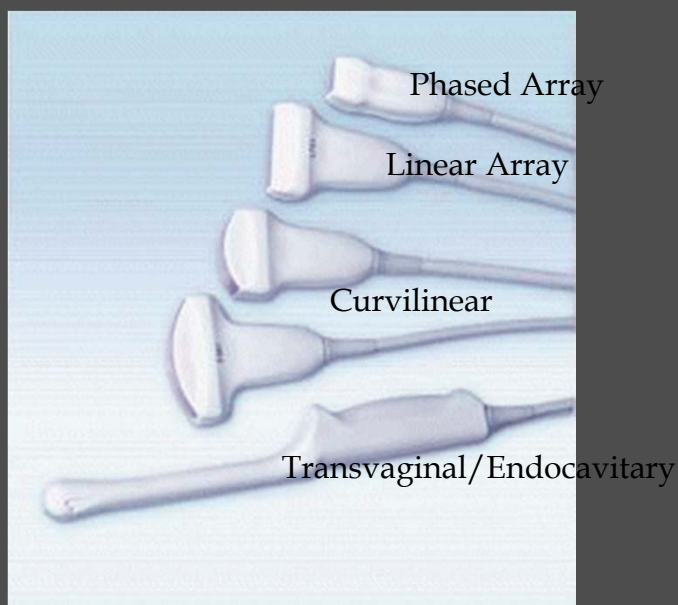


POINT OF CARE ULTRASOUND FOR AIRWAY & BREATHING

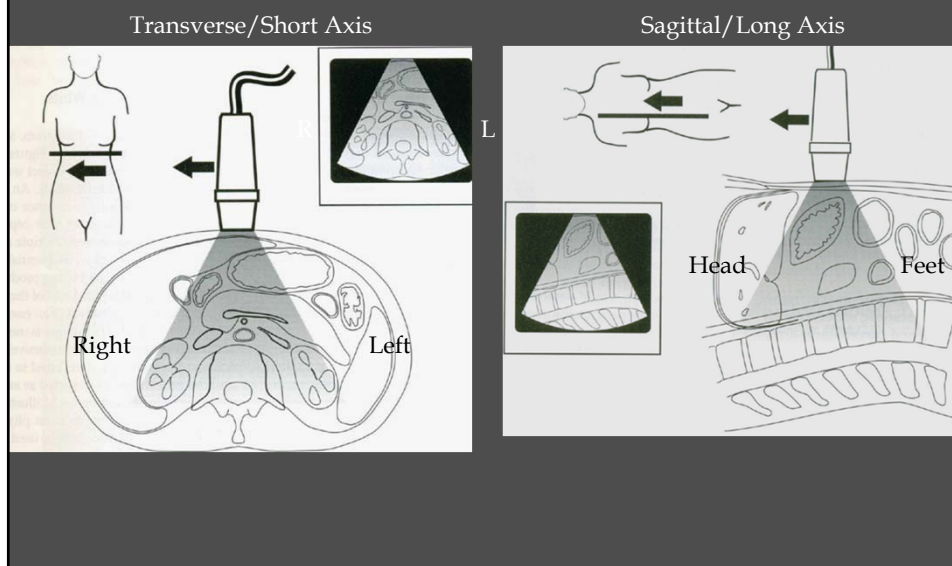


James W. Tsung, MD, MPH
Mount Sinai School of Medicine

Probes



Probe Orientation



*"THE LUNG IS A MAJOR HINDRANCE TO THE USE
OF ULTRASOUND AT THE THORACIC LEVEL"*
HARRISON'S PRINCIPLES OF INTERNAL MEDICINE,
1992; P1043

*"Ultrasound imaging is not useful for evaluation of
the parenchyma"*
Harrison's Principles of Internal Medicine, 2001;p1454

Nelson's Textbook of Pediatrics
"No comment"

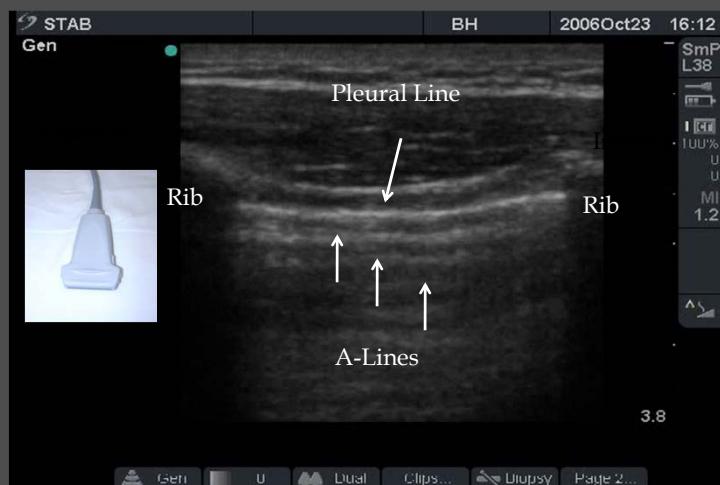
Advancing Technology



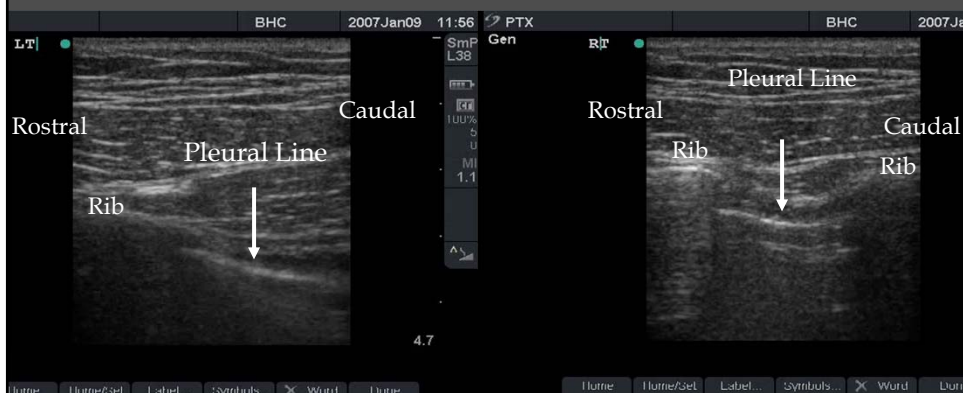
Probe Positioning



All Lung Ultrasound Patterns Arise from the Pleural Line.



