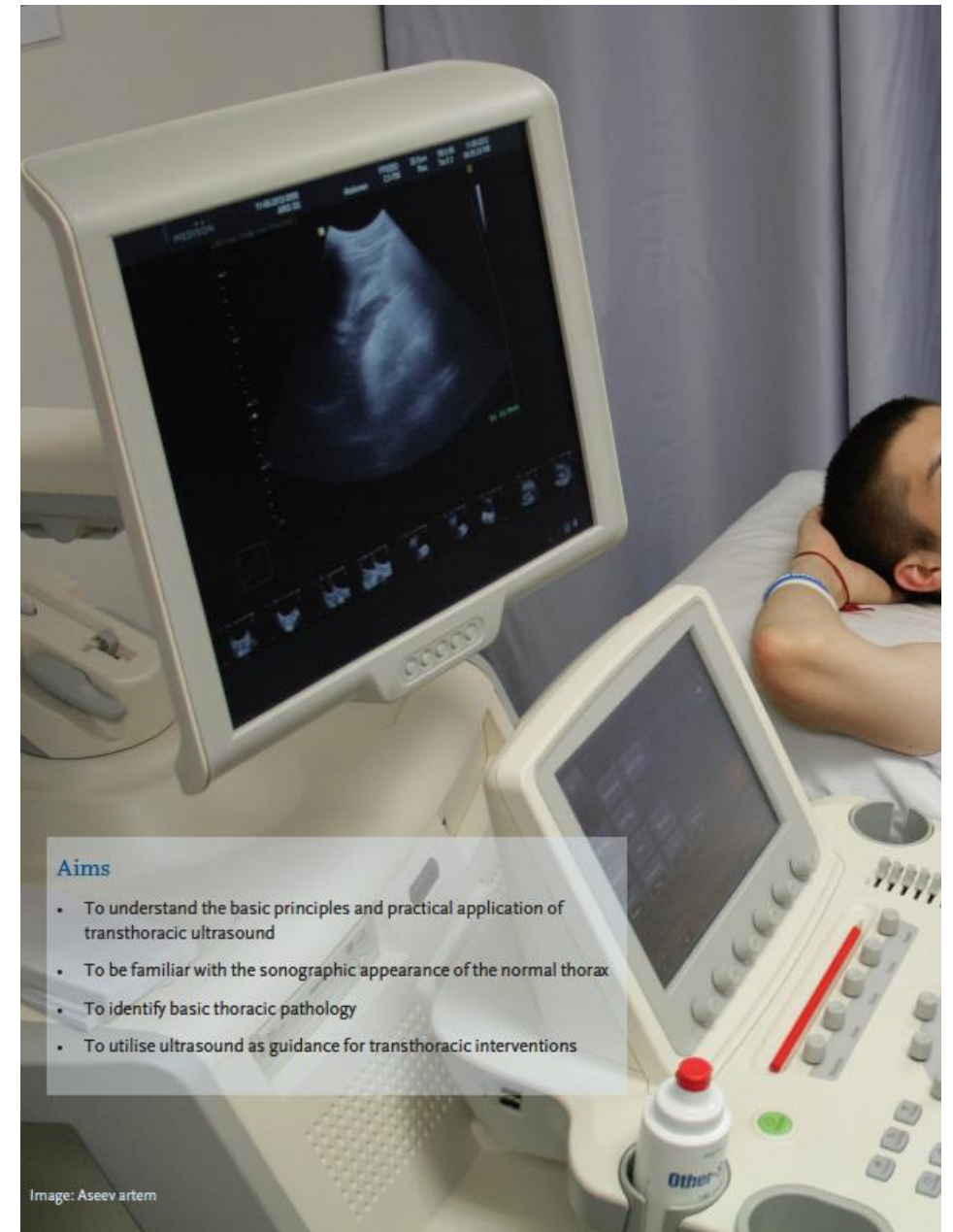


ΔΙΑΘΩΡΑΚΙΚΗ ΥΠΕΡΗΧΟΓΡΑΦΙΑ

ΠΝΕΥΜΟΝΙΑ



Aims

- To understand the basic principles and practical application of transthoracic ultrasound
- To be familiar with the sonographic appearance of the normal thorax
- To identify basic thoracic pathology
- To utilise ultrasound as guidance for transthoracic interventions

Image: Aseev artem

Pneumonia is an inflammatory, most commonly infectious process involving the lungs

Typically the alveoli in intensely inflamed areas fill with inflammatory fluid or pus, and this is known as **consolidation**

The changes may be widespread, patchy or lobar

Ultrasound can detect the pulmonary changes associated with pneumonia as long as the process involves some of the outer (non-mediastinal) pleural surface – as it almost always does



