LUNG ULTRASOUND IN ICU

OVERVIEW

- Need for USG
- Mechanics of USG
- Principles of lung USG
- BLUE protocol
- Alveolar syndrome
- Interstitial syndrome
- Weaning assessment
- Pneumonia / VAP
- Prone position ventilation assessment
- ETT positioning
- Post extubation stridor

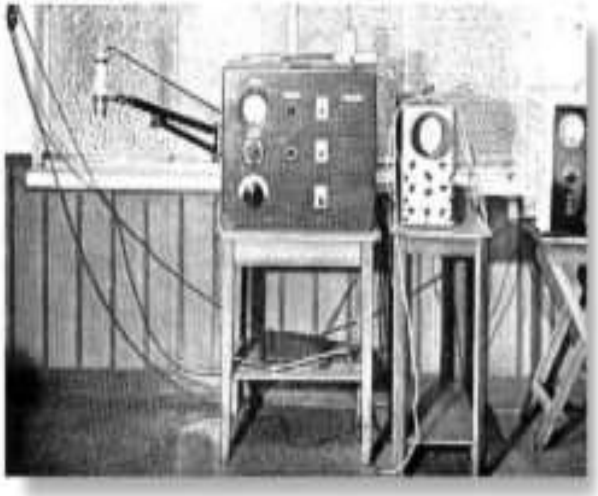
Need for USG??

- Supplement clinical assessment in critically ill

Portable ultrasound device

- Stethescope of modern intensivist!!
- Absence of radiation, better portability, real-time imaging, and the ability to perform dynamic imaging, faster, relatively cheap
- Convenience

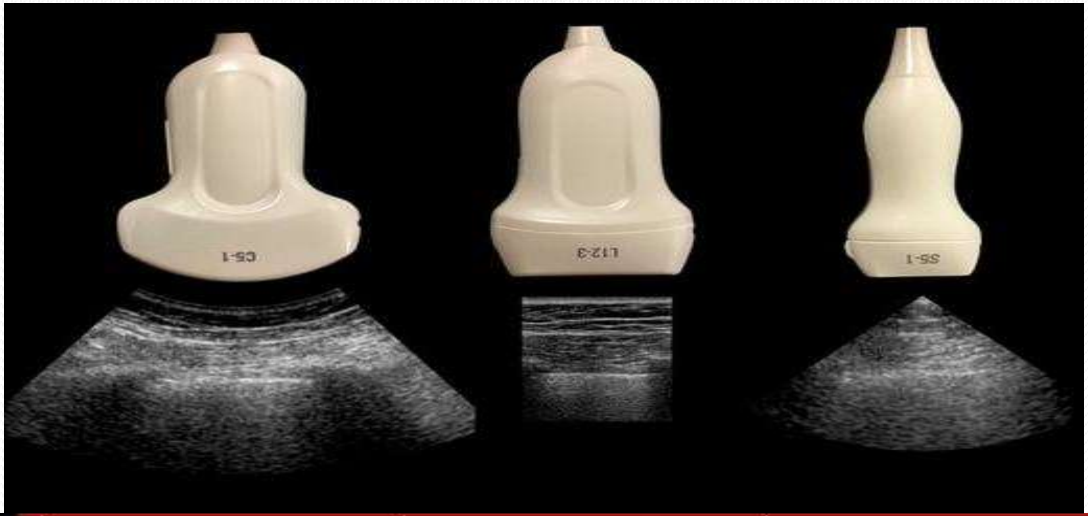
USG – THEN AND NOW !!!



Denier's ultrasonic apparatus in 1946

USG – THEN AND NOW !!!

TRANSDUCERS

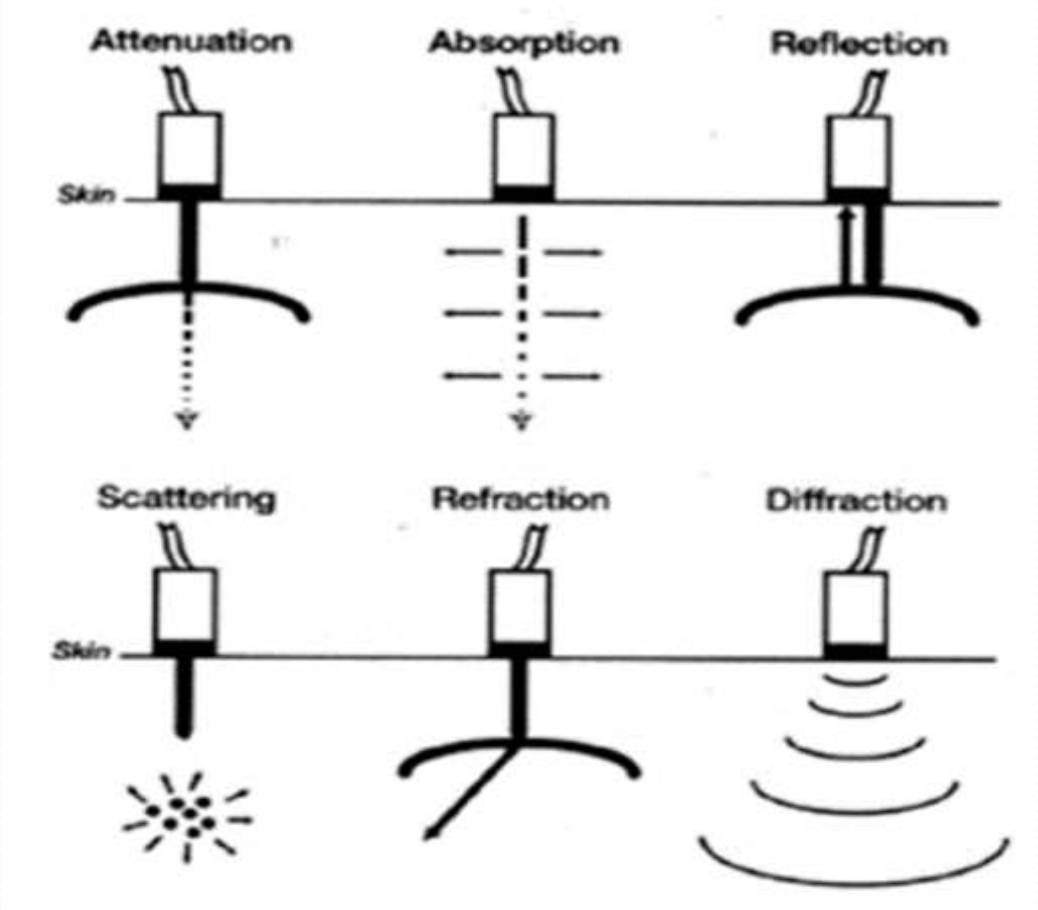


Frequency (MHz)	2-5	5-12	1.5-4
Footprint (cm^2)	Large (6x1.5)	Large (5x1)	Small (2.5x1.5)
Axial resolution	Good to average	Very good	Good to average
Penetration	Good	Poor	Good
Uses	Abdomen	Vascular	Echo, Lung, Pleura

Probes

• Cardiac	• 2.5-3.5 MHz
• Abdominal	• 3.5-5.0 MHz
• Endocavity	• 5.0-7.5 MHz
• Vascular	• 7.5-10 MHz
• Lungs	• 5 mhz curvilinear probe is ideal (low frequency for deeper tissue)

USG – Tissue interactions



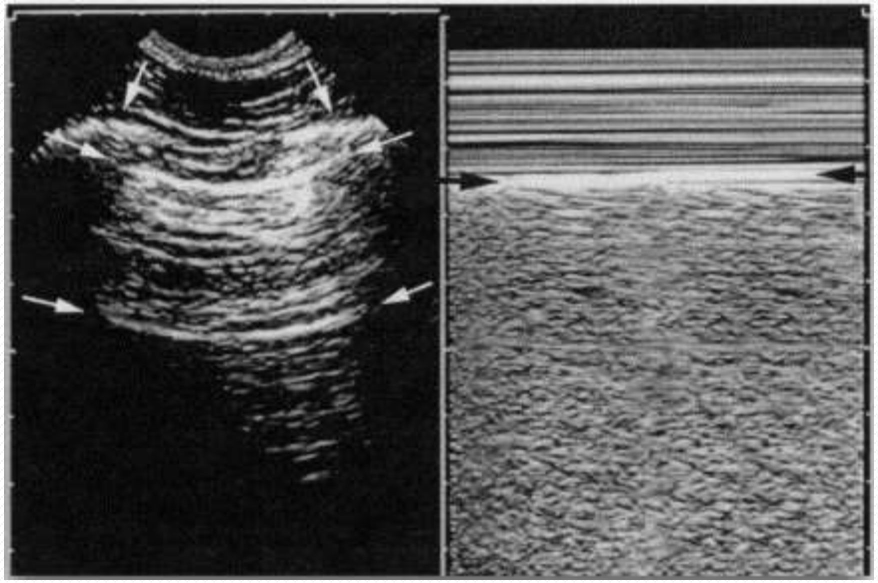
MODES OF USG

B Mode: Brightness

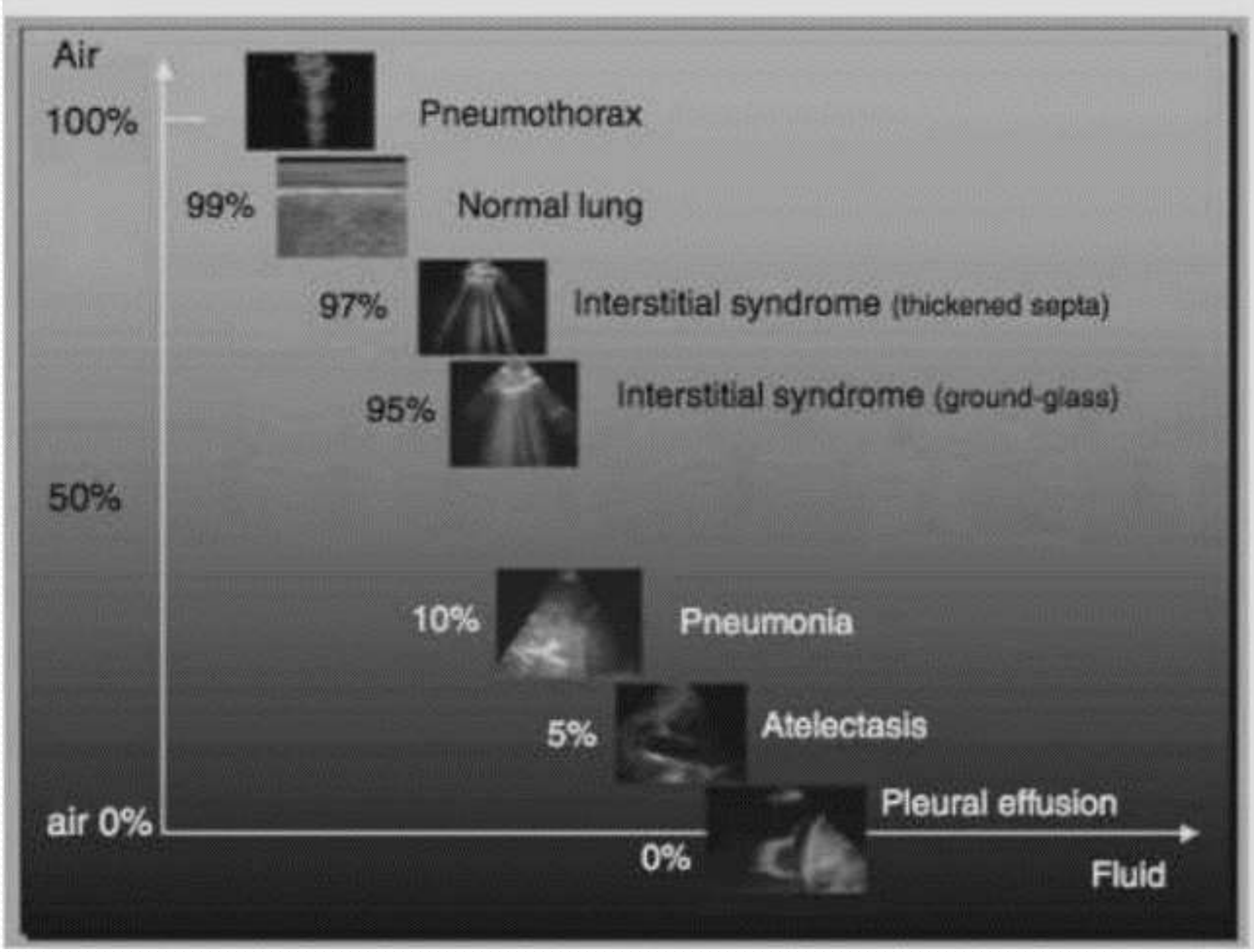
- 2D Image
- Intensity of brightness : strength of echo

M mode: Motion

- What the line see vs time
- Stationary stuff: Straight line
- Moving things: curved/ dot