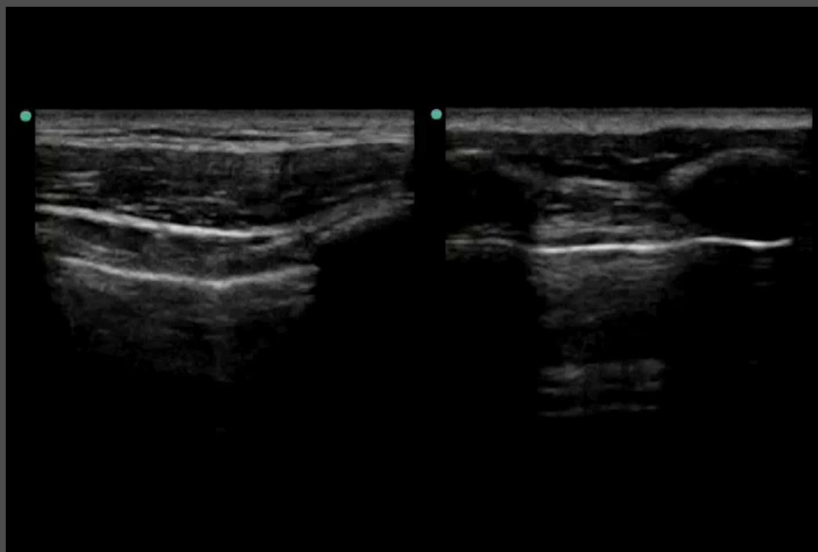
The Sliding Lung Sign looking for Pneumothorax



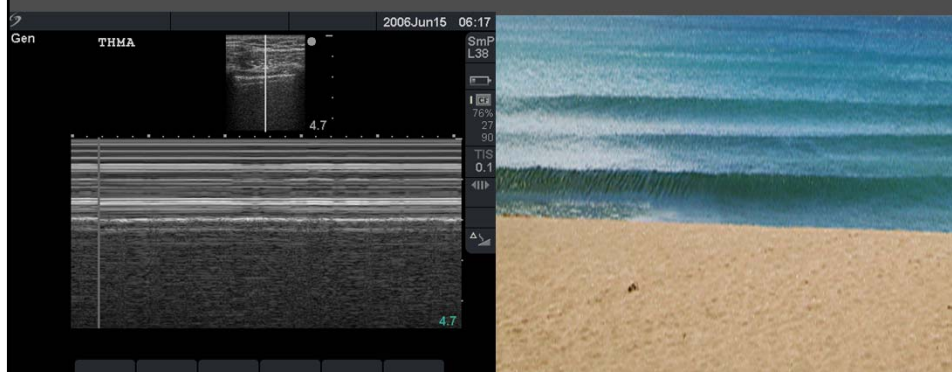
Blaivas et al. A prospective comparison of supine chest radiography and bedside ultrasound for the diagnosis of traumatic pneumothorax. *Acad Emerg Med* 2005
 N=136 CT Ref standard: CXR Sens - 75.5% /Spec - 100% ; US Sens - 98.1% /Spec - 99.2%

Kirkpatrick et al. Hand held US for detecting post-traumatic PTx: the EFAST. *J Trauma* 2004. N=225 CT composite ref std; Sensitivity 59% / Specificity 99.1%.
 eFAST sens 48% vs. CXR 20.8%; eFAST and CXR spec both 99%

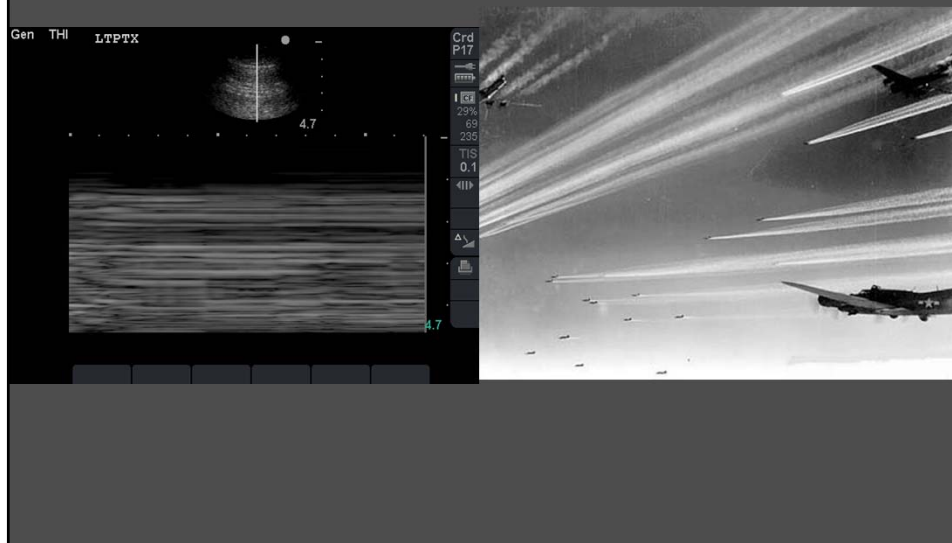
The Sliding Lung Sign looking for Pneumothorax



