Lung Ultrasound – 3 Easy techniques anyone can learn

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Disclosures

- Consulting: Novartis, ScPharmaceuticals
- Research Grants: NIH

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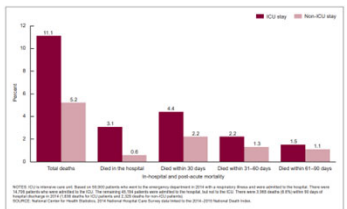
Why should you care?

Acute respiratory illness requiring hospitalization associated with high in-hospital & post-acute mortality



Ashman JJ. National Health Statistics Reports. Jan. 2021

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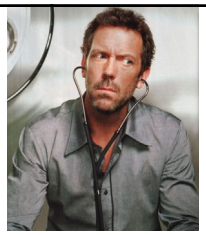

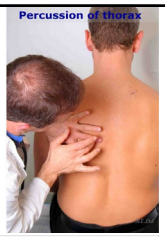

Overview

1. Pneumothorax
2. Pulmonary edema
3. Pleural effusion

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Which ultrasound machine?

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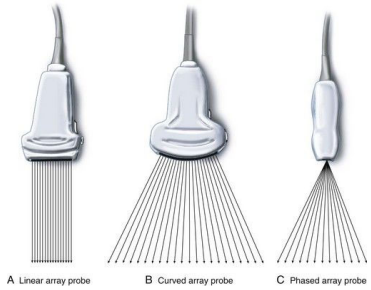
Which transducer?



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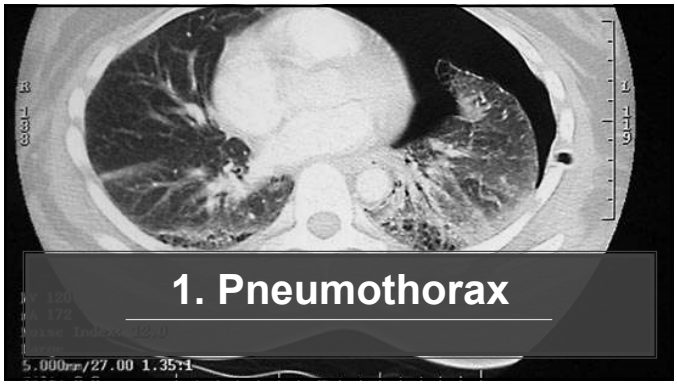

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LUS more sensitive than chest x-ray for pneumothorax detection

No.	Ultrasonography		Chest Radiography	
	Sensitivity, %	Specificity, %	Sensitivity, %	Specificity, %
176	98.1	99.2	75.5	100.0
97	88.2	89.3	47.1	94.0
184	95.7	100	…	…
133	48.8	98.7	20.9	99.6
27	100	93.8	36.4	100.0
186	98.2	100	53.6	100.0
109	92.0	99.5	52.0	100.0
135	86.2	97.2	27.6	100.0
Meta-analysis:	**90.9%**	**98.2%**	**50.2%**	**99.4%**

Reference standard: Chest CT or chest tube

Alrajhi K. Chest 2012

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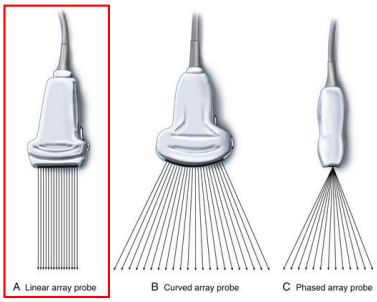
Which transducer?



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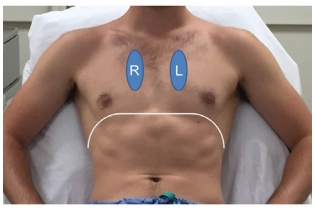
Where to scan?



Mennicke M, … Platz E. Am J Emerg Med 2011

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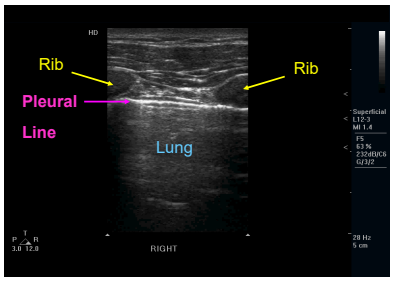
Landmarks: Lung sliding



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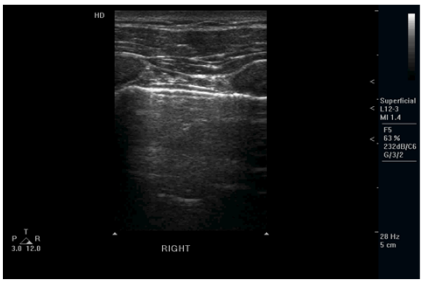
Pneumothorax?