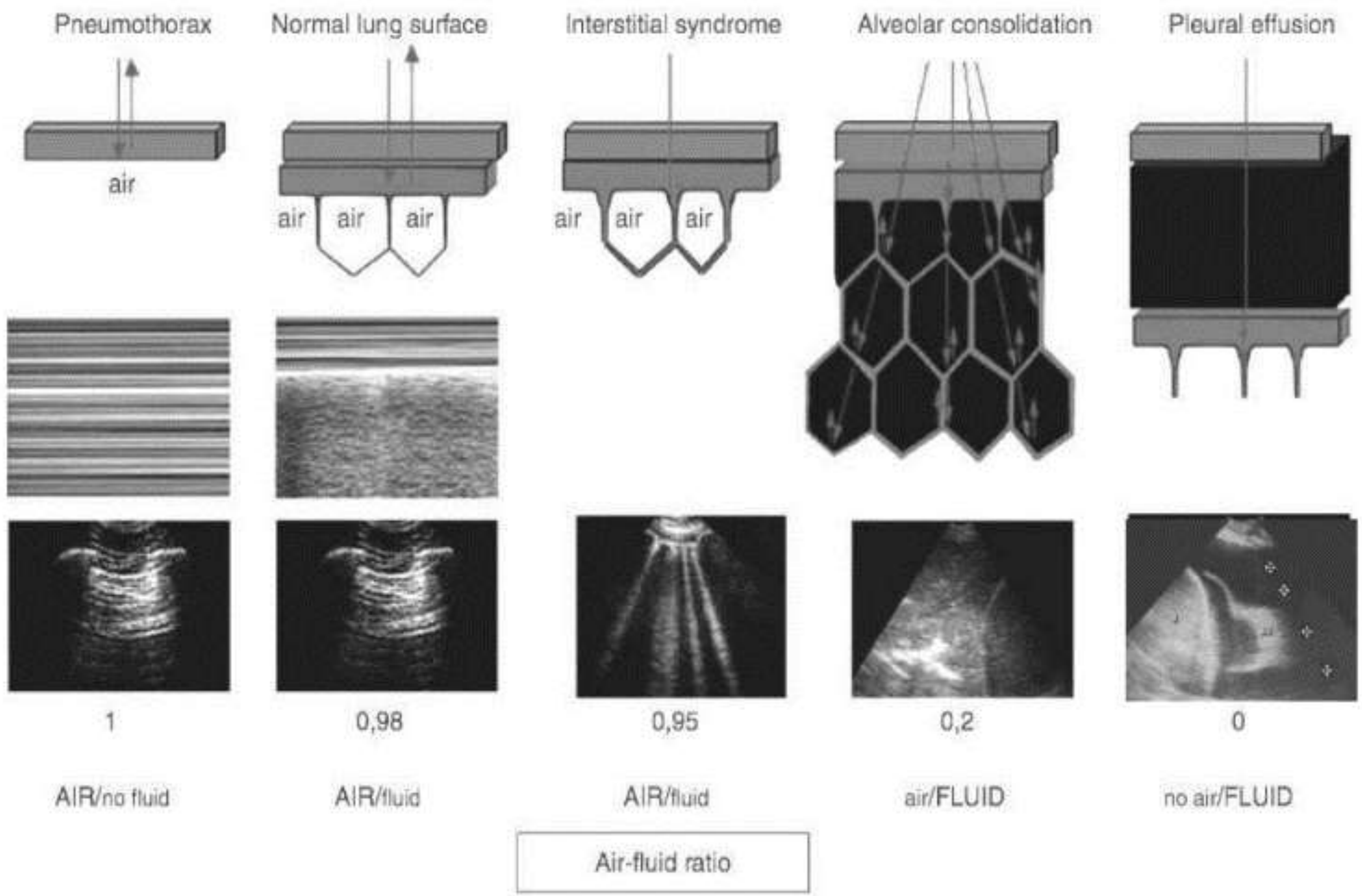


LUNG USG



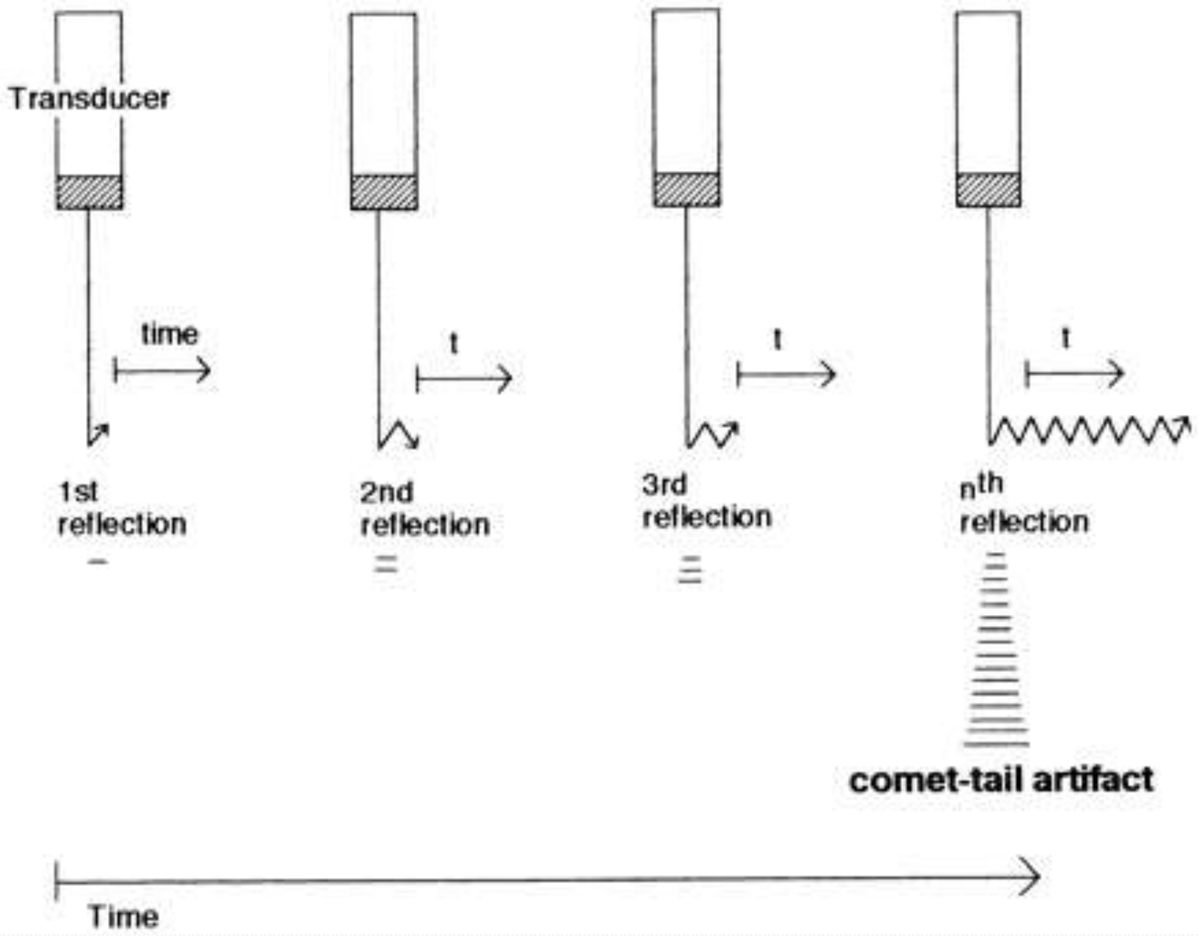
Air
100%
Pneumothorax
99%
Normal lung
97%
Interstitial syndrome (thickened septa)
95%
Interstitial syndrome (ground-glass)
50%
10%
Pneumonia
5%
Atelectasis
air 0%
Pleural effusion
0%
Fluid

LUNG USG



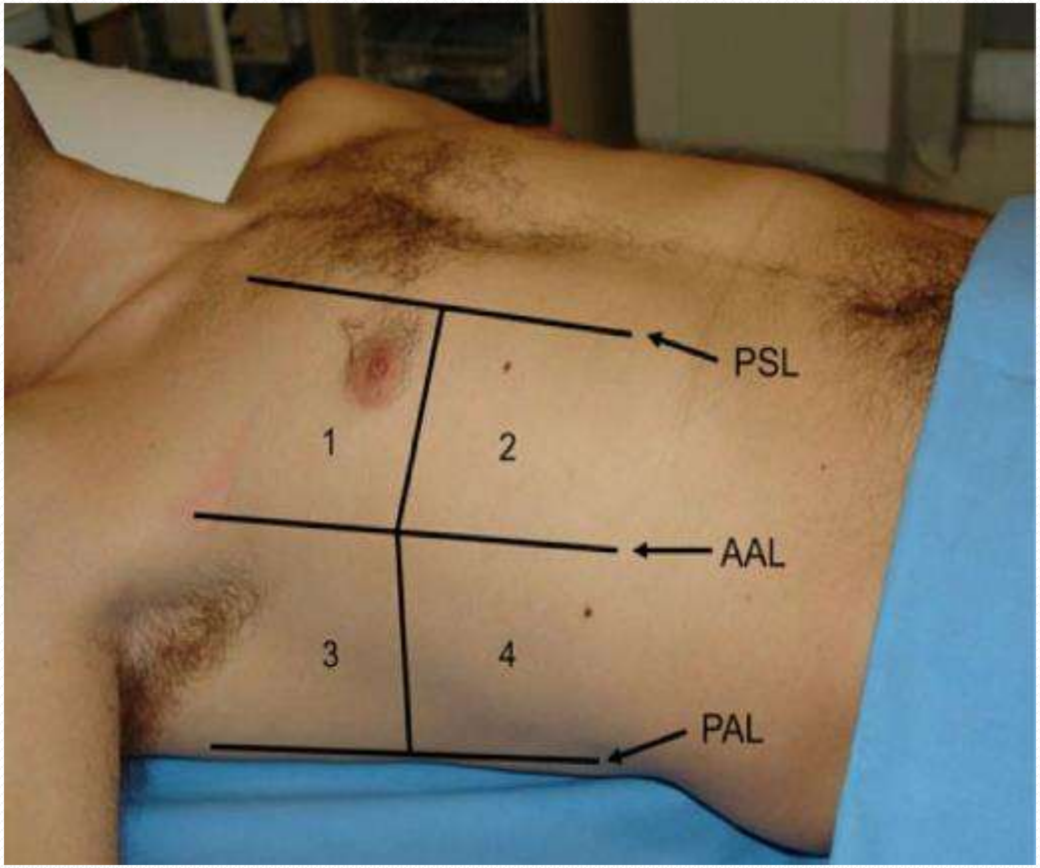
Pneumothorax
Normal lung surface
Interstitial syndrome
Alveolar consolidation
Pleural effusion
air
air
air
air
air
air
air
1
0,98
0,95
0,2
0
AIR/no fluid
AIR/fluid
AIR/fluid
air/FLUID
no air/FLUID
Air-fluid ratio

LUNG USG – ARTIFACTS



SCANNING PROCEDURE

- Position patient, arm abducted
- Adjust depth of usg window to 5-8cm
- Longitudinal placement of transducer between ribs
- Systematic scanning, apex to base of both sides



NORMAL PLEURAL USG

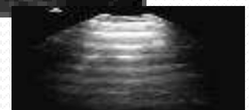
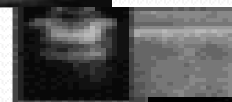
- Sonographer should visualise two rib shadows with hyperechoic pleural line moving back and forth

- Bat sign

- Lung sliding should be seen

LUNG USG: CRITICALLY ILL

The bat sign

The A-line

Lung sliding

The quad sign

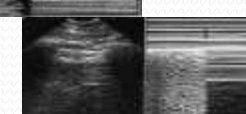
The sinusoid sign

The tissue-like sign

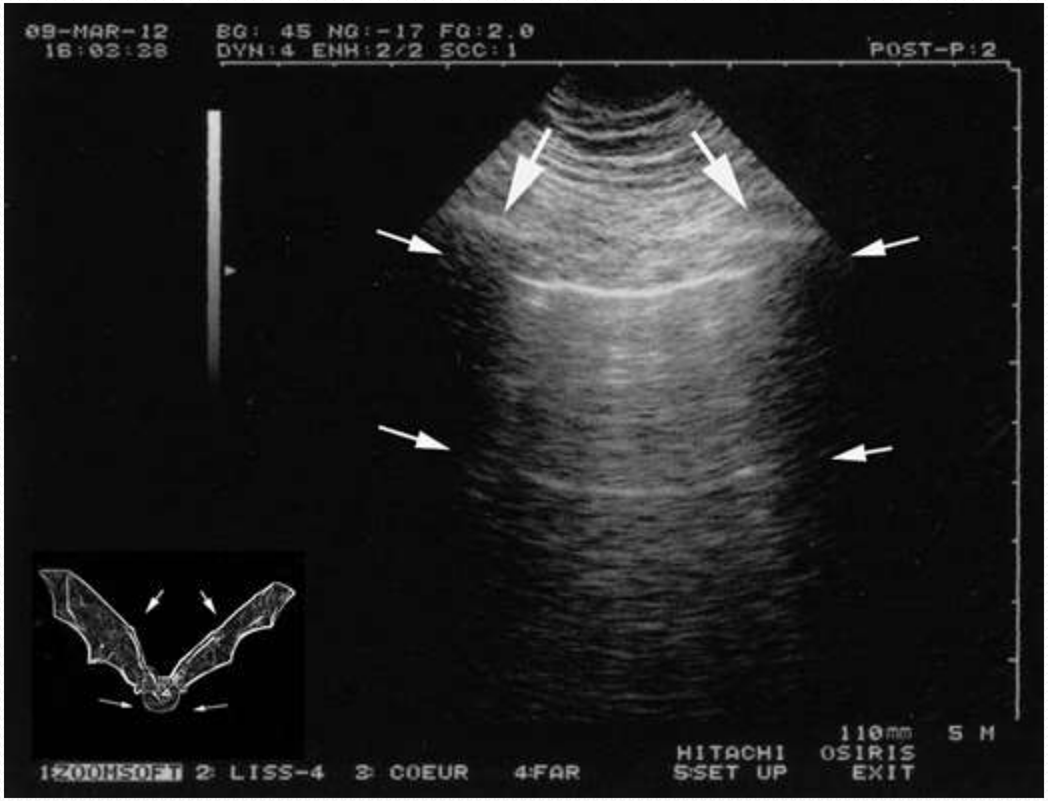
The shred sign
The B-line(& lung rockets)

