

Journal Meeting

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Real-time lung ultrasound for the diagnosis of alveolar consolidation and interstitial syndrome in the emergency department

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Introduction

- limited as thoracic bones and pulmonary air cause production of artifacts
- Development of modern lung ultrasound procedures is mainly based on discovering of the significance of sonographic artifacts

Technical equipment

- Microconvex 5MHz probe- deep, small
- curvilinear (abdominal) probe 3–5MHz- wider visualization, deep enough, save time
- linear probe- higher resolution images of pleural line

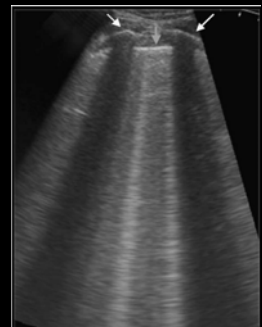
Technique



- 1&2: upper anterior and lower anterior
- 3&4: upper lateral and basal latera
- Probe:
 - ◆ longitudinal
 - ◆ oblique

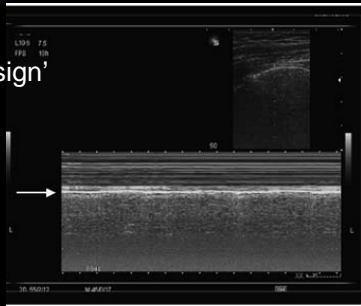
Normal lung

- Focus: depth of the pleural line
- margins of normal ribs
- 'bat sign'
- 'lung sliding'



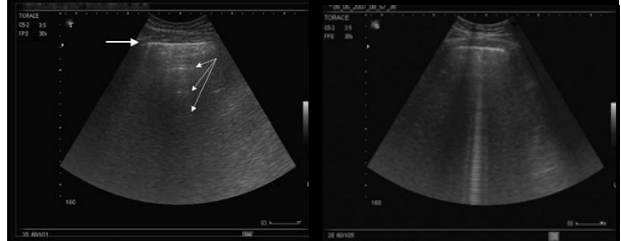
Normal lung

- M mode
- 'seashore sign'



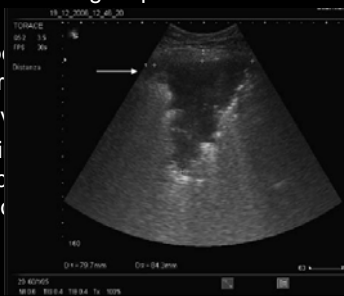
'A lines' & 'B lines'

- ultrasound beam is irregularly reflected back to the probe by the microspheric surfaces of the air inside the moving alveoli



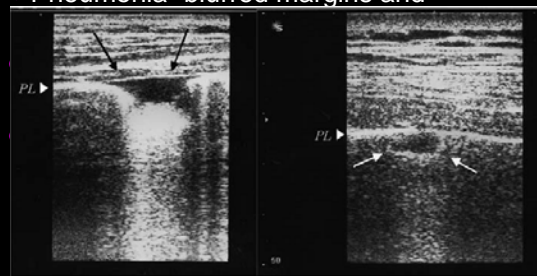
Pulmonary pathologies

- Alveolar consolidations- high liquid content and loss of air
- pleural-based hyperechoic area with pleural line below
- 'superficial fluid alveolar consolidation'
- limited specificity in pneumonia, lung cancer, pulmonary infarction

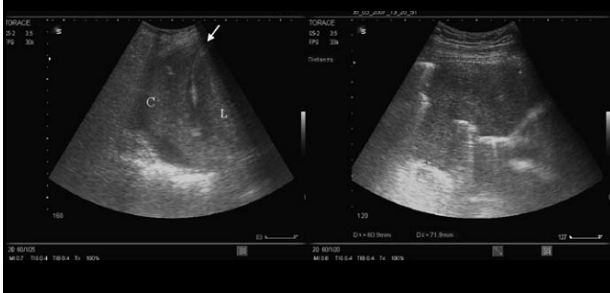


Shape and margins

- Pneumonia- blurred margins and



Echotexture



Bronchograms

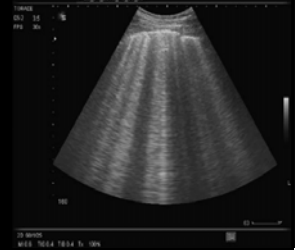
- air or fluid inclusions in the bronchial tree, trapped in the consolidated area
- echoic (air) or anechoic (fluid), linear or lentil sized
- inspiratory centrifugal movement- nonretractile consolidation (pneumonia)
- Static- late-stage retractile condition (atelectasis)