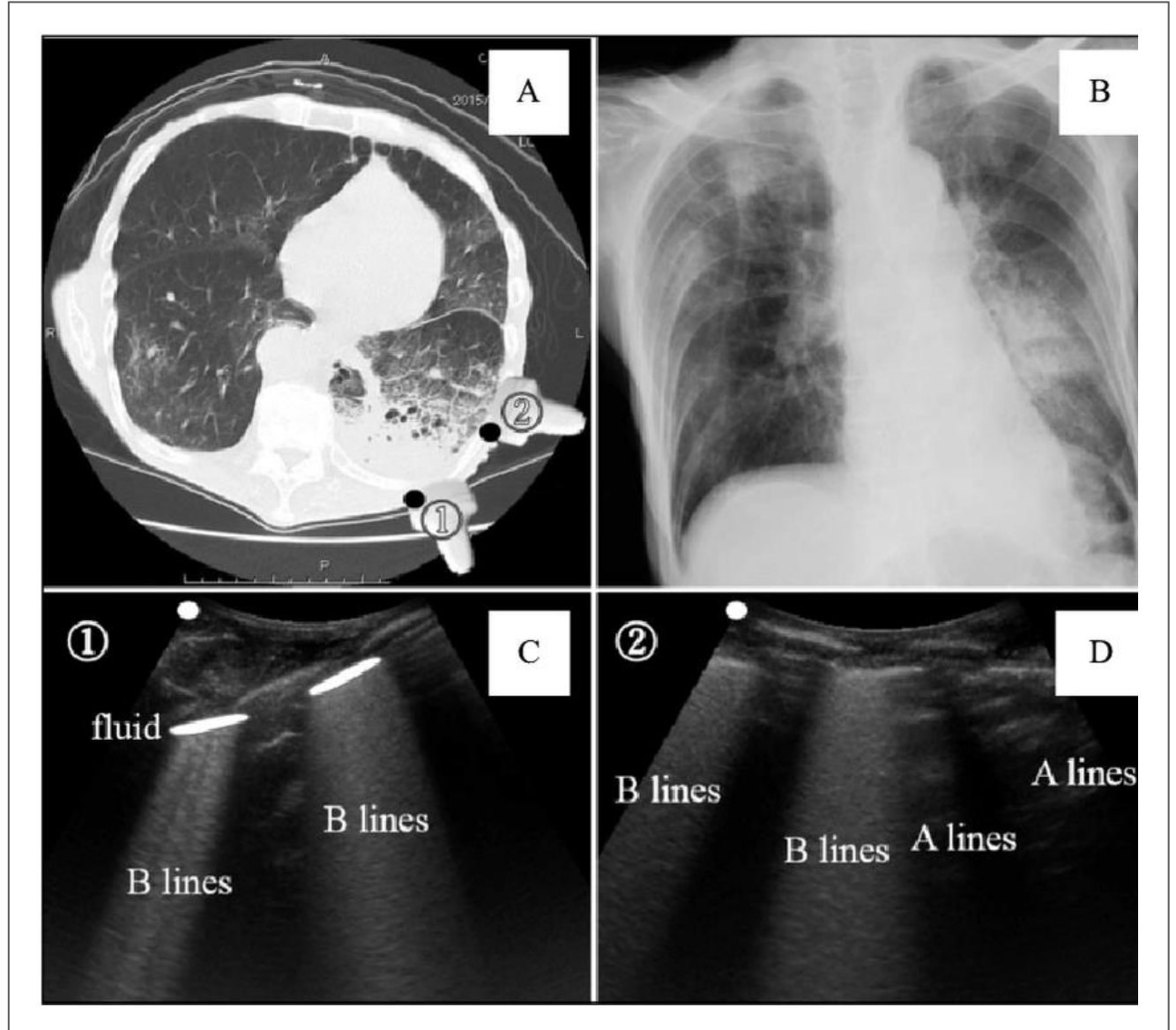
The ultrasound appearance of pneumonia

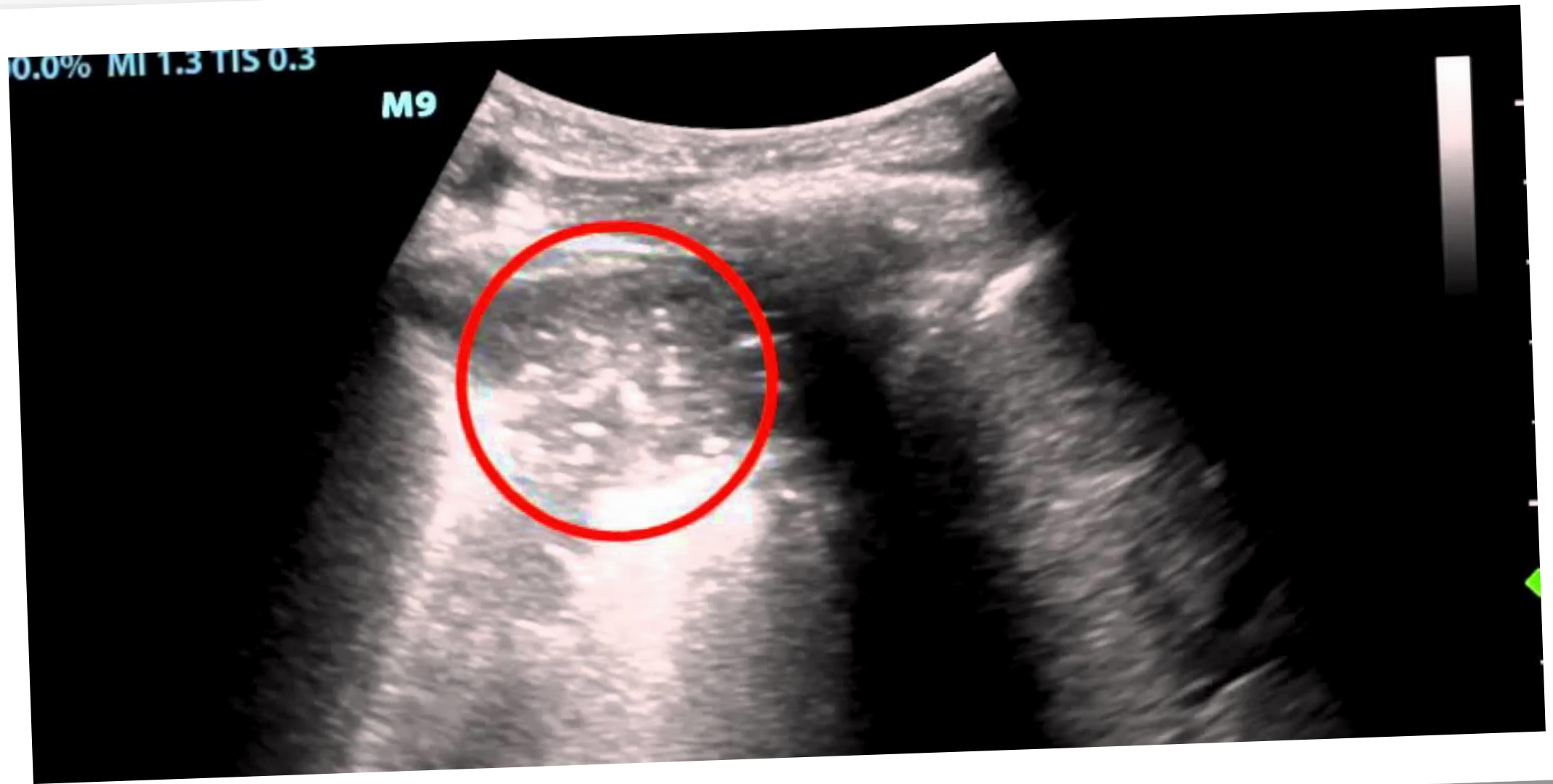
Pneumonia progresses through stages, and the ultrasound changes vary depending on the degree and extent of consolidation

