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Short Communication

Pleural Separation Sign: Posterior–Basal Predominance and Physiologic Interpretation

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Abstract

Background: The pleural line in lung ultrasound normally appears as a single, thin, hyper echoic contour representing the close adherence of the parietal and visceral pleura. Under certain chronic or post-inflammatory conditions, these layers may be visualized separately.

Objective: To describe and interpret the pleural separation sign as a potential sonographic indicator of chronic visceral pleuritis.

Methods and Observations: In basal and posterior lung zones, 2.5-5MHz frequency ultrasound probe revealed double pleural contours in chronic pulmonary and post-cicatricial disease. This likely reflects fibrotic or ischemic remodeling of the visceral pleura leading to partial decoupling from the parietal layer.

Conclusion: The pleural separation sign may assist in differentiating chronic from acute pleural processes and even chronic from acute pulmonary embolism, particularly in posterior–basal regions where mechanical and vascular factors favor stable visualization.

Keywords: pleural separation sign; chronic visceral pleuritis; lung ultrasound; posterior–basal predominance; pulmonary embolism.

Background

In standard lung ultrasonography, the pleural line appears as a single, thin, hyper echoic interface representing the close apposition of the parietal and visceral pleura. These layers are normally indistinguishable due to their tight adherence and synchronous movement ("lung sliding"). However, in high-frequency imaging, certain pathologic conditions may reveal a double pleural contour, suggesting that the parietal and visceral pleurae can sometimes be resolved separately.

Clinical Observation and Deductive Hypothesis

In acute microbial pleuritis, the inflammatory process is characterized by edema, fibrin deposition, and a reactive exudate that increases pleural reflectivity but maintains adherence between layers. Consequently, the pleural complex appears thickened but unified. In contrast, during chronic or post-inflammatory stages, fibrosis, focal retraction, or partial detachment of the visceral pleura can create a microscopic separation. This may produce two parallel hyper echoic lines — the parietal and visceral pleurae — separated by a narrow hypo echoic interspace corresponding to fibrotic or residual fluid tissue. Thus, the probability of visualizing separated pleural layers may be lower in acute inflammation (due to adhesion and exudate) and higher in chronic pleuritic remodeling (due to fibrosis and mechanical decoupling).

Ultrasound Correlates

- A curved probe (2.5–5 MHz) may reveal a double pleural contour when the acoustic impedance between layers differs.
- Dynamic assessment may show asynchronous motion of the two layers in chronic fibrosis, versus unified sliding in acute inflammation.
- This sign differs from A-lines (deeper) and from costal cartilage contours (non-mobile, curved).

Physiopathologic Rationale

The hypothesis aligns with tissue acoustic principles: edema and fibrin homogenize impedance (single reflection), while chronic fibrosis introduces discontinuity (dual reflection).

From a mechanical standpoint, the posterior–basal regions of the lungs exhibit unique structural and functional characteristics that favor the visualization of pleural separation. Posterior diaphragmatic excursion is smaller because the dome of the diaphragm rises higher and forms a steeper angle with the posterior thoracic wall. The posterior intercostal musculature, designed primarily for stabilization rather than expansion, contributes to limited displacement of the parietal pleura during inspiration.

The pulmonary vascular network is denser posteriorly, with larger and more numerous segmental branches, and venous drainage converging toward the left atrium through posterior pathways. These regions sustain both higher and more stable perfusion, yet the flow velocity is lower, leading to relative vascular stasis.

In these dependent areas, the intrapleural pressure is less negative, producing slightly smaller alveoli and a reduced transpulmonary gradient compared with anterior zones. The combination of mechanical stability, dense vascularity, and slower microcirculatory flow enhances the acoustic contrast of the pleural interface, making any structural dissociation between the visceral and parietal pleura more apparent.

This physiologic background also explains why most peripheral infarcts, pleural irregularities, and chronic vascular changes in pulmonary embolism are preferentially detected in posterior– basal regions.

Potential Applications

If validated, this "double pleural line" could serve as a bedside sonographic marker of chronic visceral pleuritis, aiding differential diagnosis between active and **chronic or sequel lesions.**