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Pneumothorax?

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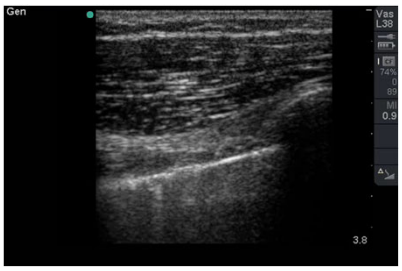
Pneumothorax?



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Pneumothorax?

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False positives?

- Rt. mainstem intubation
- Adhesions
- Apnea
- ? Large blebs

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Take home points: Pneumothorax

- Lung ultrasound more sensitive than supine chest x-ray for detection of pneumothorax
- Ultrasound finding: **Lung sliding**
- Know common false positives:
  Right mainstem intubation, adhesions
- ***Don't forget clinical context!***

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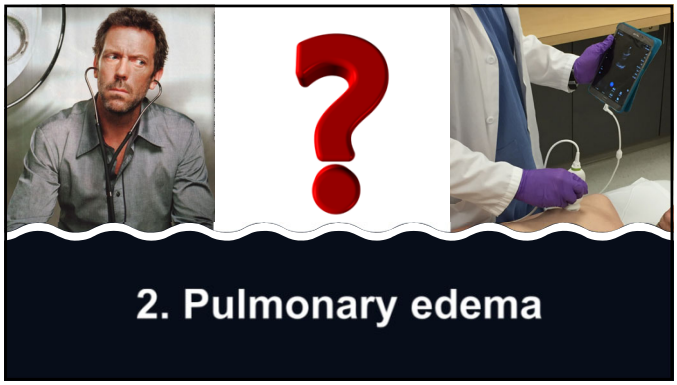

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Case 1:
Shortness of breath

- **HPI:** 61 y/o F c/o worsening SOB x2 days. No fever/ chest pain.
- **PMH/PSH:** COPD (multiple intubations), HFrEF (last EF~40%), AICD
- **Physical exam:**
  Tachycardic, tachypneic, distended neck veins, wheezing/crackles, no leg edema

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Case 2:
Shortness of breath

- **HPI:** 62 y/o lawyer c/o worsening SOB x1 day. Brief episodes of SOB x 3 months (minutes). Recent empiric treatment for pneumonia.
- **PMH:** Anxiety, asthma, non-ischemic cardiomyopathy (EF 45%), no prior heart failure; stress echo this month: no ischemia
- **Physical exam:**
  SpO2 88% on room air, tachycardic, tachypneic, ?? neck veins, few bibasilar crackles, no leg edema

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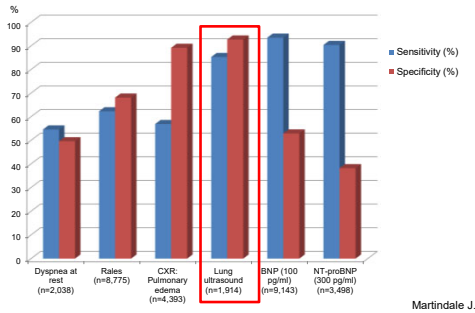
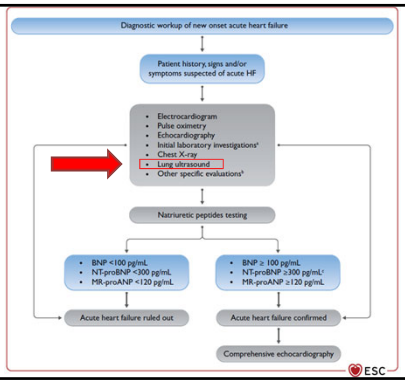
Lung ultrasound has high diagnostic accuracy for acute heart failure in dyspneic Emergency Department patients



Martindale J. Acad EM 2016

24

2021 ESC Heart Failure Guidelines



McDonagh T. EHJ 2021

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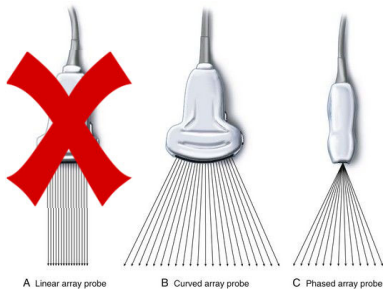
Which transducer?



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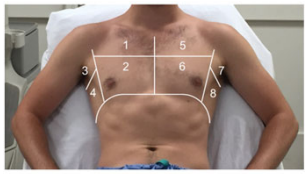
Scanning technique: 8 zones



Exam duration: 2-5 min.