- **Early pneumonia – B-lines and tiny areas of sub pleural consolidation**
- **Solid appearing consolidated lung – hepatization**
- **Irregular consolidation / air interface – the shred sign**
- **Aerated bronchi – air bronchograms and dynamic air bronchograms**
- **Associated pleural effusion or empyema**

Early pneumonia

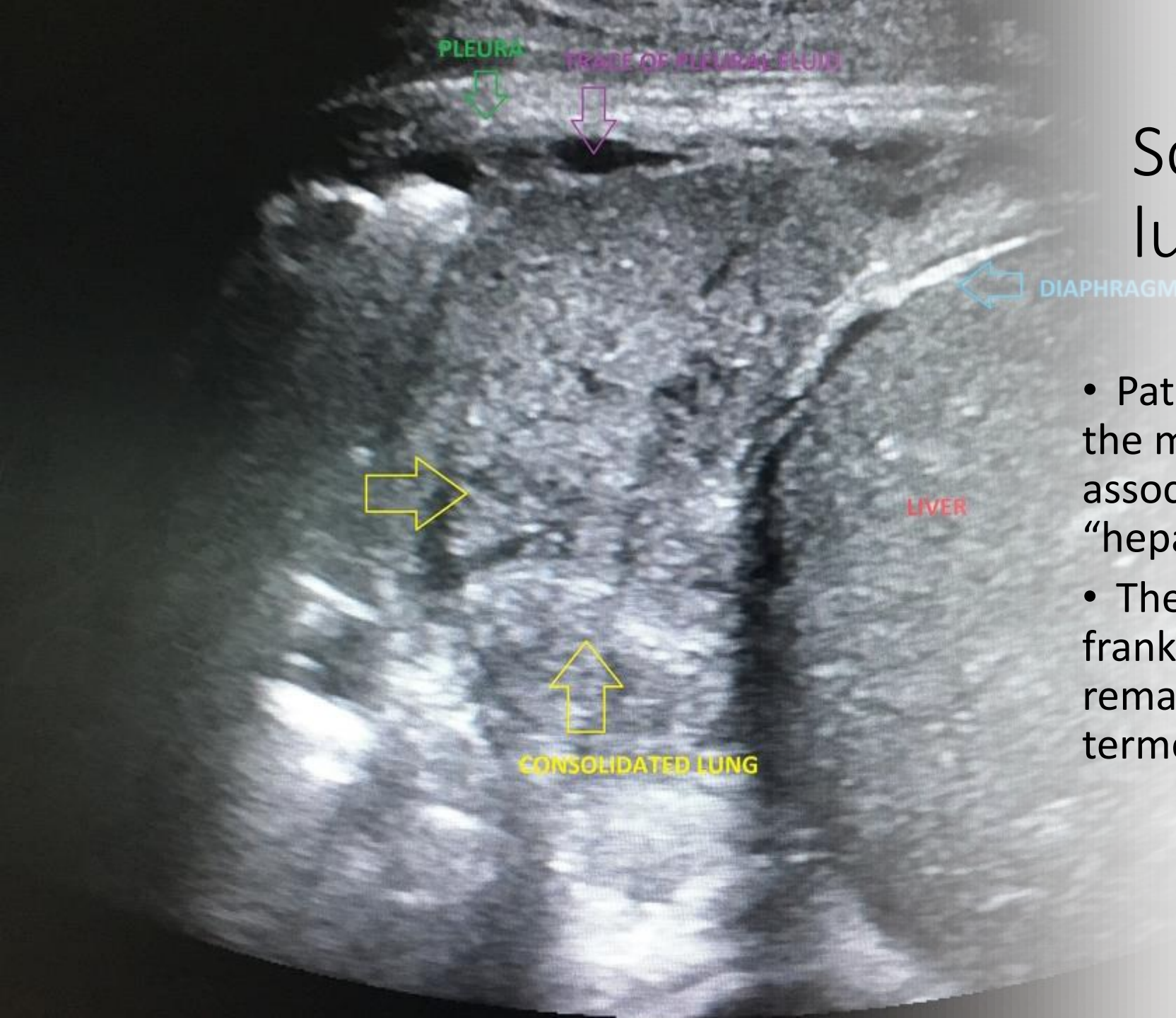
- In early pneumonia fluid fills only some of the alveoli
- Where fluid filled alveoli are surrounded by air filled lung, **B-lines**
- In the appropriate clinical setting a localised patch of numerous B-lines, often with tiny areas of sub pleural consolidation, suggests early pneumonia