The stratosphere sign

The lung point

The lung pulse
Dynamic air bronchogram


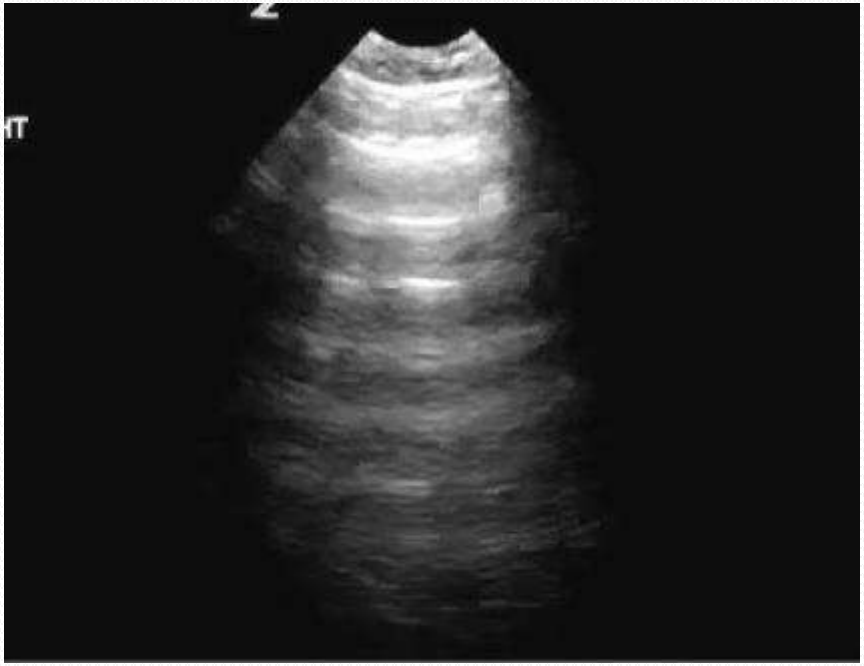
BAT SIGN



Two ribs with posterior shadowing represents the wings of the bat, and the hyperechoic pleural line, its body

Between these two ribs, the two layers of pleura are seen sliding across one another

A LINES



- Horizontal lines parallel to chest wall
- Brightly echogenic
- Located between rib shadows when probe positioned longitudinally

B LINES

- Arise at the border between aerated and compressed lung
- Multiple ray-like, or comet-tail, vertical lines
- Extend from the pleural line to the ***lower edge of the screen without fading***
- Move synchronously with the lung during respiration and tend to ***erase A lines***

B LINES

Figure 6 – B-lines on lung ultrasound. Although B-lines are seen in normal individuals, the number and intensity of B-lines are directly proportional to the degree of pulmonary, septal, or alveolar edema. Adapted from Lichtenstein et al.[23]

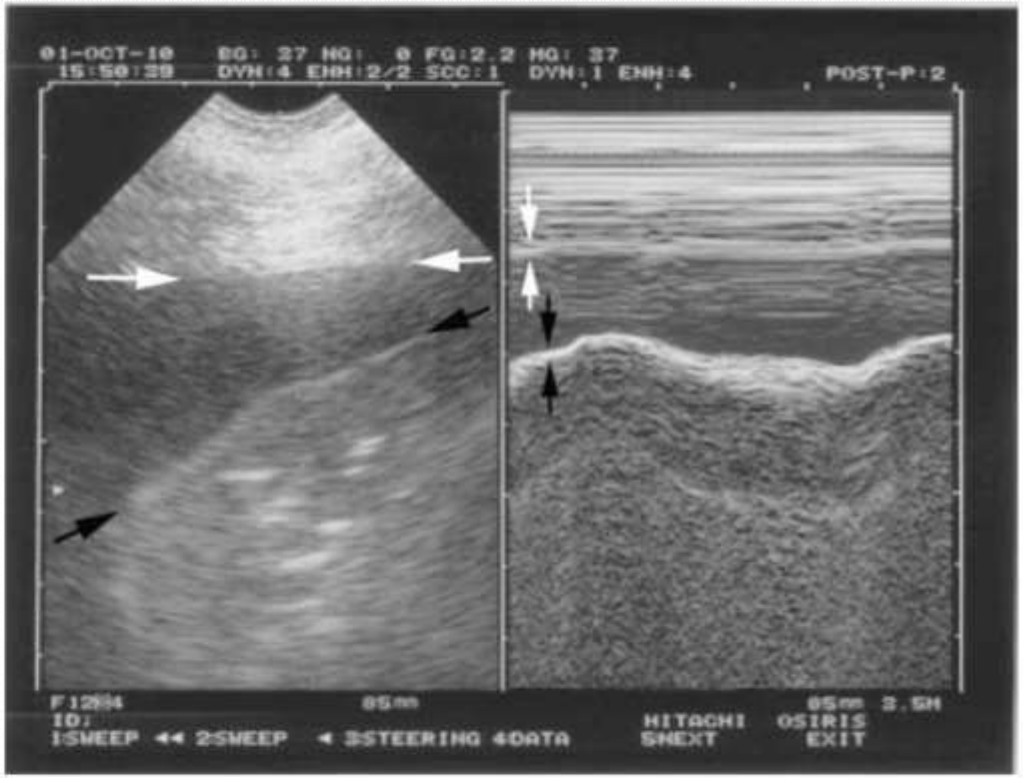
E LINES

- Suspected when subcutaneous emphysema can be palpated
- Vertical lines start at a level external to the ribs extending deep into chest
- Similar to B lines ,but ***arise from chest wall*** and not pleural line

LUNG PULSE (T LINES)

- Rhythmic movement of the pleura in synchrony with the cardiac rhythm
- Best viewed in areas of the lung adjacent to the heart, at the pleural line
- result of cardiac vibrations being transmitted to the lung pleura in poorly aerated lung

QUAD SIGN/SINUSOIDAL SIGN

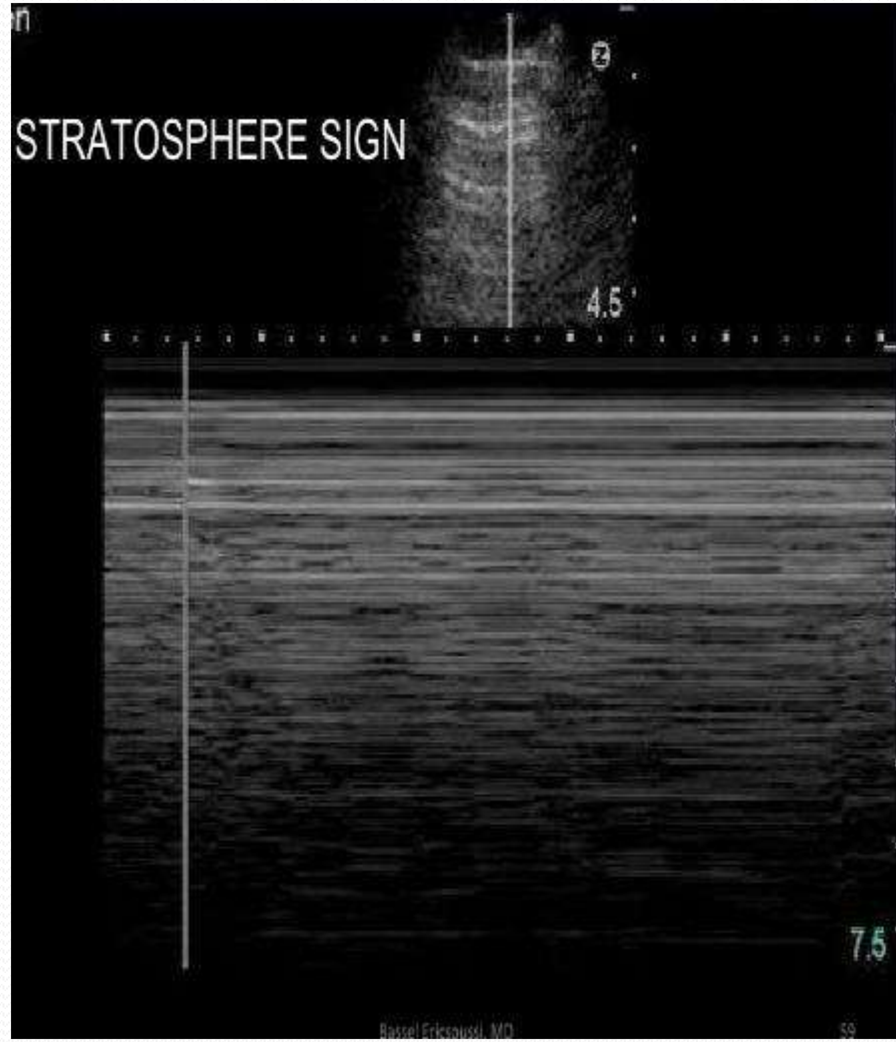


- Characteristic of pleural effusion
- "quad sign" - fluid is framed within four borders: pleural line, lung line, acoustic shadows of two ribs (or diaphragm)
- "sinusoid sign" - appears in the M-mode as a result of alteration of respiratory transverse interpleural space

SEA SHORE SIGN/ BAR CODE SIGN

- Dynamic sign
- Best seen at apex in supine position
- Present in normal lung
- The motionless portion of the chest above the pleural line creates horizontal 'waves,' and the sliding below the pleural line creates a granular pattern, the 'sand‘


THI
SEASHORE SIGN
7.5
Chest wall
7.5

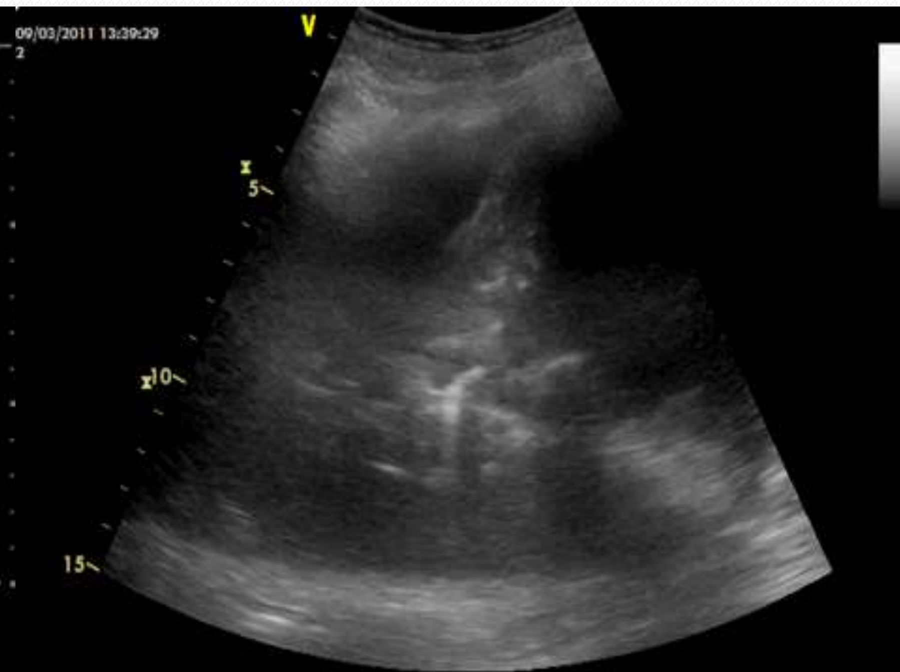

STRATOSPHERE SIGN
4.5
7.5

LUNG POINT

- Defines the border of pneumothorax
- Helps in defining size of pneumothorax
- Not seen in cases of total lung collapse

