Sơ lược siêu âm phổi (LUS) & Các dấu hiệu LUS

ThS.BS. **Trần Ngọc Nguyên**

Bộ môn Lao và Bệnh phổi, Trường Y - Đại học Y Dược TP.HCM

Nội dung

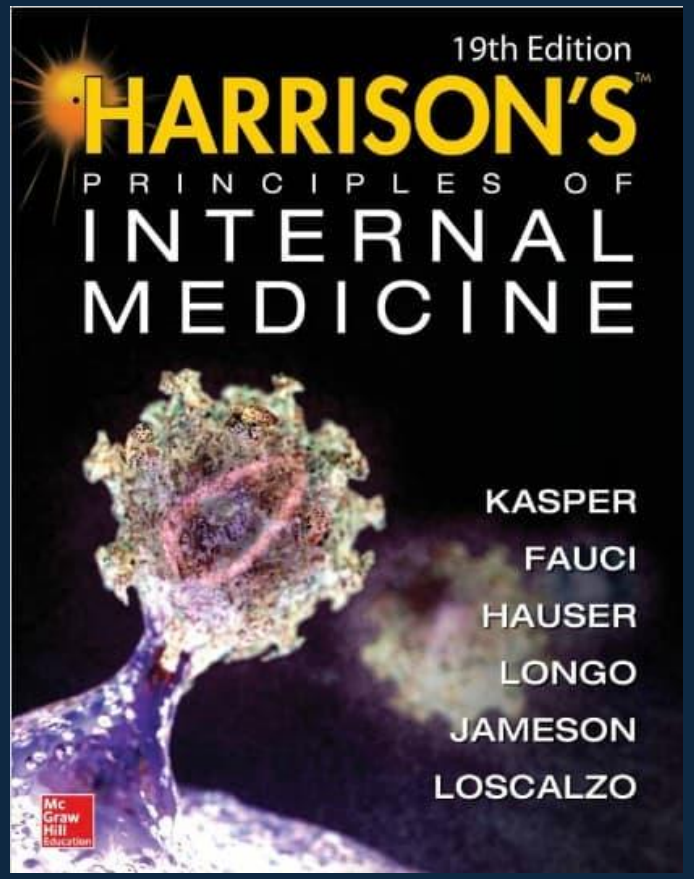
- Lịch sử của LUS
- Vai trò của LUS ở đâu và khi nào?
- Các dấu hiệu sinh lý/bệnh lý của LUS (A-B-C-D-E)

Lịch sử của LUS

Prof. Daniel Lichtenstein, MD. PhD.

SIÊU ÂM PHỔI CÓ KHẢ THI KHÔNG???

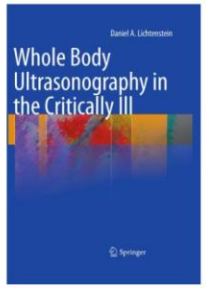
- “The lung is a major ***hindrance*** to the use of ultrasound at the thoracic level” (e1992; p1043)
- ”The ***air is importance barrier*** to use the ultrasound for lung study” (e2001; p1043)
- “Because ultrasound energy is ***rapidly dissipated in air***, Ultrasound imaging is not useful for evaluating of the lung parenchyma”(e2005; p1454)
- “Ultrasound imaging: ***not useful*** for evaluating of the pulmonary parenchyma” (e2011; p2098)

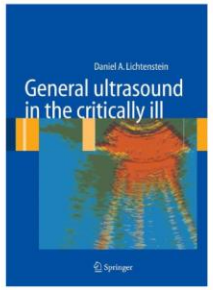


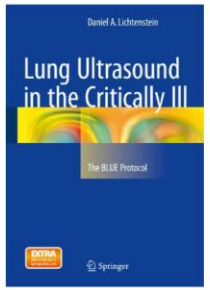
Critical Ultrasound Pioneer

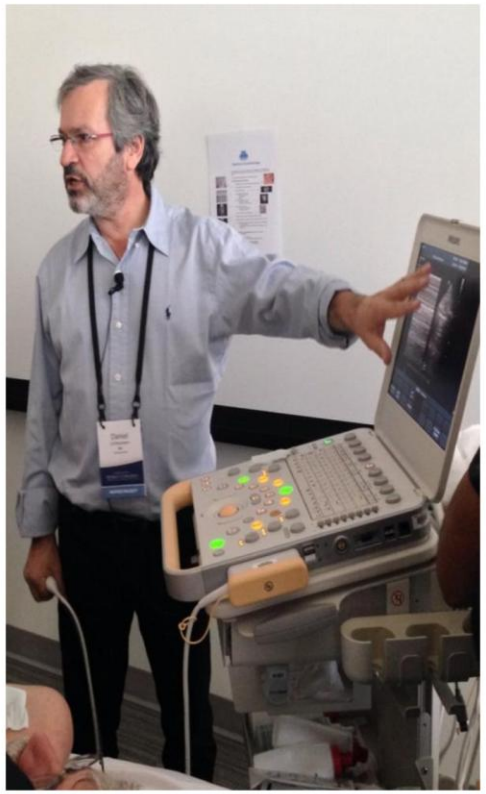
Prof Dr Daniel Lichtenstein

- Adult Intensivist
- University Hospital Ambroise-Pare, Paris
- Developed critical whole body ultrasound since 1989









MISSION: POSSIBLE

Volume 134, Issue 1, July 2008, Pages 117-125

Original Research

Critical Care Medicine

Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure*: The BLUE Protocol

Daniel A. Lichtenstein MD, FCCP [a], Gilbert A. Mezière MD [b]

[a] Service de Réanimation Médicale, Hôpital Ambroise-Paré, F-92 Boulogne, Paris-Ouest, France
[b] Service de Réanimation Polyvalente, Centre Hospitalier, F-92 Saint-Cloud, Paris-Ouest, France

Received 17 November 2007, Accepted 16 February 2008, Available online 16 December 2015.

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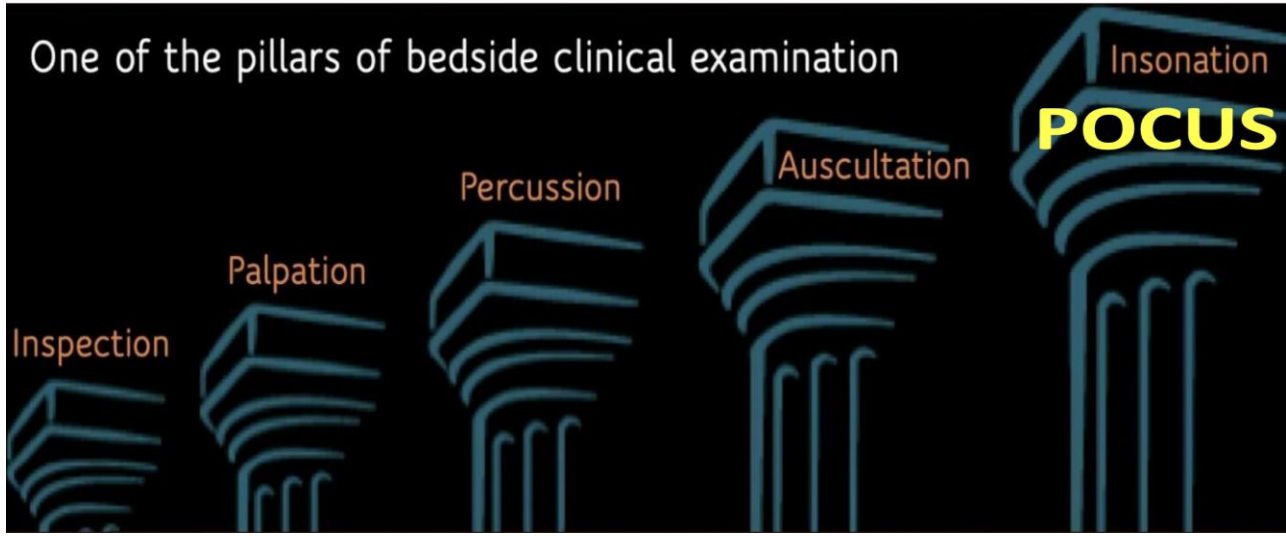
“Time to add a Fifth Pillar to bedside Physical Exam” *E. Braunwald & N. Jagat. Jama of Cardiology 2018. Special communication*



Vai trò của LUS??

