

Basics of Lung Ultrasound



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R
AP



Operator :

Usefulness of ultrasound

- Ultrasonography : routine approach tool in evidence based medicine
- Management of real-time crisis
- Indispensable technique from bedside assessment to facilitate intervention
- The clinical area is expanding
 - Critical care setting
 - Intraoperative field
 - OPD based

Seven principles

- Lung ultrasound is performed at best using simple equipment.
- Thorax, gas and fluids have opposite locations, or are mingled by pathologic processes, generating artifacts.
- The lung is the most voluminous organ. Standardized areas can be defined.
- All signs arise from the pleural line.
- Static signs are mainly artifactual.
- The lung is a vital organ. The signs arising from the pleural line are foremost dynamic.
- Almost all acute life-threatening disorders about the pleural line, explaining the potential of lung ultrasound.

Principle

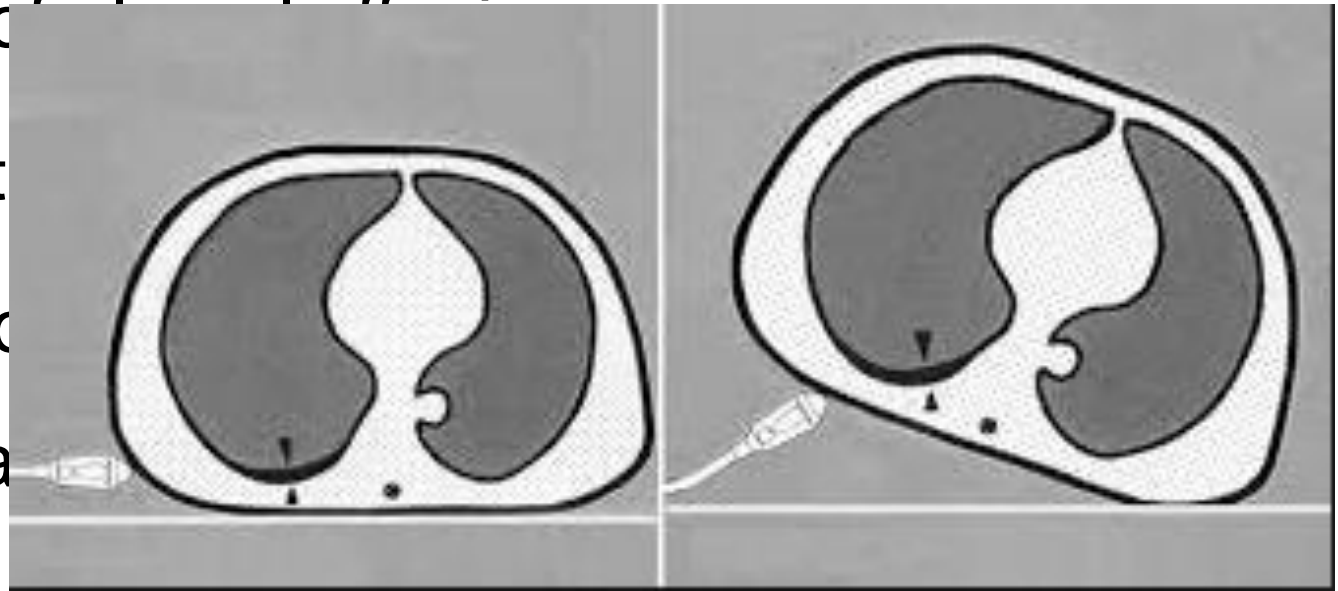
- 5-MHz Microconvex/Linear probe (4 -12 MHz)
 - 1 -17cm range of exploration
- Normal lung : invisible
- Air : non transmitter
- Fluid : good mediator
- Pneumothorax : interrupt of visceral pleura
- Pleural effusion : identification of visceral pleura