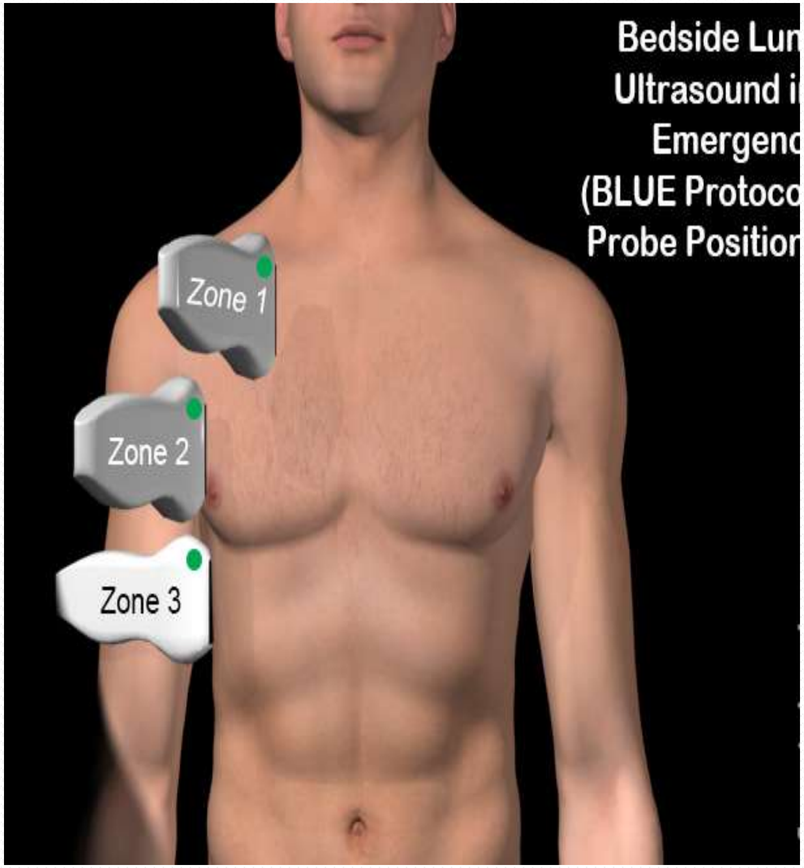
Tissue sign & shred sign

TISSUE LIKE SIGN



SHRED SIGN

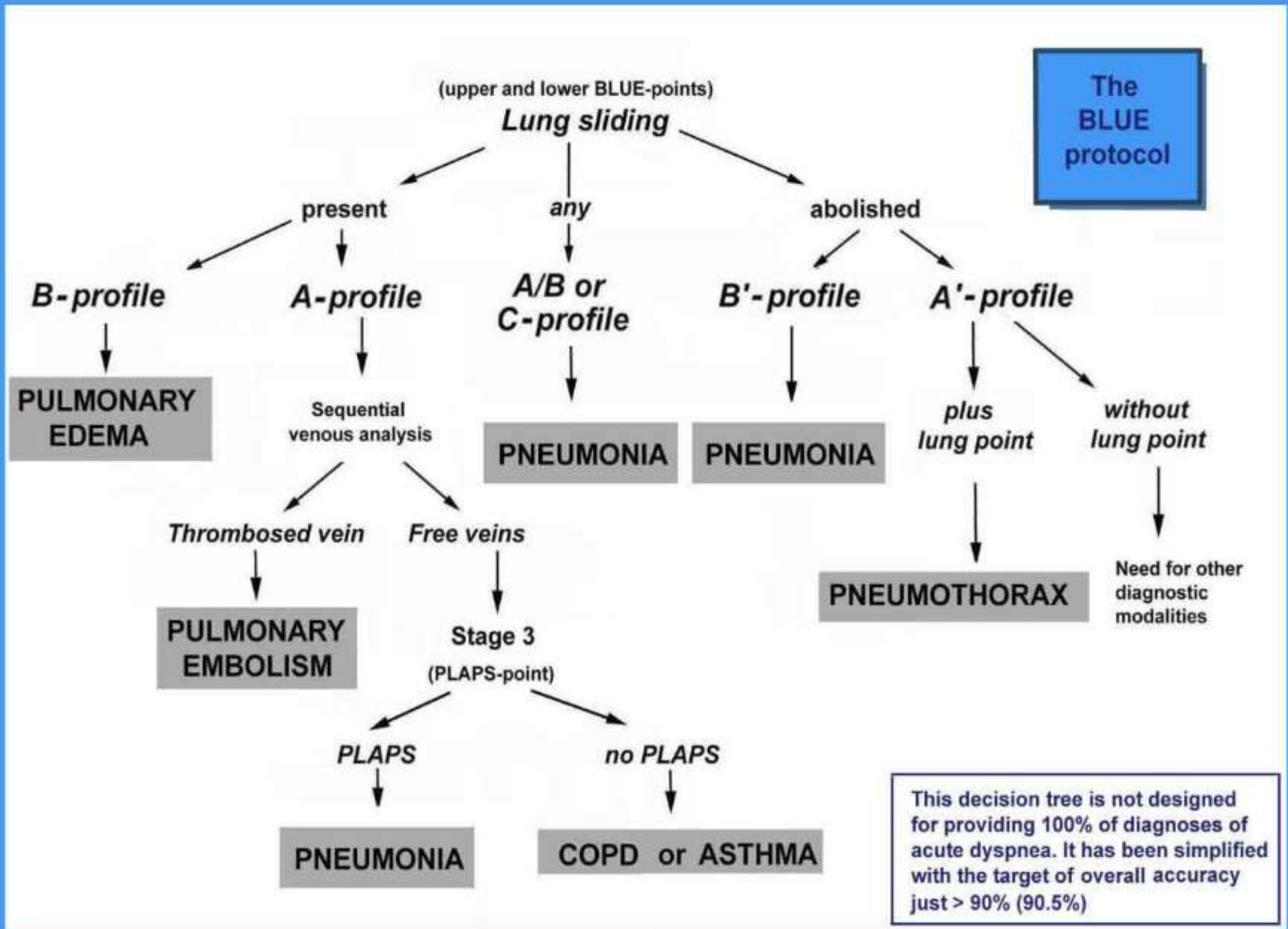
BLUE PROTOCOL



- Bedside lung ultrasound in emergency
- In <3minutes
- Step-by-step diagnosis of the main causes of acute respiratory failure
- six diseases seen in 97% of patients in the emergency room with overall 90.5% accuracy

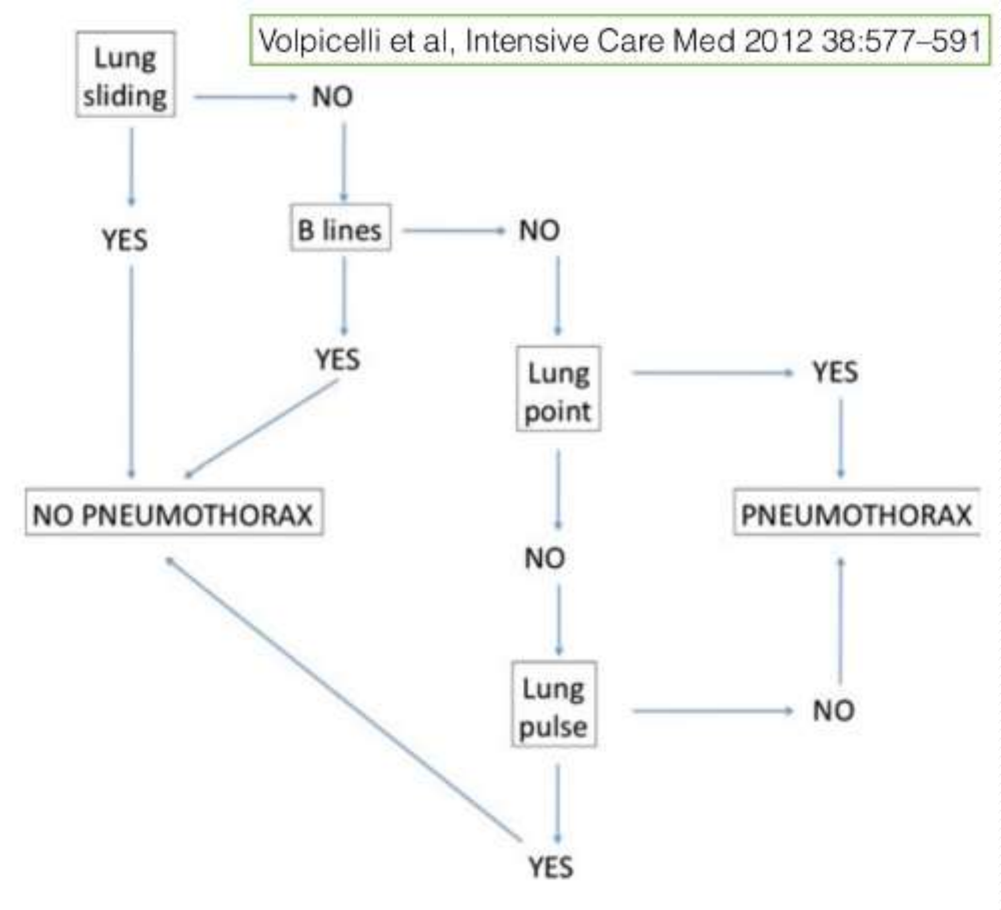
*Rantanen NW: **Diseases of the thorax.** Vet Clin North Am 1986, **2:** 49–66*

*Lichtenstein D: **BLUE-protocol.** In Whole Body Ultrasonography in the Critically Ill. Heidelberg, Berlin, New York: Springer-Verlag; 2010:189–202*



The BLUE protocol
(upper and lower BLUE-points)
Lung sliding
present
any
abolished
B-profile
A-profile
A/B or C-profile
B'-profile
A'-profile
PULMONARY EDEMA
Sequential venous analysis
PNEUMONIA
PNEUMONIA
plus lung point
without lung point
Thrombosed vein
Free veins
PULMONARY EMBOLISM
Stage 3 (PLAPS-point)
PNEUMOTHORAX
Need for other diagnostic modalities
PLAPS
no PLAPS
PNEUMONIA
COPD or ASTHMA
This decision tree is not designed for providing 100% of diagnoses of acute dyspnea. It has been simplified with the target of overall accuracy just > 90% (90.5%)

USG: Pnuemothorax



US FOR DIAGNOSIS OF PNEUMOTHORAX

Ultrasound Feature	Patient Population	Sensitivity	Specificity
No Lung Sliding	328 Surgical And Trauma	95.5%	100%
No Lung Sliding	111 Medical ICU	95.3%	91.1%
No B Lines "Comet Tails"	114 Med-surgical Unit	100%	60%
Combined	617	100%	96.5%
Lung Point	233 Med-surgical Unit	66%	100%

Chan SSW et al Acad Emg Med Jan 2003Vol 10 1

USG : PNEUMOTHORAX

	Sensitivity	Specificity
Cxray	52%	99%
USG	88%	100%

Zhang et al ;meta-analysis.CHEST 2011

- Disappearance of lung sliding in 100%
- The lung point is 100% specific for pneumothorax but only moderately sensitive

ALVEOLAR SYNDROME

Atelectasis

- intercostal space narrowing
- liver and spleen elevated
- Compressive atelectasis within transudative effusions demonstrates sinusoidal movements of the lung tip with respiration

Pneumonia

- lung volume is maintained
- hyperechoic (hepatization) than atelectasis
- Dynamic air bronchograms- 94% specific for pneumonia, although sensitivity is only 61%[1]

[1]D Lichtenstein: The Dynamic Air Bronchogram Chest 2009;135(6)

USG- CONSOLIDATION

- Probe at PLAPS point
- 90% sensitive and 98% specific
- No lung sliding with tissue or shred sign

2012 consensus evidence based recommendations: intensive care med (2012) 38:577 - 591

INTERSTITIAL SYNDROME

- Interstitial syndrome is caused by:

1. Pulmonary oedema - either haemodynamic (fluid overload, cardiac failure) or permeability induced (acute lung injury / ARDS)

2. Interstitial pneumonia or pneumonitis

3. Lung fibrosis

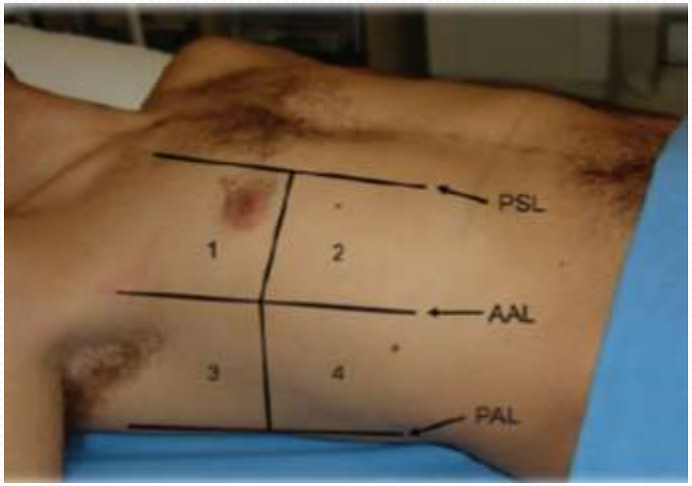
INTERSTITIAL SYNDROME

- Multiple B lines are the sonographic sign

- Ideally-8 region scan
  or
  rapid 2 region scan
  or
  28 rib interspaces

(Volpicelli et al, Intensive care medicine 2012 38 577-591)