Ở tại giường bệnh

Bất kể khi nào thăm khám bệnh nhân

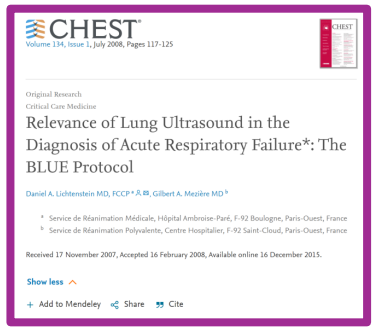
KHÁC GÌ NHAU?

• POCUS	• DIAGNOSTIC US
• **Tiếp cận theo vấn đề & trả lời câu hỏi lâm sàng (problem-based multiple organs)**	• **Khảo sát từng cơ quan (organ-based)**
• BS lâm sàng chỉ định, biết rõ BN và thực hiện tại giường	• BS khác chỉ định – BS tim mạch/CĐHA (không biết BN) thực hiện tại echo-lab
• Thời gian huấn luyện ngắn	• Cần đào tạo chuyên sâu, dài hạn
• Thời gian: hạn chế, cần kết quả ngay lập tức → phạm vi giới hạn và theo mục tiêu	• Thời gian: không giới hạn → mục tiêu mở rộng
• Chẩn đoán, điều trị, theo dõi, thủ thuật	• Chẩn đoán

1993 Lichtenstein introduction of US in ICU

1995 ACR recommended daily Chest X-ray in ICU
MV patients

2000 ARDS Network.
Lower Vt in ARDS patients


CHEST
Volume 134, Issue 1, July 2008, Pages 117-125

Original Research
Critical Care Medicine

Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure*: The BLUE Protocol

Daniel A. Lichtenstein MD, FCCP a, Gilbert A. Mezière MD b

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Received 17 November 2007, Accepted 16 February 2008, Available online 16 December 2015.

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2007 Hendrikse – Low value of routine Chest X-ray in ICU

2009 ACCP/SRLF Consensus for the ultrasound use in ICU

2009 Lichtenstein BLUE Protocol

2012 Volpicelli International Consensus Conference, POC-LUS

2013 Miglioranza, LUS for the evaluation of pulmonary congestion

2015 Lichtenstein FALLS-protocol

2016 Ponikowski, LUS in Acute and Chronic HF

2020 Lichter
LUS predicts clinical course in ICU

2023

1990 | 2000 | 2010 | 2020 | 2030

2001 Agency for Healthcare Research and Quality
2002 National Institute for Clinical Excellence

2004 E-FAST protocol

2010 BTS for pleural disease guideline

2010 Bouhemad, LUS score

2012 Soummer, LUS score and weaning phase

2013 Amorosa, ACR appropriateness for chest X-ray in ICU patients.

2014 Choosing Wisely don't order diagnostic tests at regular interval

2022 Kattan
The concept of fluid tolerance:

2022 Vetrugno Level of Diffusion and Training of LUS-COVID-19 Pandemic

2023 Cammarota
LUS to evaluate aeration change with prone position

Ultrasound J **16**, 7 (2024)

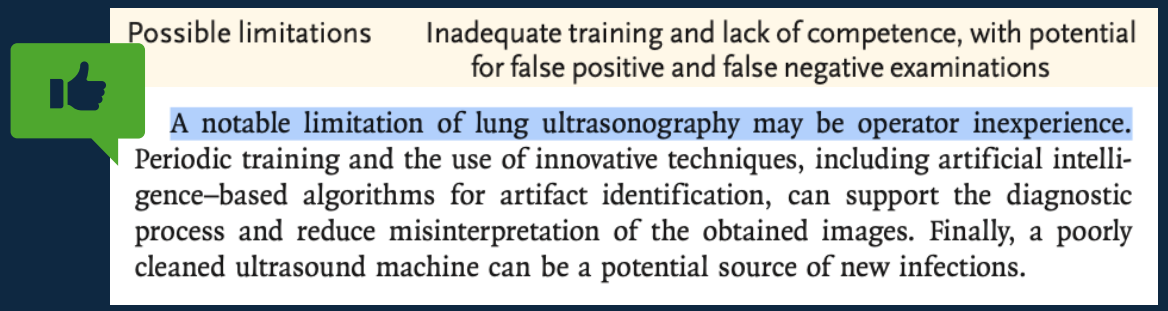
LUS tại ICU

- Thường phối hợp với các cơ quan khác trong chiến lược POCUS
- Tiếp cận khó thở, đau ngực, shock
- Giá trị cao, bổ trợ để nâng tầm CXR
- Hỗ trợ đặt NKQ
- Siêu âm cơ hoành tiên lượng cai máy thở
- Hỗ trợ thủ thuật trong hồi sức

LUS cho chuyên ngành phổi

- Chẩn đoán và theo dõi điều trị viêm phổi, lao phổi
- COVID-19
- Bệnh lý màng phổi
- Sinh thiết phổi/màng phổi dưới hướng dẫn của siêu âm
- Theo dõi diễn tiến của ILD
- Hỗ trợ khi rửa phổi
- ...

MỤC ĐÍCH CỦA LUS LÀ TRẢ LỜI CÂU HỎI LÂM SÀNG



Possible limitations	Inadequate training and lack of competence, with potential for false positive and false negative examinations

A notable limitation of lung ultrasonography may be operator inexperience. Periodic training and the use of innovative techniques, including artificial intelligence–based algorithms for artifact identification, can support the diagnostic process and reduce misinterpretation of the obtained images. Finally, a poorly cleaned ultrasound machine can be a potential source of new infections.