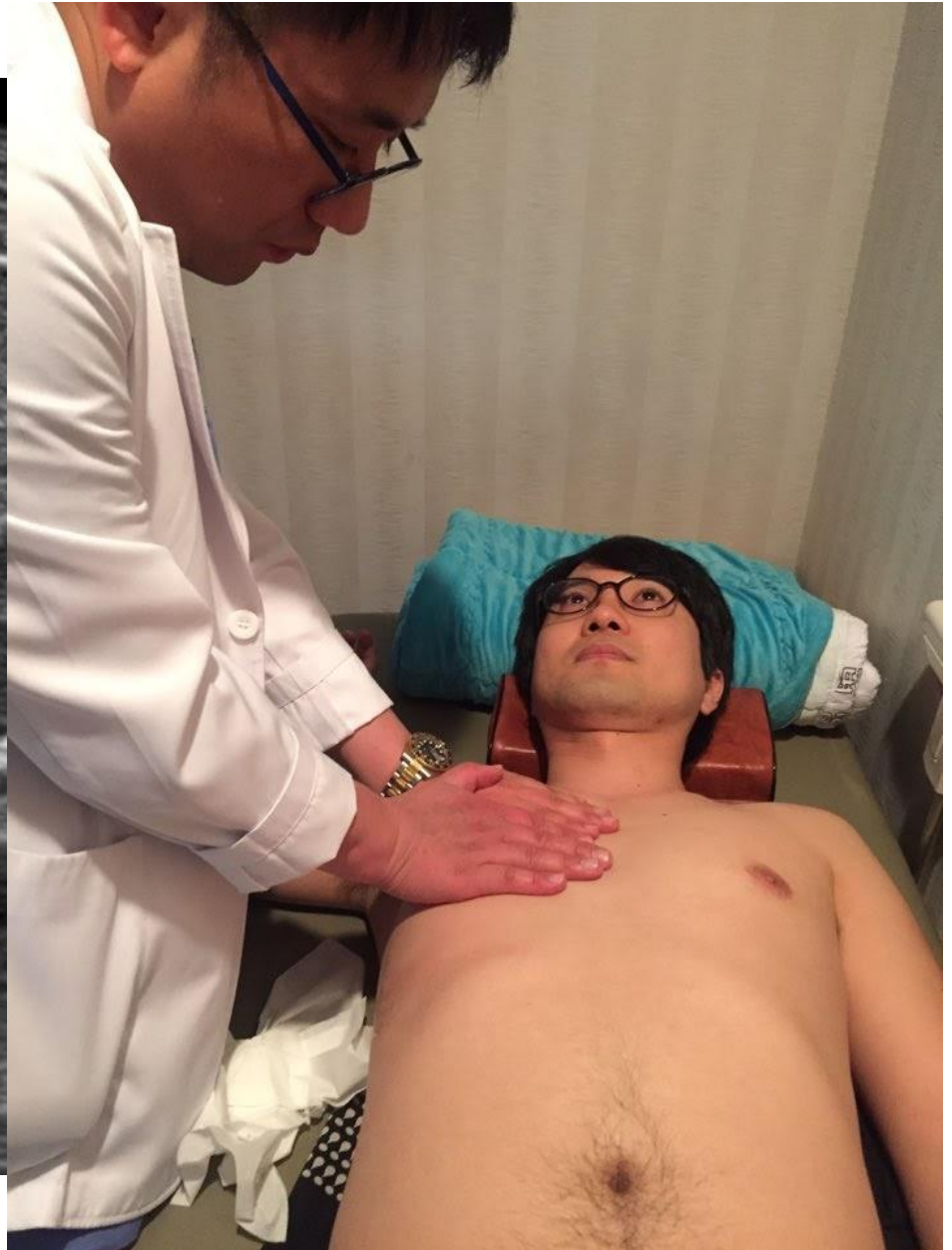
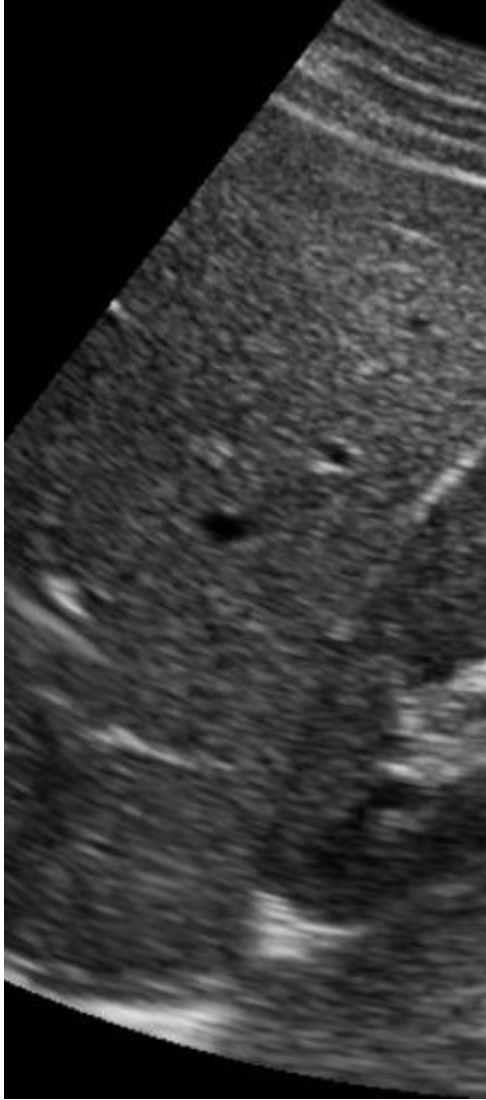
Principle

- High frequency (5 -10 MHz)
 - Greater resolution
 - Less penetration
 - Superficial structure
- Lower frequency (2 – 3.5 MHz)
 - Greater penetration
 - Less resolution
 - Deep structure

PLAPS-point

- Posterior axillary line + Lower BLUE point
- Alveolar syndrome : consolidation
- Pleural syndrome : pleural fluid
- Milestone of the BLUE protocol
- The lowest point of the lung
- BLUE protocol for pneumonia