Diagnostic Considerations

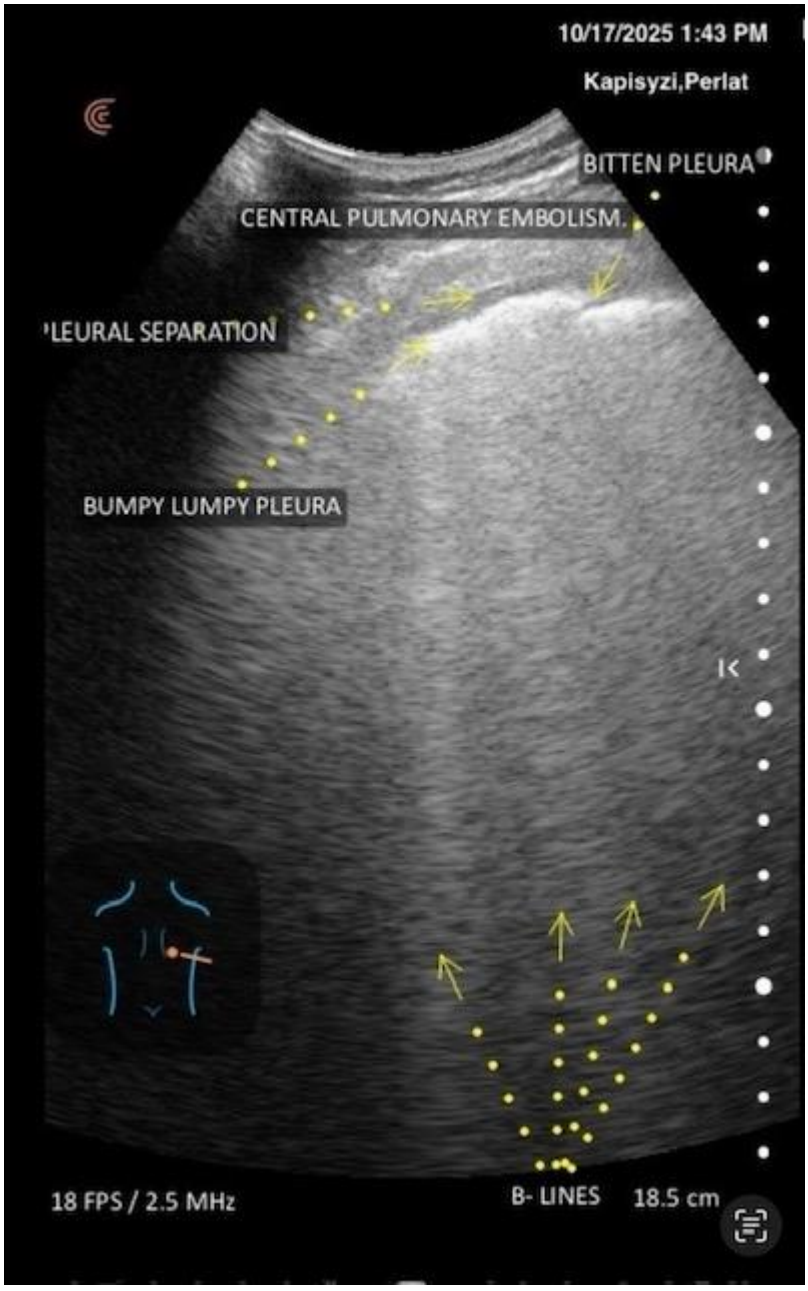
When we are faced with an ultrasound image showing a separation between the parietal and visceral pleurae, each with different thickness or echogenicity, an immediate clinical question arises: what diagnostic possibilities can explain this finding?