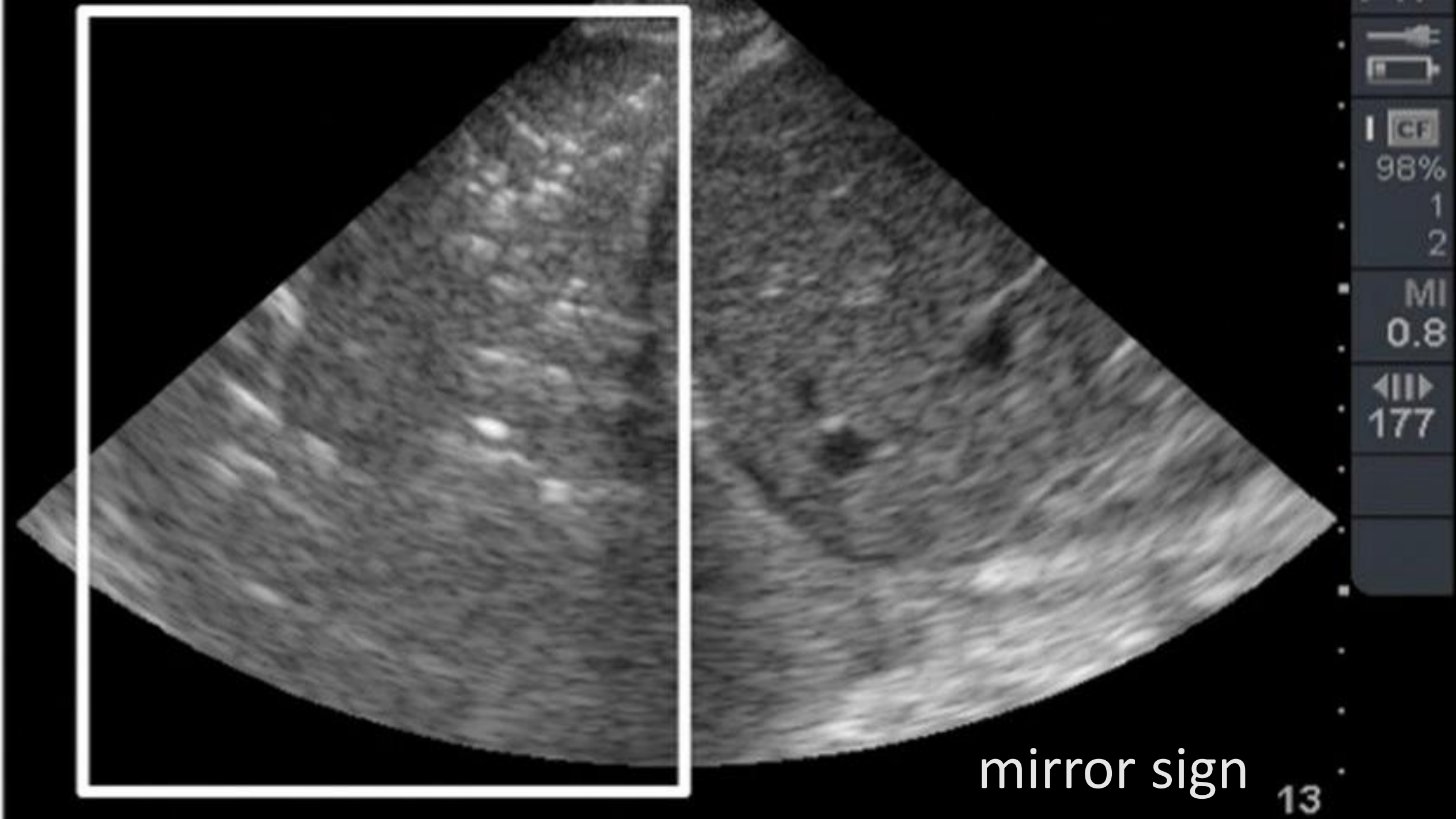




Solid consolidated lung – hepatization

- Pathologists have long described the macroscopic changes associated with consolidation as “hepatization” of the lung
- The sonographic appearance of frank consolidation looks remarkably liver-like and is also termed **hepatization**





