

**“SOLO EDEMA POLMONARE O ANCHE
INFEZIONE?
UTILITÀ DELL’ IMAGING IN QUESTO
PAZIENTE: ECO CUORE, ECO POLMONE, RX
TORACE E FIBROBRONCOSCOPIA..”**

DANIELA DALL’OGLIO

QUANTO POSSO SCOPRIRE CON UN RX TORACE?

«Several reasons account for the limited reliability of bedside chest radiography:

- 1) during the acquisition the patient and the thorax often moves decreasing the spatial resolution**
- 2) the film cassette is placed posterior to the thorax**
- 3) the X ray beam originates anterior, at a shorter distance than recommended and quite often not tangentially to the diaphragmatic cupola, thereby hampering the correct interpretation of the silhouette sign**

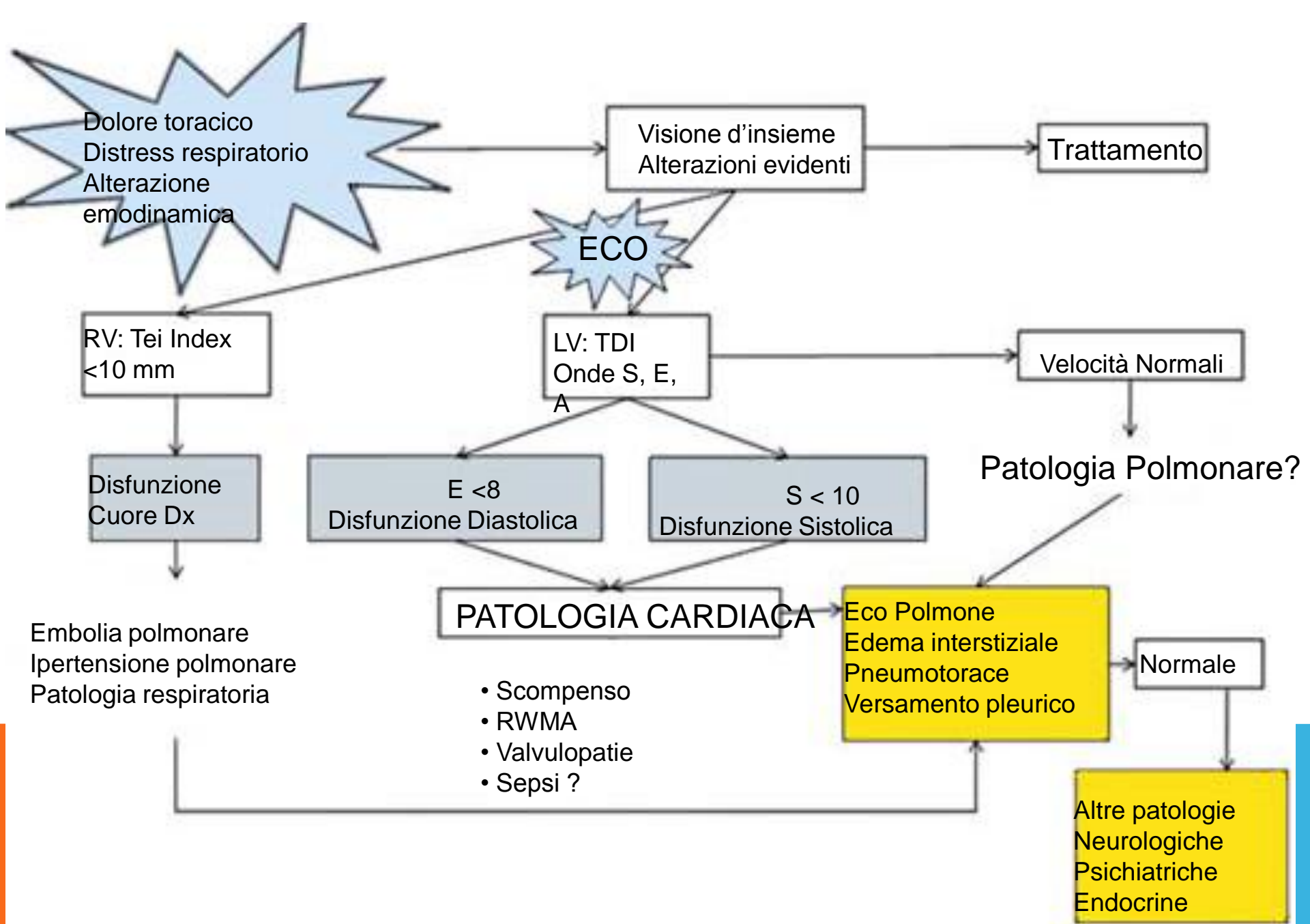
QUANTO POSSO SCOPRIRE CON UN RX TORACE?

La radiografia del torace non è particolarmente accurata e non identifica almeno il 20% delle cardiomegalie confermate poi con l'ecocardiografia (l'indice cardiotoracico è peraltro un predittore debole di disfunzione ventricolare sinistra),

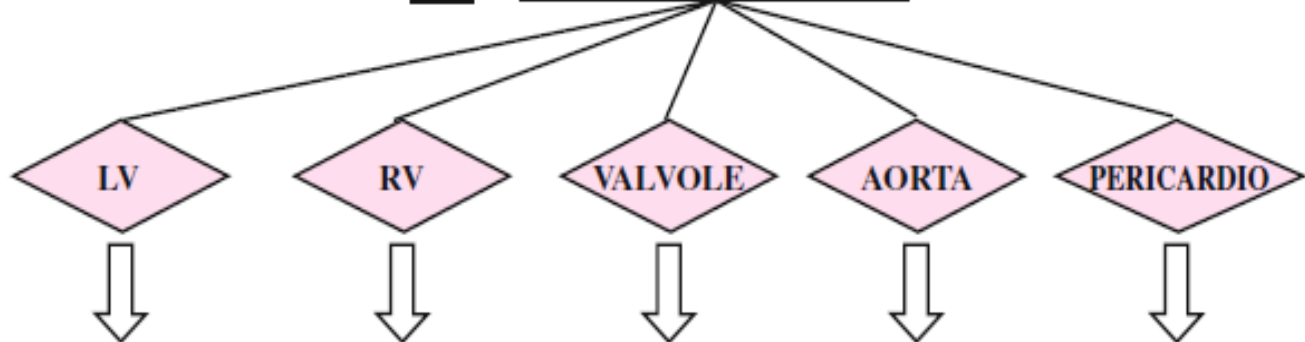
I segni di congestione polmonare possono essere minimi anche in caso di pressioni di incuneamento polmonari elevate.

Non vengono visualizzati fino al 50% dei versamenti

pleurici minori poi dimostrati ecograficamente.



1 ecocardiogramma



RVMA
ischemia,
infarto,
miocardiopatia

Complicazioni IMA
Ins. mitralica
rottura parete
rottura setto

RVEDA/LVEDA
• 0.7
• *Disf. Sistolica (setto paradosso)*
Ipertensione polmonare
ALI/ARDS
Embolia polmonare

Gradiente aortico
gradiente LVOT
Stenosi aortica
Ostruz. LVOT

Flap intinale falso lume
• Dissezione acuta

• Aneurisma aorta toracica

• Aneurisma aorta addominale

Versamento
• Pericardite
• Emopericardio

2 eco torace

lung point
seashore sign
• Pneumotorace

atelectasie
addensamenti
• Polmonite

versamento pleurico
• Pleurite
• Emotorace

code di cometa
• Edema interstiziale
• Fibrosi

M-mode diaframma nel ciclo respiratorio
• Lesione diaframmatica

4 eco-Doppler

Vasi venosi
Arti inferiori

3 eco addome

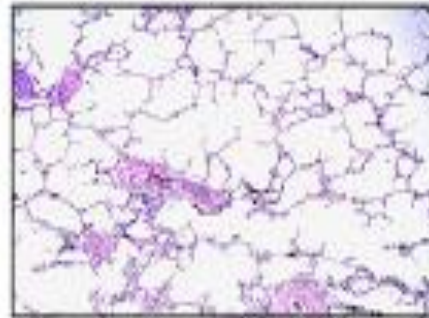
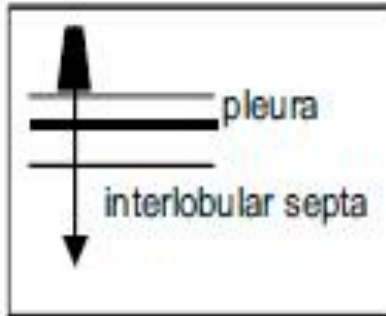
Fegato, milza,
aorta addominale

ECOGRAFIA DEL POLMONE COME LA FACCIO?