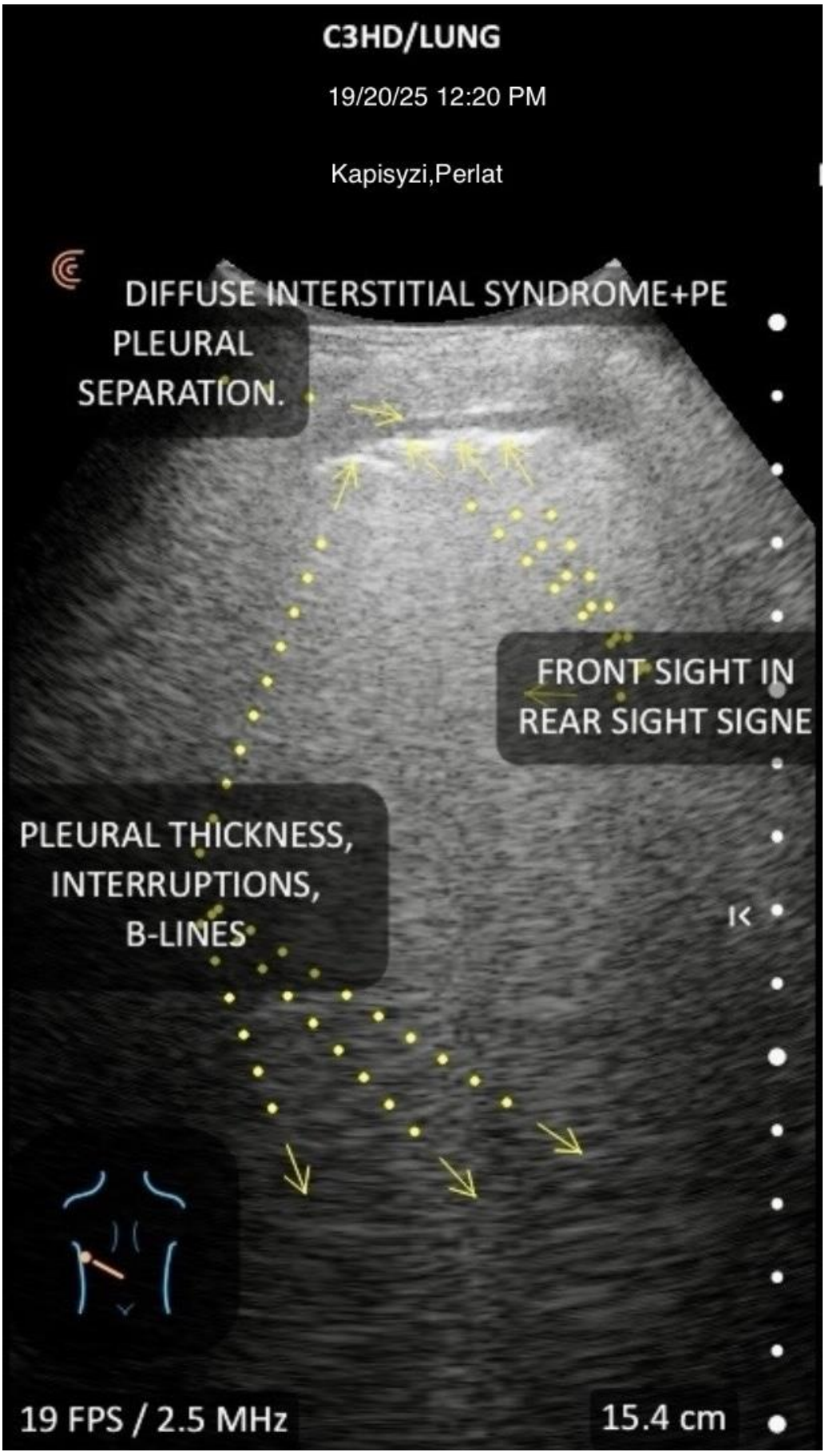
This sonographic configuration most often reflects a chronic, viscerally predominant process at the pleural–pulmonary interface. In acute pleuritis, fibrin and exudate adhere the two layers into a single thickened contour; in contrast, the chronic stage may induce partial fibrotic or mechanical decoupling, allowing the visceral and parietal pleurae to be visualized separately.

Several conditions may explain this pattern:

- Diffuse chronic interstitial lung diseases — such as idiopathic pulmonary fibrosis, asbestosis, and sarcoidosis — typically originate in the sub pleural alveolar regions, with inflammatory and fibrotic spread toward the visceral pleura, while the parietal layer remains uninvolved.
- Chronic vascular lesions, especially following pulmonary embolism or peripheral infarction, may result in localized ischemic fibrosis of the visceral pleura, since the vascular supply of this layer derives mainly from the pulmonary circulation. Notably, in this context, the presence of a clear pleural separation could even help to differentiate chronic thromboembolic disease (where fibrosis and retraction have occurred) from acute embolic events, in which the pleural line usually remains unified and reactive rather than structurally dissociated.
- Mechanical or post-fibrotic processes, including cicatricial or constrictive atelectasis, can create tractional thickening and retraction of the visceral pleura, producing a "double contour" with reduced or asynchronous motion compared to the outer parietal line.
- In selected cases, post-inflammatory sequelae of diffuse viral pneumonitis (e.g., post-COVID fibrosis) may also lead to focal chronic thickening of the visceral pleura, independent of parietal involvement.

In all these entities, the parietal pleura remains morphologically preserved, while the visceral pleura becomes thickened, less mobile, and distinguishable as a separate hyper echoic interface. Recognition of this subtle, often **disproportional pleural separation** should therefore orient the clinician toward chronic, non-exudative, viscerally confined inflammatory or fibrotic processes, and in the vascular setting, may also provide a non-invasive sonographic clue to distinguish chronic from acute pulmonary embolism.