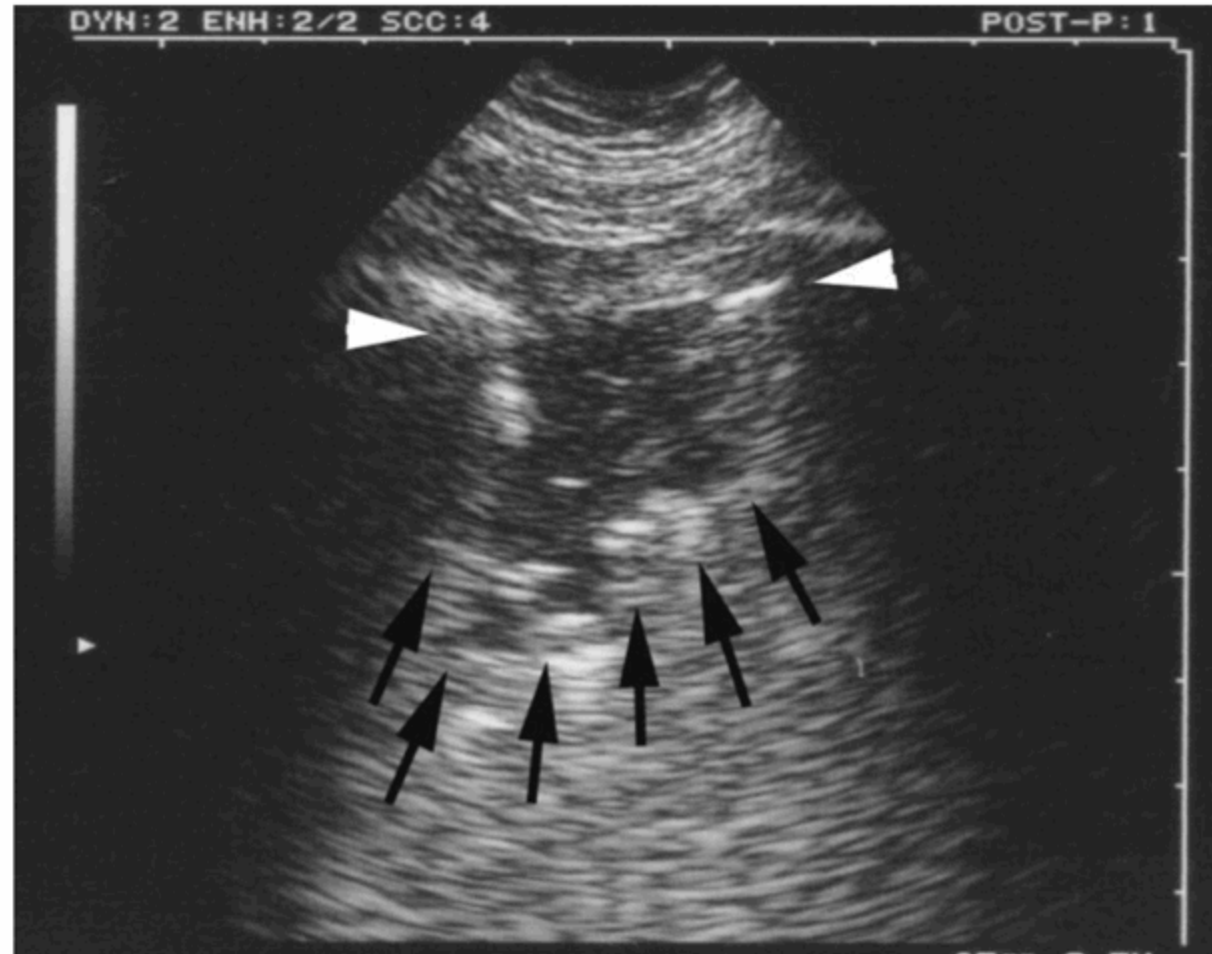
Left

BASE



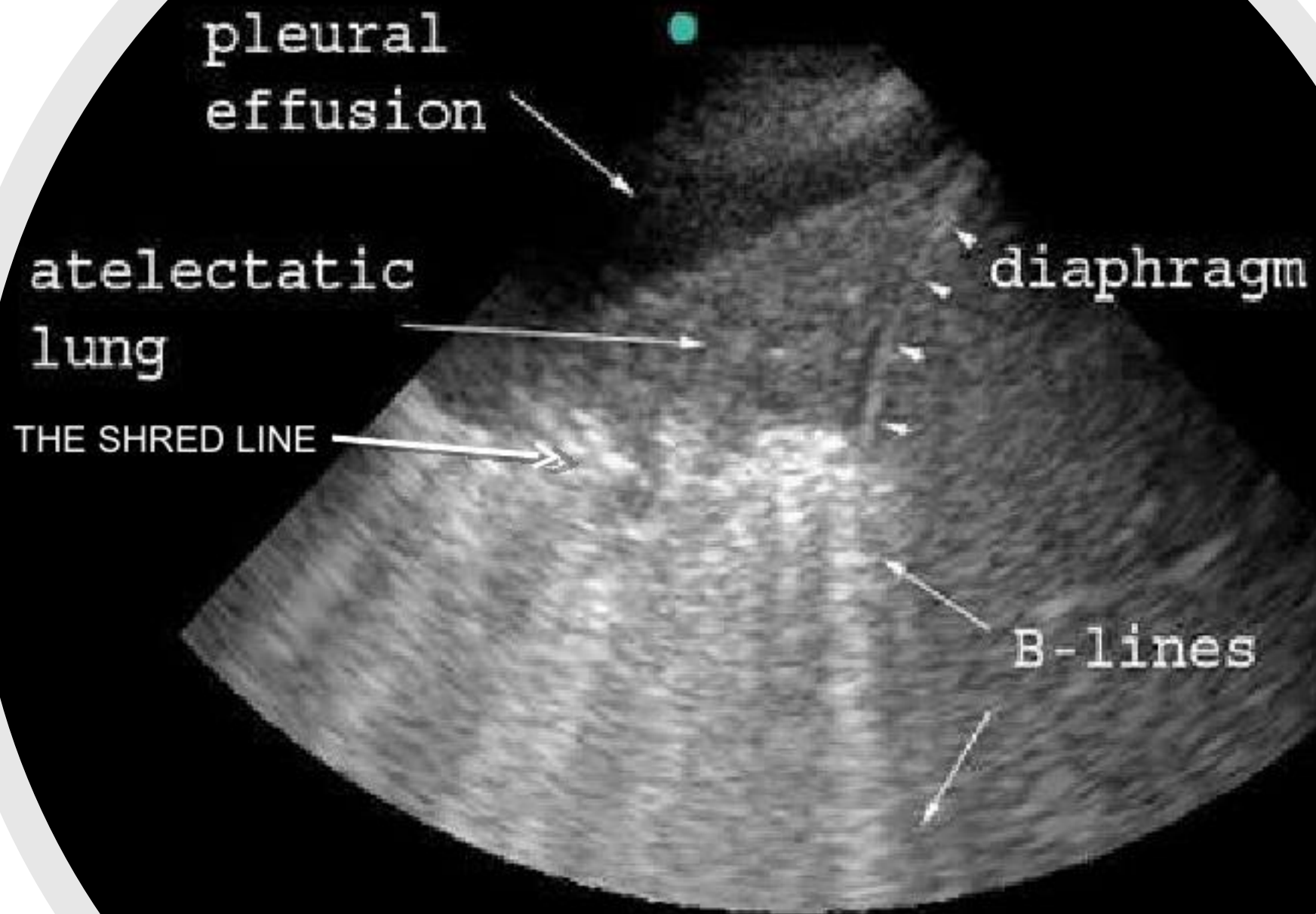
Irregular consolidation / air interface – the shred sign