	Mid-axillary	Anterior axillary	Mid-clavear	Para-sternal	Inter-costal space	Para-sternal	Mid-clavear	Anterior axillary	Mid-axillary	
right side					2					left side
					3					
					4					
					5					



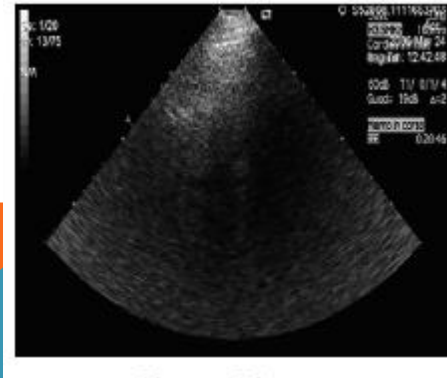
CHE COSA VEDO



normal lung



normal echo pattern



CHE COSA VEDO



Pleural line and A-lines. Intercostal space, longitudinal view: the ribs (arrowheads) yield hyperechoic curves generating frank acoustic shadows. The pleural line is a roughly horizontal, hyperechoic line (large arrows), which is located 0.5 cm below the rib line in the adult. Its visible length between two ribs is 2.5 cm. The upper rib (pleural line)-lower rib pattern outlines the bat sign, a basic landmark. The A-lines (thin arrows) are those repetitive horizontal echogenic lines that arise from the pleural line at regular intervals (skin-pleural line distance). They indicate subpleural air, which completely reflects the ultrasound beam. The length of an A-line can be roughly the same as the pleural line, but it can be shorter, and even not visible. On the left margin: “-1” indicates the skin location, “0” the pleural line, “1” the first A-line, “2” a second A-line (lines A1, A2. . .). Note the equidistance between all these structures. Chest 2009

CHE COSA VEDO



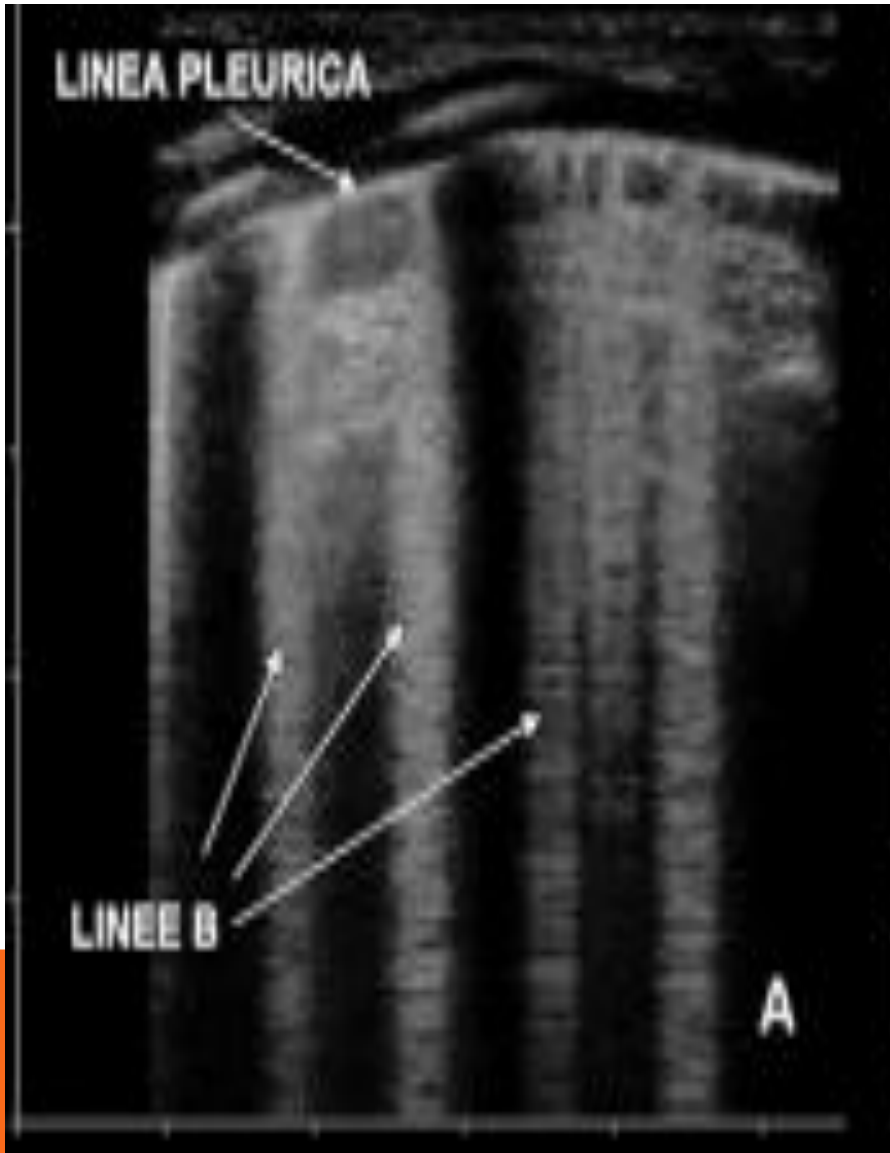
CHE COSA VEDO

Left panel: Pleural line and A line (real-time). The pleural line is located 0.5 cm below the rib line in the adult. Its visible length between two ribs in the longitudinal scan is approximately 2 cm. The upper rib, pleural line, and lower rib (vertical arrows) outline a characteristic pattern called the bat sign. The horizontal lines arising from the pleural line (horizontal arrows) are separated by regular intervals that are equal to the distance between the skin and the pleural line. These were called A lines. A lines are usually large (see upper line) but can be shorter (lower line), which has no clinical significance.

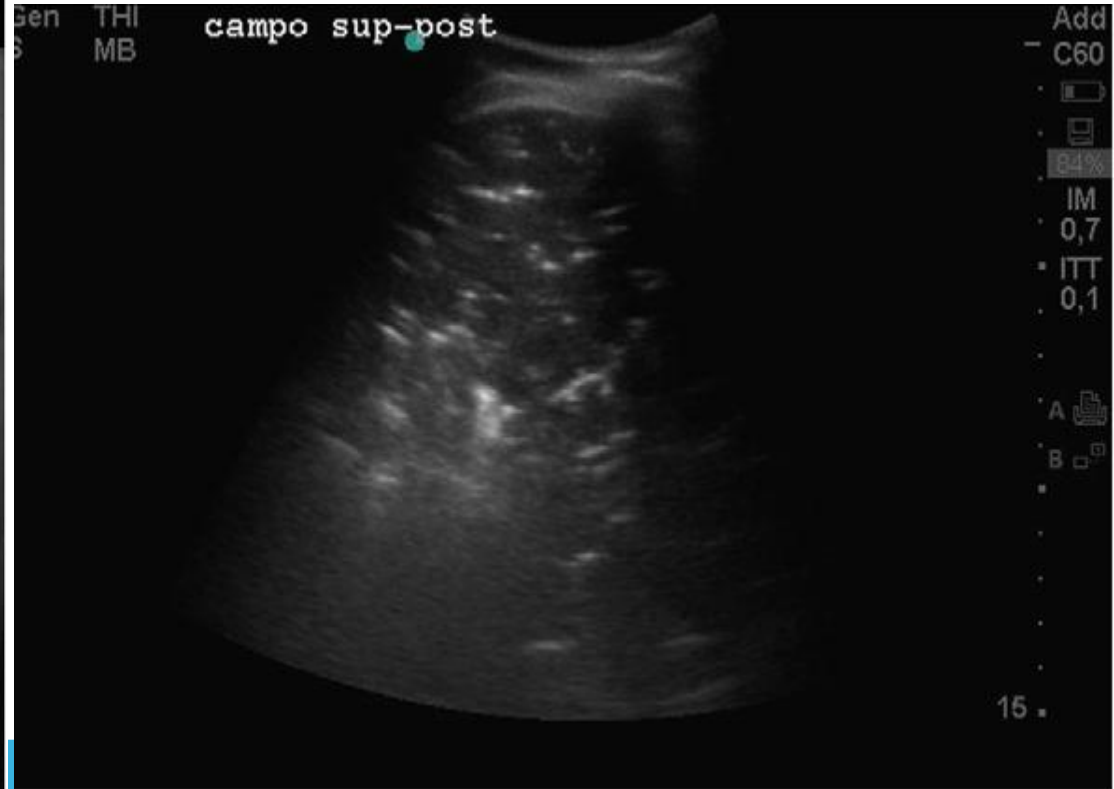
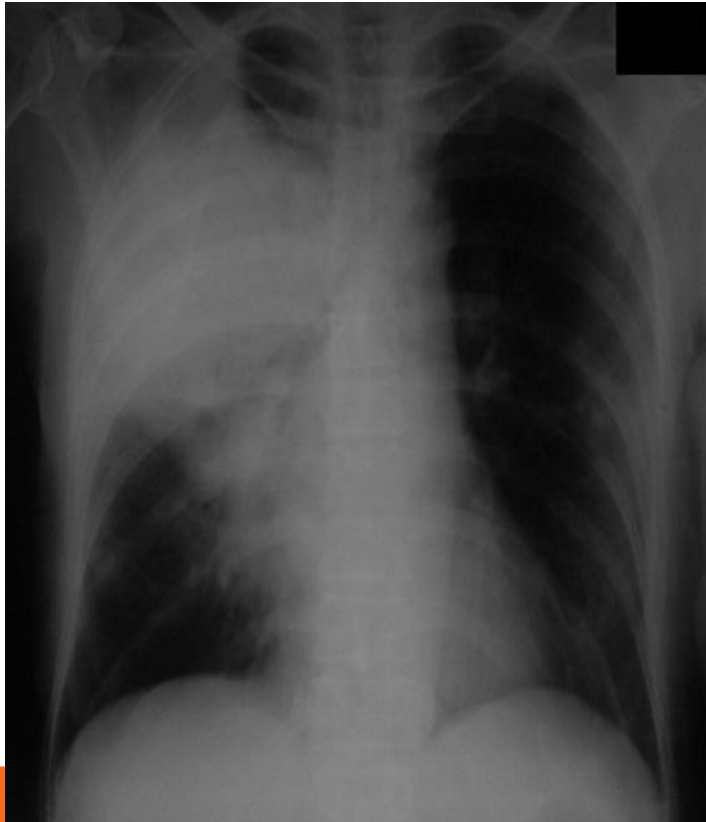
Right panel: M mode. An obvious difference appears on either side of the pleural line (arrow). The motionless superficial layers generate horizontal lines. Lung dynamics generate lung sliding (sandy pattern). This pattern is called the seashore sign.