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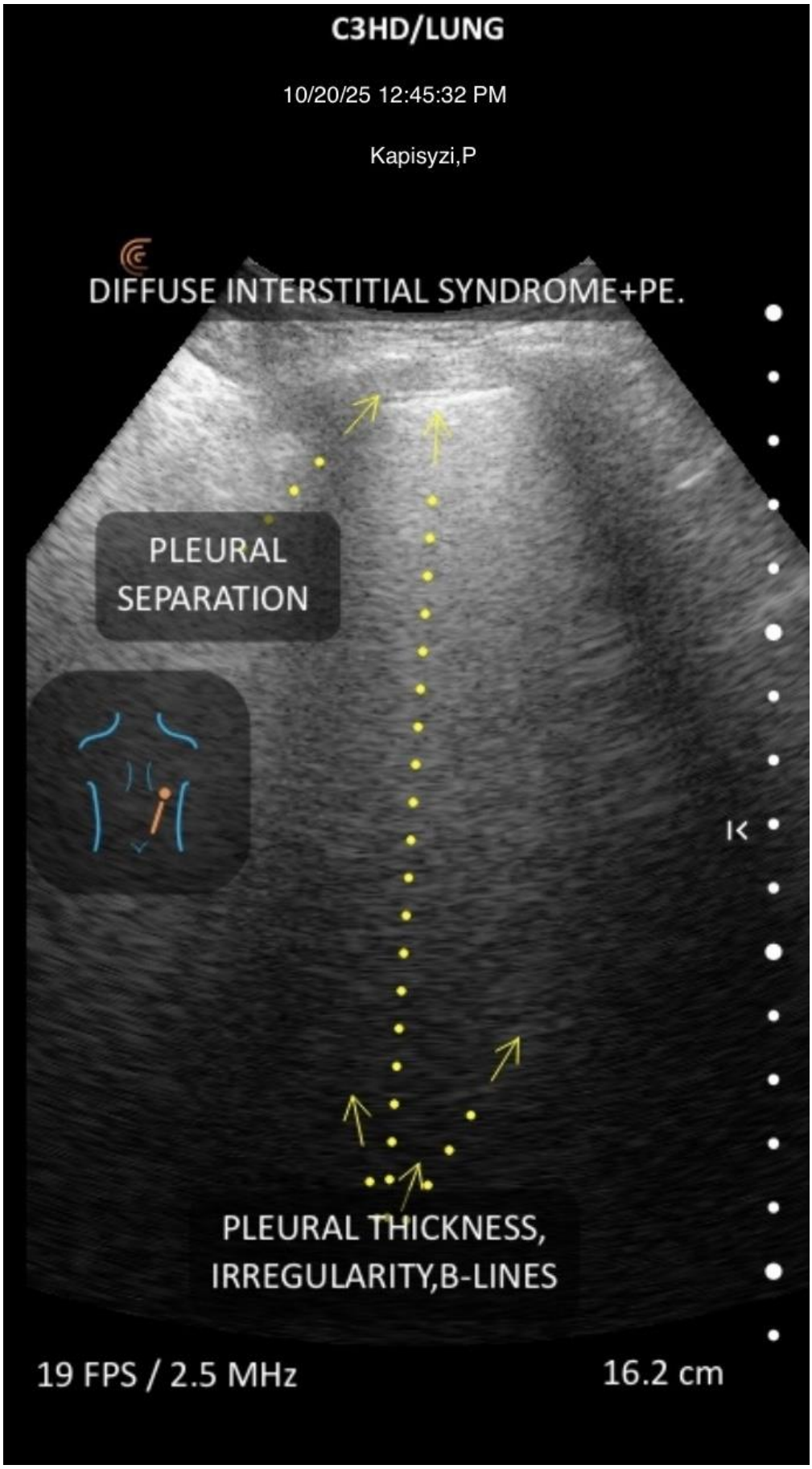
Kapisyzi,Perlat
DIFFUSE INTERSTITIAL SYNDROME+PE
PLEURAL SEPARATION.
FRONT SIGHT IN REAR SIGHT SIGNE
PLEURAL THICKNESS, INTERRUPTIONS, B-LINES
19 FPS / 2.5 MHz