- If there is lobar consolidation the borders of the consolidated areas will be linear and well defined – as consolidated and aerated lung lie adjacent on opposite sides of the linear pleural fissures
- More commonly there are smaller areas of consolidation. Where these abut the pleural surface they are linear, but their deeper borders usually demonstrate an irregular interface with underlying aerated lung. This irregular junction between consolidated and aerated lung is known as the “shred sign”



Shred sign: aerated lung tissue adjacent to a consolidated area reflects ultrasound waves, obscuring any distant structure (black areas indicate the area of “shredding”)

- Lichtenstein D Chest 2009; 135: 1421



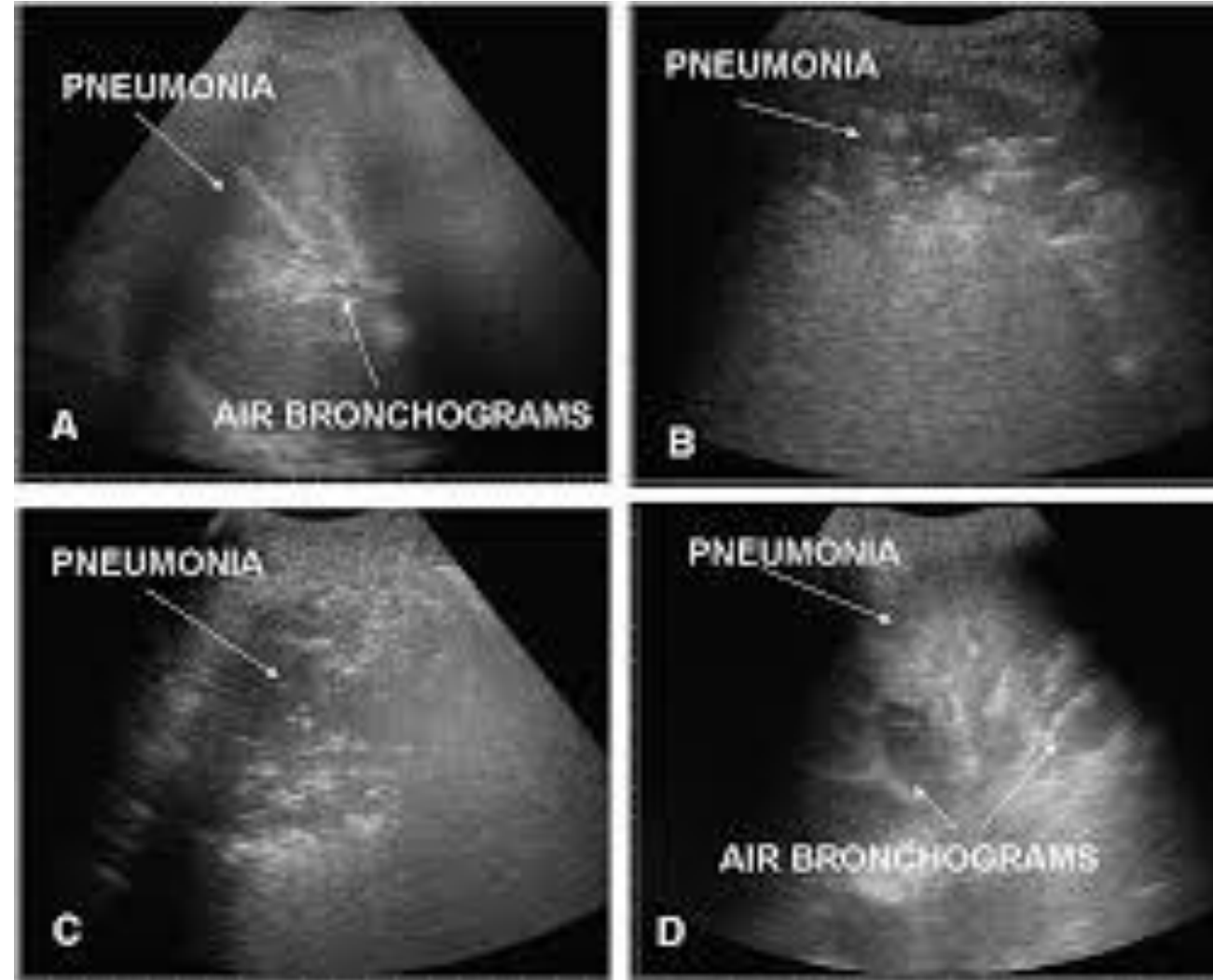
Aerated bronchi

air bronchograms and dynamic air bronchograms

- Air within the consolidated area may remain in small aerated patches of lung, or more commonly air remains within small bronchi. The echogenic appearance of small air bubbles all lined up within a bronchus is known as the **the sonographic air bronchogram**
- When the small bubbles in an air bronchogram can be seen to bubble in and out with each breath the term **“dynamic air bronchogram”** is used. This means that there is no complete bronchial obstruction and infers the solid lung is more likely due to true consolidation rather than collapse associated with reabsorption atelectasis
- With time the air within air bronchograms is replaced with fluid. Fluid filled bronchi have a branched hypoechoic appearance with relatively echogenic walls. Colour Doppler fails to demonstrate flow within the lumen.