CHE COSA VEDO

Nel caso di ispessimento dei setti interlobulari subpleurici, come si verifica nell'edema polmonare, il gradiente di impedenza acustica (tra aria alveolare e setti edematosi) risulta nettamente incrementato, determinando la produzione di microriflessioni o risonanze, ring down, che appaiono come riverberi verticali iperecogeni che originano dalla linea pleurica e che si estendono in profondità a tutto lo schermo, denominati comete ultrasoniche polmonari o linee B. In alcuni casi le linee B appaiono più numerose, spesso distanti tra loro pochi millimetri o addirittura confluenti in campi di iperecogenicità che oscurano le linee A. Sebbene il caso più frequente in cui si osservano linee B sia rappresentato dall'edema polmonare cardiogenico, tutte le cause che inducono una parziale perdita di areazione del polmone per espansione dell'interstizio (edema lesionale, interstiziopatie fibrotiche o flogistiche) possono provocare la produzione di linee B. Solamente se l'aria viene esclusa totalmente o quasi dalla cortex polmonare gli ultrasuoni possono mostrare tessuto, in maniera tanto più evidente quanto meno aria è contenuta nell'organo.



SE FOSSE POLMONITE?



A: Chest X-ray performed on the day of her hospital admission shows infiltration on the right side. B: Corresponding lung ultrasound reveals echopoor lesion with typical positive air bronchogram.

Journal of Internal Medicine 23 (2012)

A. Reissig et al. / European

SE FOSSE POLMONITE?

Parenchymal criteria of CAP

CAP has echopoor echogenicity and an inhomogeneous echotexture.

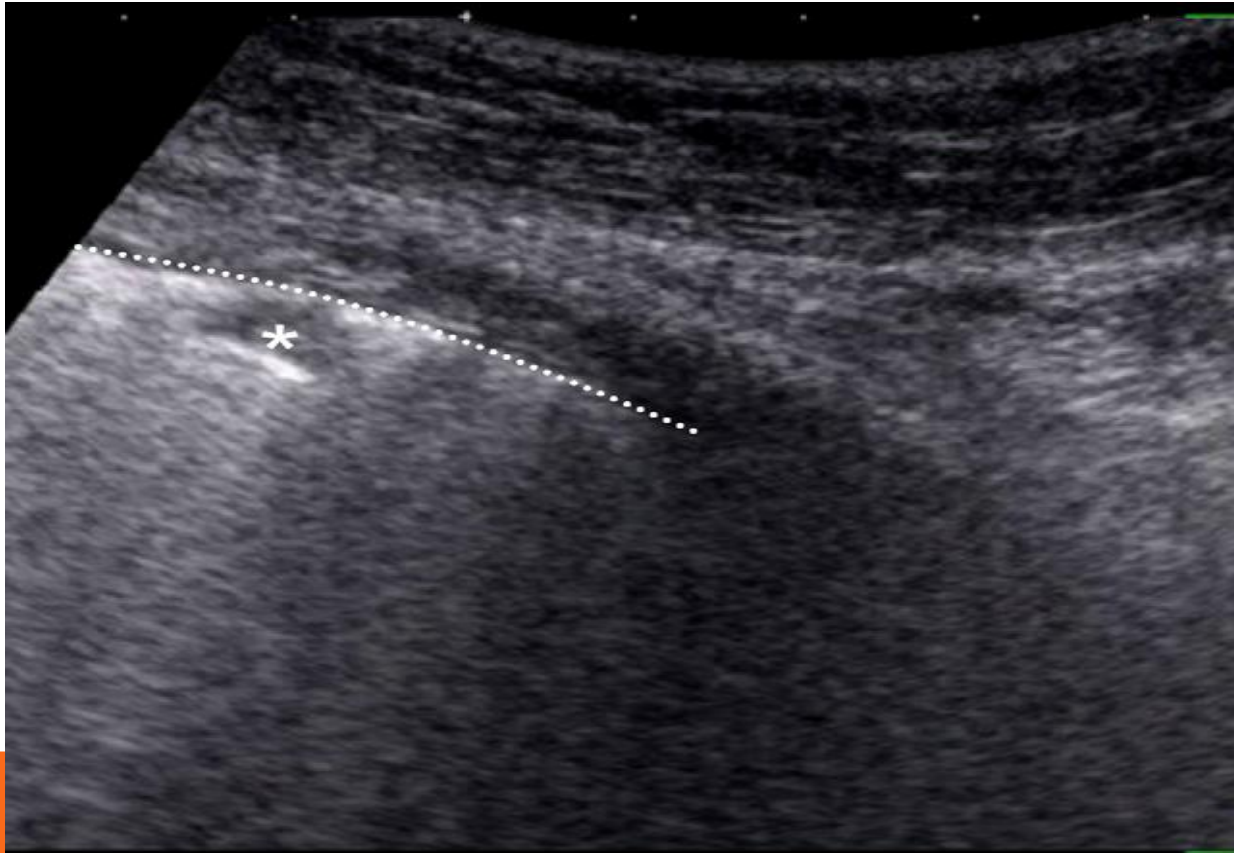
The most characteristic sign is a positive air bronchogram, which is detectable in about 70–97% of cases (Fig. 1). The air bronchogram reflects residua of air within consolidated areas comparable to the air bronchogram visible on X-ray and CT.

About 98–100% of lesions show a breath-dependent motion. The margins of such areas are mostly irregular and blurred and they are mostly polygonal (43–51%) or oval (40–46%) and not sharply demarcated.

The lesions are nearly identical shared on the right and left side and in about 10–15% of cases are found on both sides of the lung.

Hyperechoic punctiform or linear images indicates air bronchograms. These air bronchograms can be motionless

SE FOSSE POLMONITE?

