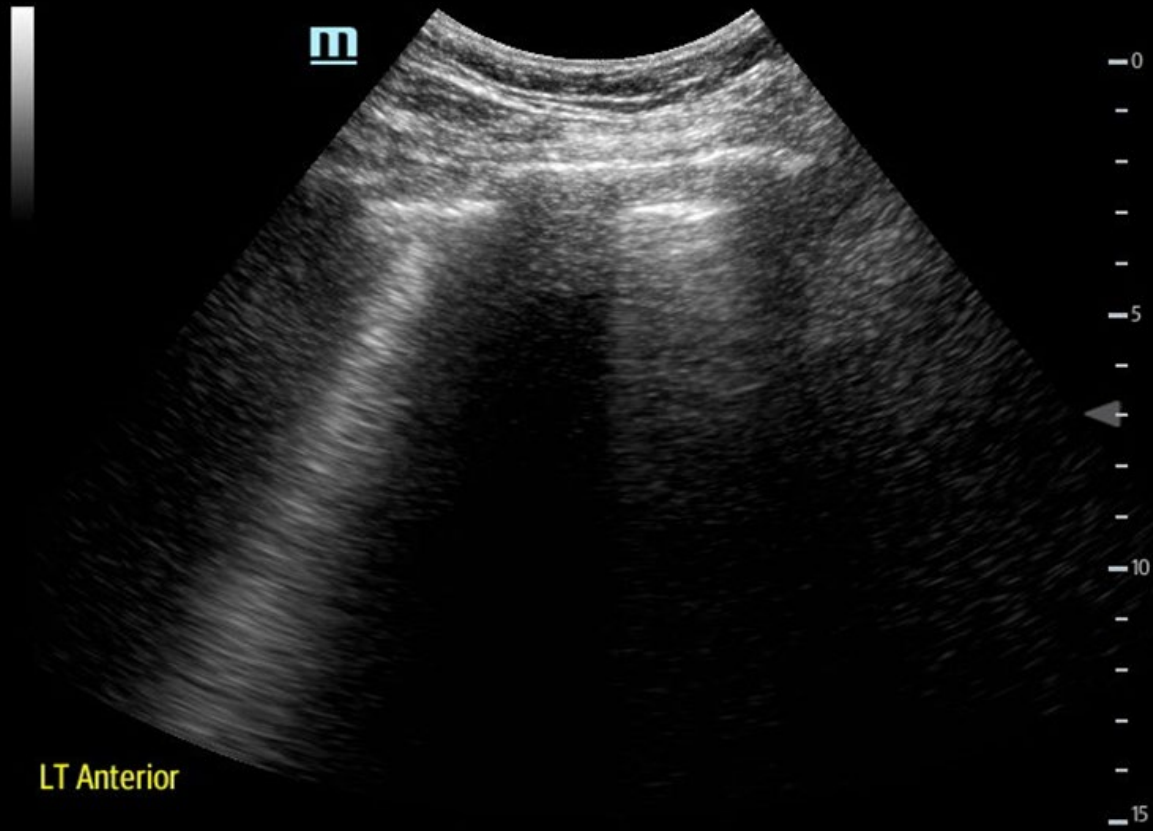
What to look for



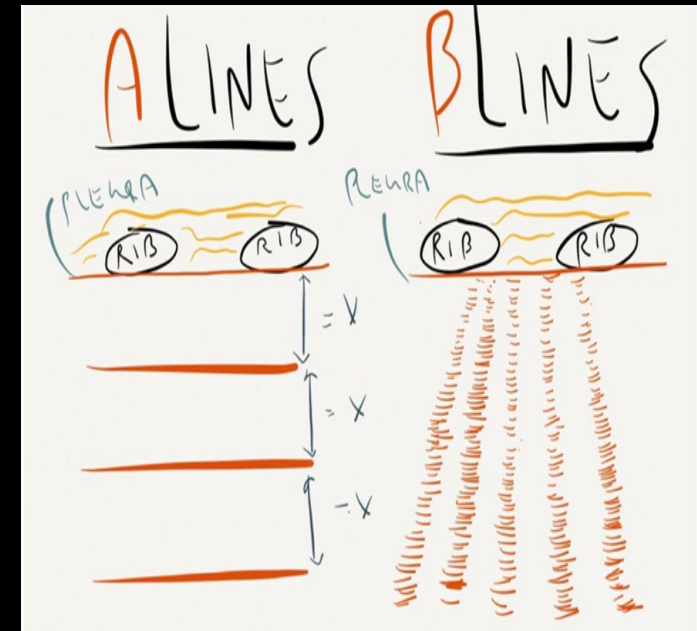
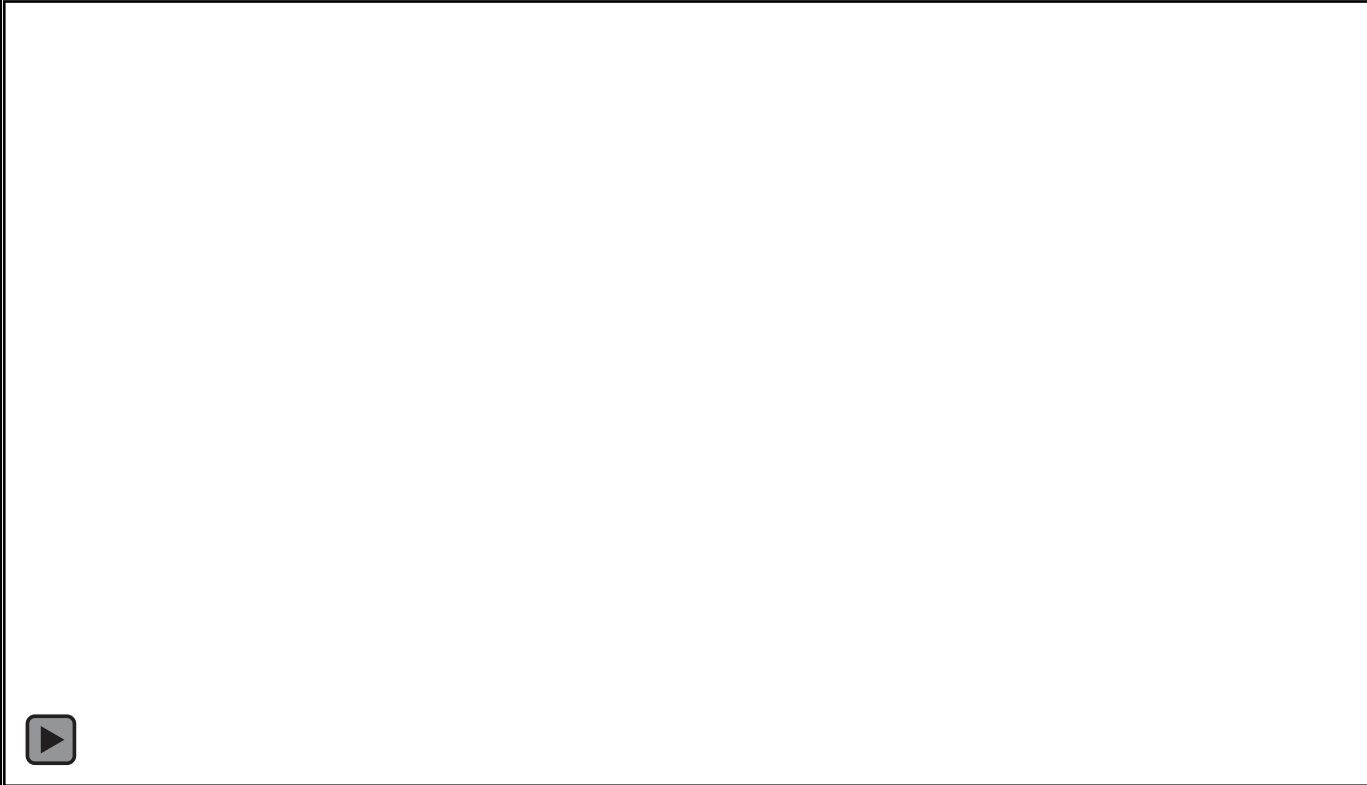
-0
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-1
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-2
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-5

RT Posterior Inferior

What to look for B-Lines (Reverberation)