M-Mode “Seashore Sign” for Normal Lung

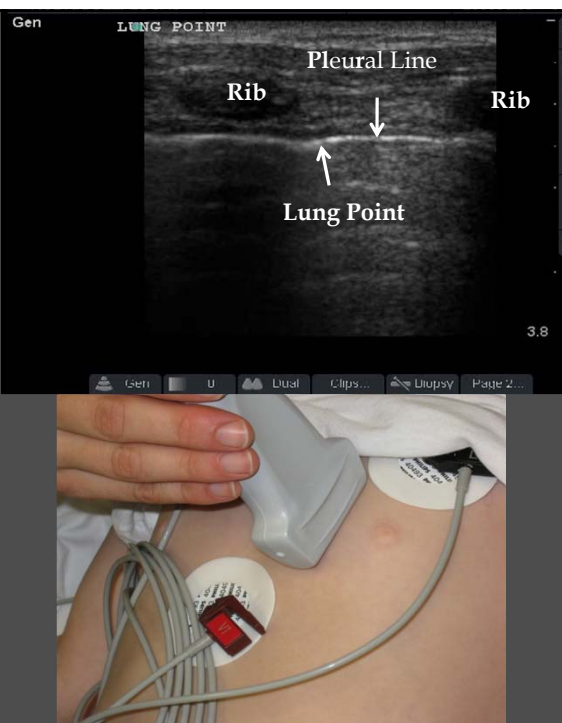


M-Mode “Stratosphere Sign” for Pneumothorax



The Lung Point for Pneumothorax

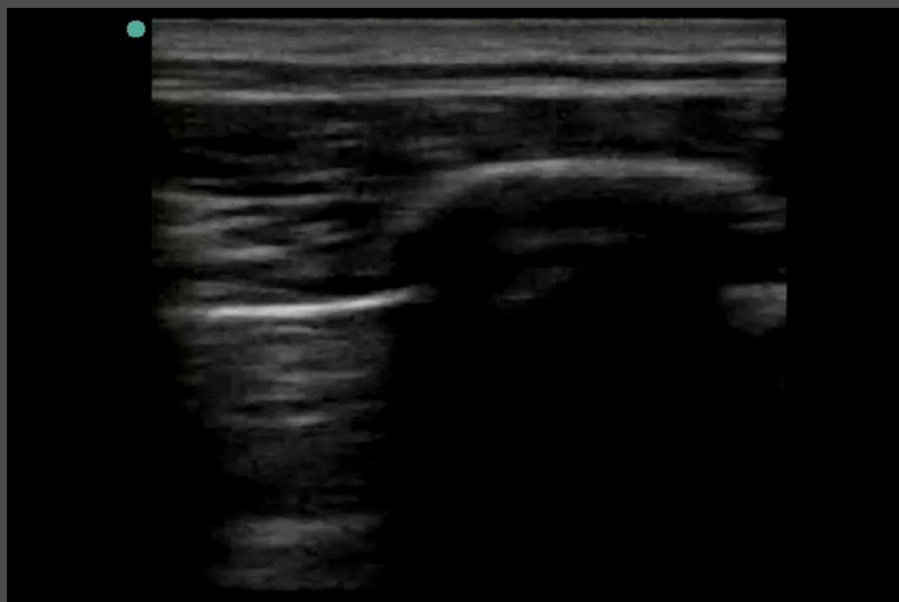
 Lichtenstein et al. The “lung point”: an ultrasound sign specific to pneumothorax. Intensive Care Medicine 2000
 CCM 2005: Lung Point –
 Sensitivity 79%
 Specificity 100%



The Lung Point



The Lung Point



ACLS/PALS: Incorporating...