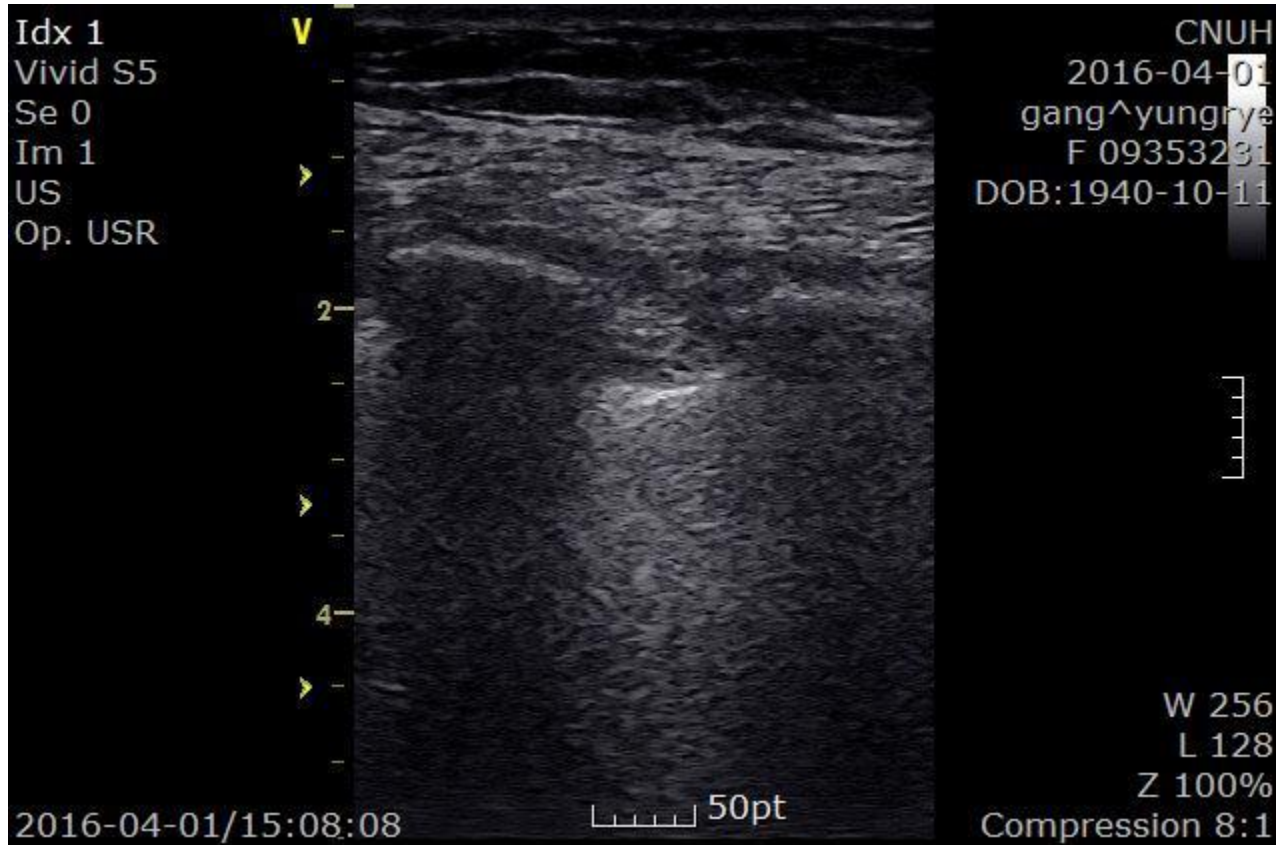




Bat sign

- Location of the lung – 1st sign, landmark
- Upper rib, lower rib, pleural line
- Pediatrics : same as adult
- Normal : do not distinguish visceral and parietal pleura
- More important indicator than lung sliding sign

Bat sign ??



A-lines

- First letter of Alphabet
- Horizontal, Reverberations, Motionless
- Manifestation of air
- Only finding in two third of normal lung
- A-line + lung sliding = A profile
- A-line only without sliding = A' profile

Lung sliding

- Pleural sliding (visceral pleura movement)
- Lung touching chest wall
- Greatest in lower thorax
- Absence : pneumothorax, intrathoracic adhesion, critical parenchymal disease, esophageal intubation
- M-mode : Seashore sign

B-lines

- **Comet-tail sign : water contained anatomy**
- **Originates from pleura, absence of air**
- Hyperechoic, vertical narrow bands
- Obliterate A-line, move with lung sliding
- 3 more at once : abnormal interstitial pathology, lesion in alveoli, lung rockets
- Join of B-lines : severity

Lung rockets

- PLAPS point : non specific (d/t gravity)
- Bilateral all fields : cardiogenic edema
- Localized : consolidation (pneumonia, interstitial diseases)
- Lung rockets + lung sliding = B profile
- Lung rockets without sliding = B' profile

Stratosphere sign

- Barcode sign
- Absence of lung sliding
- D/D with lung pulse
- Pneumothorax in M mode