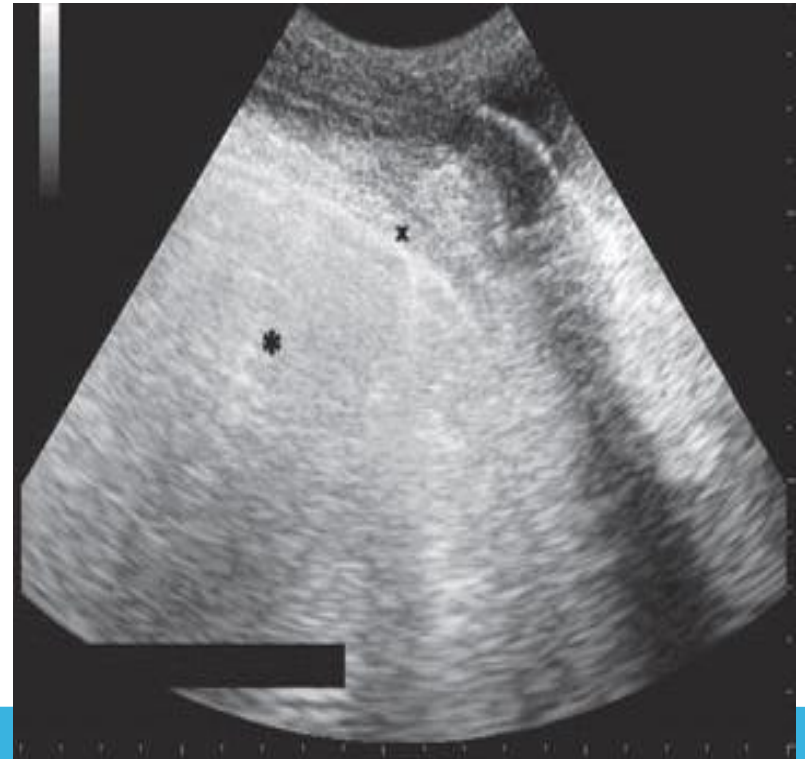


Visualisation de la ligne pleurale (pointillés) et d'une consolidation souspleurale (zone hypoéchogène arrondie) (astérisque). Aspect pouvant évoquer une pneumonie

L. Zieleskiewicz et al. / Annales Francaises d'Anesthésie et de Réanimation 31

(2012)

SE FOSSE POLMONITE?

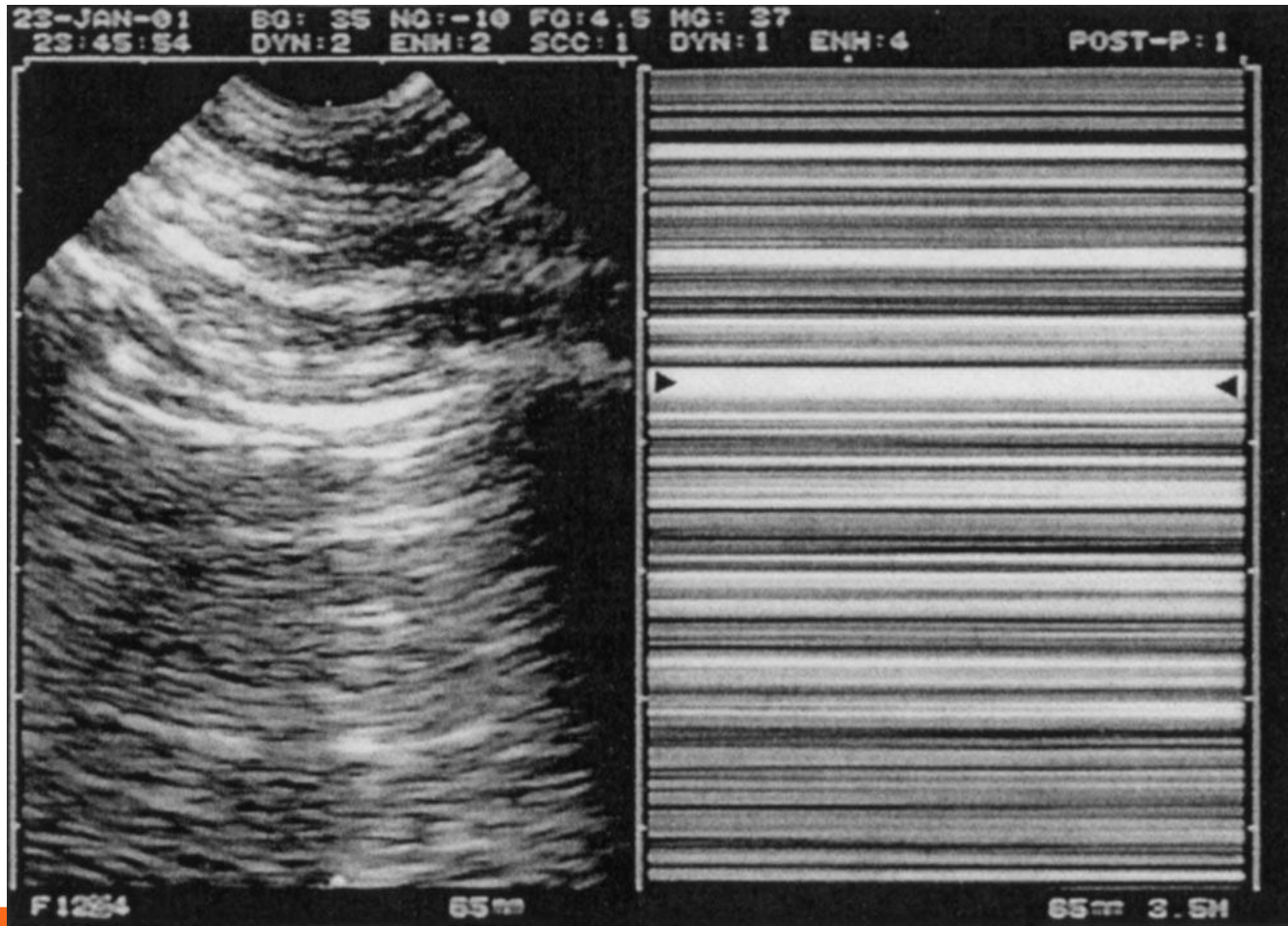


patient's lungs: consolidation and contiguous B-lines; * = alveolar interstitial syndrome;
X = pleural thickening.

PNEUMOTORACE ?

Pneumothorax is defined by the interposition of gas between visceral and parietal pleural layers. As a consequence, lung sliding is abolished, ultrasounds cannot be transmitted through the injured lung parenchyma and comet tails (vertical B-lines) are no longer visible. Only longitudinal reverberations of motionless pleural line (horizontal A-lines) can be seen.

The ultrasound diagnosis of pneumothorax is the most difficult part of training: long experience is required to acquire appropriate skills that rely on the ability to recognize lung sliding and its abolition . When possible, the use of higher emission frequencies (5 to 10 MHz) facilitates the recognition of lung sliding abolition.



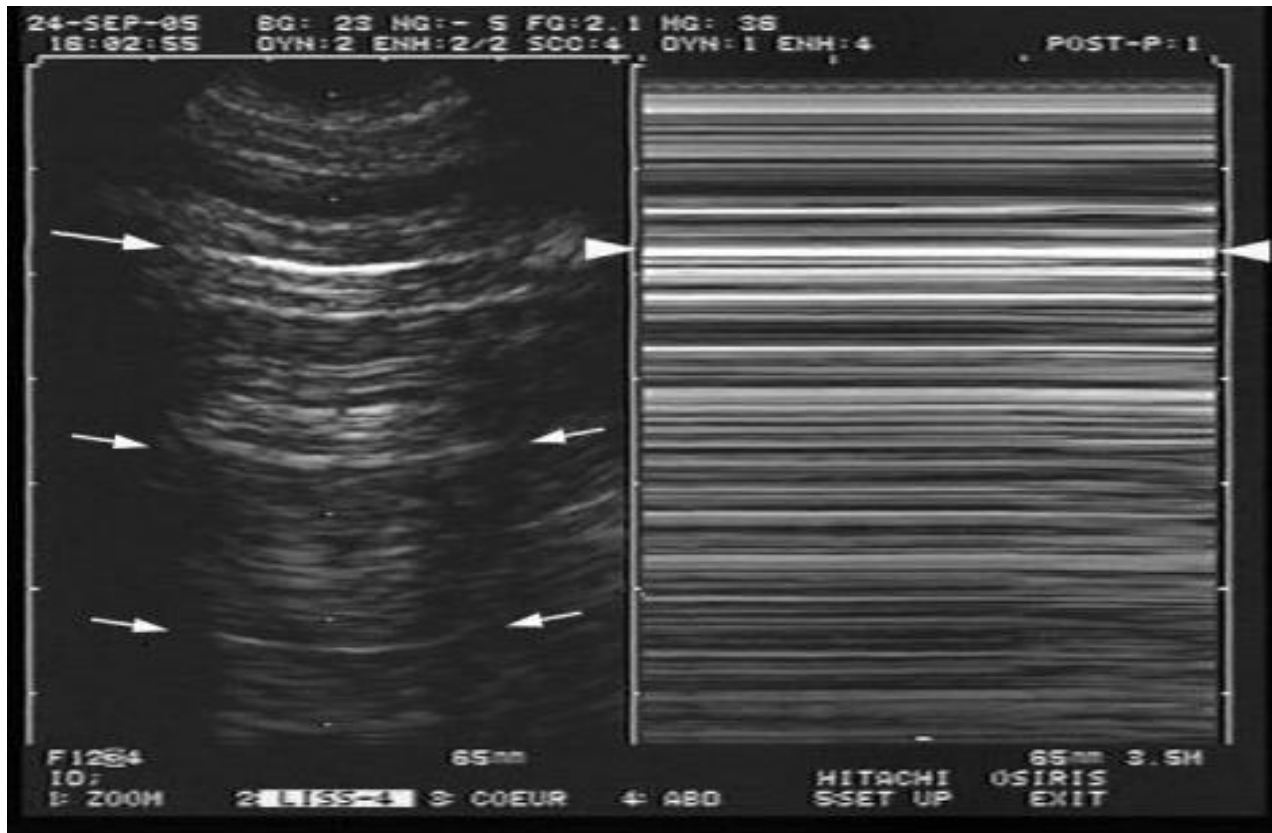
Pneumothorax and stratosphere sign. The complete abolition of lung sliding can be objectified using M mode (right). Exclusively horizontal lines are displayed, indicating complete absence of dynamics at the level of, and below, the pleural line (arrowheads), a pattern called the stratosphere sign. Note the absence of a B line at left.