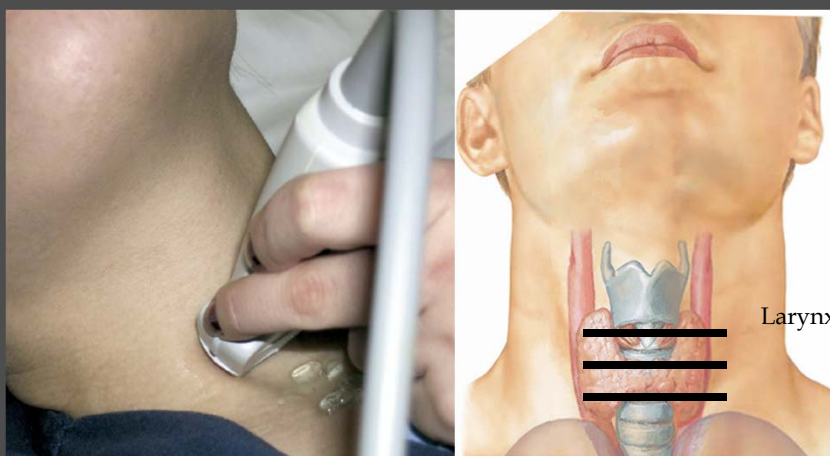
Circulation

Point-of-Care
Ultrasound

Airway

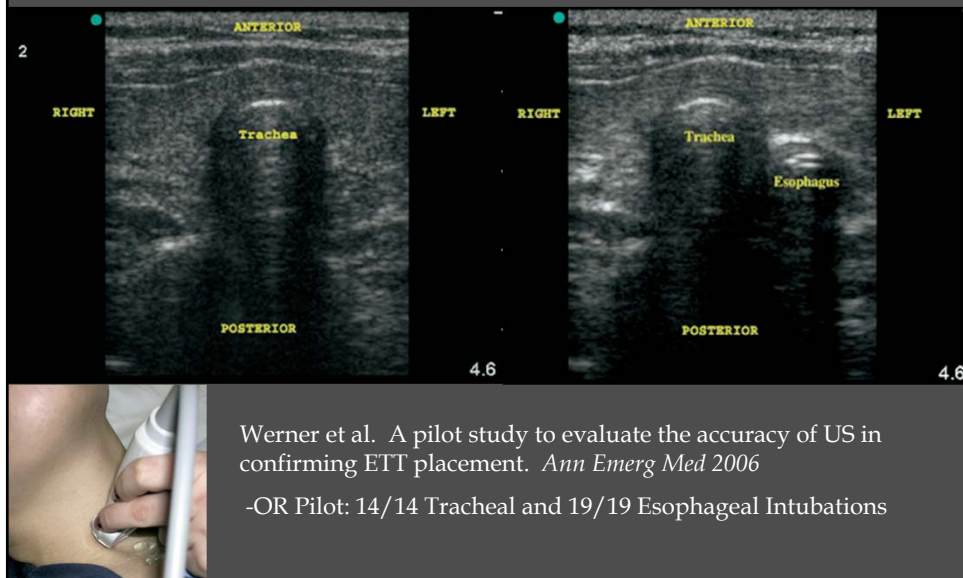
Breathing

Ultrasound for E.T. Tube Confirmation

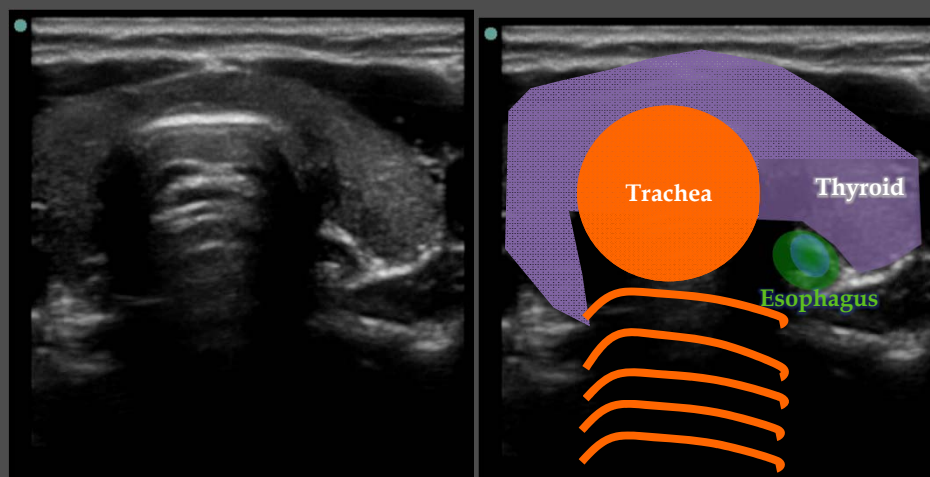


Position of ultrasound probe

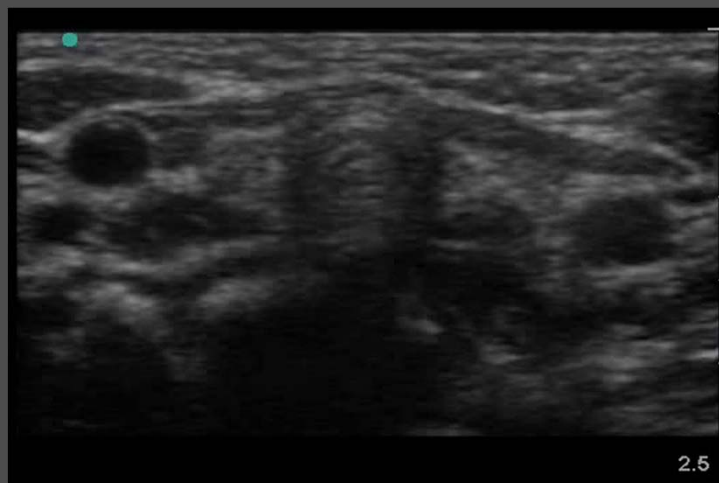
Ultrasound for E.T. Tube Confirmation



Ultrasound Anatomy for E.T. Tube Confirmation



Ultrasound Anatomy for E.T. Tube Confirmation



“Airway”: ETT Confirmation



Slovic et al. ETT in neonates: sonographic positioning. *Radiology* 1986

Galicinao et al. Use of bedside US for ETT placement in pediatric patients: a feasibility study. *Pediatrics* 2007 - N=99; 100% accuracy

Werner et al. A pilot study to evaluate the accuracy of US in confirming ETT placement. *Ann Emerg Med* 2006

E.T. Tube Confirmation by Static Ultrasound

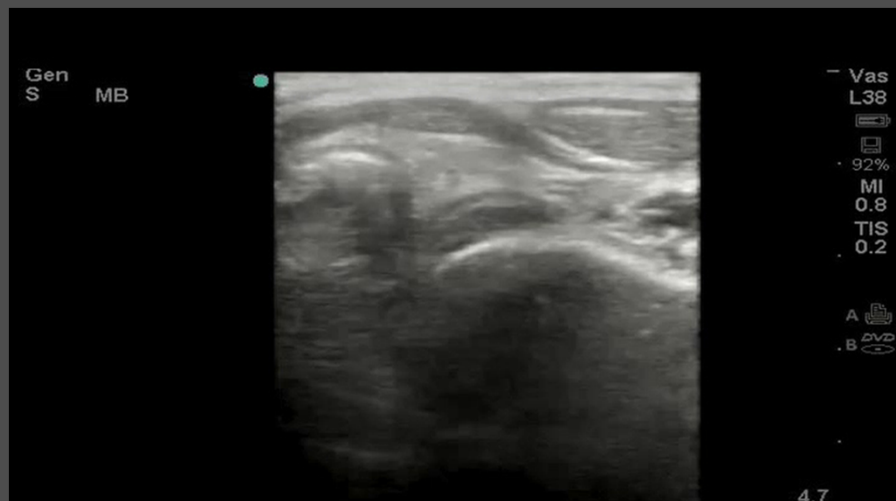


E.T. Tube Confirmation by Dynamic Ultrasound



Courtesy Beatrice Hoffman, M.D. PhD

Ultrasound by Dynamic E.T. Tube Confirmation



Courtesy Beatrice Hoffman, MD, PhD

Evidence for Dynamic Confirmation

Hoffmann et al. WINFOCUS 2009

	Sensitivity	Specificity	LR+
Endotracheal Intubation		N=89	
Intubator	97	80	4.9
Sonologist	100	100	Infinity
Esophageal Intubation		N=10	
Intubator	90	98	81
Sonologist	100	100	Infinity

“Breathing”: Lung Sliding



Weaver et al. Confirmation of E.T.T. placement after intubation using the ultrasound sliding lung sign. *Acad Emerg Med.* 2006 Mar;13(3):239-44