15.4 cm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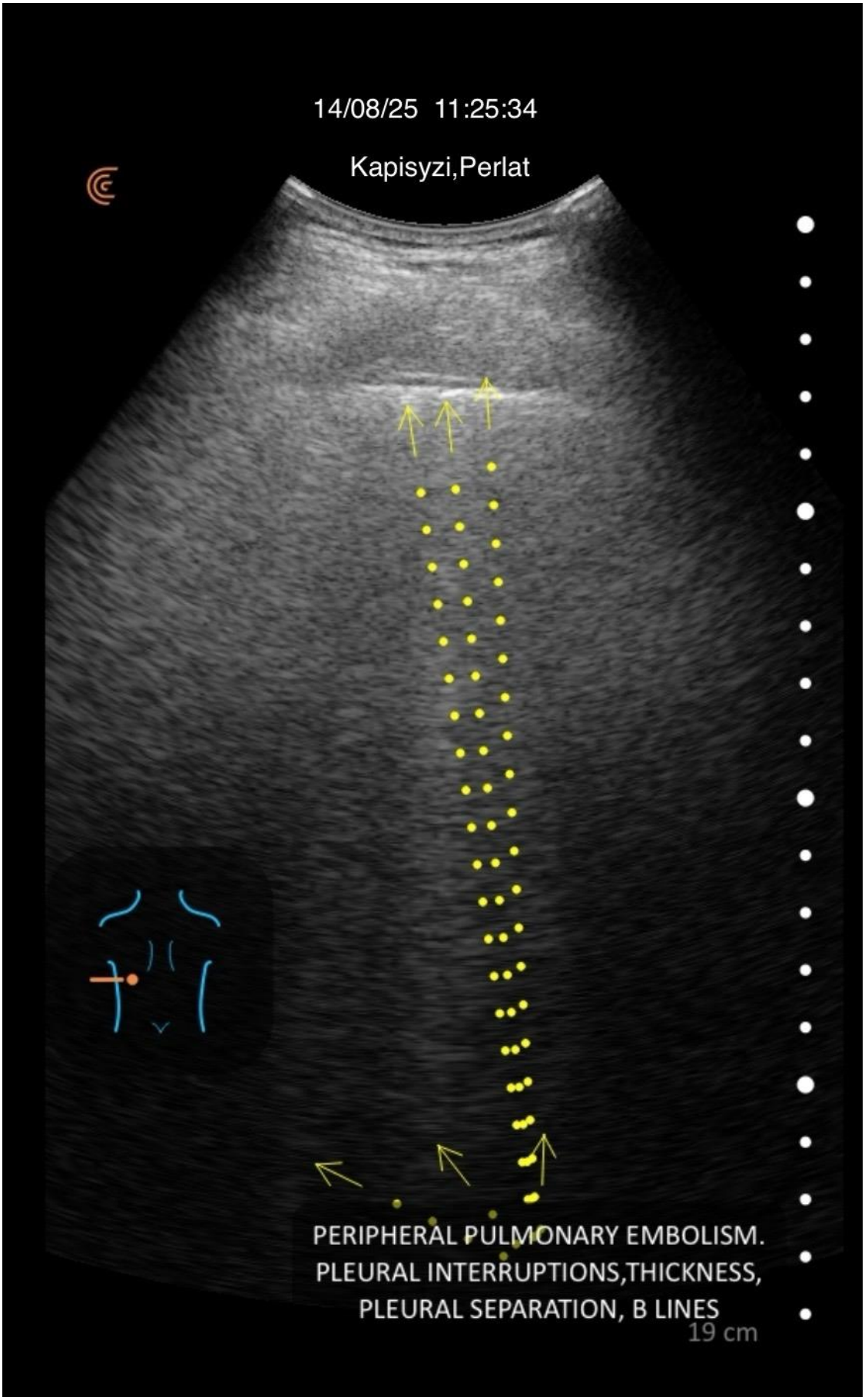
PLEURAL SEPARATION
PLEURAL THICKNESS, IRREGULARITY,B-LINES
19 FPS / 2.5 MHz
16.2 cm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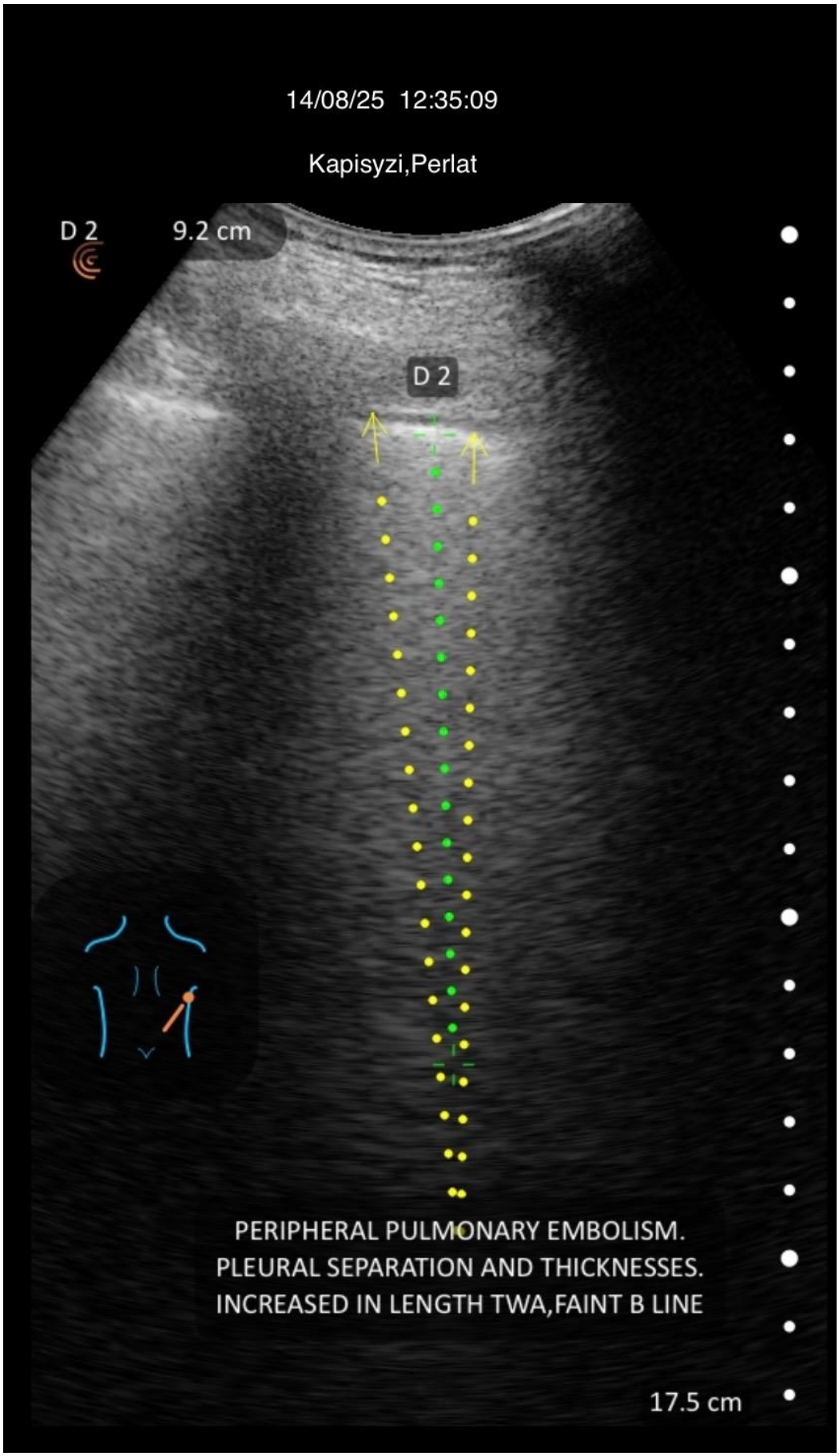
PLEURAL INTERRUPTIONS,THICKNESS,