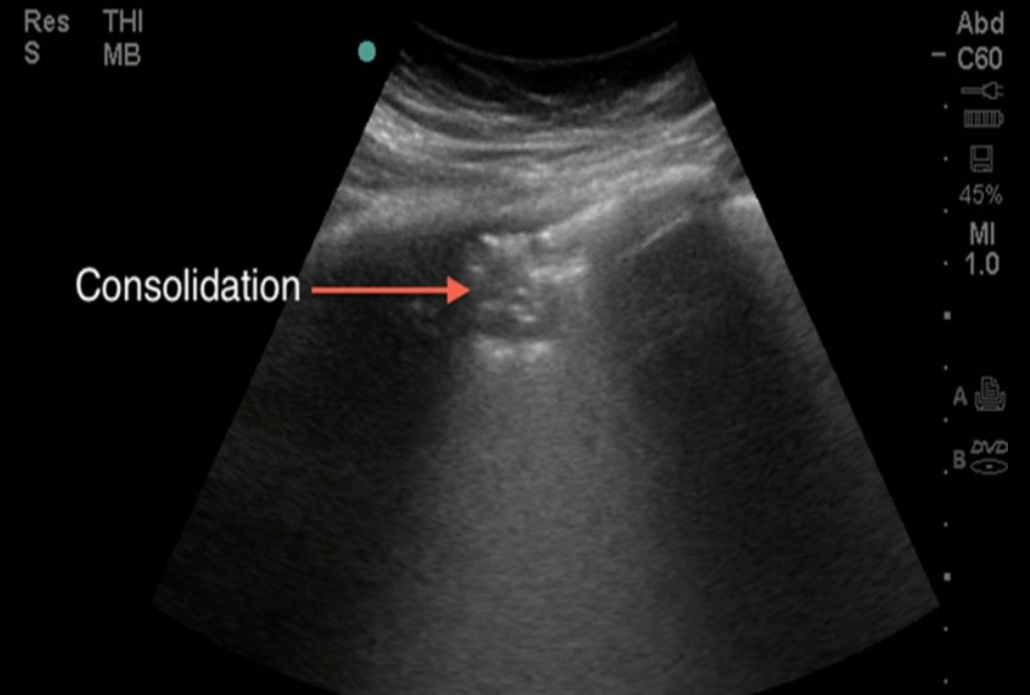


What to look for B-Lines (Reverberation)