“Breathing” Right Main-Stem Intubation

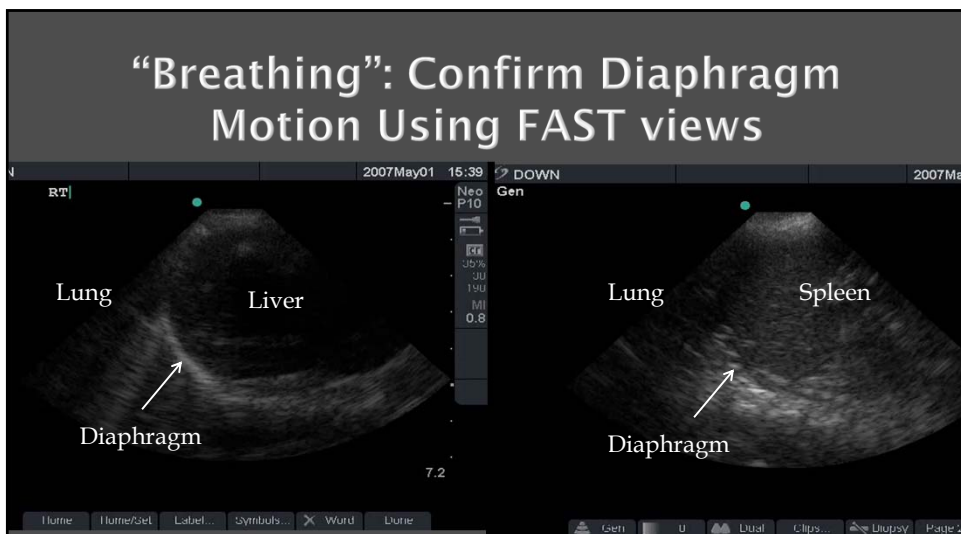


Before

After

Endotracheal Tube Pulled Back

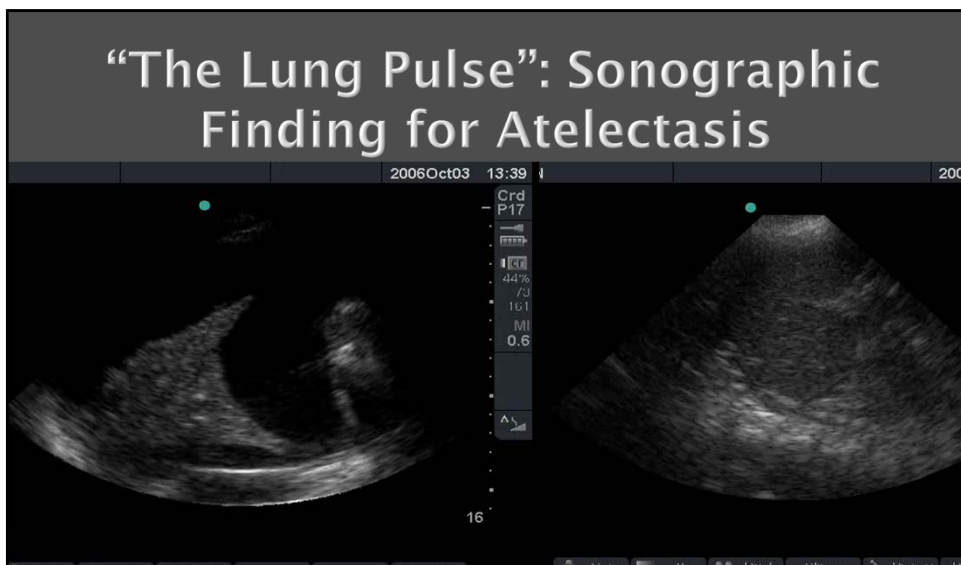
“Breathing”: Confirm Diaphragm Motion Using FAST views



Right
Left

Hsieh K et al. Secondary confirmation of E.T.T. position by US image. *Crit Care Med.* 2004 Sep;32(9 Suppl):S374-7.
 Gerscovich et al. Ultrasonographic evaluation of diaphragm motion. *J Ultrasound Med.* 2001;20:597-604

“The Lung Pulse”: Sonographic Finding for Atelectasis



Right
Left

Lichtenstein et al. The lung pulse: an early sign for complete atelectasis. *Intensive Care Med* 2003