PLEURAL SEPARATION, B LINES
19 cm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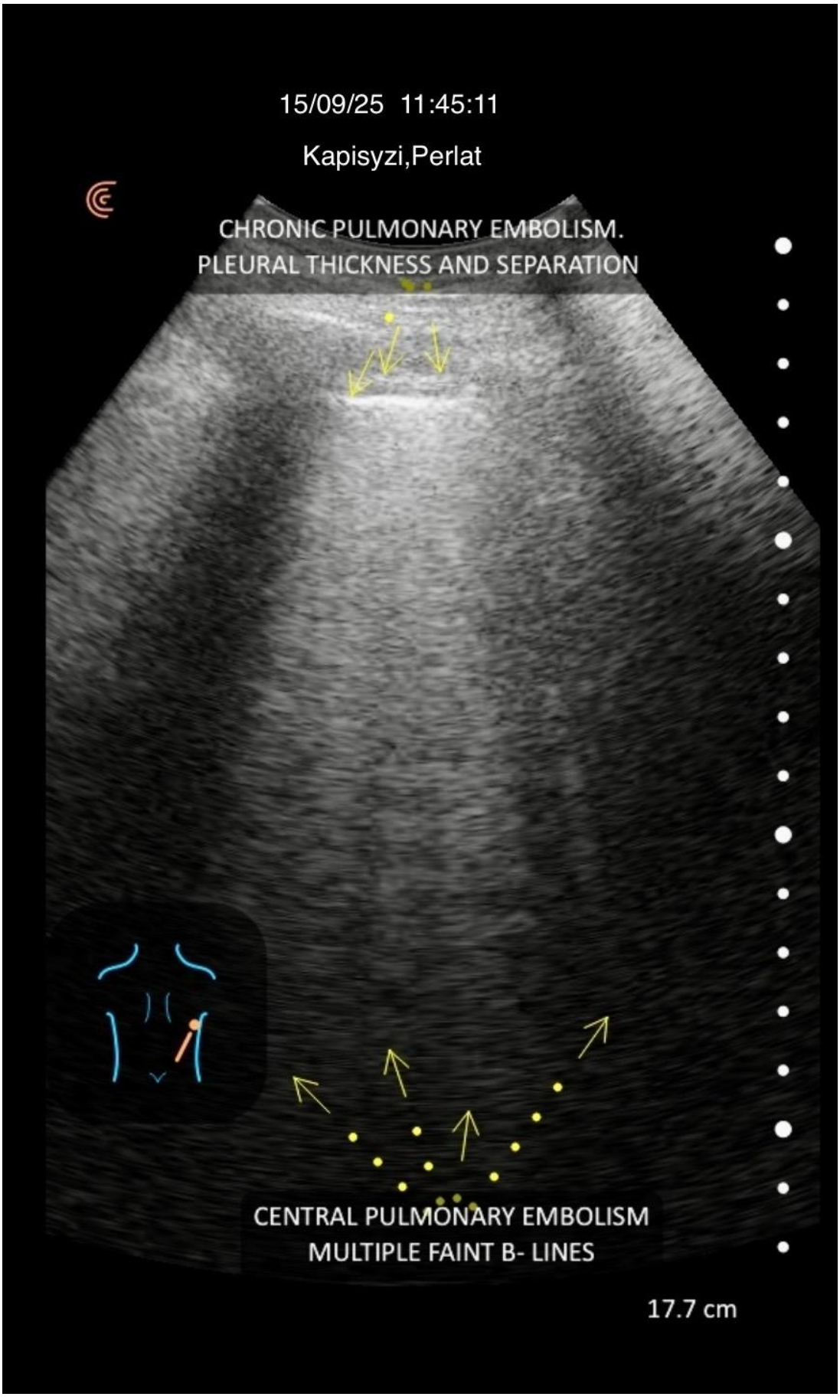
D 2
9.2 cm
D 2
PERIPHERAL PULMONARY EMBOLISM.
PLEURAL SEPARATION AND THICKNESSES.
INCREASED IN LENGTH TWA,FAINT B LINE
17.5 cm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