What to look for

Air Bronchogram & Hepatization



What to look for

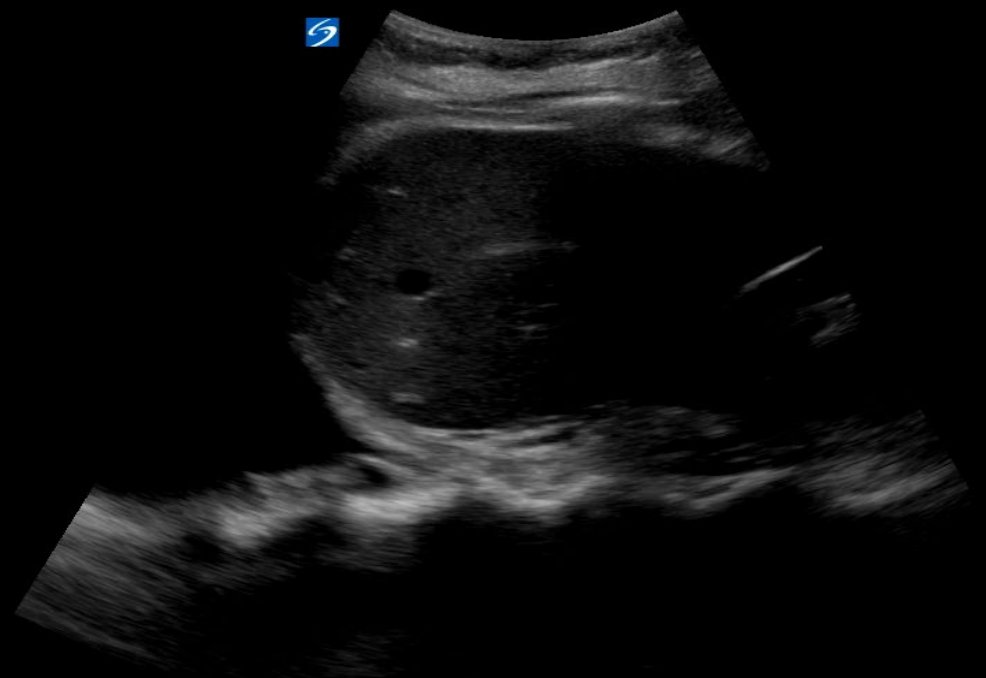
Pleural Effusions & Spine Sign



Pleural Effusions & Spine Sign



7 Feb 2020 / 15:55



SonoSite

C60xp/5-2 Abdomen
MI: 0.9 TIS: 0.2

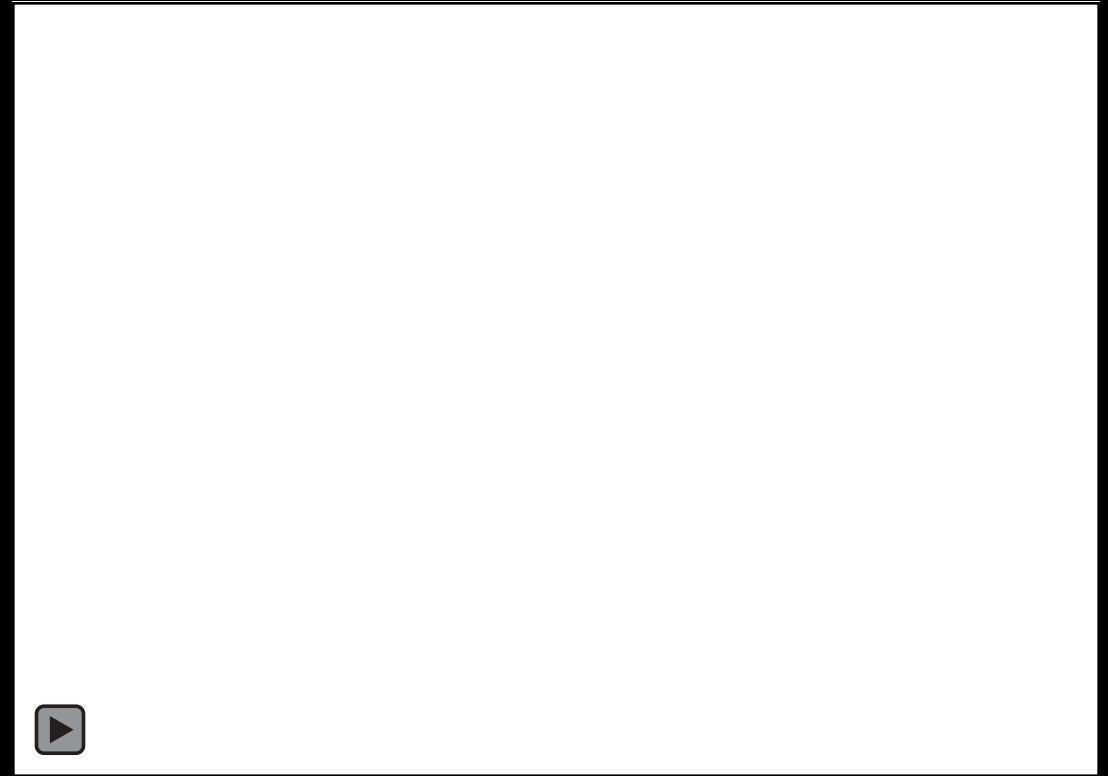
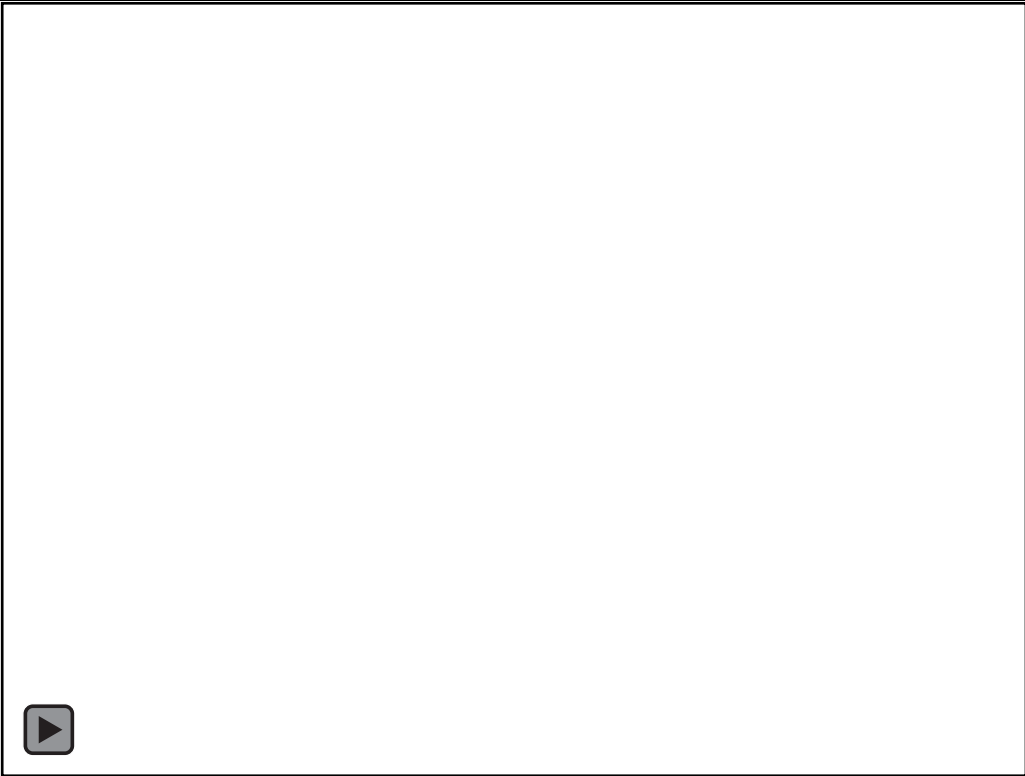
16.2 cm