- Học hỏi – Học tập – Học hành
- Luôn tạo ấn tượng trong đầu
- Làm nghiên cứu khoa học

- Là ***cột trụ thứ 5*** trong thăm khám lâm sàng
  → **validity, reliability**
- Tích hợp với nhiều kỹ năng và công cụ khác
  → sensitivity, specificity
- Biện luận kết quả LUS như là một vấn đề lâm sàng
  → physiopathology

तारका तिमिरं दीपो मायावश्याय बुद्बुदम् ।
स्वप्नं च विद्युदभ्रं च एवं द्रष्टव्य संस्कृतम् ॥ (Vajracchedikā 32)

Hình ảnh sinh lý/bệnh lý của phổi qua US

A / B lines

Consolidation

Diaphragm

Effusion

NGUYÊN TẮC SIÊU ÂM PHỔI:
ARTIFACTS ANALYSIS

Phổi là cơ quan trộn lẫn bởi khí và nước

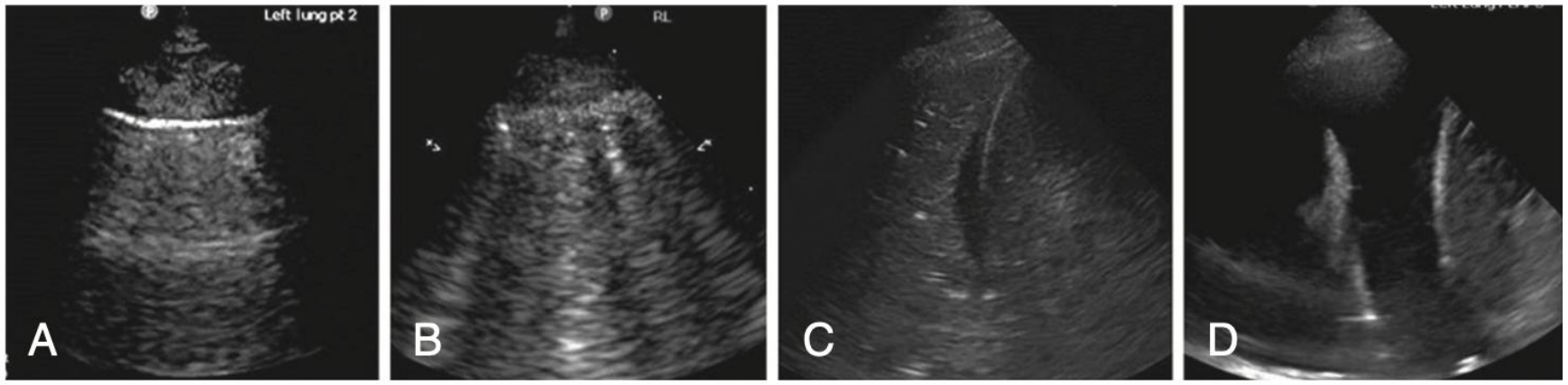
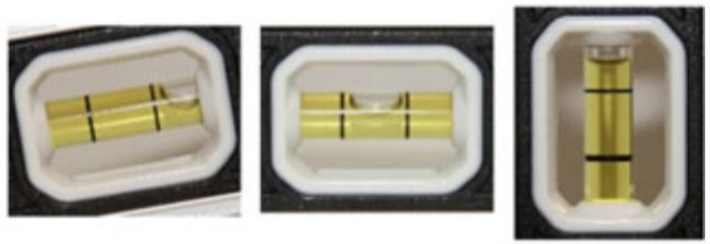


Figure 9.1 Air/Fluid Ratios and Lung Artifacts. (A) A-lines are seen in a "dry" lung, with no fluid-filled or thickened interlobular septa. (B) B-lines appear as fluid begins to widen the interlobular septa. (C) Consolidation pattern is seen when fluid completely fills the alveoli, displacing air. (D) Pleural effusion with consolidation pattern from compressive atelectasis is seen with fluid accumulation in the pleural space.

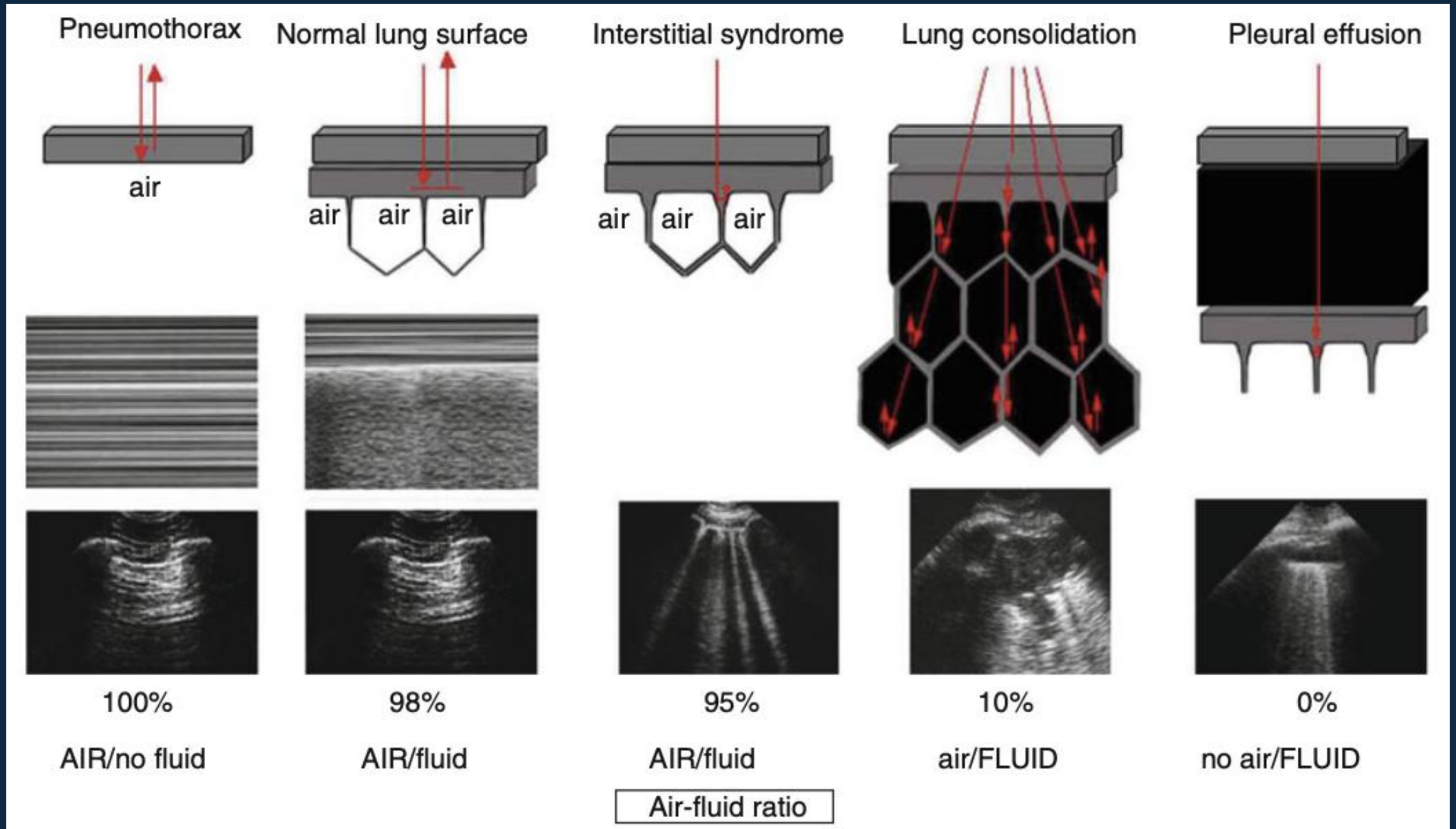


Màng phổi là "cửa sổ của tâm hồn"