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2016-03-29

Acuson X300

Se 1 VF13-5

Im 2 LUNG 34 dB

US 7.3 MHz

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Edge 2

Sweep 2

Map E

Tint 1

30 fps

Edge 2

Sweep 2

Map E

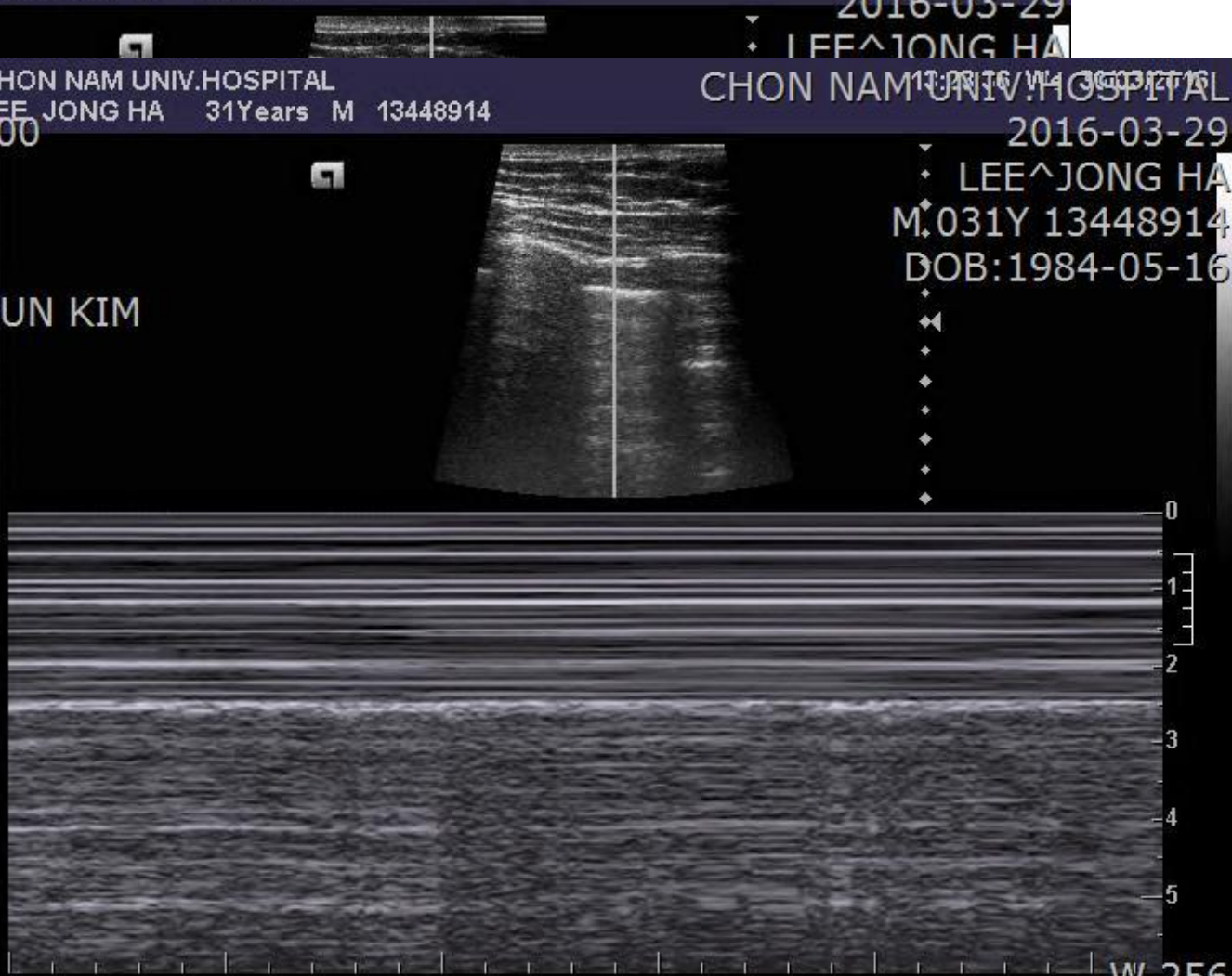
Tint 1

30 fps

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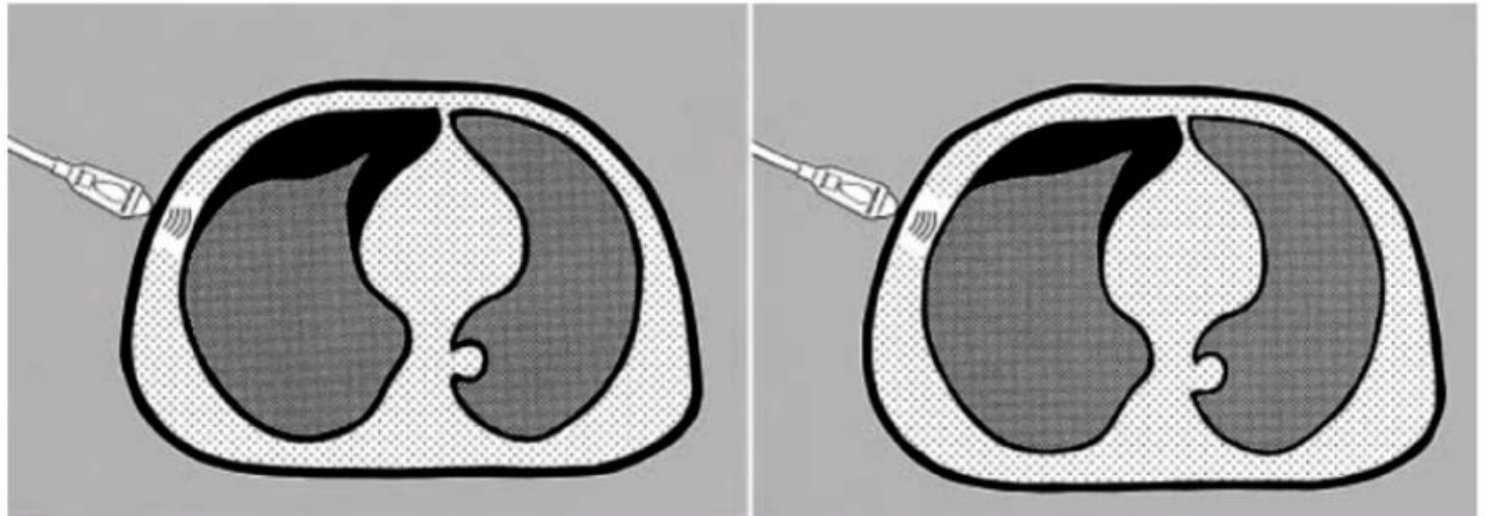
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Lung point