Platz E. EJHF 2019

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How to scan: Zones 1 - 4

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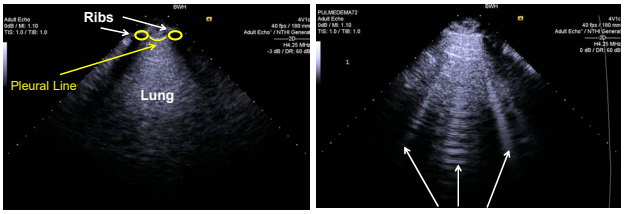
B-lines on lung ultrasound



No B-lines B-lines

Pivetta E. Eur J Heart Fail 2019

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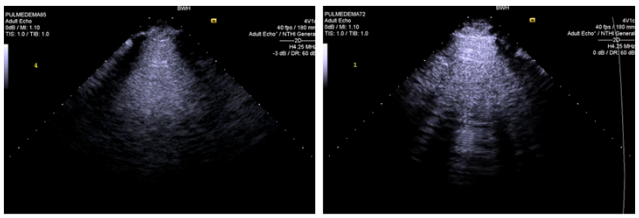
B-lines on lung ultrasound



No B-lines B-lines

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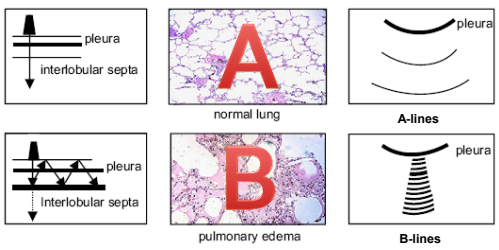
Lung ultrasound findings



Picano E. JASE 2006

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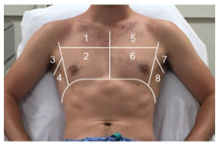
B-line cut-off for diagnosis of AHF in dyspneic patients

≥3 B-lines per lung "zone"
≥2 zones on each hemithorax



Pivetta E. EJHF 2019

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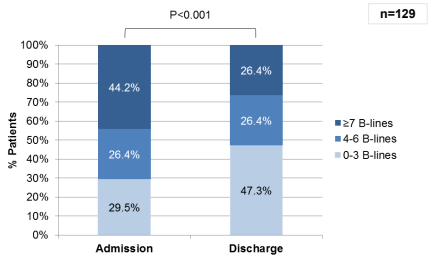
Pulmonary congestion by 4-zone LUS method common in AHF



Platz E. JACC Heart Fail 2019

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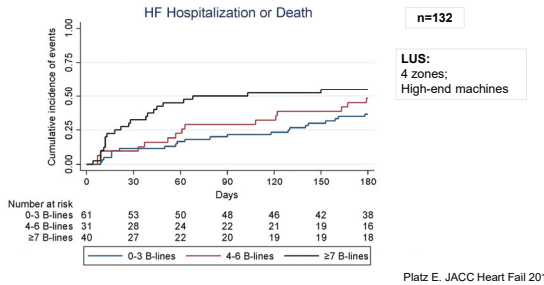
AHF: Higher number of pre-discharge B-lines marker for adverse events



Platz E. JACC Heart Fail 2019

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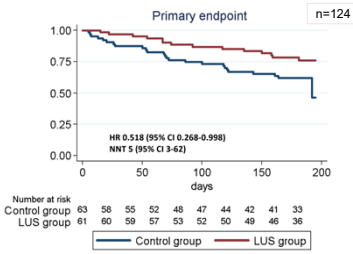
LUS-guided HF therapy may prove effective & safe post-discharge



	Control	LUS	P value
Hospitalization			
Hypotension	0	1	0.50
Hyperkalemia	1	0	1.00
Worse renal function	1	1	1.00
Electrolytes & Renal			
Hyperkalemia	26	26	1.00
Hypokalemia	6	2	0.27
Worse renal function	8	9	0.77

Rivas-Lasarte M. EJHF 2019

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Conditions with B-lines on lung ultrasound

Pulmonary contusion

- Pulmonary edema
- Pneumonitis (incl. COVID)
- ARDS
- Pulmonary contusions
- Pulmonary fibrosis

Volpicelli G. Intensive Care Med 2012
Platz E. Am J Emerg Med 2009

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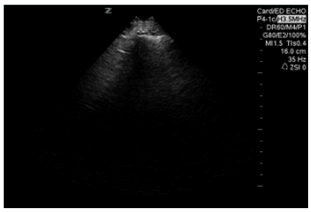
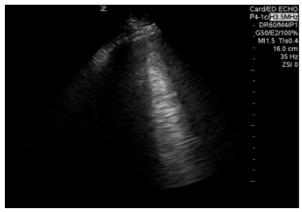
LUS for Cases 1 & 2

Case 1



Case 2



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Take home points: Pulmonary edema

- Lung ultrasound more sensitive than physical exam/chest x-ray for detection of pulmonary edema in dyspneic ED patients
- Ultrasound finding: **B-lines**
- Know false positives: Viral pneumonia, pulmonary fibrosis, pulmonary contusions, etc.