2D: G: 50
Gen DR: 0
MB
THI





Pleural Effusions & Spine Sign



C-Lines & Shred Sign



23 Jan 2020 / 15:00

23 Jan 2020 / 14:58



SonoSite
C60xp/5-2 Abdomen
MI: 1.0 TIS: 0.2

7.7 cm

2D: G: 58
Gen DR: 0
MB
THI



7.7 cm

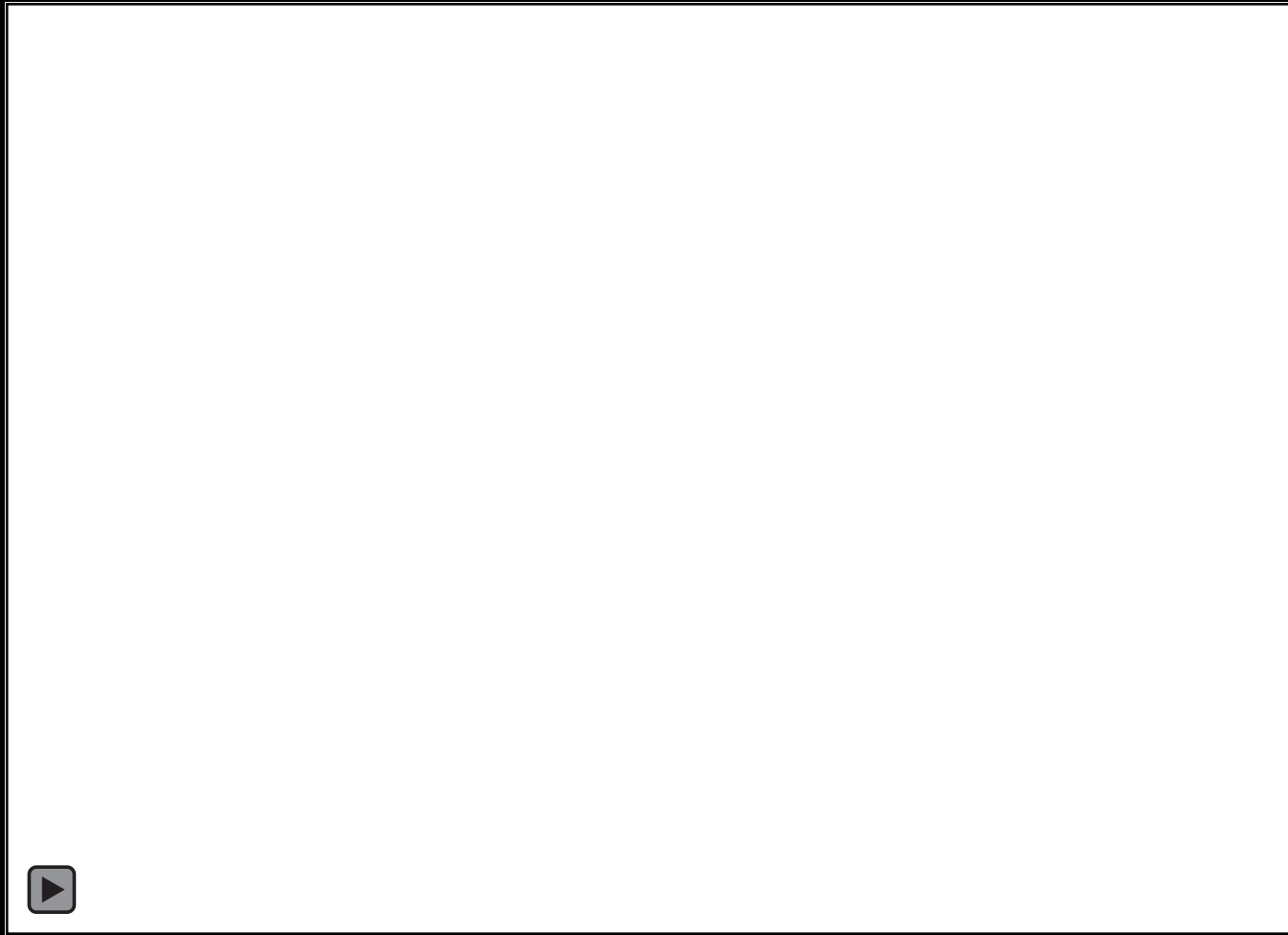
2D: G: 40
Gen DR: 0
MB
THI

What to look for



C-Lines & Shred Sign

Appears when the border of aerated lung and consolidated lung is not sharp



Evidence Behind it



Lichtenstein *Annals of Intensive Care* 2014, **4**:1
<http://www.annalsofintensivecare.com/content/4/1/1>

 **Annals of Intensive Care**
a SpringerOpen Journal

REVIEW

Open Access

Lung ultrasound in the critically ill

Daniel A Lichtenstein

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Pleural Effusion	94	97	95	90
Alveolar Consolidation (Pneumonia)	90	98	88	95
Interstitial Syndrome (CHF, ARDS)	93	93	87	99
Complete Pneumothorax	100	96	100	98
Occult Pneumothorax	79	100	89	99
AECOPD	89	97	93	95
Pulmonary Embolism	81	99	94	98

Evidence Behind it

REVIEW

Lung ultrasound: routine practice for the next generation of internists



H.R.W. Touw^{1,2}, P.R. Tuinman^{1,3,4}, H.P.M.M. Gelissen¹, E. Lust¹, P.W.G. Elbers^{1,3,4}

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Accuracy of BLUE protocol

Mechanism of dyspnoea	BLUE protocol profile	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Acute haemodynamic pulmonary oedema	B-profile	97%	95%	87%	99%
Exacerbated COPD or severe acute asthma	Nude profile (A-profile with no DVT and no PLAPS)	89%	97%	93%	95%
Pulmonary embolism	A-profile with DVT	81%	99%	94%	98%
Pneumothorax	A'-profile (with lung point)	88%	100%	100%	99%
Pneumonia	All profiles [#]	89%	94%	88%	95%