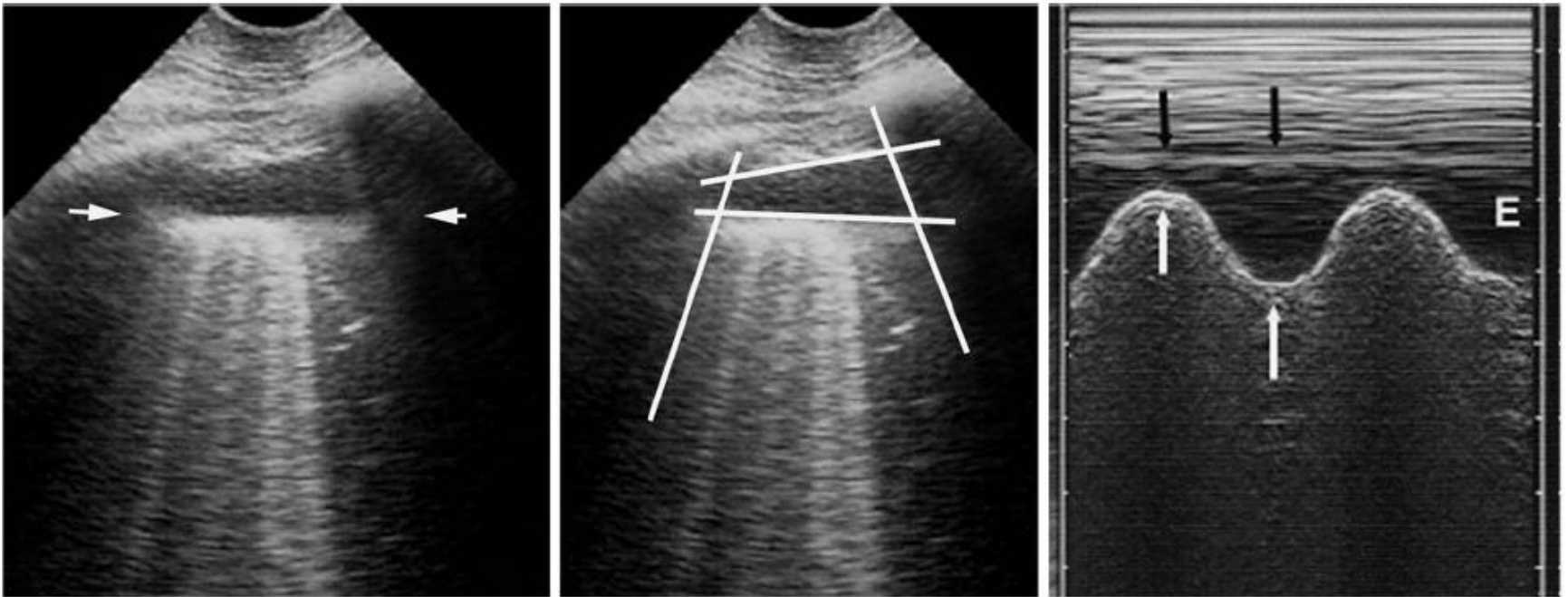
- Indicator of pneumothorax
- Abrupt appearance
- Lateral side : Pneumothorax size ↑

- On c
- On t
- Pne
- pne



Quad sign

- PLAPS point
- Dependent position
- Static sign, pleural and lung line, rib
- Deep boundary of the collection : regular
- Roughly parallel to the pleural line
- Sub B-lines