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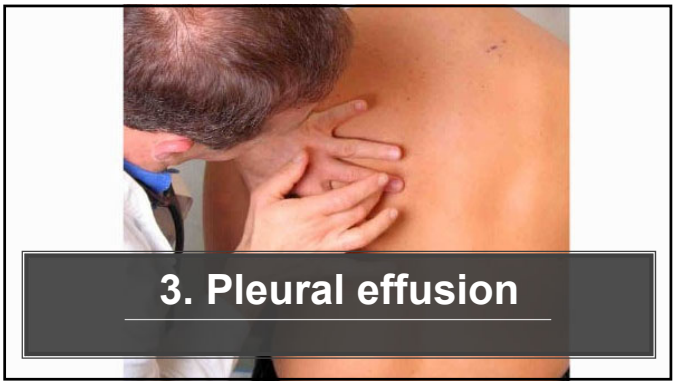

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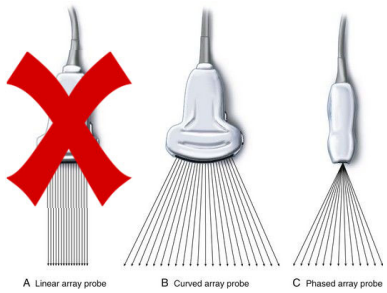
Which transducer?



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Where to scan & what to look for?

- Posterior axillary line
- Look for “spine sign”
- Simple vs. complex effusion

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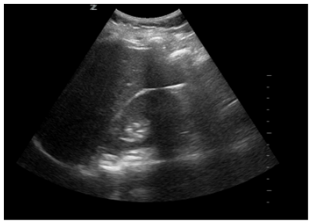
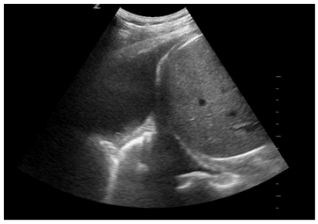
Right: Pleural effusion?



No pleural effusion



Pleural effusion

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Left: Pleural effusion?

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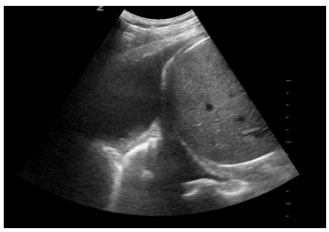
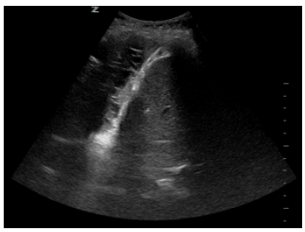
Pleural effusion?





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Take home points: Pleural effusion

- Useful in many different patients: Trauma, medical patient with dyspnea
- Ultrasound finding: **Fluid** above diaphragm
- Differentiate simple vs. complex

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Question

A 73 y/o female with a history of hypertension, diabetes, atrial fibrillation and COPD presents to the Emergency Department with shortness of breath for 3 days. She reports progressively worsening dyspnea on exertion, bilateral leg swelling and episodes of shortness of breath at night. She also reports mild wheezing but denies cough, chest pain or fever.

Which statement is correct?

1) Chest x-ray identifies pulmonary congestion in patients with undifferentiated dyspnea with higher sensitivity than lung ultrasound.
2) Lung ultrasound for the detection of B-lines is difficult to learn and takes at least 20 minutes to perform.
3) The identification of multiple bilateral B-lines on lung ultrasound would support the diagnosis of a cardiogenic etiology (i.e. pulmonary congestion) in this patient.
4) None of the above.

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Free Online Resources

Free online lectures
(Point of care ultrasound):
www.emergencyultrasoundteaching.com
www.coreultrasound.com/5ms/

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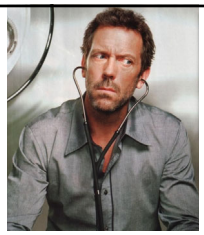

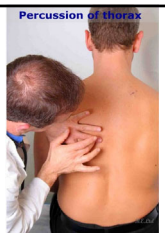

Before:

1. **Pneumothorax**
2. **Pulmonary edema**
3. **Pleural effusion**

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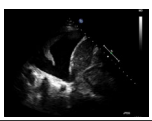
After: Lung ultrasound

1. **Pneumothorax**
   - Lung sliding

2. **Pulmonary edema**
   - B-lines

3. **Pleural effusion**
   - Fluid above diaphragm



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