8 REGION SCAN

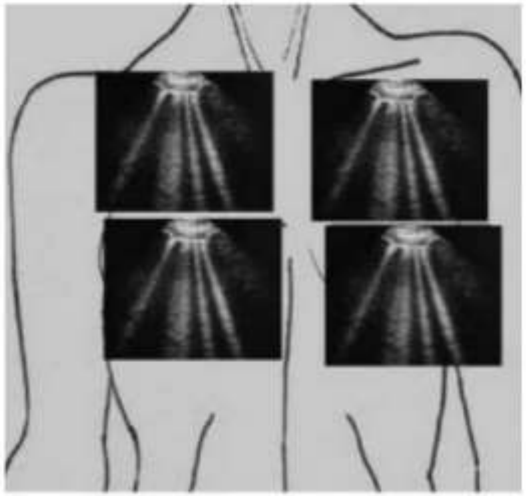


- Positive: ≥3 B lines

  ≥2 regions each side

Volpicelli et al, Intensive care medicine 2012 38 577-591

BLUE POINT

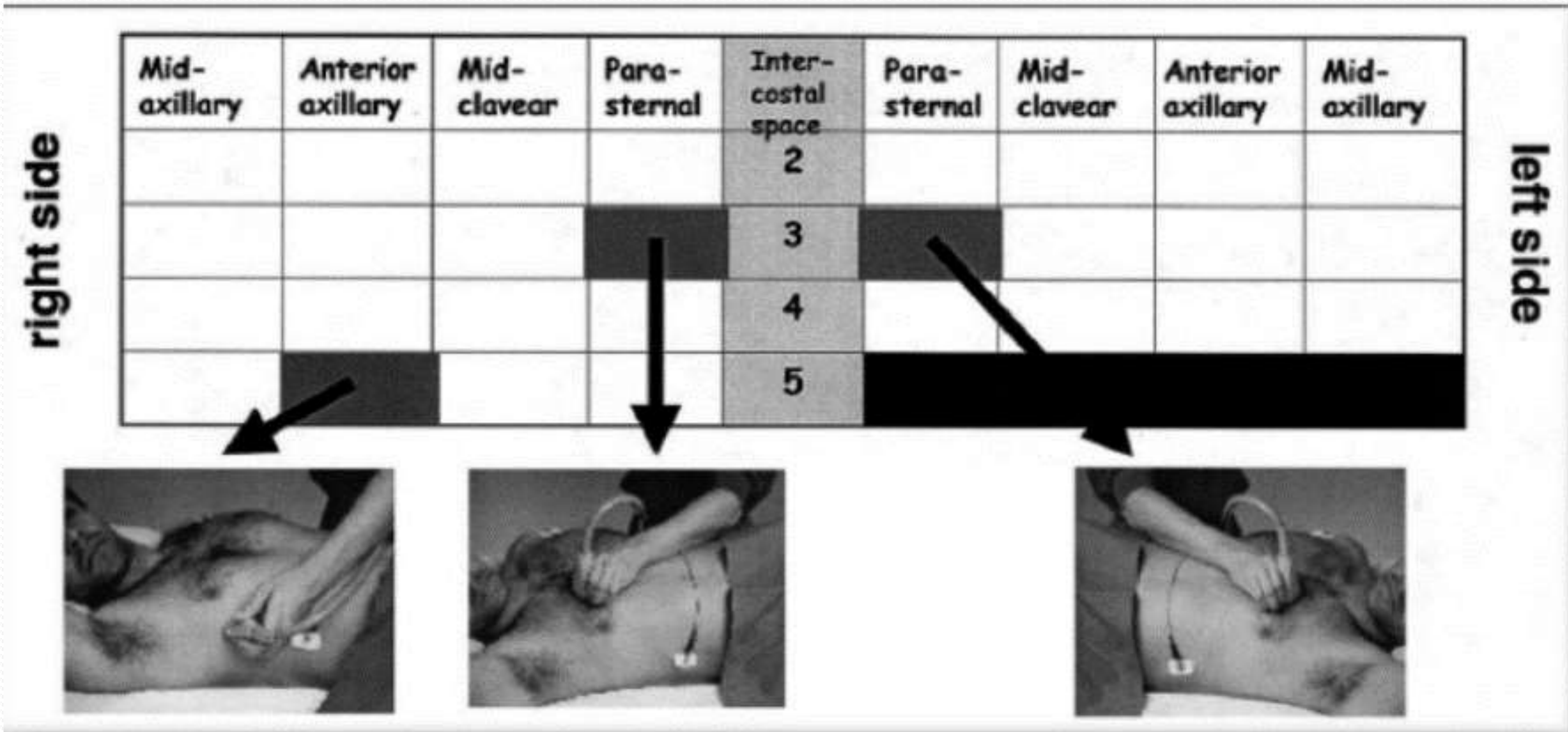


The B profile

Positive : ≥ 3 B-line each area

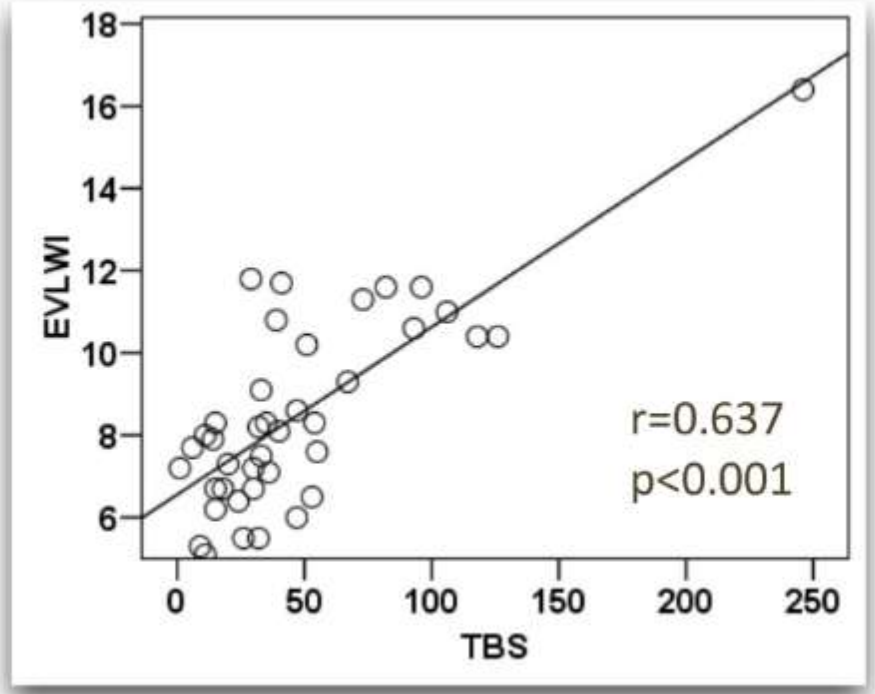
Lichtenstein, et al. Chest 2008 ;134:117-25.

TOTAL B LINE SCORE(TBS)



Jambrik et al Am J Cardiol 2004:93 1265-70

TBS was significantly correlated with extra vascular lung water index



Pirompanich P et alCritical Care 2015, 19(Suppl 1):P223

Diagnosis of pulmonary edema

	SENSITIVITY	SPECIFICITY
TBS ≥ 39	91.7	75
BLUE POINT (+ VE in all 4 regions)	33.3	100
8 REGIONS (+ ve in 2/4 regions each side)	50	96

Pirompanich P et al ,Critical care 2015

Hydrostatic edema vs ARDS

- Acutely ill patients with hypoxemia and a bilateral B-line pattern
- Ultrasound -detect pleural line abnormalities in ARDS

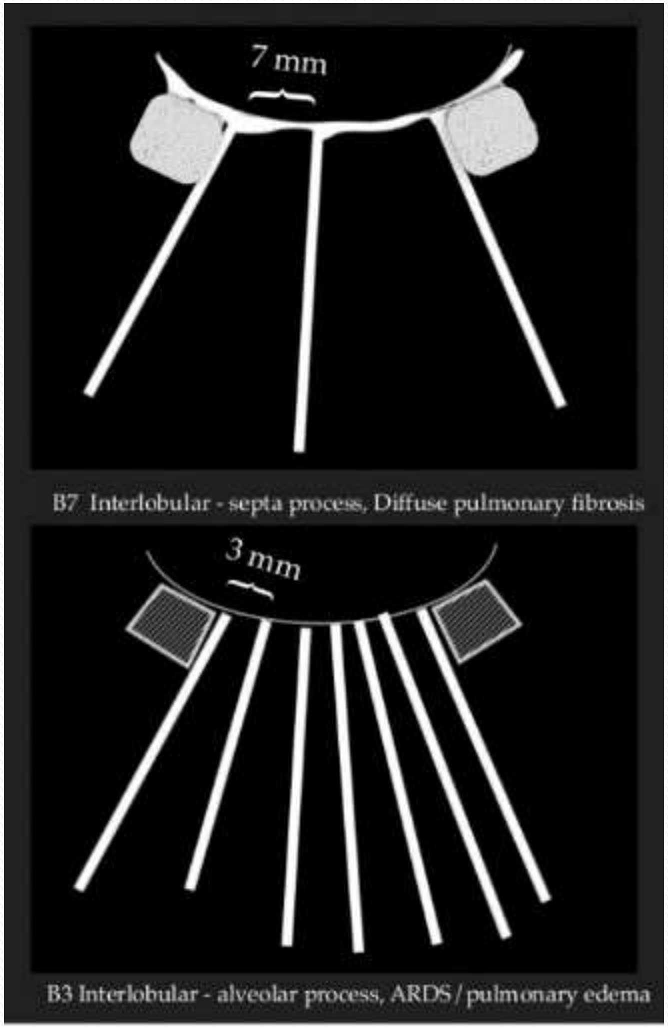
  -thickenings > 2 mm

  -evidence of small subpleural consolidations

  -coarse appearance of the pleural line, (rare in cardiogenic edema)

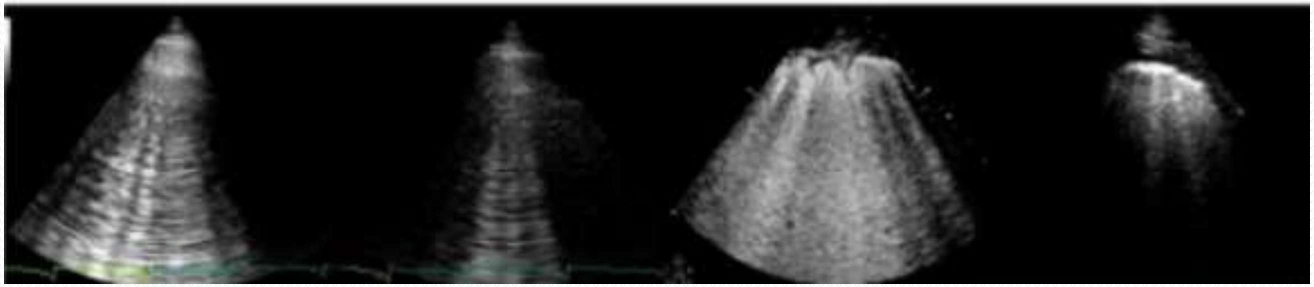
- Areas of sparing are found in 100% of patients with ARDS but are not present in cardiogenic edema