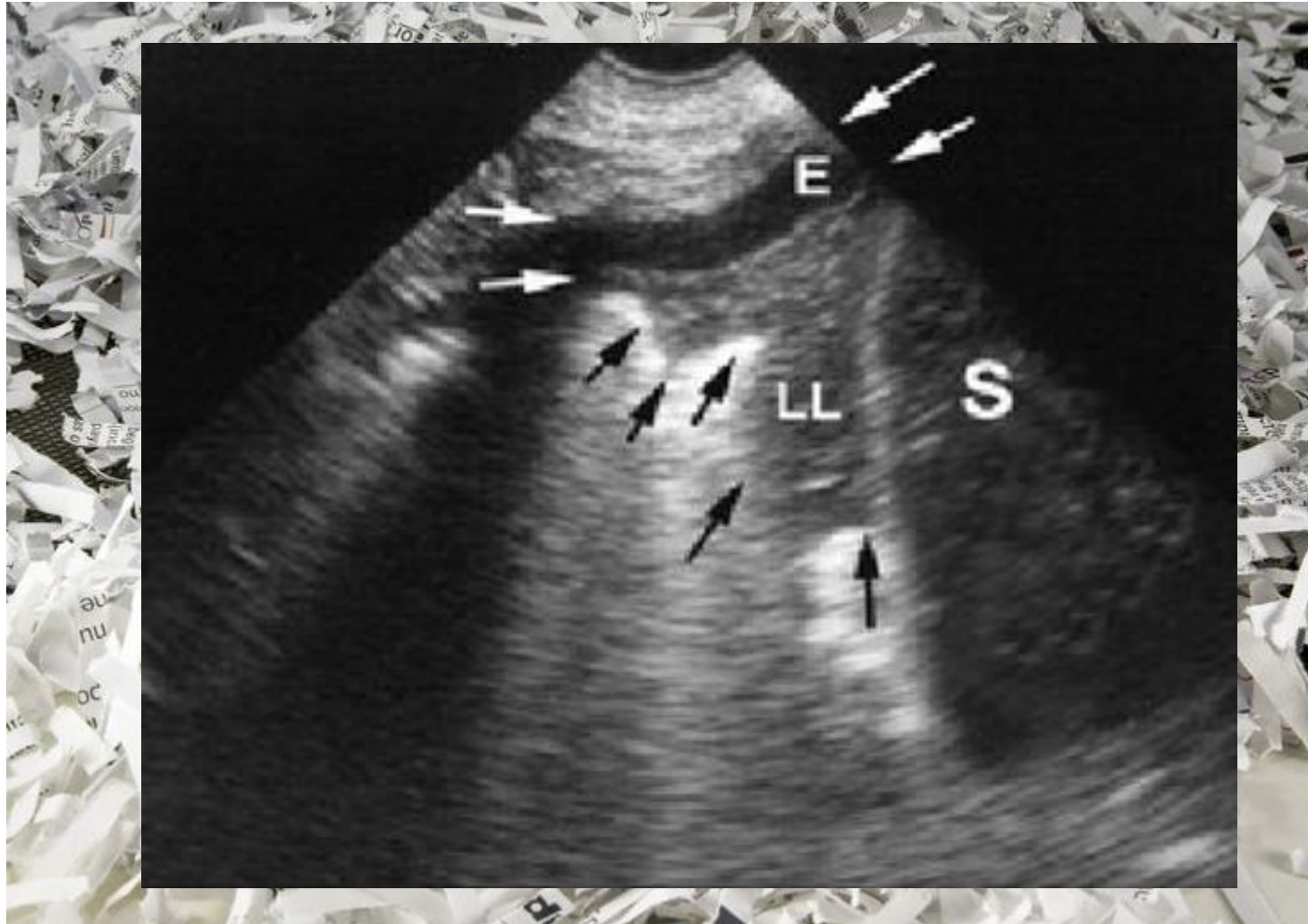


Lichtenstein DA. Lung ultrasound in the critically ill. Annals of Intensive Care 2014, 4:1

Shred sign

- Alveolar consolidation
- More common
- Boundary – pleural line, air-consolidative border
- Fractal line
- The nontranslobar sign of consolidation
- Mixed pattern : aerated lung and consolidation
- Tissular pattern