Air bronchograms

Placing the probe on the right posterolateral lung field, you see something abnormal. Instead of seeing a linear pleural line between ribs and a-lines, you see a hypoechoic pulmonary consolidation that contains hyperechoic lines and flecks that move with respiration. These are known as **air bronchograms**



Air bronchograms

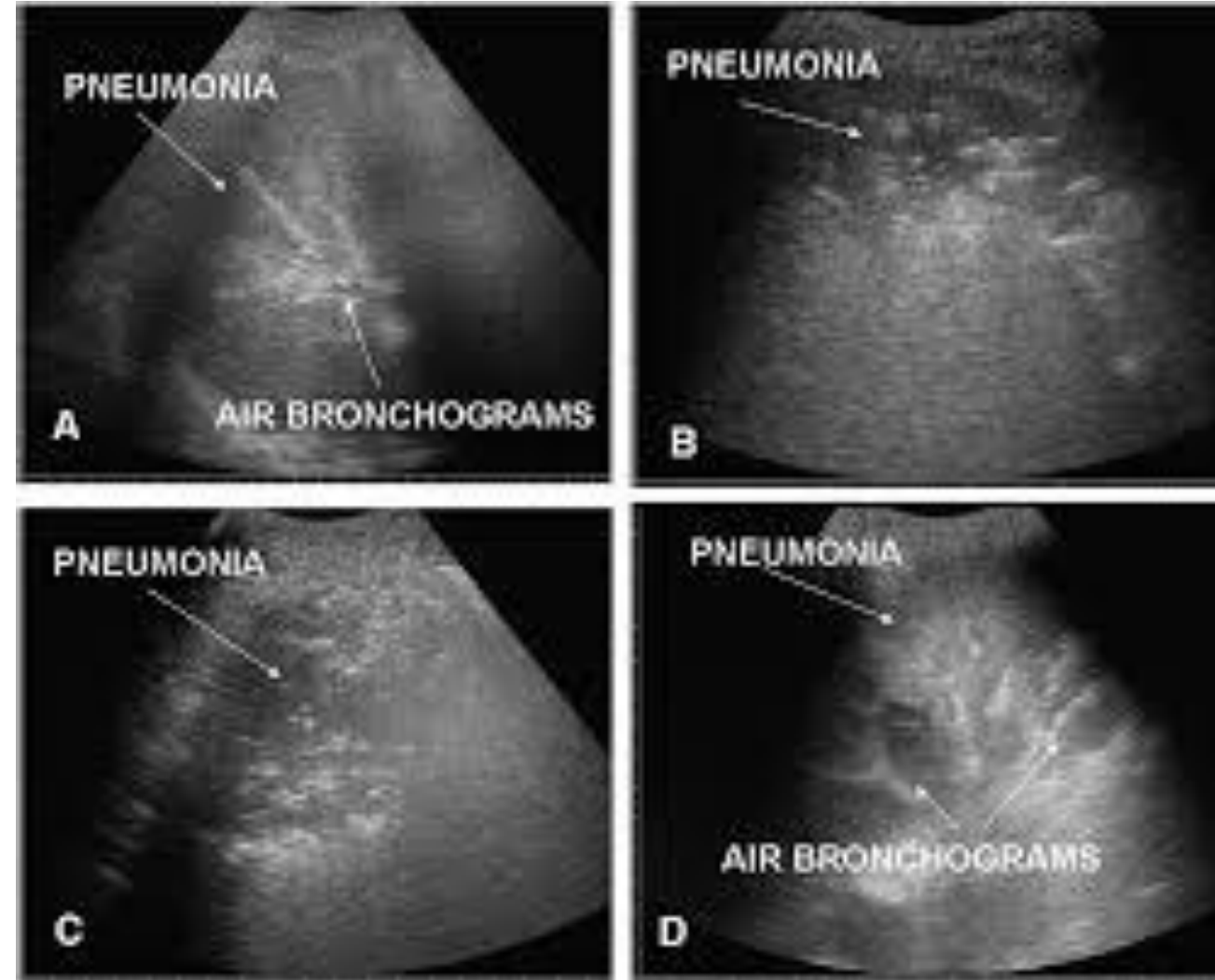
- The most specific sign for the diagnosis of pneumonia is the presence of **air bronchograms**, which are hyperechoic lines and dots within a hypoechoic area, thought to represent air trapped in small airways within a consolidation
- Air bronchograms are divided into two types: Dynamic and Static
 - If the bronchograms are mobile, they are considered **dynamic** air bronchograms and are thought to be **pathognomonic** for pneumonia.
 - If the bronchograms are immobile they are then called **static** air bronchograms which can be seen in both atelectasis and pneumonia