PNEUMOTORACE ?

Lung Sliding: Present or Abolished:

Abolition occurs when the visceral pleura does not slide against parietal pleura (inflammatory adhesences, loss of lung expansion, atelectasis, apnea, chronic symphysis) or is separated (pneumothorax, pneumonectomy).

If abolished lung sliding is associated with A lines, the search for pneumothorax is mandatory. The lung point is aspecific sign of pneumothorax, alternating lung sliding and abolished lung sliding plus A lines at the same location.



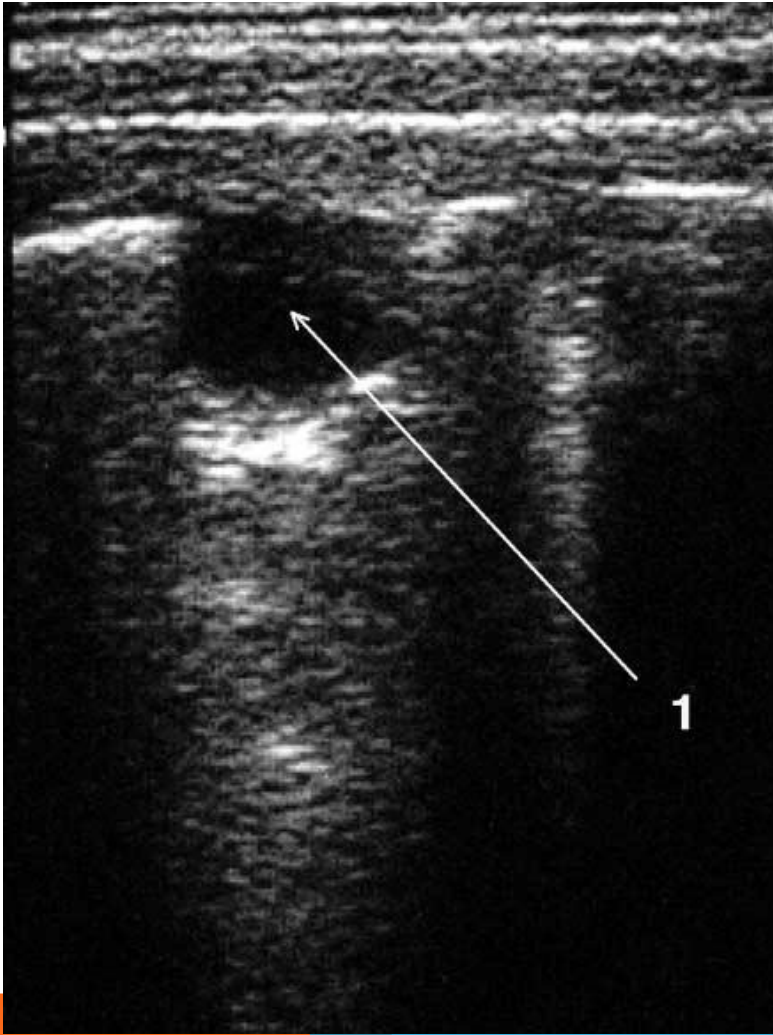
Pneumothorax. Left panel (real-time): one significant item is the complete absence of the B line. Lower arrows: A lines; upper arrow: pleural line. Right panel (M mode): this succession of horizontal lines indicates complete absence of dynamics at, and below, the pleural line (arrowheads). This pattern is called the stratosphere sign. The lung point (not featured here) confidently rules in the diagnosis. Lichtenstein Chest 2008

EMBOLIA POLMONARE?

PE suggestive, consisting of

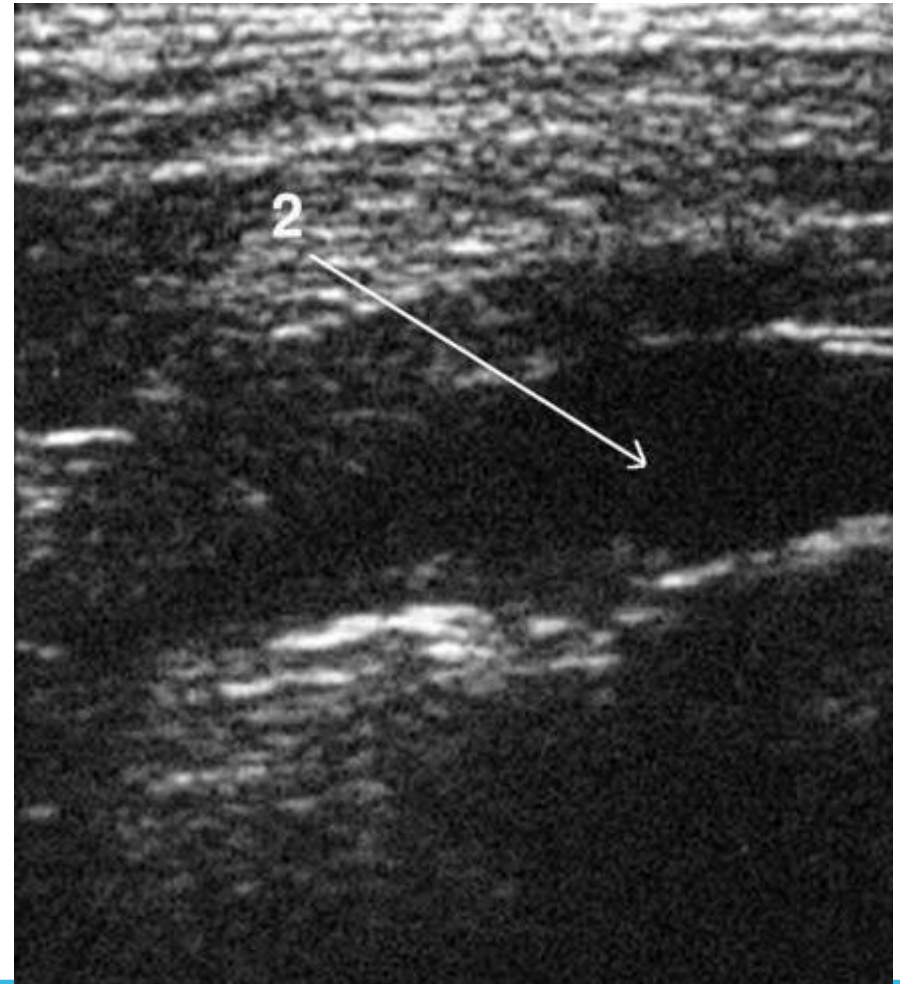
1) wedge-shaped, hypoechoic, homogeneous pleural-based lesions or

2) sharply outlined pleural-based lesions, triangular or rounded to the hilus, with a hyperechoic reflection at the center, possibly corresponding to the bronchioles .



Sonogram suggestive of PE showing a wedged shaped hypoechoic, homogeneous pleural-based lesion..