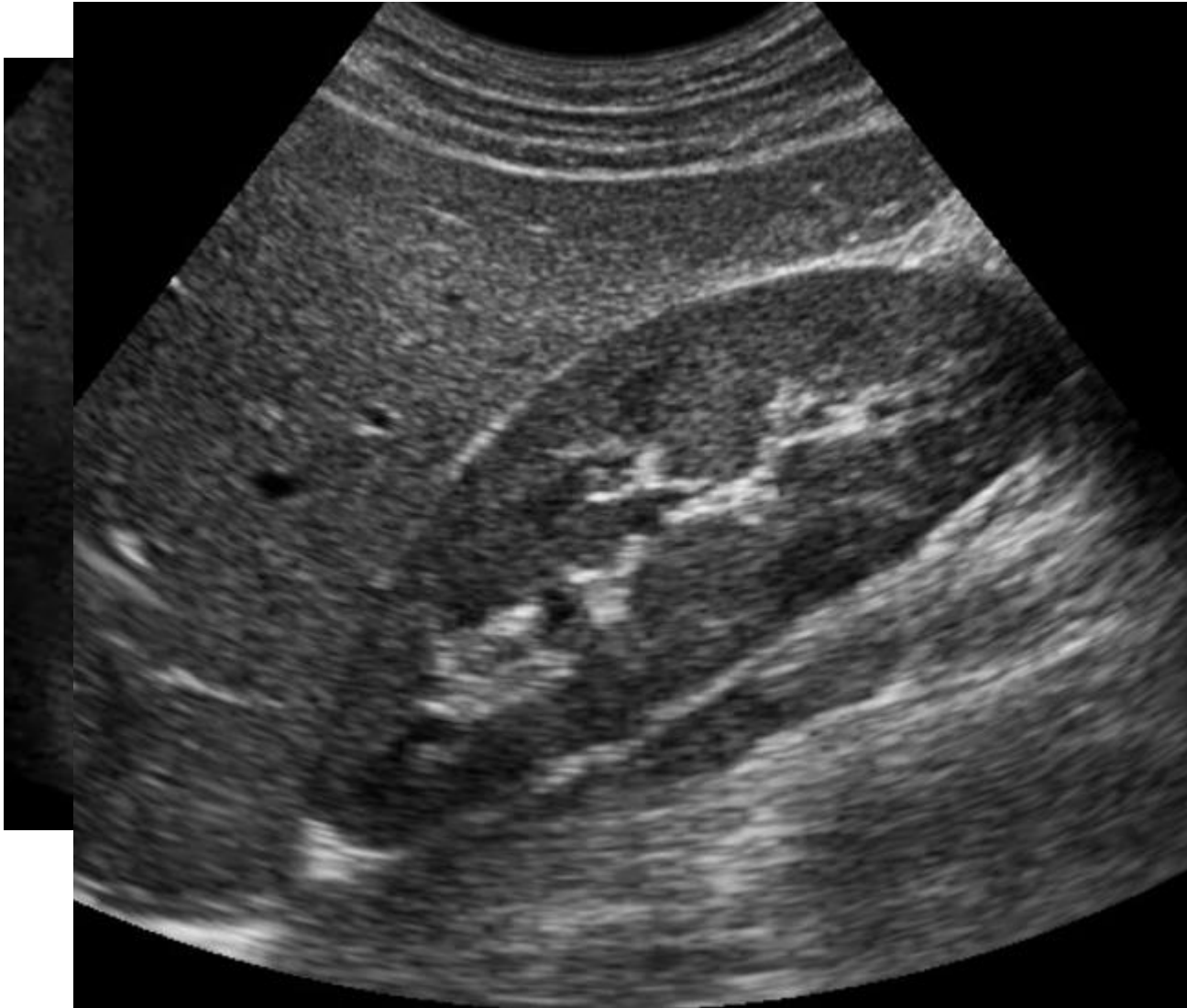
Shred sign



Tissue like sign

- The sign of translobar consolidation
- Hepatization
 - Disorder looking like a solid organ
- No sinusoid sign : a size remains steady
- No fractal line

Tissue like sign



BLUE-protocol

- Acute respiratory failure
- Very fast (< 3 min.)
- Upper point : upper lobe
- Lower point : middle lobe, lingular segment
- PLAPS point : lower lobe

Accuracy

- U/S sensitivity : 98%
- U/S specificity : 95%
- X-ray sensitivity : 67%
- X-ray specificity : 85%

Pneumothorax

- High frequency probe
- Disappearance of lung sliding
- Presence of lung point
- Evaluation of whole respiratory cycle
- Presence of B-line : r/o pneumothorax
- Supine : lower BLUE point
- Fowler's : upper BLUE point

Pneumothorax

- High frequency probe
- Disappearance of lung sliding
- Presence of lung point
- Absence of lung pulse
- Presence of B-line : r/o pneumothorax
- Supine : lower BLUE point
- Fowler's : upper BLUE point