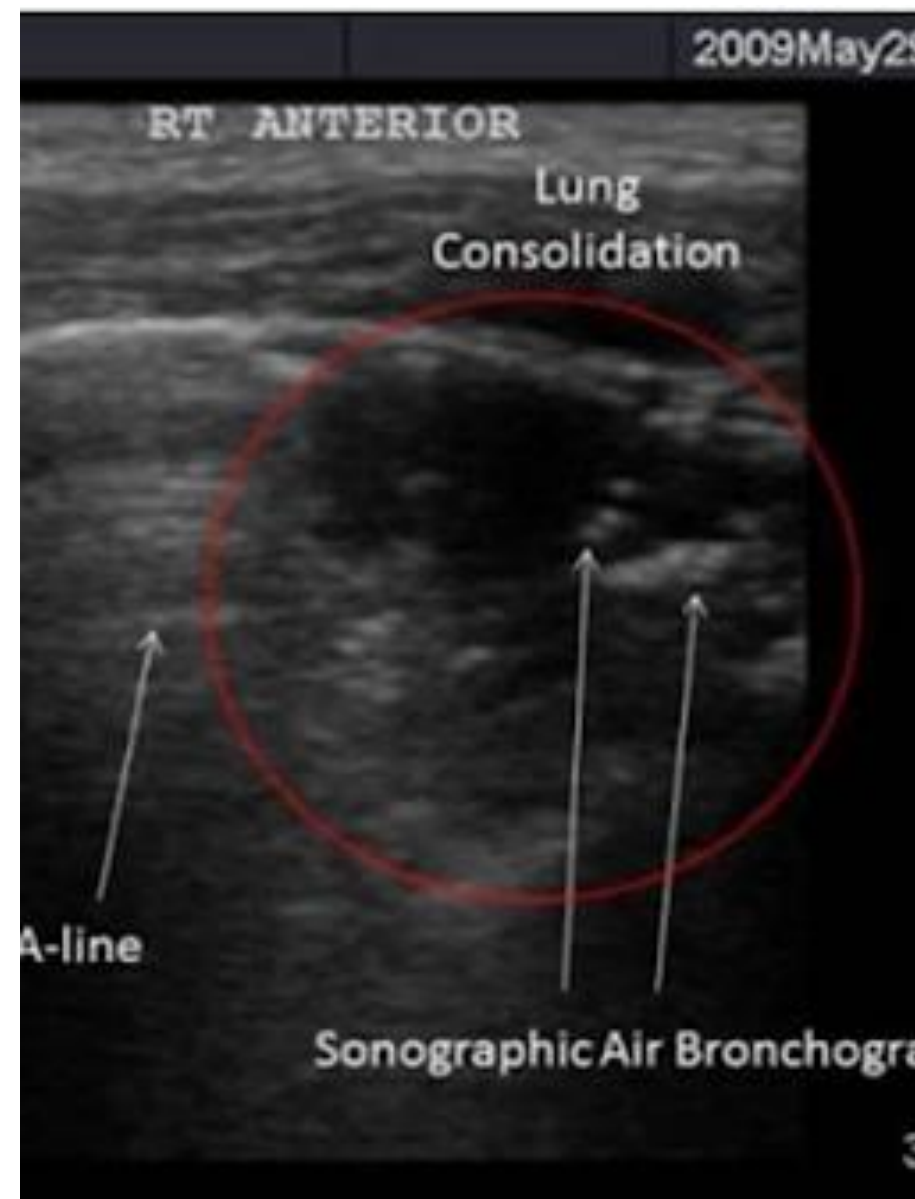
Το σημείο του αεροβροχογράμματος

Το σημείο του αεροβροχογράμματος αποτελεί σημαντικό διαγνωστικό σημείο στη διαφορική διάγνωση μεταξύ πνευμονίας και ατελεκτασίας

Το **δυναμικό αεροβροχόγραμμα** χαρακτηρίζεται από παρουσία αέρα σε δυναμική κίνηση εντός του βρογχικού δικτύου και απαντάται στην κυψελιδική πύκνωση. Το σημείο αυτό παρουσιάζει 94% και 97% ειδικότητα και θετική προγνωστική αξία, καθώς και 61% και 43% ευαισθησία και αρνητική προγνωστική αξία στη διάγνωση της πνευμονίας έναντι της ατελεκτασίας.

Αντίθετα, το **στατικό αεροβροχόγραμμα** αποτελεί σημείο ενδεικτικό ατελεκτασίας και απεικονίζεται με την ανάδειξη του στατικού εναπομείναντα εγκλωβισμένου αέρα εντός της ατελεκτατικής περιοχής του πνεύμονα.







Associated pleural effusion or empyema

A small, hypoechoic parapneumonic effusion is frequently demonstrated. Echogenic debris within the effusion can suggest empyema

Υπερηχογραφική απεικόνιση πνευμονίας - Περιορισμοί της μεθόδου

- ❖ Το υποδόριο εμφύσημα αποτελεί έναν από τους σημαντικούς περιορισμούς της εξέτασης, βασιζόμενο στο γεγονός της αδυναμίας των ηχητικών κυμάτων να διαπεράσουν αεροπληθείς δομές
- ❖ Αποτιτανώσεις του υπεζωκότα, παρουσία συμφύσεων και πλευροδεσία είναι καταστάσεις που περιορίζουν τη χρήση του διαθωρακικού υπερηχογραφήματος
- ❖ Επίσης, σημαντική θεωρείται και η προαπαιτούμενη εκπαίδευση του εξεταστή, τόσο στην απεικόνιση του φυσιολογικού πνεύμονα και υπεζωκότα, όσο και στην αναγνώριση παθολογικών καταστάσεων