K. Mohn et al J Ultrasound Med 2003

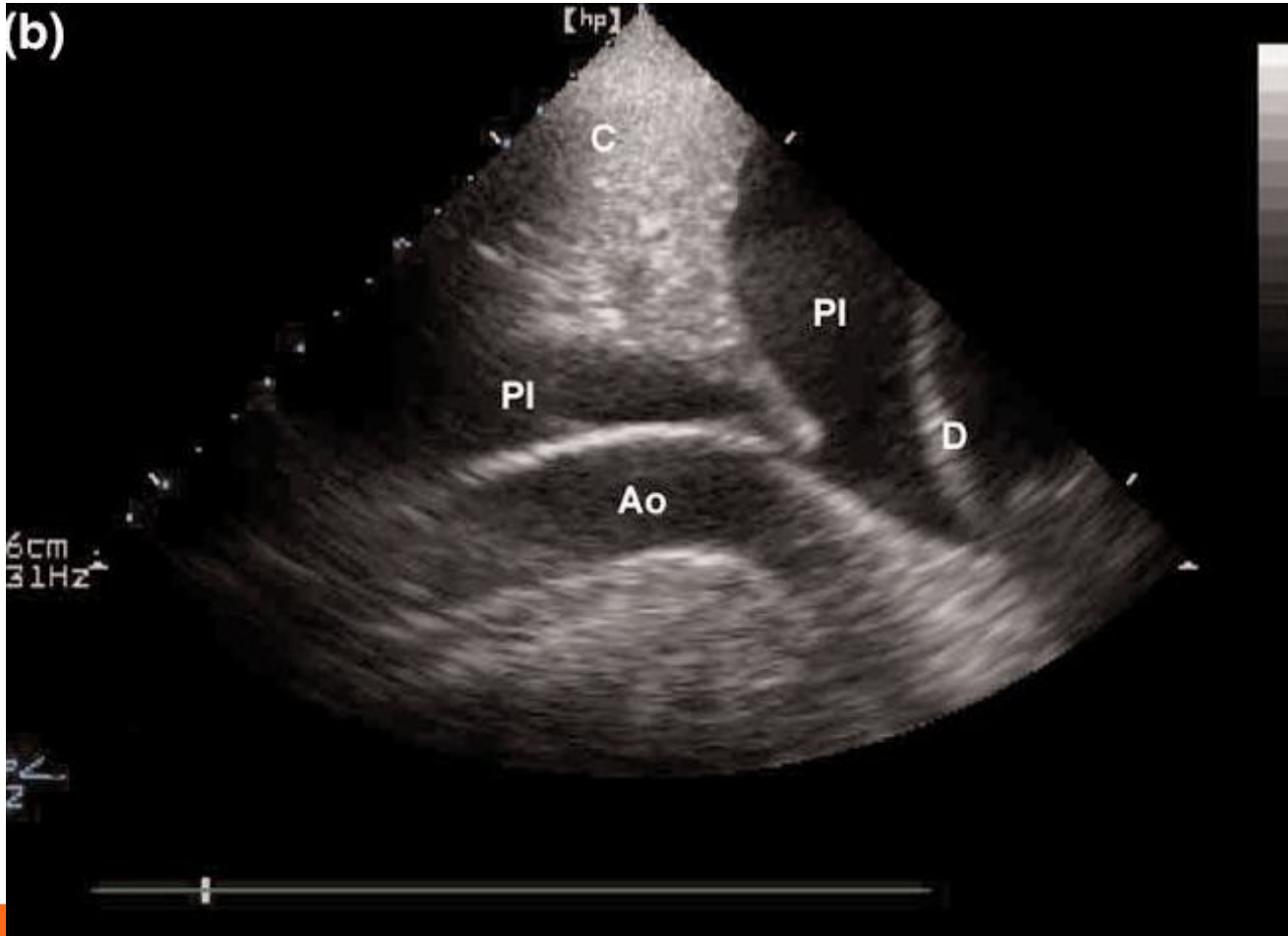


Sonogram suggestive of PE showing a sharply outlined pleural-based lesion, triangular or rounded to the hilus, with a hyperechoic reflection at the center, possibly corresponding to the bronchioles.

VERSAMENTO PLEURICO?

Pleural effusion should be sought on a longitudinal view, in dependant lung regions delineated by the chest wall and the diaphragm. It appears as a hypoechoic and homogeneous structure with no gas inside and is present during expiration and inspiration. In other words, it appears as a dependant dark zone free of echo

Since pleural effusion acts as an acoustic window, lung can be seen as a bright pleural line if it remains aerated. If the pleural effusion is abundant enough to be compressive, the lung is seen consolidated and floating in the pleural effusion

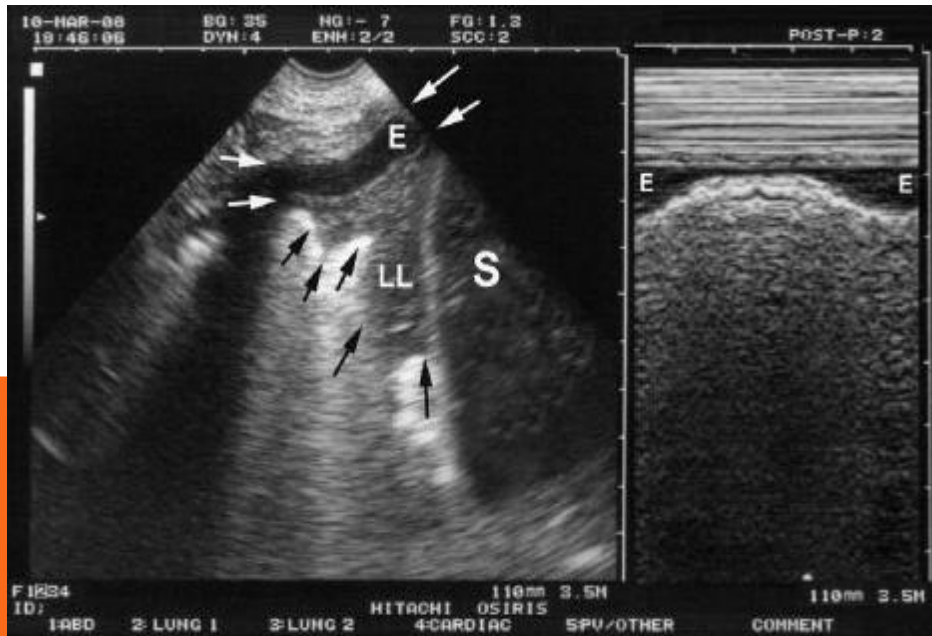


Cephalocaudal view of consolidated left lower lobe: lung consolidation with air bronchograms. Ao, descending aorta; D, diaphragm; PI, pleural effusion Bouhemad Crit Care 2007

VERSAMENTO PLEURICO?

Pleural effusion classically yields an anechoic-dependent pattern an inconstant criterion. The roughly quadrangular shape with a regular lower border (the visceral pleura, called the lung line) was required for the diagnosis. The inspiratory shift of the lung line toward the pleural line is called the sinusoid sign. The sensitivity of these signs is 92%, and specificity is 97%.

Lichtenstein Chest 2008



The quad sign: a pleural effusion on expiration (E) is delineated between the pleural line (upper white arrows) and the lung line, always regular, which indicates the visceral pleura (lower white arrows).

Right panel: time-motion demonstrates the sinusoid sign, a basic dynamic sign of pleural effusion.

EDEMA POLMONARE?

Ultrasound lung comets (ULCs) represent an echocardiographic sign detectable with cardiac ultrasound on the chest and consisting of multiple comet tails fanning out from the lung surface.

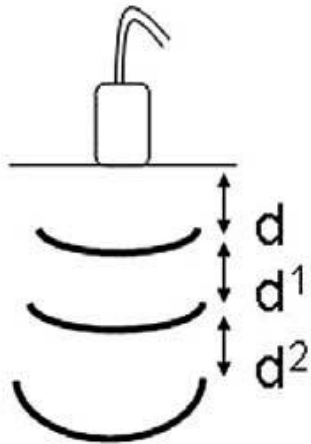
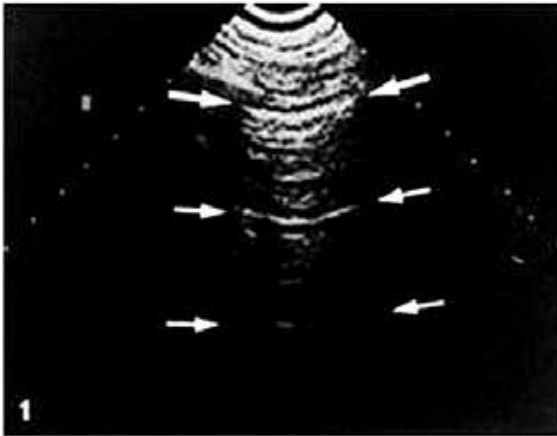
ULCs originate from water-thickened interlobular septa and arise from the hyperechoic pleural line, which represents the parietal and visceral layers of the pleura in normal subjects.