Interstitial syndrome : B3 Vs B7

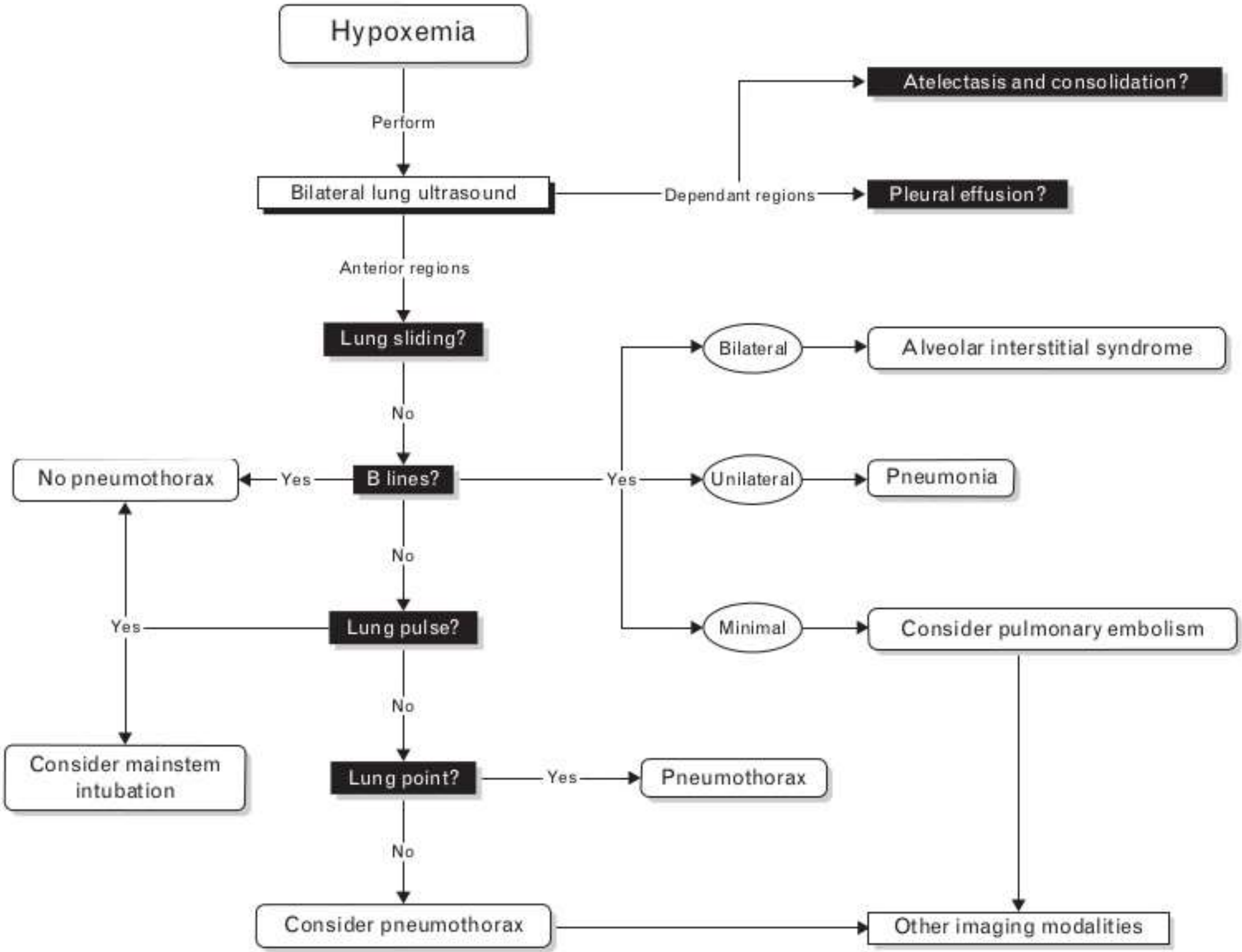


B7 Interlobular - septa process, Diffuse pulmonary fibrosis

B3 Interlobular - alveolar process, ARDS / pulmonary edema

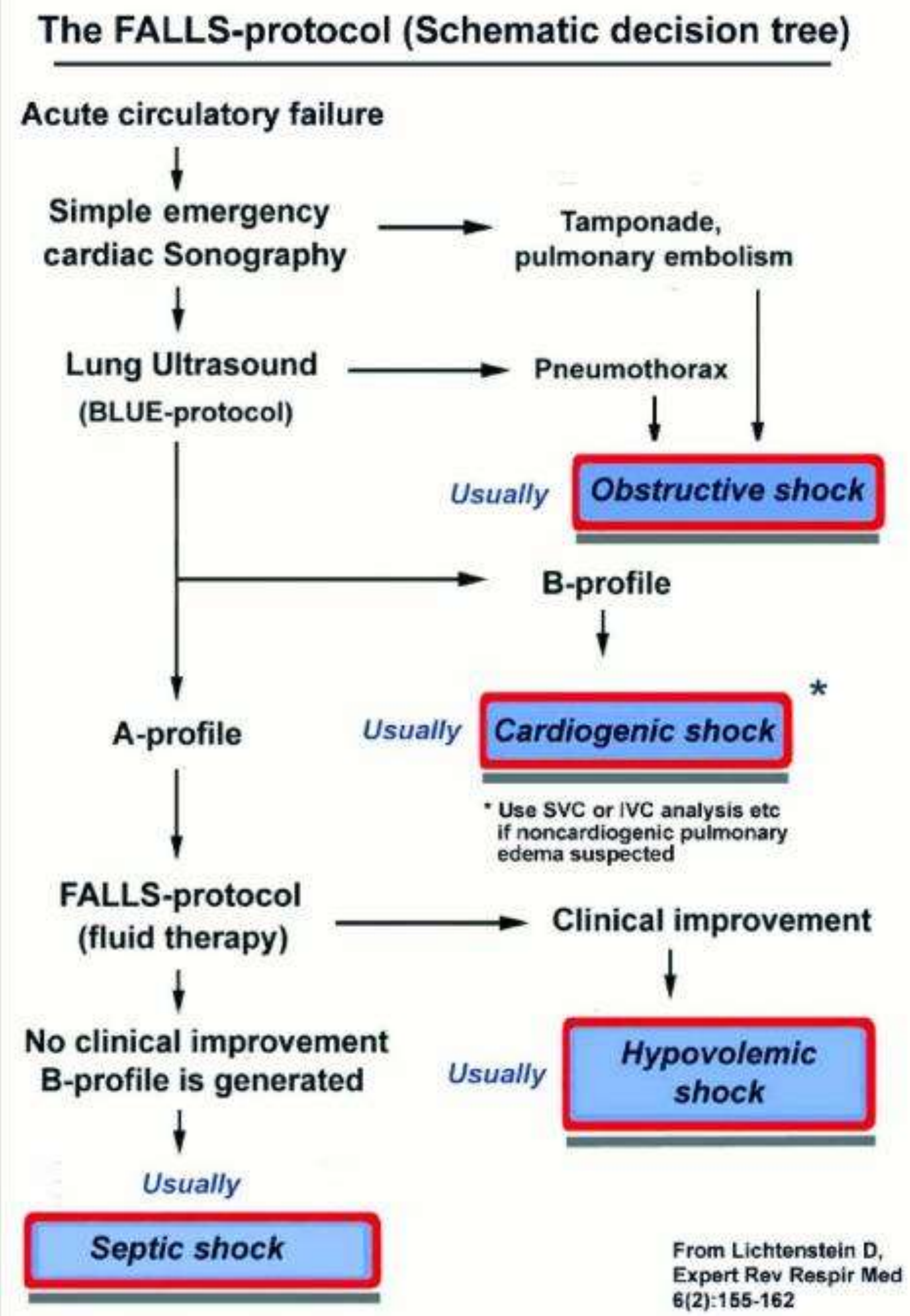


	Ac cardiogenic pulm edema	Chronic heart failure	ARDS	Pulm fibrosis
Clinincal setting	Acute	Chronic	Acute	Chronic
No of B lines	++++	+/++/+++	++++	+/++/+++
B lines distribution	Multiple, diffuse, B/L	Multiple, diffuse, B/L	Non homogenous distribution, spared areas	More frequently base of lungs
Other LUS signs	Pl effusion	Pl effusion	Pl effusion, consolidations	Pl thickening
ECHO	Abnormal	Abnormal	Likely normal	Likely normal


Hypoxemia
Perform
Bilateral lung ultrasound
Dependant regions
Atelectasis and consolidation?
Pleural effusion?
Anterior regions
Lung sliding?
No
B lines?
Yes
No pneumothorax
Yes
Bilateral
Alveolar interstitial syndrome
Unilateral
Pneumonia
Minimal
Consider pulmonary embolism
No
Lung pulse?
Yes
Consider mainstem intubation
No
Lung point?
Yes
Pneumothorax
No
Consider pneumothorax
Other imaging modalities

FALLS PROTOCOL

- Fluid administration limited by lung sonography
- It is the adaptation of BLUE protocol in patients with acute circulatory failure
- Simple real time echo with lung ultrasound
- Endpoint of fluid therapy- appearence of b lines


The FALLS-protocol (Schematic decision tree)
Acute circulatory failure
Simple emergency cardiac Sonography
Tamponade, pulmonary embolism
Lung Ultrasound (BLUE-protocol)
Pneumothorax
Usually
Obstructive shock
B-profile
A-profile
Usually
Cardiogenic shock
*
* Use SVC or IVC analysis etc if noncardiogenic pulmonary edema suspected
FALLS-protocol (fluid therapy)
Clinical improvement
No clinical improvement B-profile is generated
Usually
Hypovolemic shock
Usually
Septic shock
From Lichtenstein D, Expert Rev Respir Med 6(2):155-162

USG – Pleural Effusion

- Confirm the diagnosis, allows distinction btn effusion and consolidation
- Usg(97%) is more accurate than cxray(47%)
- Distinction btn transudative and exudative effusion

THORACOCENTESIS

- Identify best site to perform puncture
- Know the depth of adjacent organs
- Reduces complications

Safety of Ultrasound-Guided Thoracentesis in Patients Receiving Mechanical Ventilation*

Paul H. Mayo, MD, FCCP; Hayden R. Goltz, DO; Mehran Tafreshi, MD, FCCP; Peter Doelken, MD, FCCP

USG - Thoracocentesis

- 211 patients MV patients requiring thoracocentesis
- 232 usg guided taps were done(by critical care physicians without radiologist support)
- Pnuemothorax occured in 3 of 232 (1.3%)

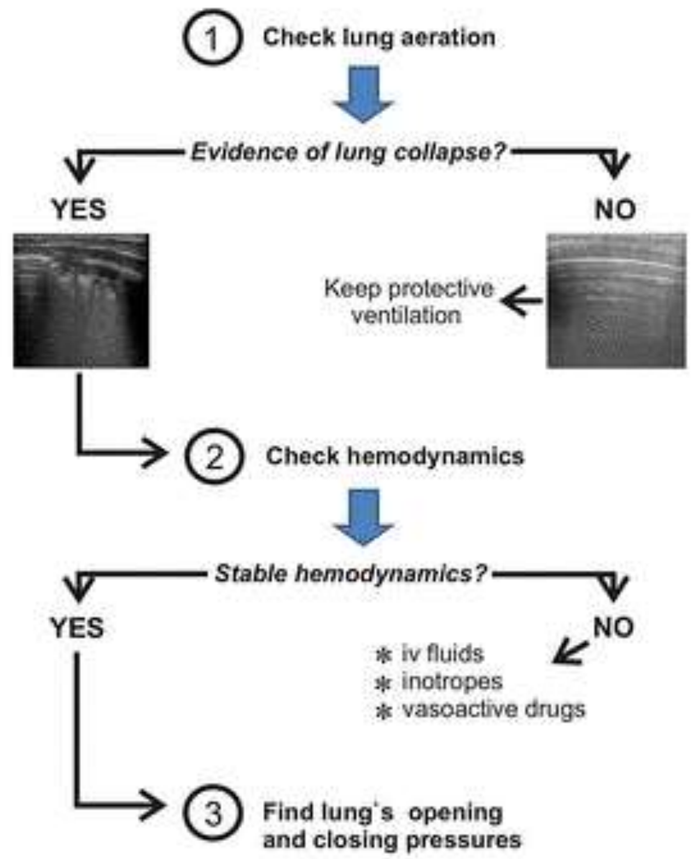
VENTILATOR WEANING

- DT assessed by ultrasound is an excellent predictor of weaning outcome in mechanically ventilated COPD patients
- DT was significantly different between patients who failed and patients who succeeded SBT
- Success of SBT

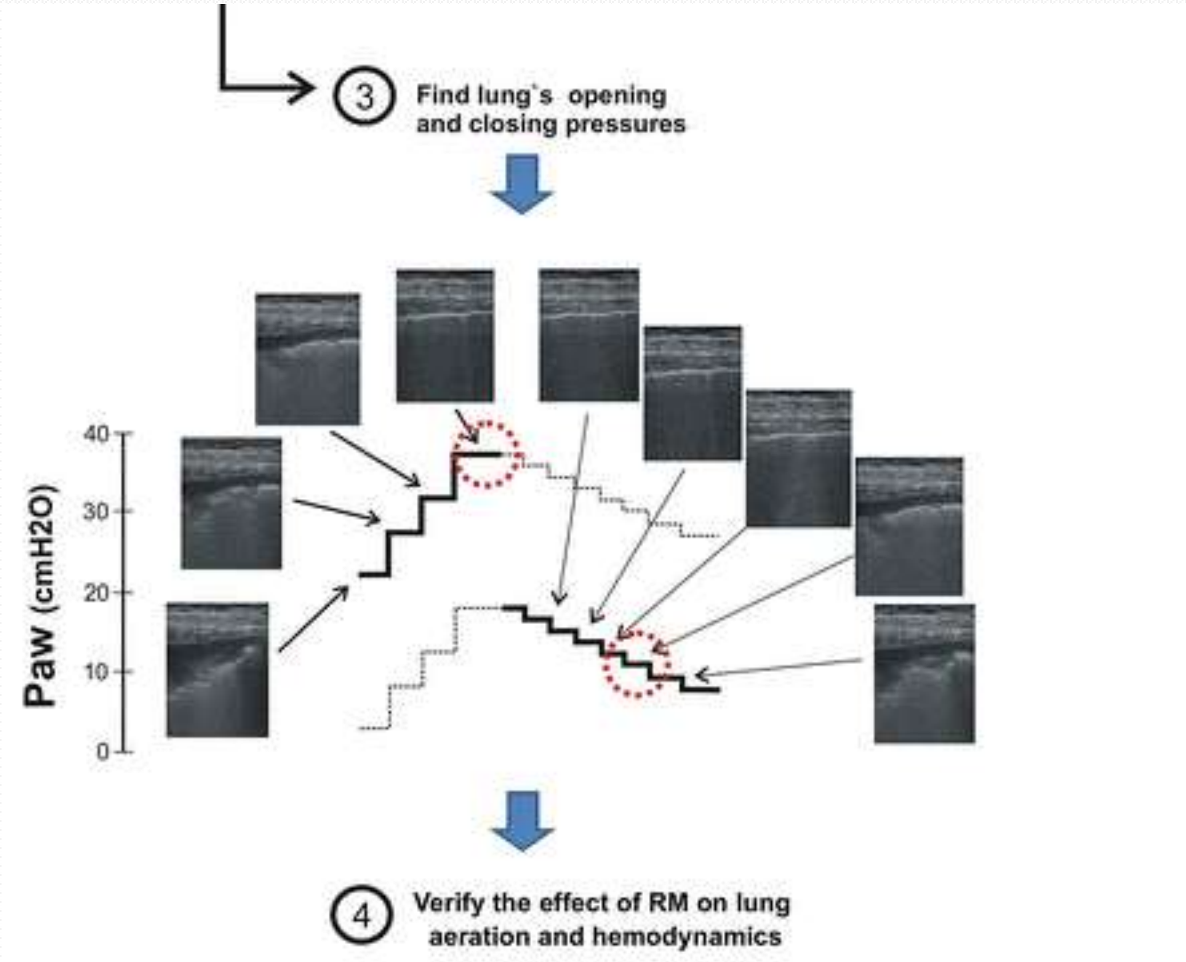
	Sensitivity	Specificity	PPV	NPV
DT > 40%	88	92	95	82
RSBI <105	95	90	96	92