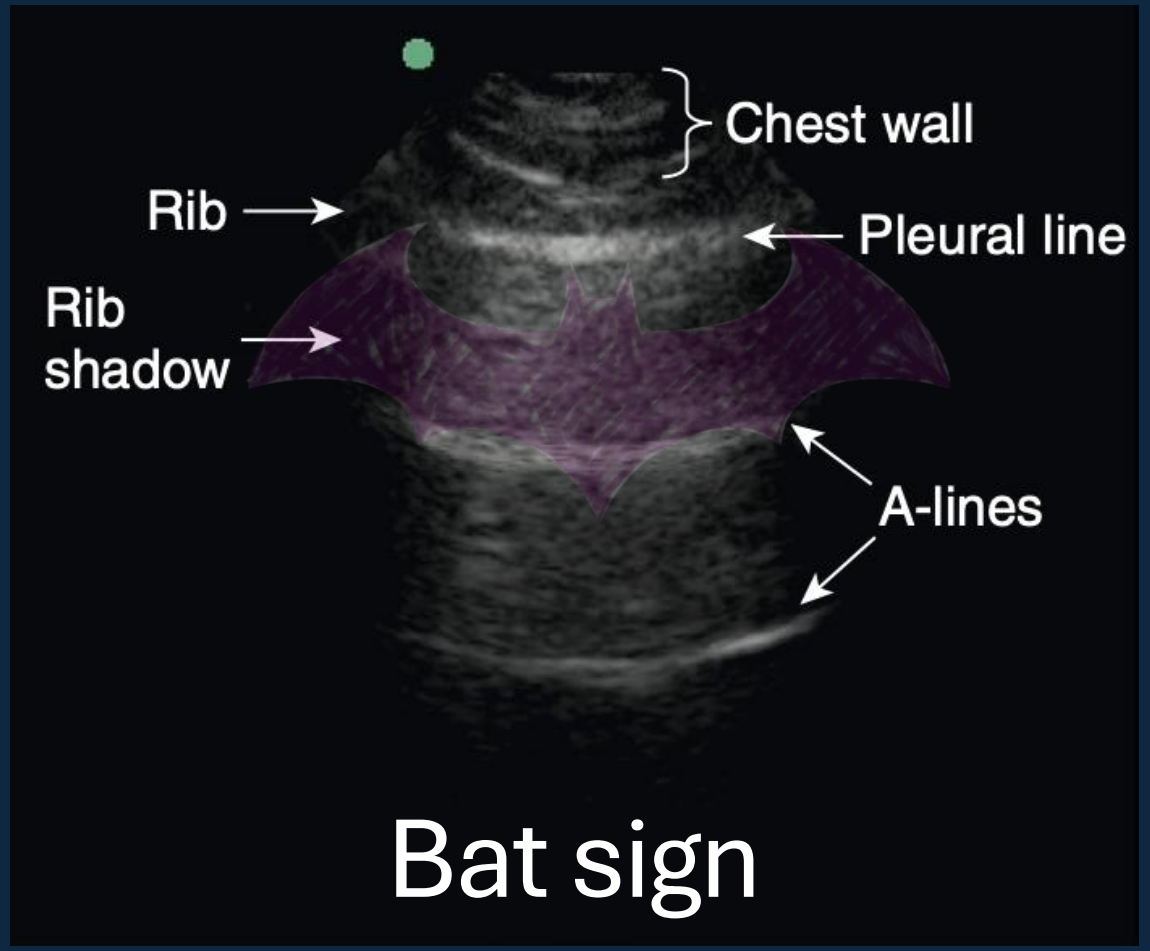
ACTIFACTS IN US

Artifacts are false images or parts of images that do not represent true anatomic structures

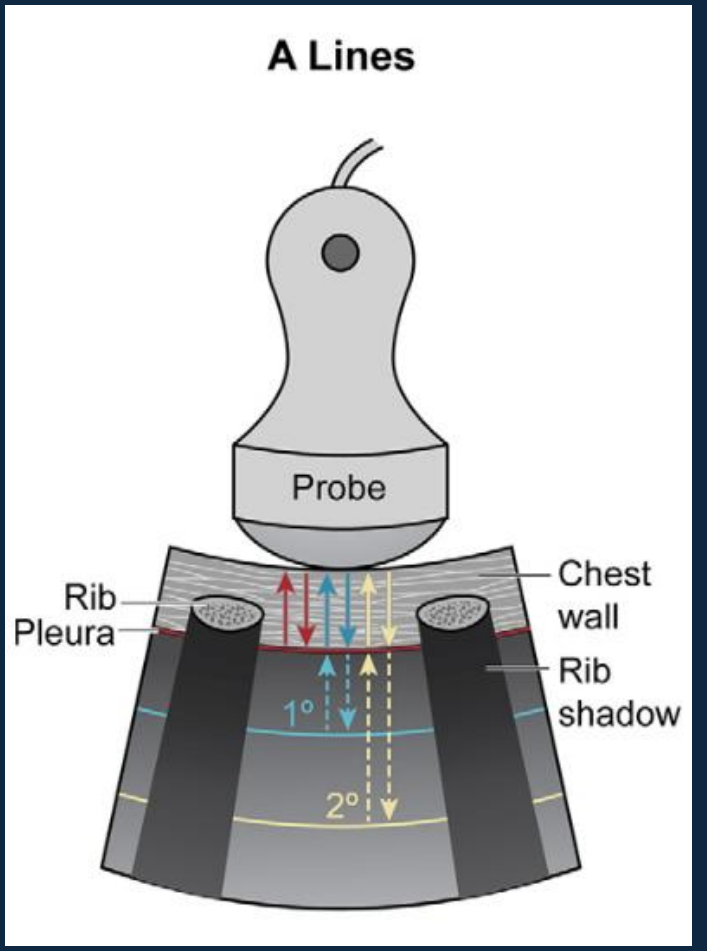
Artifacts of Wave Propagation	Artifacts Due to Velocity Errors	Artifacts Due to Beam Characteristics	Artifacts Due to Wave Attenuation
Reverberation (dội âm)	**Refraction** (khúc xạ)	**(Side) Lobe artifacts** (xảo ảnh thuỳ)	**Acoustic shadowing** (bóng âm)
Mirroring (soi gương)			**Acoustic enhancement** (gia cường âm)


Pneumothorax
Normal lung surface
Interstitial syndrome
Lung consolidation
Pleural effusion
air
air air air
air air air
100%
98%
95%
10%
0%
AIR/no fluid
AIR/fluid
AIR/fluid
air/FLUID
no air/FLUID
Air-fluid ratio