	B'-profile	11%	100%	100%	70%
	A/B-profile	14.5%	100%	100%	71.5%
	C-profile	21.5%	99%	90%	73%
	A-V-PLAPS profile	42%	96%	83%	78%

Table 1. Performance of ultrasound compared with computer tomography scan as gold standard

	Sensitivity (%)	Specificity (%)
Pleural effusion ¹³	94	97
Alveolar consolidation ¹⁴	90	98
Interstitial syndrome ¹⁵	93	93
Complete pneumothorax ¹⁶	100	95
Occult pneumothorax ¹⁷	79	100



Keep in Mind

- B-lines originate from the visceral pleura & erase A-lines (rule out pneumothorax)
- Air-broncho-gram is -----
- Look for Pneumothorax at the anterior points in a supine patient (air spreading out over the anterior chest)
- Spine sign is -----
- Consolidation and effusion usually appears first posteriorly
- Z-line is -----
- Very dense B-lines, more than 10 per screen or only 3 mm apart, favor the diagnosis of ARDS



References

- Zanobetti, M., Poggioni, C. and Pini, R., 2011. Can chest ultrasonography replace standard chest radiography for evaluation of acute dyspnea in the ED?. *Chest*, 139(5), pp.1140-1147.
- Touw, H.R.W., Tuinman, P.R., Gelissen, H.P.M.M., Lust, E. and Elbers, P.W.G., 2015. Lung ultrasound: routine practice for the next generation of internists. *Neth J Med*, 73(3), pp.100-107.
- Lichtenstein, D.A. and Meziere, G.A., 2008. Relevance of lung ultrasound in the diagnosis of acute respiratory failure*: The BLUE Protocol. *Chest*, 134(1), pp.117-125.
- Lichtenstein, D.A., 2015. BLUE-protocol and FALLS-protocol: two applications of lung ultrasound in the critically ill. *Chest*, 147(6), pp.1659-1670.
- Lichtenstein, D.A., 2014. Lung ultrasound in the critically ill. *Annals of intensive care*, 4(1), p.1.