Gamal Agmy, Samiaa Hamdy, Sherin Farghally European Respiratory Journal 2015 46: OA3264

Lung recruitment



Lung recruitment



USG & Recruitment

- Highly significant correlation was found between PEEP-induced lung recruitment measured by PV curves and ultrasound reaeration score (Rho = 0.88; $P < 0.0001$)
- ultrasound reaeration score of
  - ≥ 8 : PEEP-induced lung recruitment greater than 600 ml
  - ≤ 4 : PEEP-induced lung recruitment ranging from 75 to 450 ml
- A statistically significant correlation was found between LUS reaeration score and PEEP-induced increase in $Pa(O_2)$ (Rho = 0.63; $P < 0.05$)

USG : Pneumonia

- Four signs :
  - interstitial syndrome
  - abnormal pleural line
  - alveolar consolidation
  - pleural effusion

- Combining four USG signs : sensitivity 94.6% for diagnosing CAP

Liu XL, Lian R, Tao YK, et al. Lung ultrasonography: an effective way to diagnose community-acquired pneumonia. Emerg Med J 2015;32:433-8

USG : Pneumonia

Original Article

Effectiveness of lung ultrasonography for diagnosis of pneumonia in adults: a systematic review and meta-analysis

Yang Xia, Yinghua Ying, Shaobin Wang, Wen Li, Huahao Shen

J Thorac Dis 2016;8(10):2822-2831

USG : Pneumonia

- 14 articles
- LUS :
  - pooled sensitivity of 0.904 (0.884–0.921)
  - pooled specificity of 0.884 (0.861–0.904)
  - pooled + ve LR of 6.6 (3.7–11.7)
  - pooled - ve LR of 0.08 (0.04–0.19)
  - AUC: 0.9611

- AUC for LUS and CXR was 0.972 and 0.867 respectively and the Z statistic of the two sROC curves was 2.31

USG - VAP

- Early diagnosis
- Response to antibiotics

USG : VAP

Chest. 2016 Apr;149(4):969-80. doi: 10.1016/j.chest.2015.12.012. Epub 2015 Dec 22.

Lung Ultrasound for Early Diagnosis of Ventilator-Associated Pneumonia.

Mongodi S[1], Via G[2], Girard M[3], Rouquette I[4], Misset B[5], Braschi A[6], Mojoli F[6], Bouhemad B[7].

⊕ Author information

Abstract

BACKGROUND: Lung ultrasound (LUS) has been successfully applied for monitoring aeration in ventilator-associated pneumonia (VAP) and to diagnose and monitor community-acquired pneumonia. However, no scientific evidence is yet available on whether LUS reliably improves the diagnosis of VAP.

METHODS: In a multicenter prospective study of 99 patients with suspected VAP, we investigated the diagnostic performance of LUS findings of infection, subpleural consolidation, lobar consolidation, and dynamic arborescent/linear air bronchogram. We also evaluated the combination of LUS with direct microbiologic examination of endotracheal aspirates (EA). Scores for LUS findings and EA were analyzed in two ways. First, the clinical-LUS score (ventilator-associated pneumonia lung ultrasound score [VPLUS]) was calculated as follows: ≥ 2 areas with subpleural consolidations, 1 point; ≥ 1 area with dynamic arborescent/linear air bronchogram, 2 points; and purulent EA, 1 point. Second, the VPLUS-direct gram stain examination (EAgram) was scored as follows: ≥ 2 areas with subpleural consolidations, 1 point; ≥ 1 area with dynamic arborescent/linear air bronchogram, 2 points; purulent EA, 1 point; and positive direct gram stain EA examination, 2 points.

RESULTS: For the diagnosis of VAP, subpleural consolidation and dynamic arborescent/linear air bronchogram had a positive predictive value of 86% with a positive likelihood ratio of 2.8. Two dynamic linear/arborescent air bronchograms produced a positive predictive value of 94% with a positive likelihood ratio of 7.1. The area under the curve for VPLUS-EAgram and VPLUS were 0.832 and 0.743, respectively. VPLUS-EAgram ≥ 3 had 77% (58-90) specificity and 78% (65-88) sensitivity; VPLUS ≥ 2 had 69% (50-84) specificity and 71% (58-81) sensitivity.

CONCLUSIONS: By detecting ultrasound features of infection, LUS was a reliable tool for early VAP diagnosis at the bedside.

USG : VAP

	PPV	+ ve liikelihood ratio
Subpleural consolidation + air bronchogram	86 %	2.8
2 dynamic linear/arborescent air bronchograms	94 %	7.1

USG : VAP

	Sensitivity	Specificity
VPLUS- EA	77	78
VPLUS	69	71

USG: VAP

Crit Care Med. 2010 Jan;38(1):84-92. doi: 10.1097/CCM.0b013e3181b08cdb.

Ultrasound assessment of antibiotic-induced pulmonary reaeration in ventilator-associated pneumonia.

Bouhemad B[1], Liu ZH, Arbelot C, Zhang M, Ferarri F, Le-Guen M, Girard M, Lu Q, Rouby JJ.

Author information

Abstract

OBJECTIVES: To compare lung reaeration measured by bedside chest radiography, lung computed tomography, and lung ultrasound in patients with ventilator-associated pneumonia treated by antibiotics.

DESIGN: Computed tomography, chest radiography, and lung ultrasound were performed before (day 0) and 7 days following initiation of antibiotics.

SETTING: A 26-bed multidisciplinary intensive care unit in La Pitié-Salpêtrière hospital (University Paris-6).

PATIENTS: : Thirty critically ill patients studied over the first 10 days of developing ventilator-associated pneumonia.

INTERVENTIONS: : Antibiotic administration.

MEASUREMENTS AND MAIN RESULTS: Computed tomography reaeration was measured as the additional volume of gas present within both lungs following 7 days of antimicrobial therapy. Lung ultrasound of the entire chest wall was performed and four entities were defined: consolidation; multiple irregularly spaced B-lines; multiple abutting ultrasound lung "comets" issued from the pleural line or a small subpleural consolidation; normal aeration. For each of the 12 regions examined, ultrasound changes were measured between day 0 and 7 and a reaeration score was calculated. An ultrasound score >5 was associated with a computed tomography reaeration >400 mL and a successful antimicrobial therapy. An ultrasound score <-10 was associated with a loss of computed tomography aeration >400 mL and a failure of antibiotics. A highly significant correlation was found between computed tomography and ultrasound lung reaeration (Rho = 0.85, $p < .0001$). Chest radiography was inaccurate in predicting lung reaeration.

CONCLUSIONS: Lung reaeration can be accurately estimated with bedside lung ultrasound in patients with ventilator-associated pneumonia treated by antibiotics. Lung ultrasound can also detect the failure of antibiotics to reaerate the lung.

USG : VAP

- Ultrasound score >5 was associated with a CT reaeration >400 mL and a successful antimicrobial therapy
- Ultrasound score <-10 was associated with a loss of CT aeration >400 mL and a failure of antibiotics
- A highly significant correlation was found between computed tomography and ultrasound lung reaeration (Rho = 0.85, $p < .0001$)

USG : Prone ventilation

Crit Care. 2016 Nov 30;20(1):385.

Lung ultrasound can be used to predict the potential of prone positioning and assess prognosis in patients with acute respiratory distress syndrome.

Wang XT[1], Ding X[1], Zhang HM[1], Chen H[1], Su LX[1], Liu DW[2]; Chinese Critical Ultrasound Study Group (CCUSG).

⊕ Author information

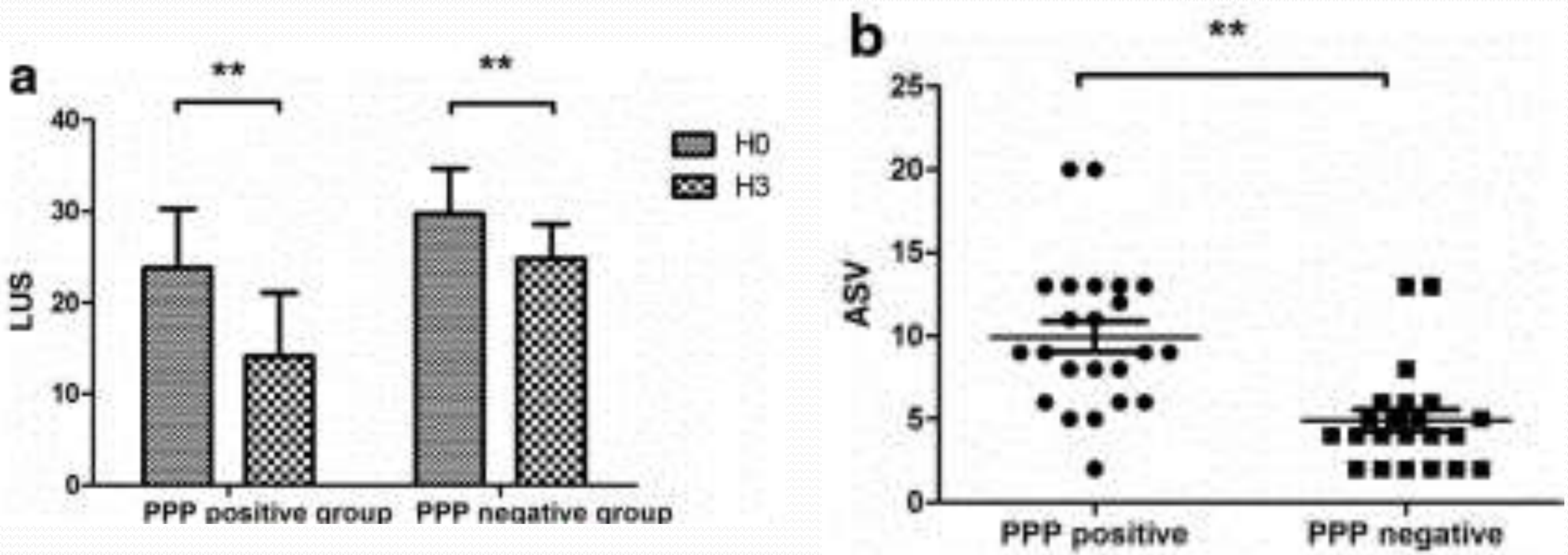
Abstract

BACKGROUND: It is very important to assess the effectiveness of prone positioning (PP) in patients with severe acute respiratory distress syndrome (ARDS). However, it is difficult to identify patients who may benefit from PP. The purpose of this study was to investigate whether prone positioning potential (PPP) can be predicted by lung ultrasound in patients with ARDS.

METHODS: In this prospective study, 45 patients with ARDS were included for the assessment of PPP. A PP lung ultrasound examination (PLUE) protocol was performed in the dorsal regions of the lung in 16 areas at H0, H3, and H6 (0, 3, and 6 h after PP). The ultrasonography videos were blindly evaluated by two expert clinicians to classify the lung regions as normal pattern (N), moderate loss of lung aeration (B1), severe loss of lung aeration (B2), and consolidation (C). The aeration scores were collected at H0, H3, and H6. According to the ratio of partial pressure of arterial oxygen to fraction of inspired oxygen (P/F ratio) at 7 days, patients were classified into PPP-positive (P/F ratio >300) and PPP-negative groups; also, the patients were classified into survival and nonsurvival groups according to 28-day mortality.