ULCs must be clearly distinguished from normal artifacts, consisting of 1 or 2 roughly horizontal, parallel lines visible at regular intervals below the pleural line.

All diagnostic ultrasound methods are based on the principle that ultrasound is reflected by an interface between media with different acoustic impedance. In normal conditions, with the transducer positioned on the chest wall, the ultrasound beam finds the lung air (ie, high impedance and no acoustic mismatch on its pathway through the chest).

In the presence of extravascular lung water, the ultrasound beam finds subpleural interlobular septa thickened by edema (ie, a low-impedance structure surrounded by air and with a high acoustic mismatch). The reflection of the beam creates a phenomenon of reverberation. When the beam meets the subpleural end of the thickened septum, the time lag between successive reverberations is interpreted by the transducer as a distance, resulting in a center that behaves like a persistent source, generating a series of very closely spaced pseudointerfaces.

Normal Artifact

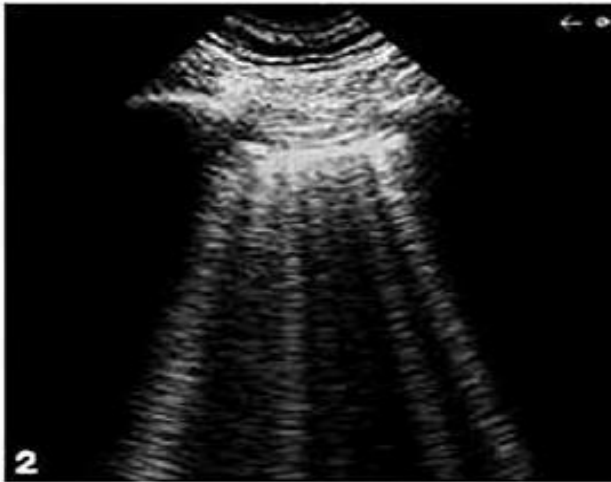


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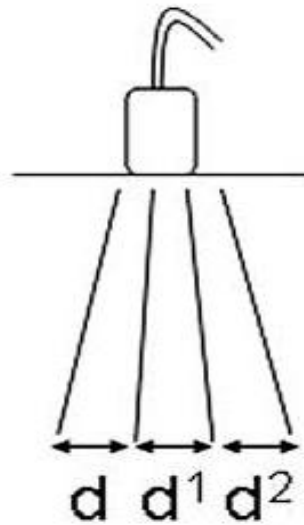
Upper panel: Normal lung appearance with horizontal artifacts originating from the pleural line (parietal and visceral pleura).

Lower panel: Schematic drawing showing how horizontal parallel lines are visible at regular intervals as multiples of the skin–pleural line distance.

The Comet-tail Artifact



Upper panel: Abnormal ULCs in a patient with heart failure and dyspnea. Between 2 ribs (lateral acoustic shadows), a hyperechogenic horizontal reflection represents the pleural line. Several vertical comets fan out from the pleural line, spreading like a laser-ray up to the edge of the screen.



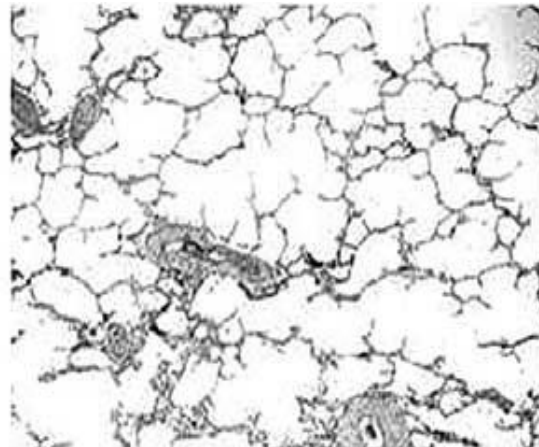
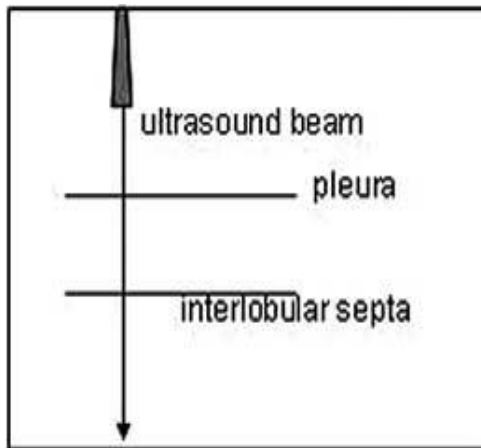
$$d = d^1 = d^2$$

Lower panel: Schematic drawing showing how the horizontal distance between reflections is consistent. Journal of the American Society of Echocardiography 2006

The physical basis of the water comets also explains the sources of pneumogenic comets, which were often found in the presence of radiologic alterations, such as pleuritis, bronchiectasia, or chronic obstructive pulmonary disease. In all of these conditions, fibrosis in the parietal pleura or interlobular septa may occur, which can lead to reflection of the ultrasound wave, generating echo comets.

The physical scatterer is represented by water-thickened interlobular septa with cardiogenic ULCs, and by connective tissue—thickened interlobular septa with pneumogenic ULCs.

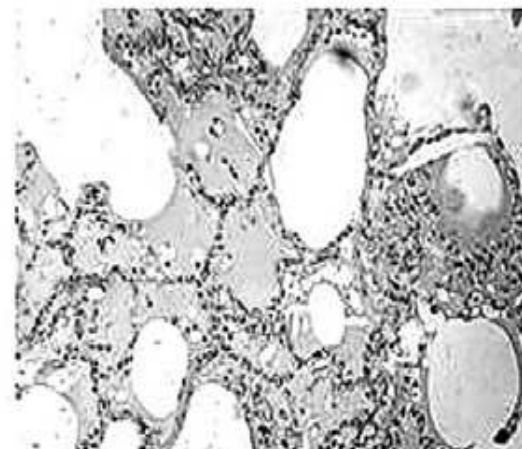
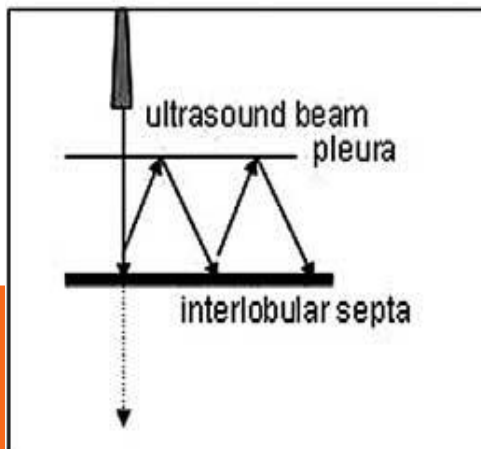
The 2 types of ULCs can pose a challenge to differential diagnosis, although some clues may help distinguish the 2 entities. Cardiogenic ULCs occur in greater numbers and are more diffuse in the right lung than in the left lung, with a “hot zone” of higher density in the right anterior-axillary third intercostal space. Cardiogenic ULCs can be dissolved in a few hours by an acute diuretic load.