level A of evidence



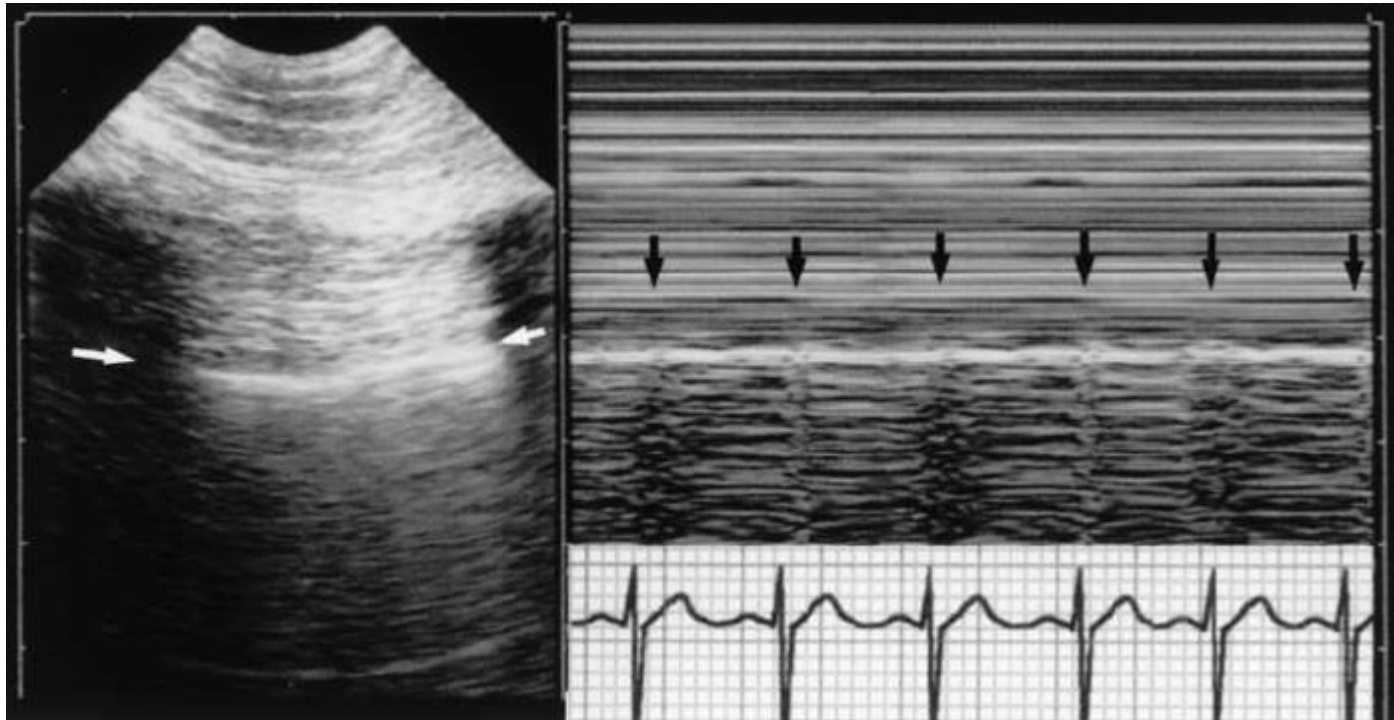
Pleural effusion

- Amount : > 20ml
- The volume does change with respiration
- Quadrangular shape with a regular lower border
- Useful Indicator of drainage site
- Transudate : anechoic
- Exudate : echogenic feature
- Sub B-line

Lung pulse

- Disappearance of lung sliding
- Heart beating
- r/o pneumothorax
- D/D pneumothorax : no lung pulse
- Atelectasis : selective intubation, ARDS

Lung pulse

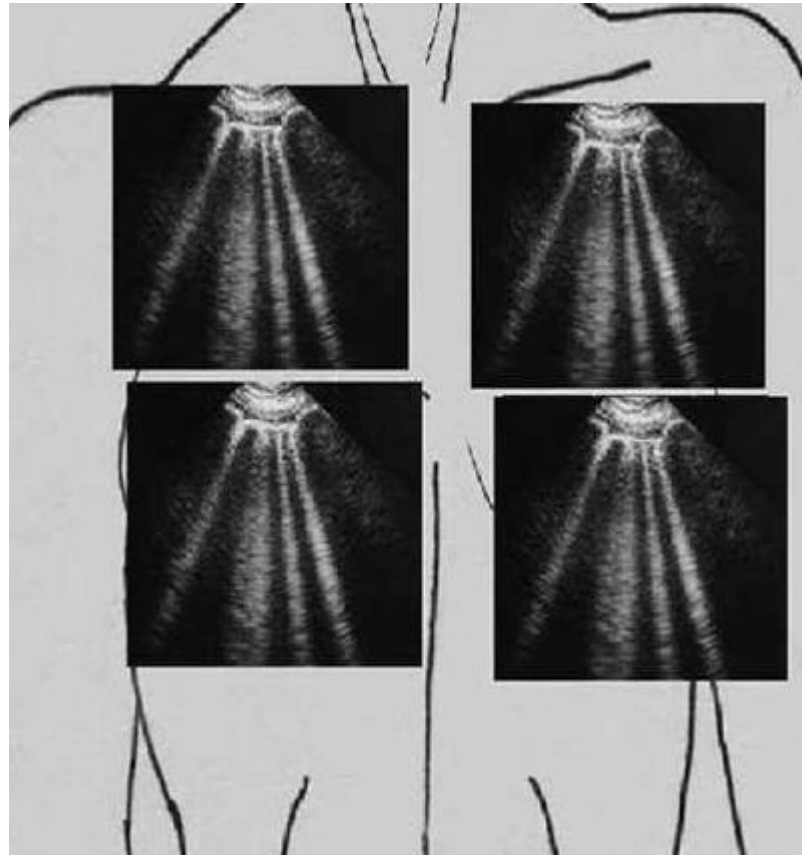


Lichtenstein DA, et al. **The “lung pulse”**: an early ultrasound sign of complete atelectasis. *Intensive Care Med* (2003) 29:2187–2192

Pulmonary edema

- Anterior-predominant bilateral B line (more > 4)
- Presence of lung sliding
- B-profile
- Smooth pleura
- Abrupt onset of B-line : endpoint of fluid therapy
- Proceed to C-profile

Pulmonary edema



Lichtenstein DA. **Relevance of lung ultrasound in the diagnosis of acute respiratory failure: the BLUE protocol.** Chest. 2008 Jul;134(1):117-25.



ABOUT

ARTICLE CATEGORY

ISSUE

SPECIALTIES

FOR AUTHORS AND REVIEWERS



The Korean Journal of Critical Care Medicine > Volume 32(1); 2017 > Article



Review


Pulmonary

Korean Journal of Critical Care Medicine 2017; 32(1): 1-8.

Published online: February 14, 2017

DOI: <https://doi.org/10.4266/kjccm.2016.00955>

Lung Ultrasound (in the Critically Ill) Superior to CT: the Example of Lung Sliding

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Conclusion

- Gold standard in the critical settings and even beyond.

Limitation

- Probes are potential source of nosocomial infection
- Equipment cost : early investment
- Pneumomediastinum
- Do not evaluation of trachea
- Dressing and drain tube
- Subcutaneous emphysema
 - Not Bat sign but E-lines

Take home message

- Understanding of basic principle
- Take matters easy
- Allows quickly approach of thoracic disorders
- Lung ultrasound has evolved from a critical care management to an other clinical intervention
- The future of ultrasound appears as Almighty decision tool