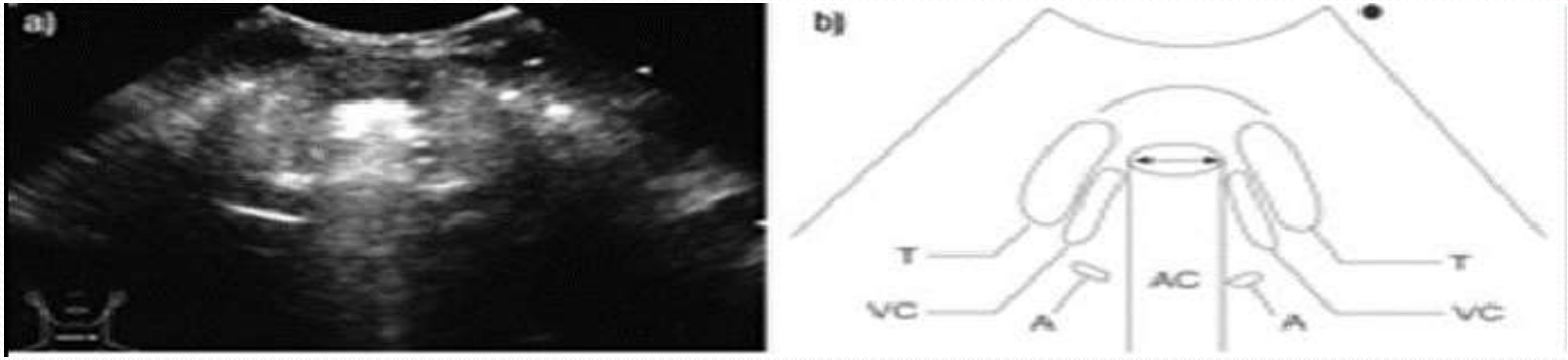
RESULTS: Aeration scores was compared at H0, H3, and H6. The scores were significantly reduced between H3 and H0, but there was no difference between H3 and H6. The aeration score variation (ASV) of the PPP-positive group between H3 and H0 was significantly higher than that in the PPP-negative group, and the sensitivity and specificity of ASV ≥5.5 for the PPP-positive group were 73.9% and 86.4%, respectively. The area under the receiver operating characteristic curve (AUROC) was 0.852 for the ASV. The ASV between H3 and H0 in the survival group was significantly higher than in the nonsurvival group. The sensitivity and specificity of ASV

USG : Prone ventilation



sensitivity and specificity of ASV ≥5.5 for the PPP-positive group were 73.9% and 86.4%, respectively

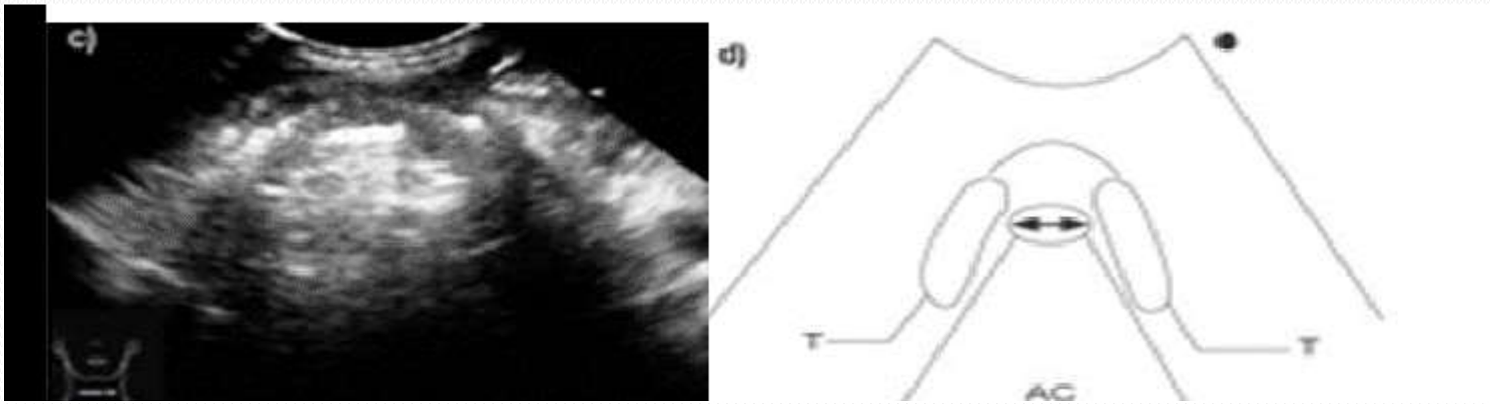
USG : Post extubation stridor



- Air column during balloon cuff inflation(hyperechoic)
- True cords are over both sides of air column(hypoechoic)
- Cartilages are behind the true vocal cords and beside the air column(hyperechoic)

Ding LW,Sand HC, Wu HD et al laryngeal usg a useful method in predicting post extubation stridor

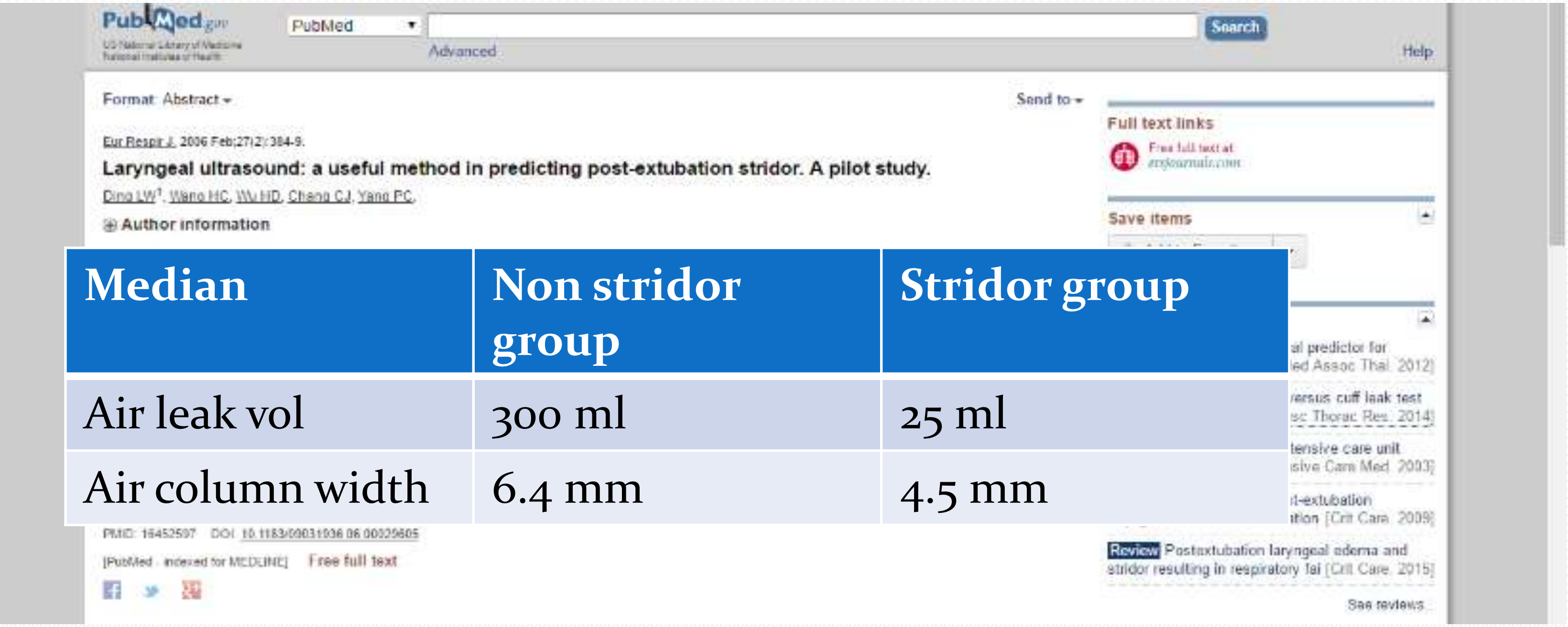
USG : Post extubation stridor



Air column during balloon cuff deflation(air column width increased)

Ding LW,Sand HC, Wu HD et al laryngeal usg a useful method in predicting post extubation stridor

USG : Post extubation stridor



Median	Non stridor group	Stridor group
Air leak vol	300 ml	25 ml
Air column width	6.4 mm	4.5 mm

Laryngeal USG- post extubation stridor

Cuff leak test : 75 & 59 %
usg :50 & 54 %
PPV of both < 20%

J Cardiovasc Thorac Res. 2014;6(1):25-8. doi: 10.5681/jcvtr.2014.005. Epub 2014 Mar 21.

Laryngeal ultrasonography versus cuff leak test in predicting postextubation stridor.

Mikaeili H[1], Yazdchi M[2], Tarzamni MK[3], Ansarin K[1], Ghasemzadeh M[1].

Author information

Abstract

INTRODUCTION: Although cuff leak test has been proposed as a simple method of predicting the occurrence of postextubation stridor, cut-off point of cuff-leak volume substantially differs between previous studies. In addition, laryngeal ultrasonography including measurement of air column width could predict postextubation stridor. The aim of the present study was to evaluate the value of laryngeal ultrasonography versus cuff leak test in predicting postextubation stridor.

METHODS: In a prospective study, all patients intubated for a minimum of 24 h for acute respiratory failure, airway protection and other causes were included. Patients were evaluated for postextubation stridor and need for reintubation after extubation. The cuff leak volume was defined as a difference between expiratory tidal volumes with the cuff inflated and deflated. Laryngeal air column width was defined as the width of air passed through the vocal cords as determined by laryngeal ultrasonography. The air-column width difference was the width difference between balloon-cuff inflation and deflation.

RESULTS: Forty one intubated patients with the mean age of 57.16±20.07 years were included. Postextubation stridor was observed in 4 patients (9.75%). Cuff leak test (cut off point: 249 mL) showed sensitivity and specificity of 75% and 59%, respectively. In addition, laryngeal ultrasonography (cut off point for air column width: 10.95 mm) resulted in sensitivity and specificity of 50% and 54%, respectively. Positive predictive value of both methods were <20%.

CONCLUSION: Both cuff leak test and laryngeal ultrasonography have low positive predictive value and sensitivity in predicting postextubation stridor and should be used with caution in this regard.

AIRWAY USG

- Assesement prior to intubation

The Feasibility of Ultrasound to Assess Subglottic Diameter Karim Lakhal, (Anesth Analg 2007;104:611-4)

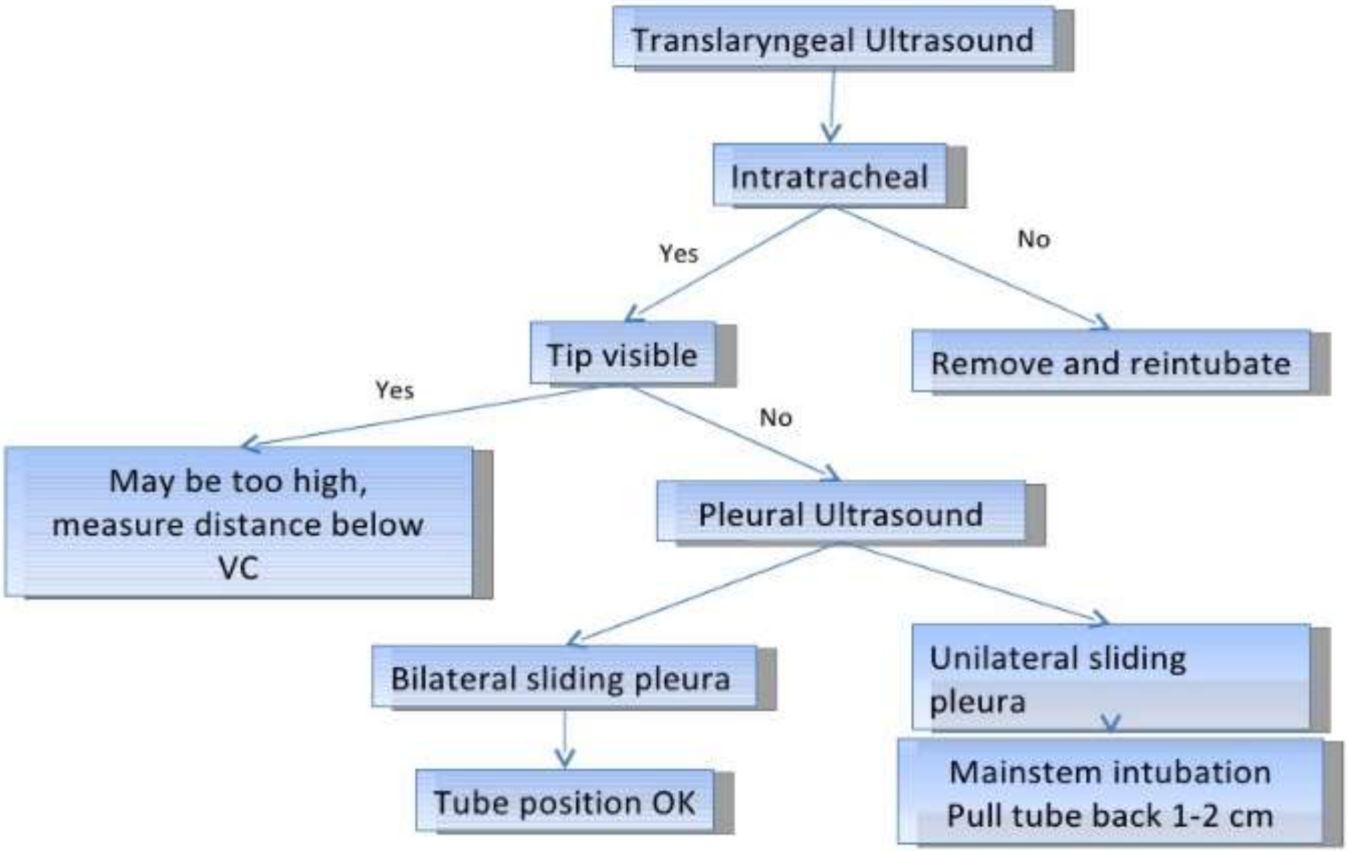
- Assessment prior to tracheostomy

Bedside Ultrasound Screening for Pretracheal Vascular Structures May Minimize the Risks of Percutaneous Dilatational Tracheostomy **Alexander C. Flint** Neurocrit Care (2009) 11:372–376

- U/S guided tracheostomy

Real-time ultrasound-guided percutaneous dilatational tracheostomy: a feasibility study
Venkatakrishna Rajajee *Critical Care* 2011, **15**:R67

ETT POSITION



Take home message

- USG over CXR →
  - Pleural effusion
  - Pnuemothorax
- Blue protocol in acute respiratory failure
- Interpreting lung aeration →

  (needs further validation and uniformity)

Weaning from MV
VAP
Assessing prone ventilation
Lung recruitment