“Breathing”: Lung Sliding



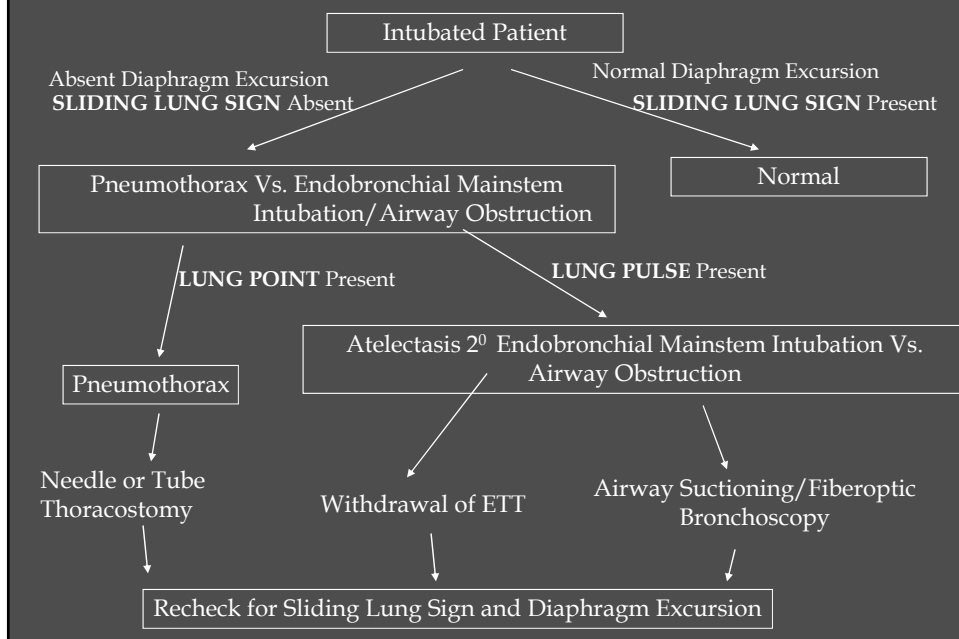
The Lung Pulse



The Lung Pulse



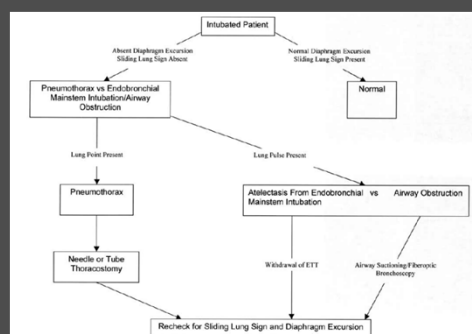
POINT-OF CARE ULTRASOUND ALGORITHM FOR AIRWAY MANAGEMENT



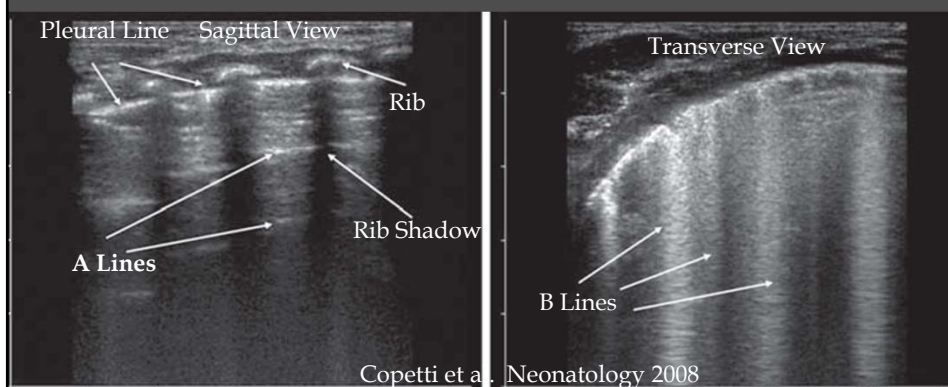
Airway and Breathing

- **D**isplacement of ETT
- **O**bstuction of ETT
- **P**neumothorax
- **E**quipment Failure