normal lung



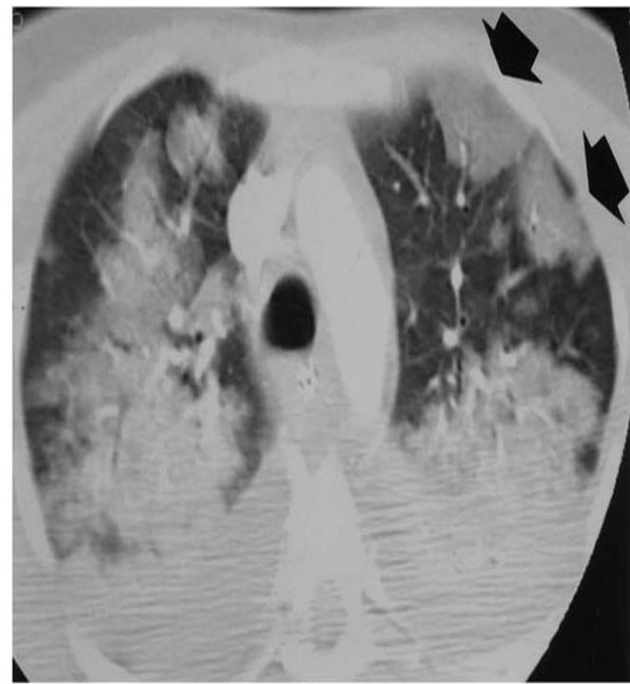
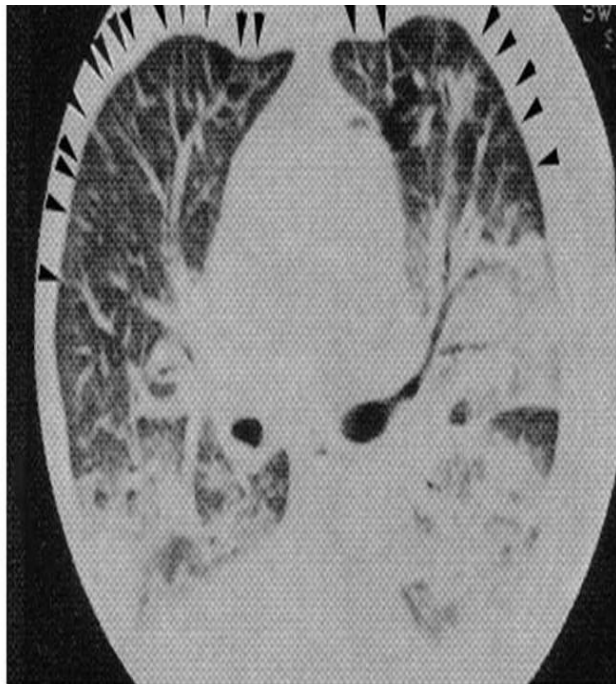
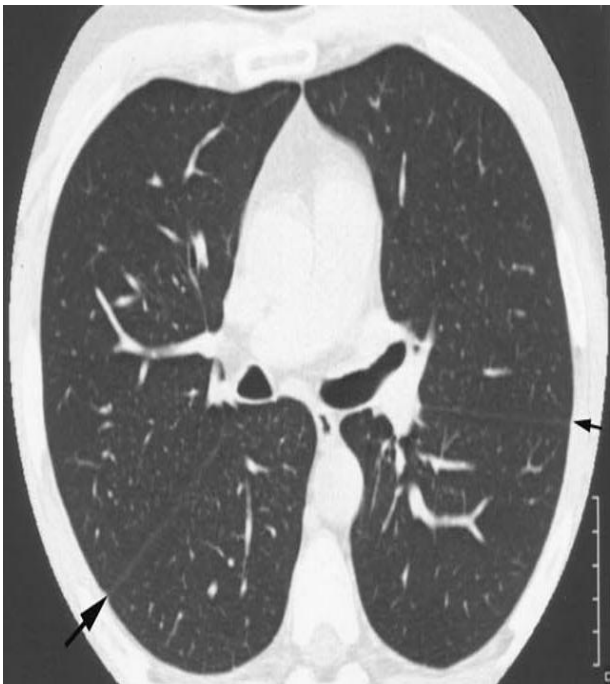
"ring-down" artifacts



pulmonary edema



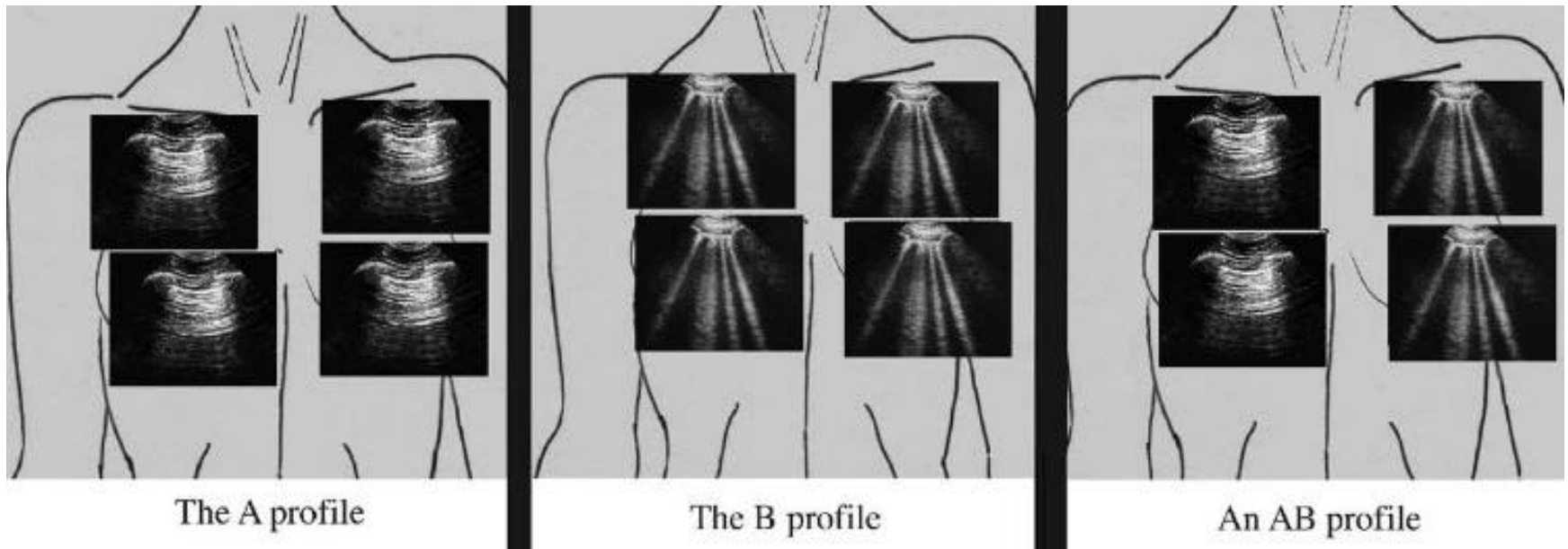
"comet-tail" artifact



Left: normal CT scan. No element is visible at the anterior chest wall (apart from isolated fissures [arrows]). Middle: acute alveolar and interstitial syndrome. The subpleural interlobular septa are thickened and therefore visible on the CT scan (arrows). Right: acute alveolar and interstitial syndrome Ground-glass areas about the anterior left lung (arrows). Chest 2008



Left: healthy subject. One isolated B-line, called “b-line,” without pathologic meaning (possibly minor fissura). Middle and right: pulmonary edema. Several (three or more) B-lines are visible between two ribs, and define interstitial syndrome. This pattern was labeled lung rockets (or B lines). Middle: four or five B-lines are visible. The distance between two B-lines (at the pleural line) is roughly 7 mm in the adult, hence the name “B7-lines.” B7-lines correlate with thickened subpleural interlobular septa. Right: seven or eight B-lines are visible, called B-3 lines (the distance between two B-lines at the pleural line is roughly 3 mm). B3-lines correlate with subpleural ground-glass lesions.



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.

Table 4—Accuracy of the Ultrasound Profiles*

Disease	Ultrasound Signs Used	Sensitivity, %	Specificity, %	Positive Predictive Value, %	Negative Predictive Value, %
Cardiogenic pulmonary edema	Diffuse bilateral anterior B+ lines associated with lung sliding (B profile)	97 (62/64)	95 (187/196)	87 (62/71)	99 (187/189)
COPD or asthma	Predominant anterior A lines without PLAPS and with lung sliding (normal profile), or with absent lung sliding without lung point	89 (74/83)	97 (172/177)	93 (74/79)	95 (172/181)
Pulmonary embolism	Predominant anterior bilateral A lines plus venous thrombosis	81 (17/21)	99 (238/239)	94 (17/18)	98 (238/242)
Pneumothorax	Absent anterior lung sliding, absent anterior B lines and present lung point	88 (8/9)	100 (251/251)	100 (8/8)	99 (251/252)
Pneumonia	Diffuse bilateral anterior B+ lines associated with abolished lung sliding (B' profile)	11 (9/83)	100 (177/177)	100 (9/9)	70 (177/251)
	Predominant anterior B+ lines on one side, predominant anterior A lines on the other (A/B profile)	14.5 (12/83)	100 (177/177)	100 (12/12)	71.5 (177/248)
	Anterior alveolar consolidation (C profile)	21.5 (18/83)	99 (175/177)	90 (18/20)	73 (175/240)
	A profile plus PLAPS	42 (35/83)	96 (170/177)	83 (35/42)	78 (170/218)
	A profile plus PLAPS, B', A/B or C profile	89 (74/83)	94 (167/177)	88 (74/84)	95 (167/176)

*Data in parenthesis indicate No. of patients (total)