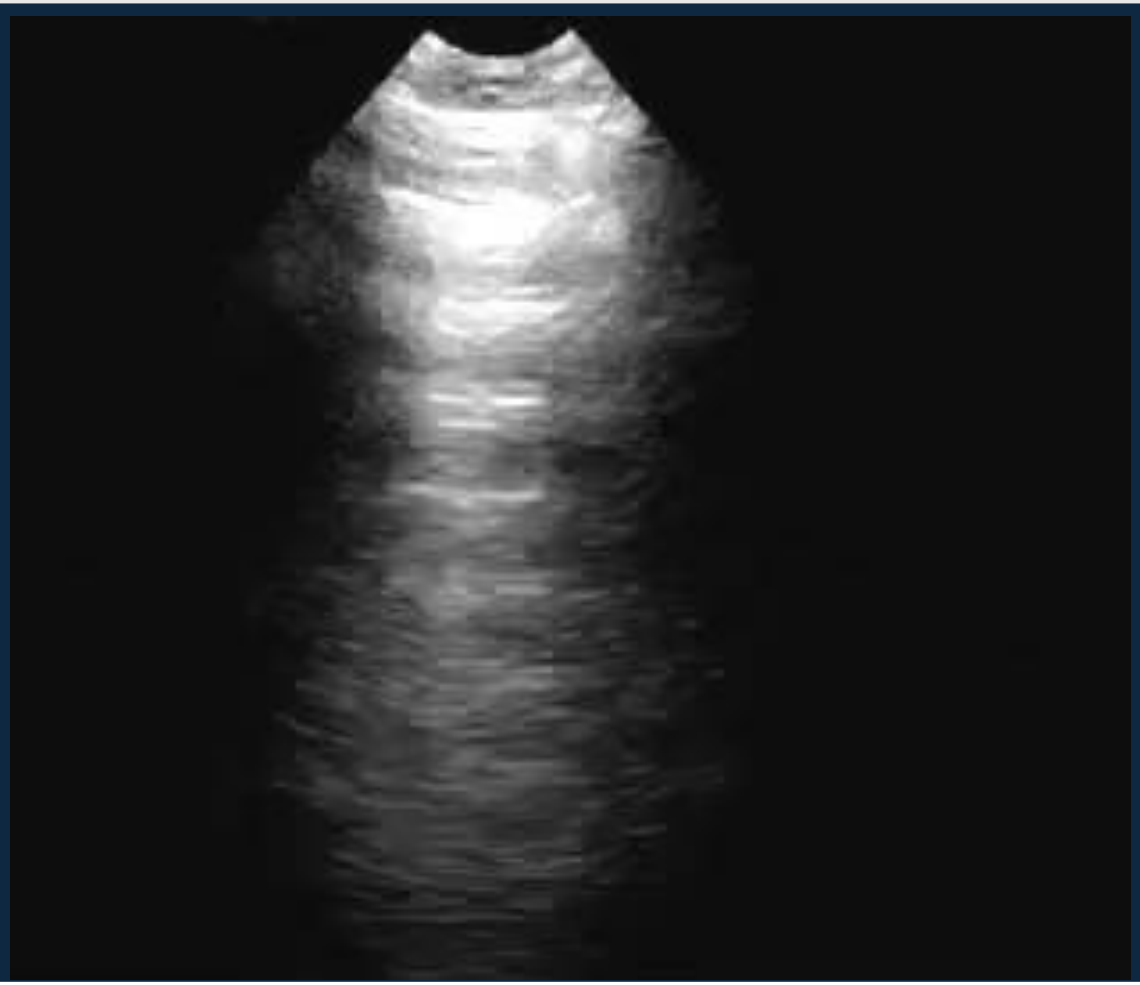
A lines



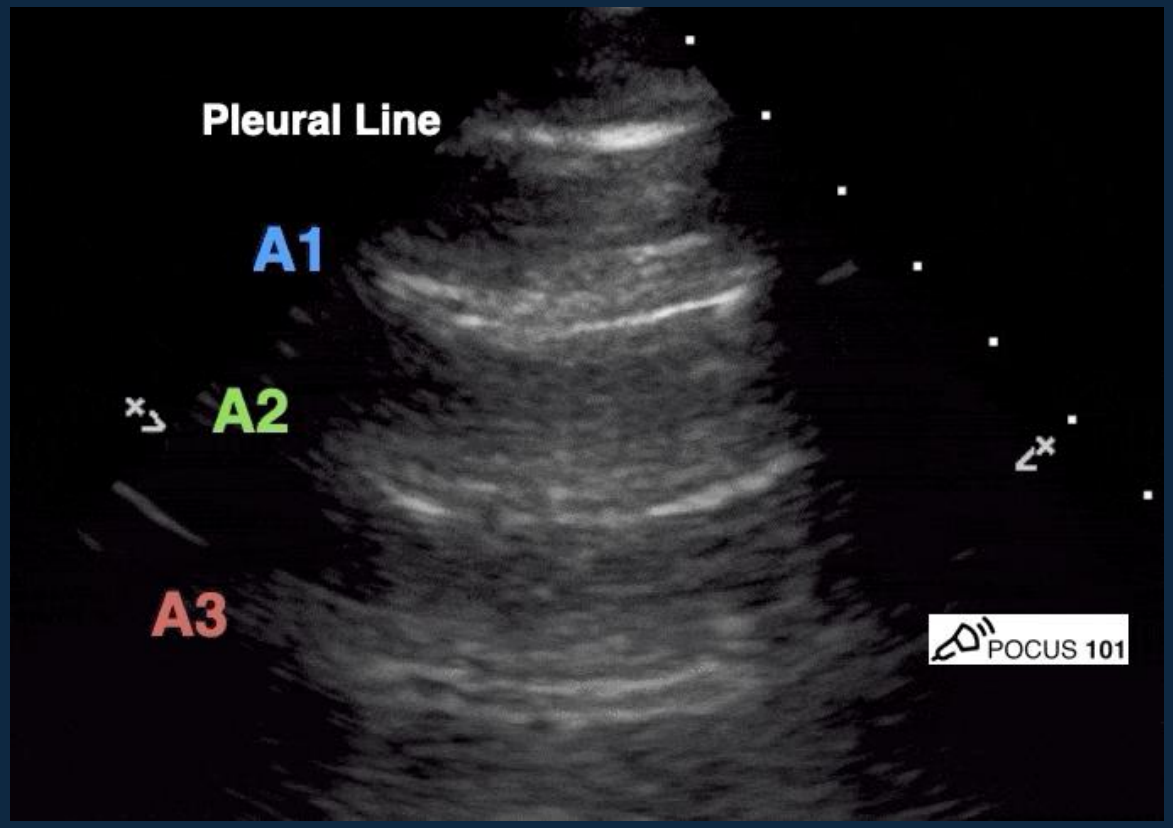
Bat sign



Pleural lines & Lung sliding

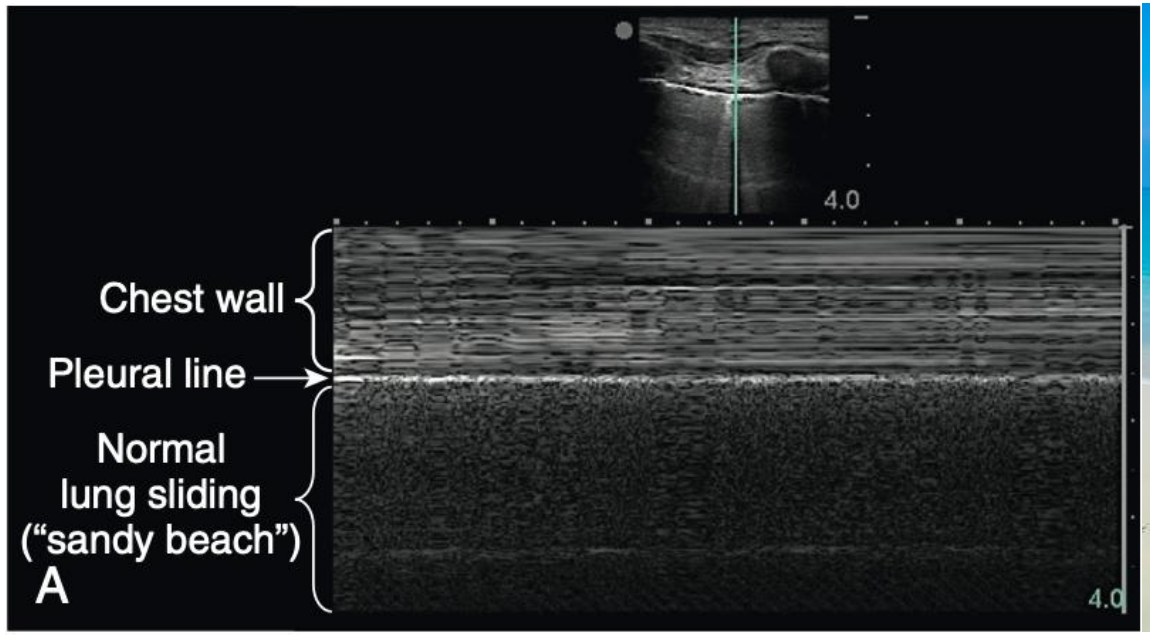


A-lines