Airway Ultrasound Algorithm



A-Lines & B-Lines

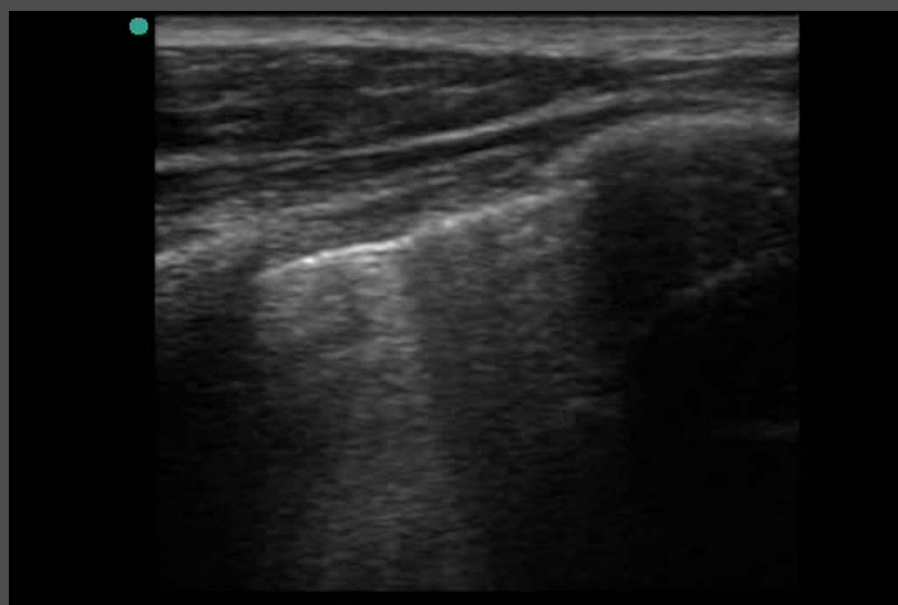


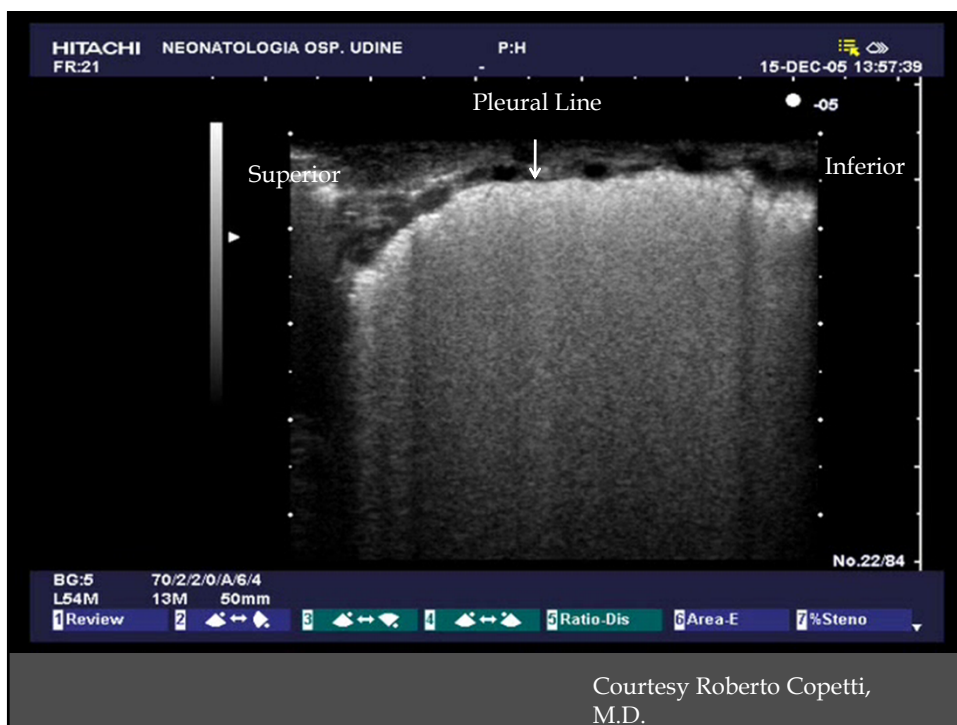
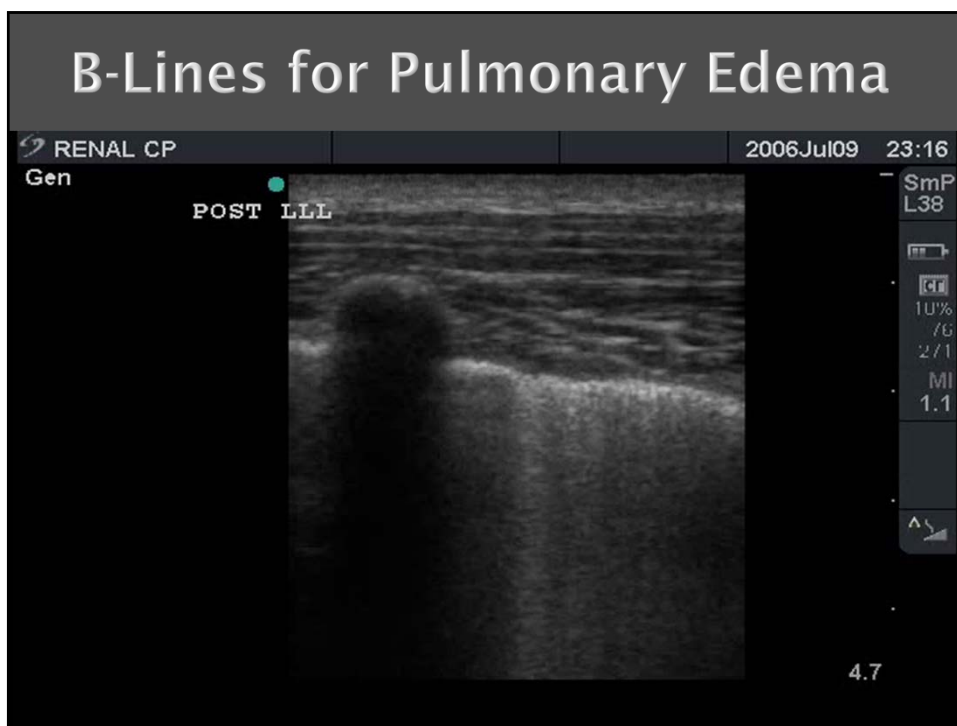
 Copetti et al. Lung ultrasound in respiratory distress syndrome: a useful tool for early diagnosis. Neonatology 2008. N=218; Sens and Spec 100%

B-Line (Single)