Lung pulse

- vibration in rhythm with the heartbeat of the consolidated lung
- nonventilated lung
- mainstem intubation or mucous plugging

B lines

- area surrounding alveolar consolidation
- increased fluid content of the interstitium
- predicts a neighboring consolidated area

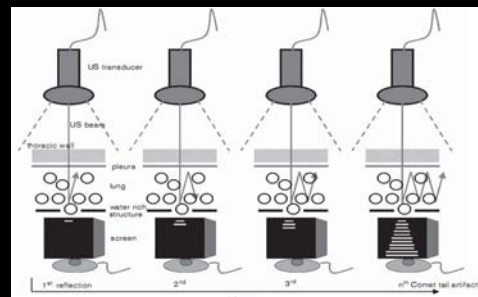


Diffuse interstitial syndrome

- abnormal increase of fluids in the interstitium
- Thickening of interlobular septa
- cardiogenic and lesional pulmonary edema, infectious interstitial processes and chronic diffuse parenchymal lung diseases

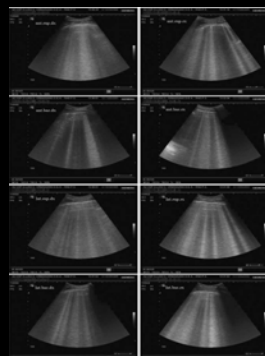
Sonographic sign

- B line, comet tail, ultrasound lung comet



'lung rockets' or B+lines

- Several B lines visible in a single scan
- more scans on each lung defines diffuse alveolar-interstitial syndrome



Definition of abnormal patterns

- First step: definition of pathological single scan-
 - ◆ microconvex probe \geq three B lines
 - ◆ linear probes $>$ six artifacts per scan
 - ◆ abdominal probe \geq three artifacts with a distance between adjacent lines of not more than 7mm

Definition of abnormal patterns

Table 1 Distribution of 85 positive scans (B+ lines) recorded in the eight individualizable areas of transthoracic lung ultrasound in a group of 145 patients with normal lungs at chest radiography and clinical final diagnosis (from ref. [29])

Areas of thoracic ultrasound	Positive scans	%
Upper anterior right	4	2.8
Lower anterior right	4	2.8
Upper lateral right	7	4.8
Laterobasal right	27	18.6
Upper anterior left	3	2.1
Lower anterior left	4	2.8
Upper lateral left	3	2.1
Laterobasal left	33	22.8

Definition of abnormal patterns

- Agricola et al: bilateral multiple comet-tail images either disseminated all over the anterolateral lung surface or limited to the lateral lung surface
- at least two scans on each thoracic side, performing four transthoracic scans per side (two anterior and two lateral)

Diagnostic limit of B+ diffuse pattern

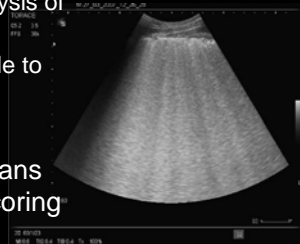
- low specificity
- cardiogenic and inflammatory pulmonary edema, pulmonary fibrosis, or interstitial pneumonia ?

Evaluating acute dyspnea in the emergency department

- B+ diffuse pattern v.s. CXR in the alveolar-interstitial syndrome
 - ◆ ICU: sensitivity of 93.4%, specificity of 93.0%, and a feasibility rate of 99%
 - ◆ ED: sensitivity 85.7%, specificity 97.7%, feasibility 98.3%
- differentiation between COPD with AE and pulmonary edema with a sensitivity of 100% and specificity of 92%

Hemodynamic assessment

- sonographic score is complex to apply
 - ◆ retrospective analysis of frozen images
 - ◆ not always possible to count B lines
- 'shining' lung
- sum of positive scans as sonographic scoring



Conclusion

- Lung ultrasound: time, cost, and sometimes life saving
- The best way to learn bedside lung application of sonography is to study literature and practice it regularly in the ED.