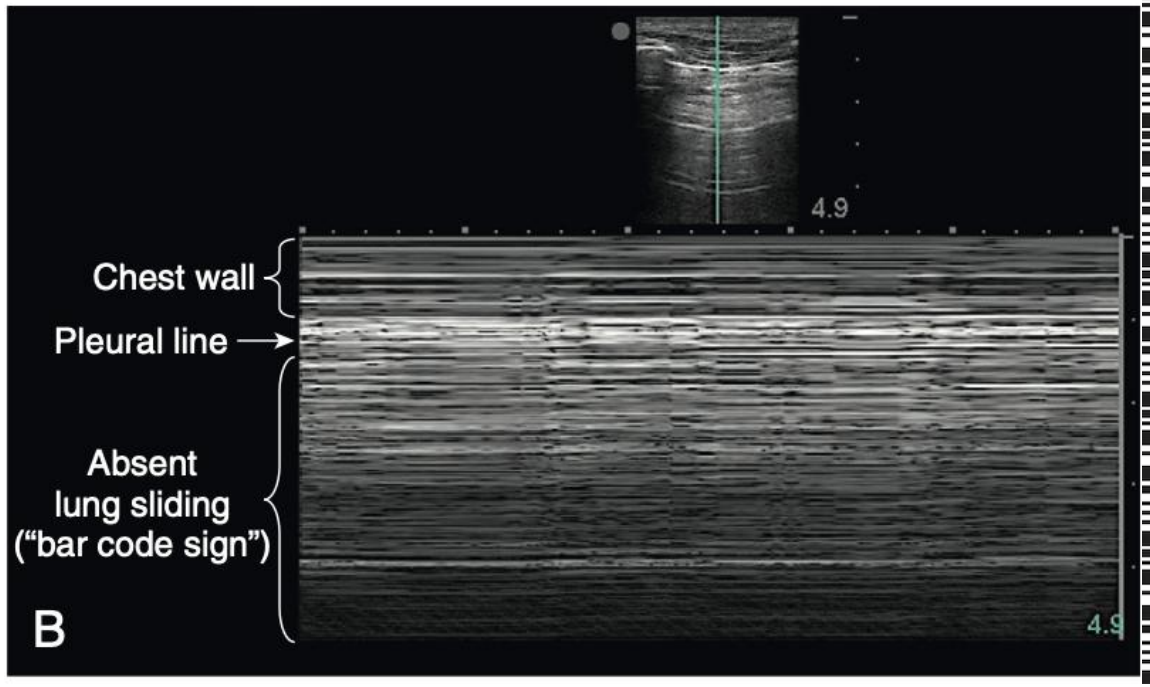


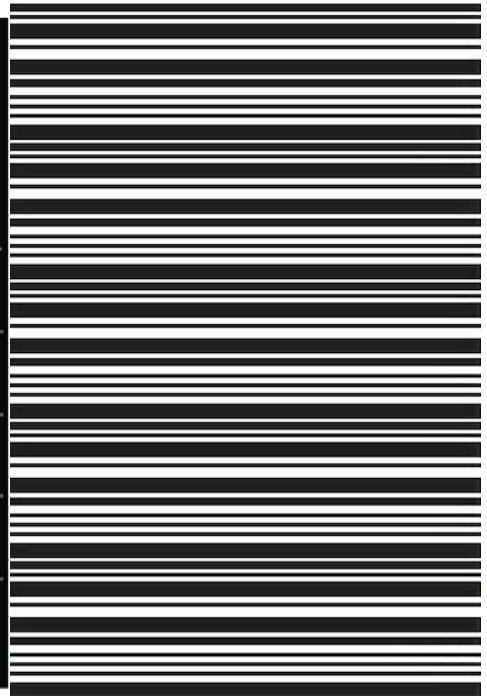
healthy aeration of the alveoli

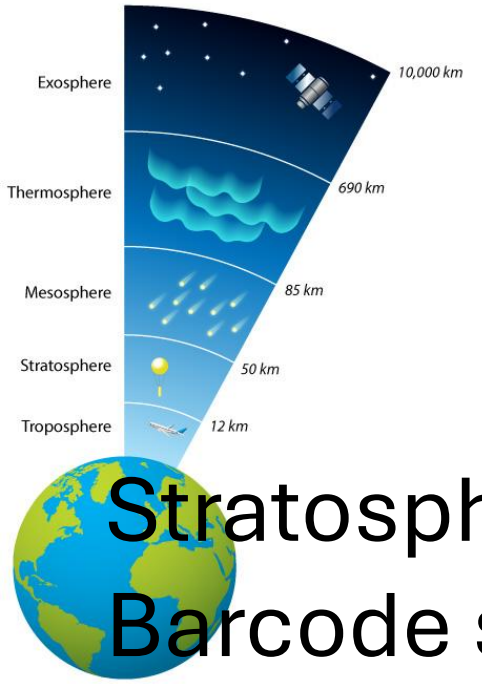
Pneumothorax: A-lines but not lung sliding ???