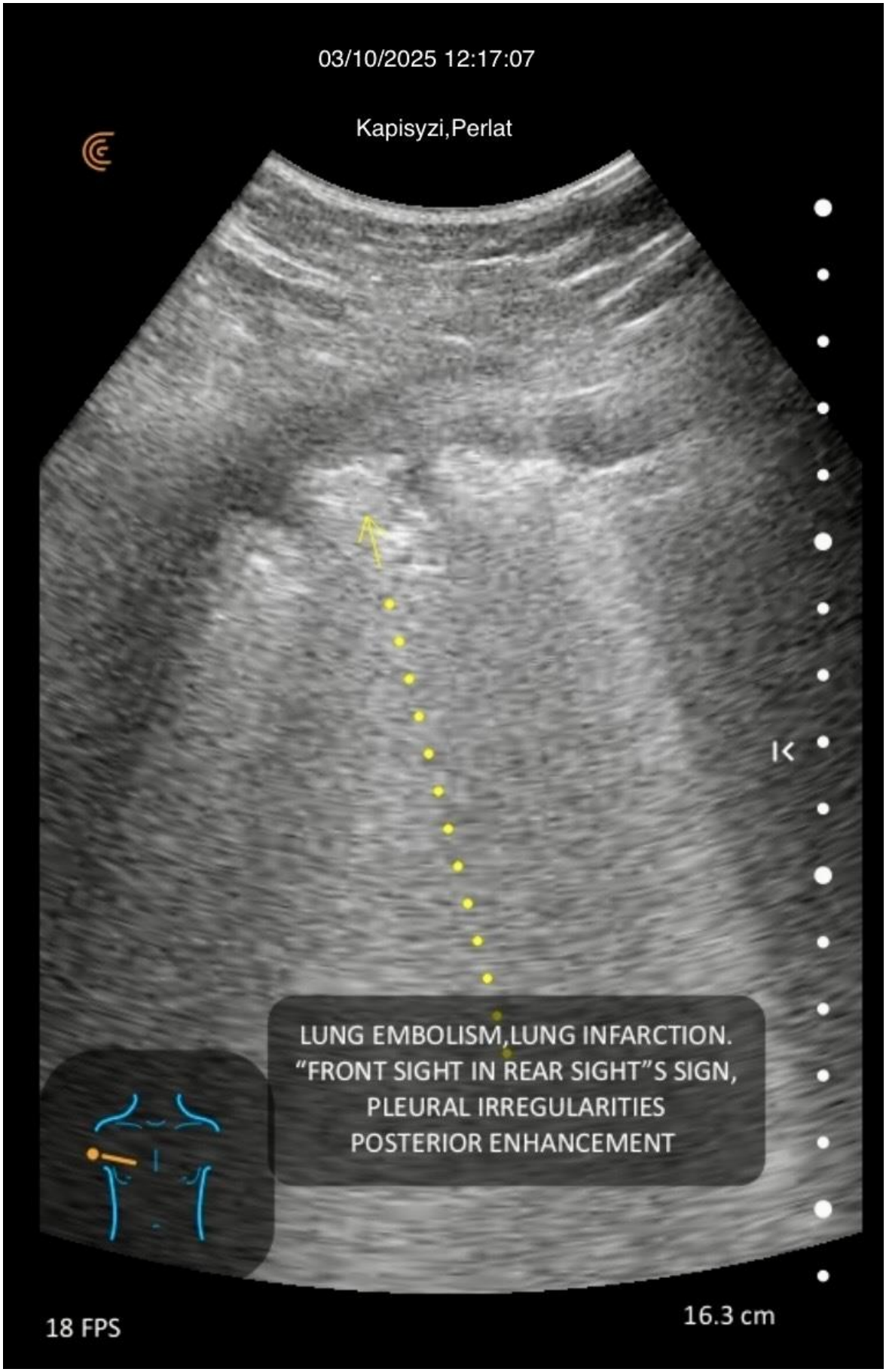
PLEURAL THICKNESS AND SEPARATION
CENTRAL PULMONARY EMBOLISM
MULTIPLE FAINT B- LINES
17.7 cm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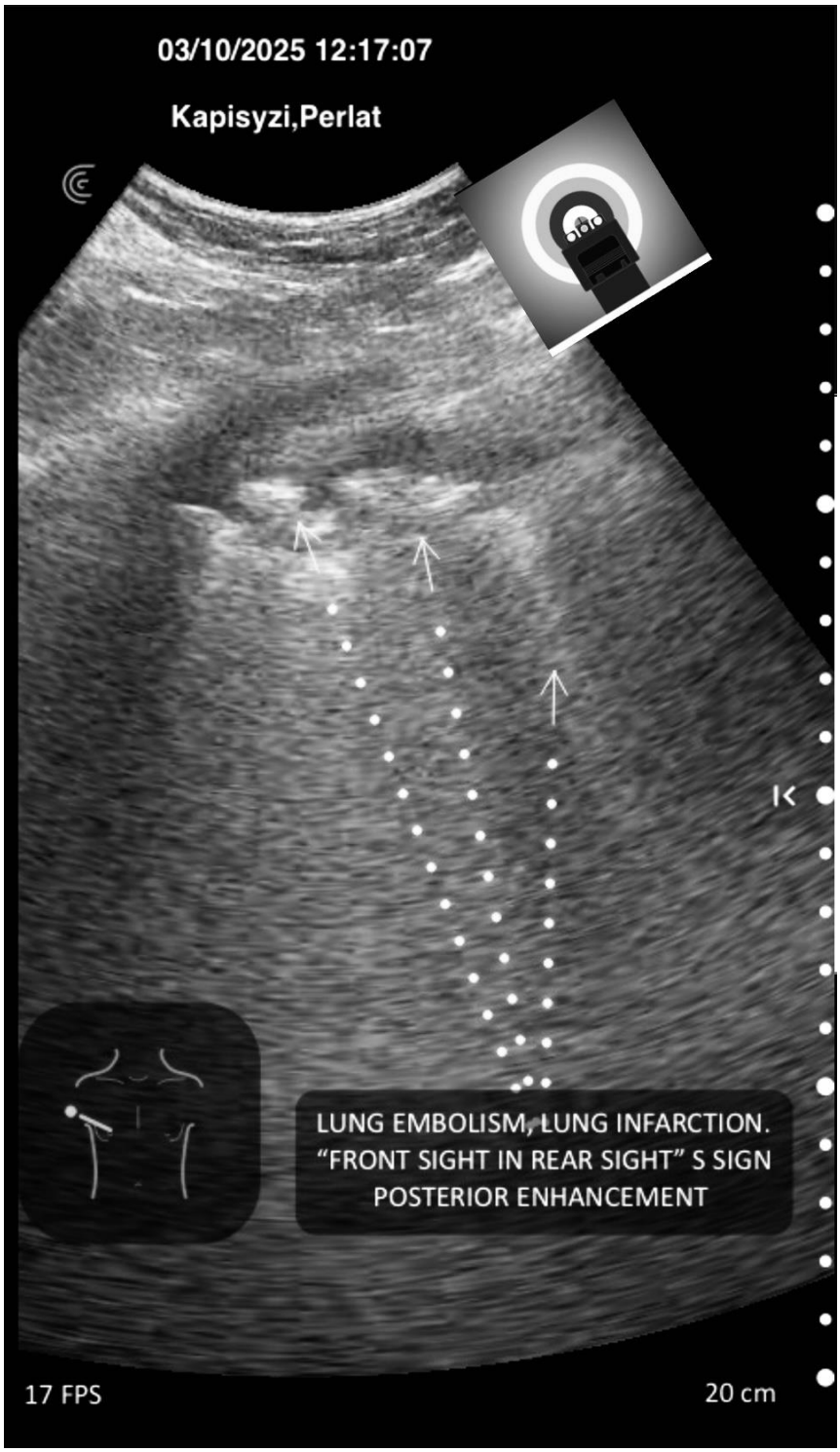
LUNG EMBOLISM,LUNG INFARCTION.
"FRONT SIGHT IN REAR SIGHT"S SIGN,
PLEURAL IRREGULARITIES
POSTERIOR ENHANCEMENT
18 FPS
16.3 cm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Kapisyzi,Perlat
LUNG EMBOLISM, LUNG INFARCTION.
"FRONT SIGHT IN REAR SIGHT" S SIGN
POSTERIOR ENHANCEMENT
17 FPS
20 cm

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