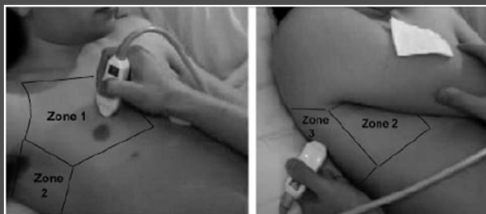


B+ Lines





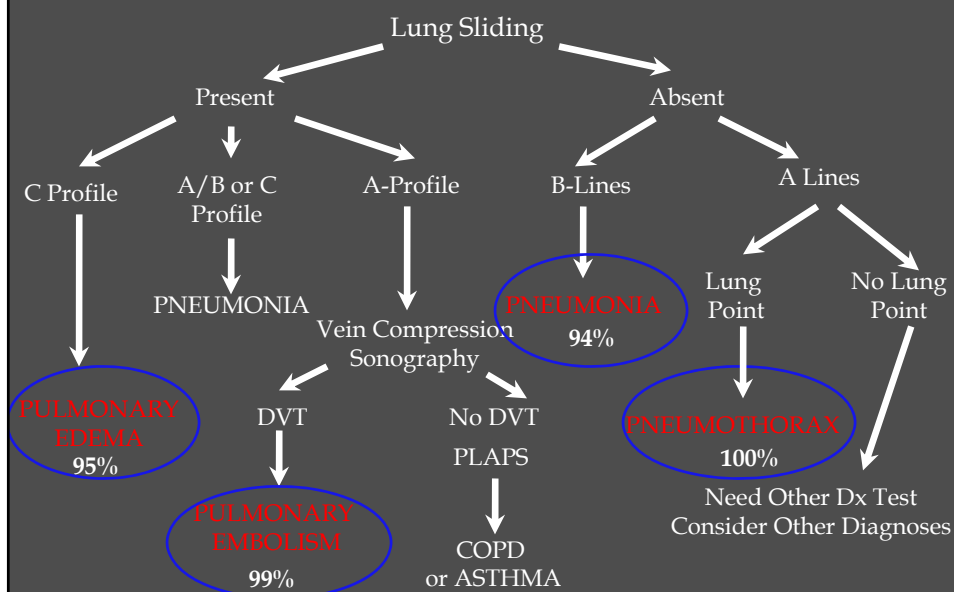
Lichtenstein's 6 Zone Scanning Protocol

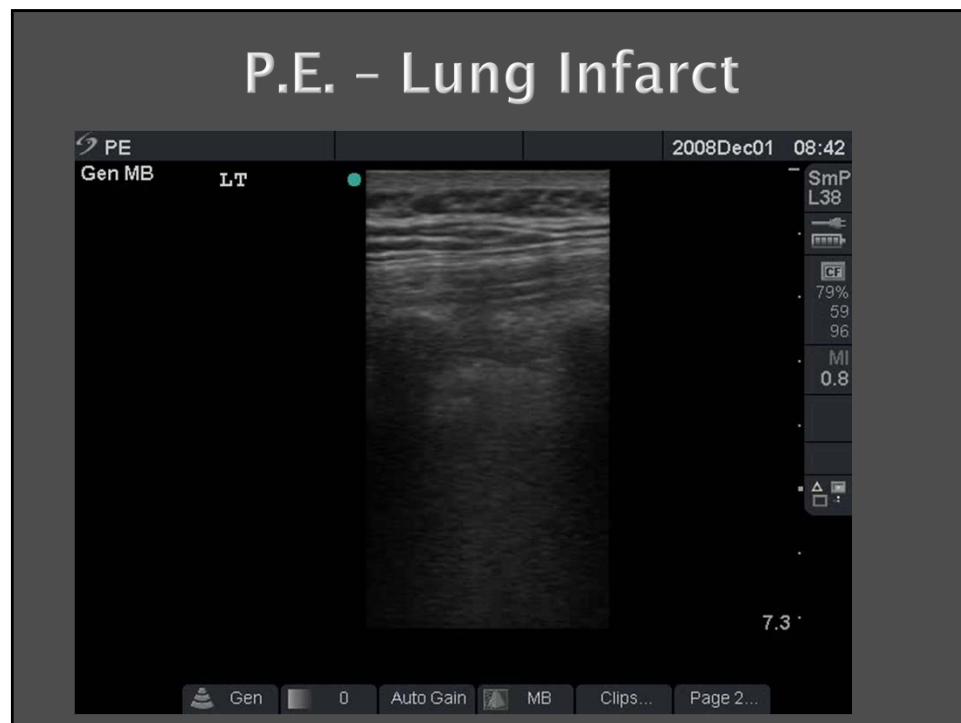
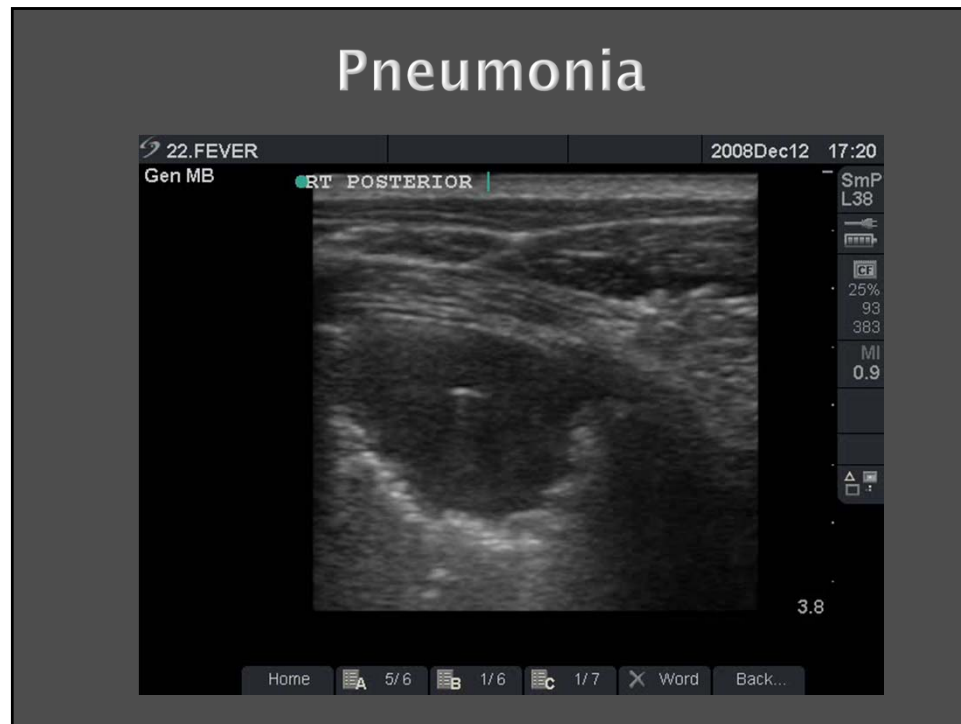


Volpicelli et al 8 Zone Scanning Protocol



Bedside Lung Ultrasound in Emergency Protocol





Lichtenstein's BLUE Protocol Profiles

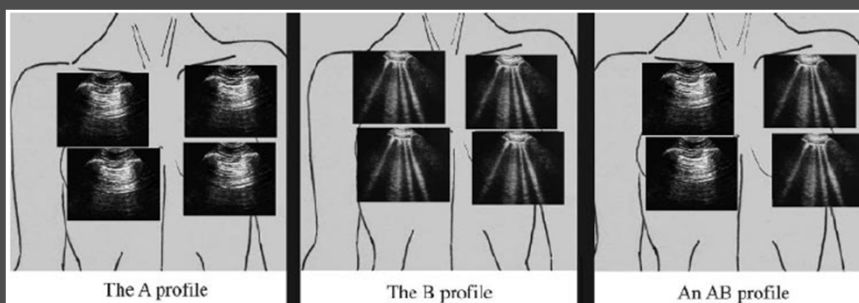
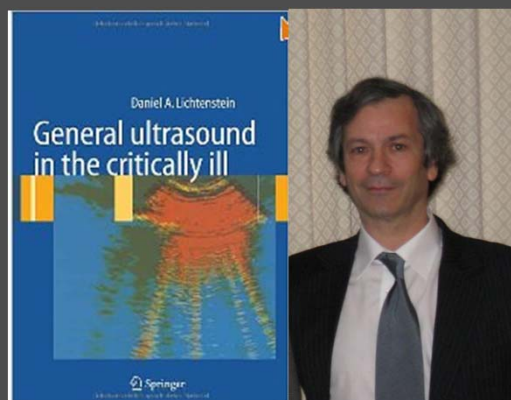


FIGURE 6. Ultrasound profiles. *Left panel:* The A profile is defined as predominant A lines plus lung sliding at the anterior surface in supine or half-sitting patients (stage 1/1⁺). This profile suggests COPD, embolism, and some posterior pneumonia. Pulmonary edema is nearly ruled out. *Middle:* The B profile is defined as predominant B + lines in stage 1. This profile suggests cardiogenic pulmonary edema, and nearly rules out COPD, pulmonary embolism, and pneumothorax. *Right panel:* an A/B + profile, massive B lines at the left lung, A lines at the right lung. This profile is usually associated with pneumonia.

STETHOS – CHEST SKOPEIN – TO OBSERVE

“Ultrasound is the real stethoscope”

- Dr. Daniel Lichtenstein



THANK YOU

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