Seashore sign



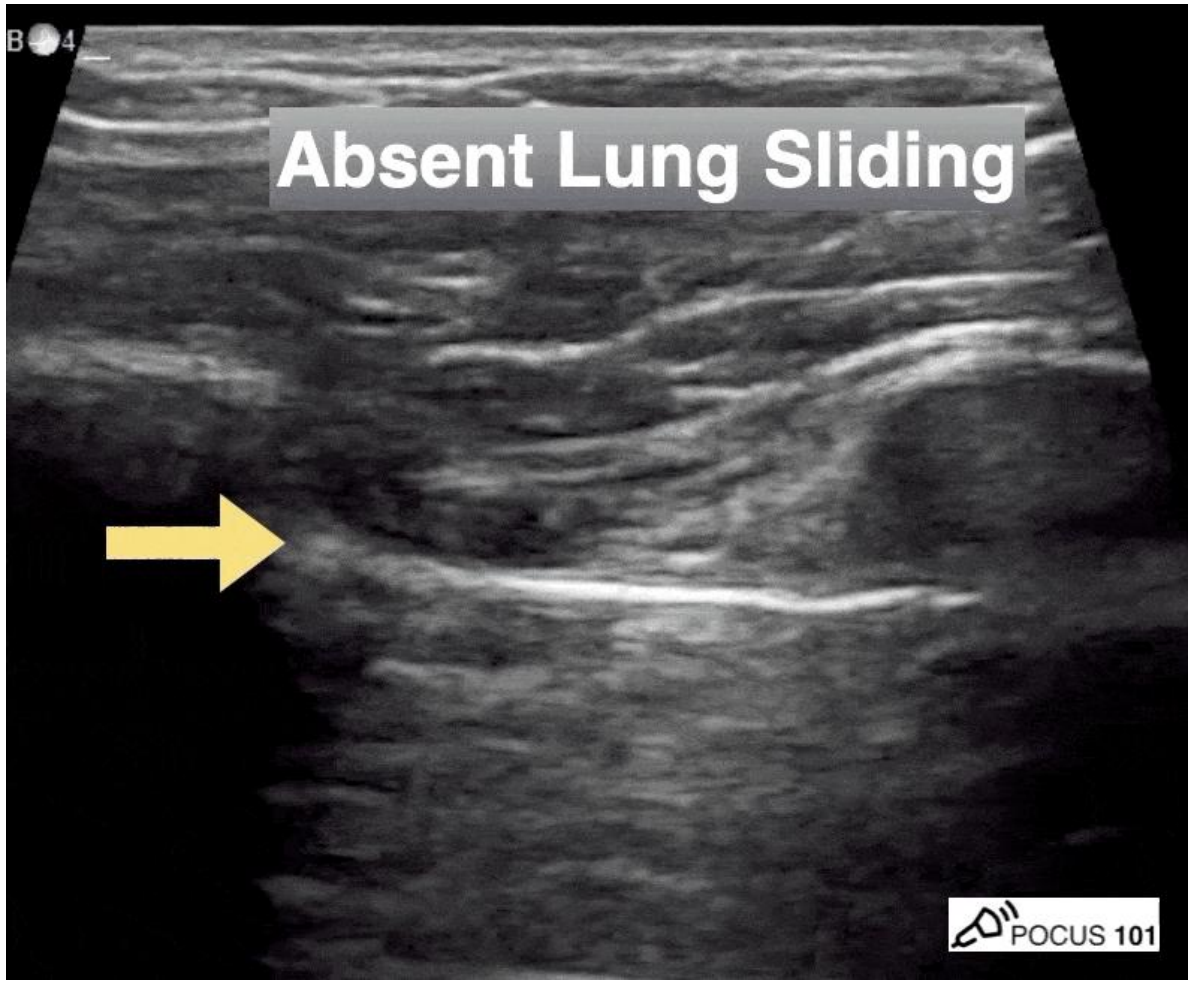


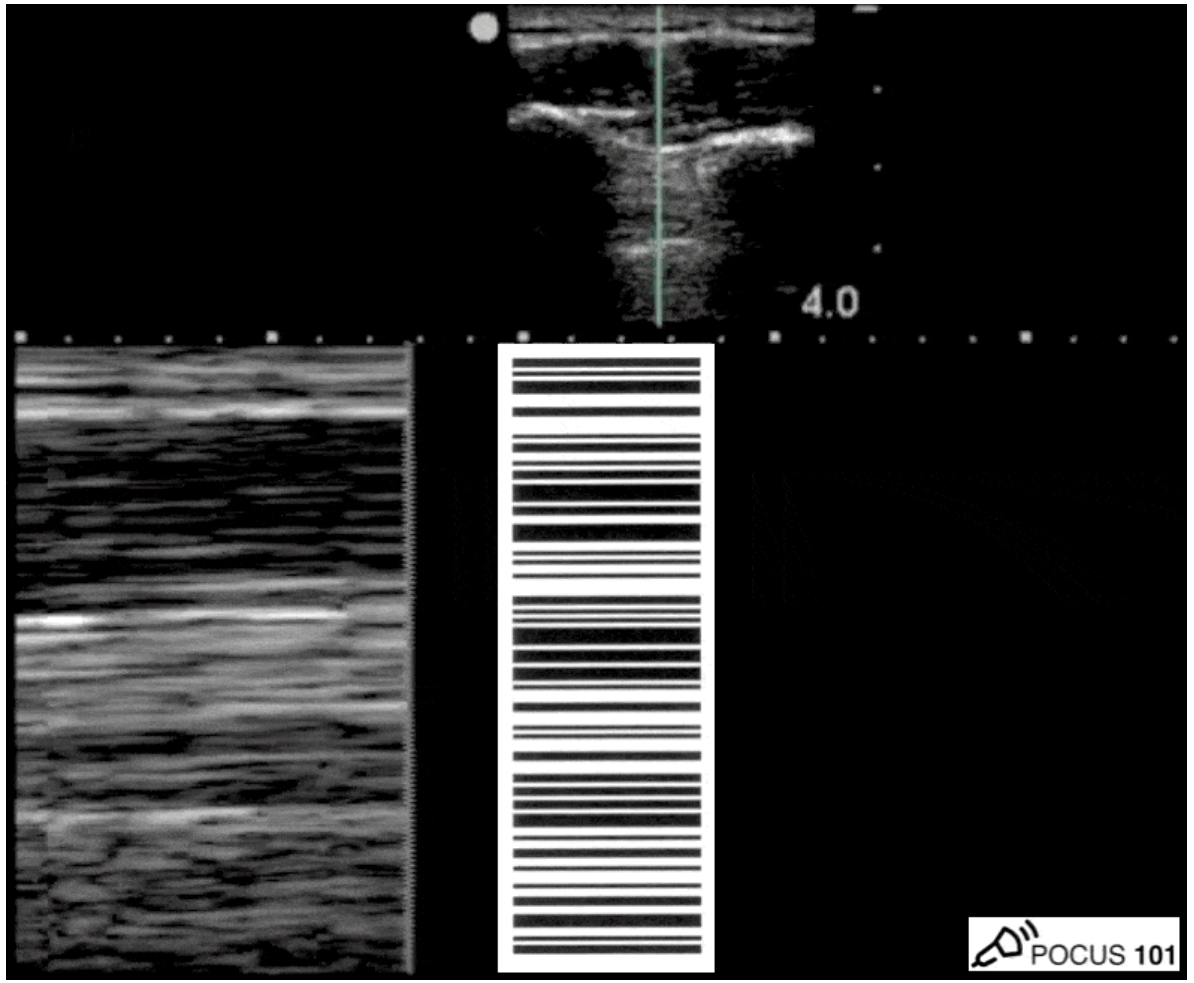


Stratosphere sign

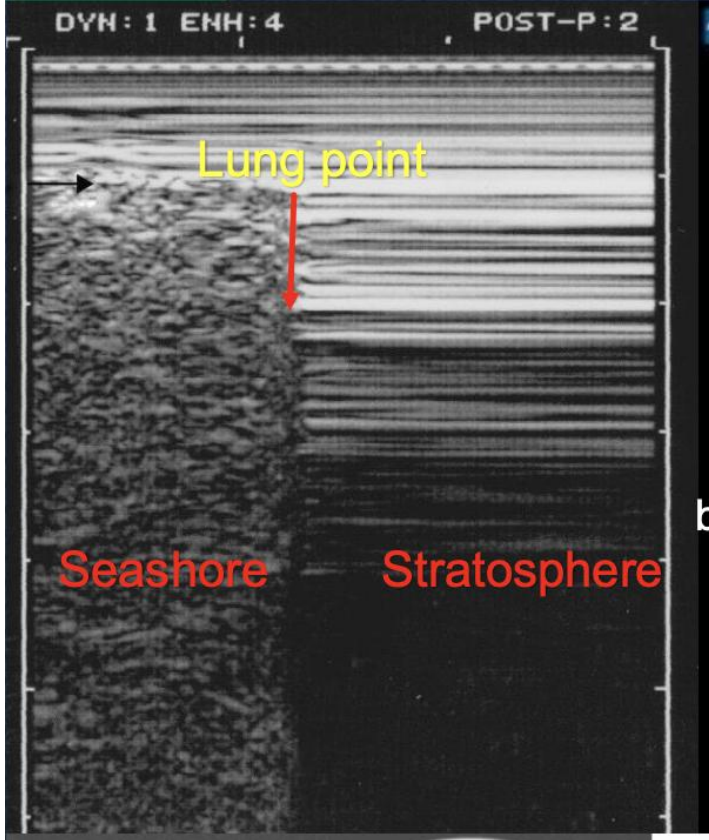
Barcode sign

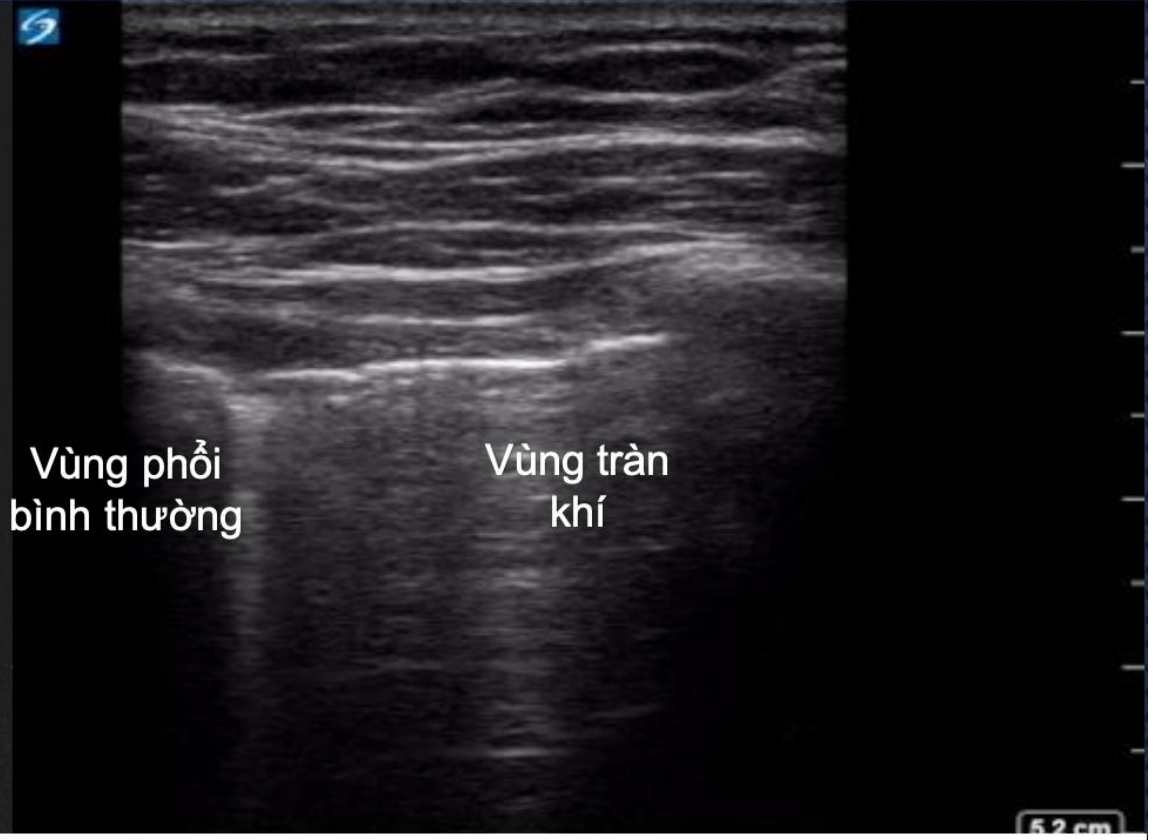
Absent Lung Sliding → Abnormal

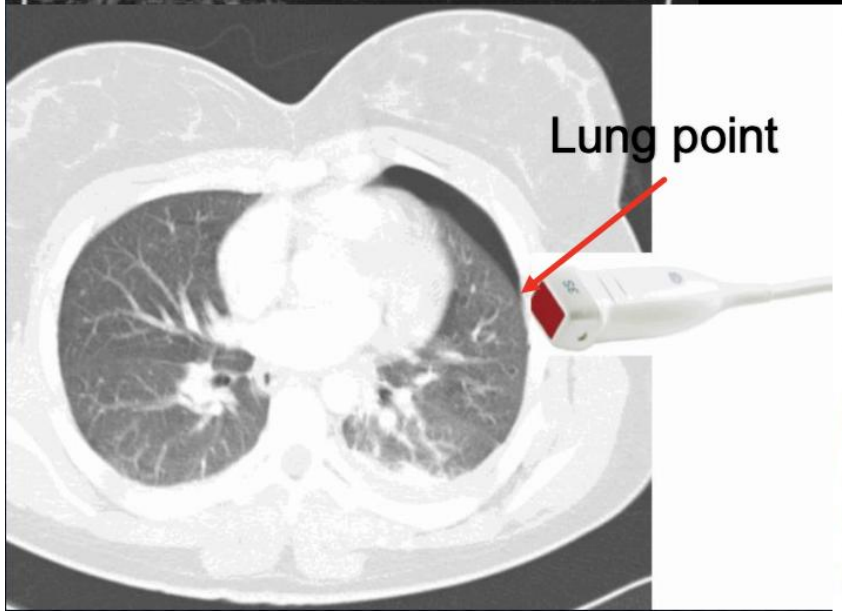




Lung point







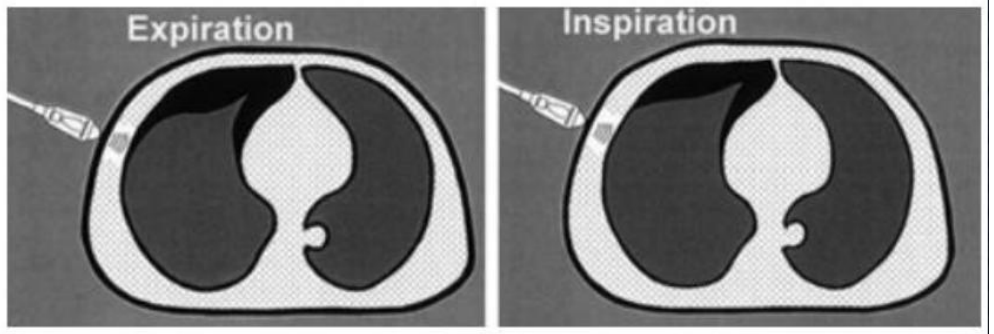
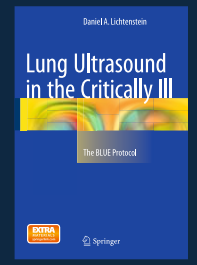
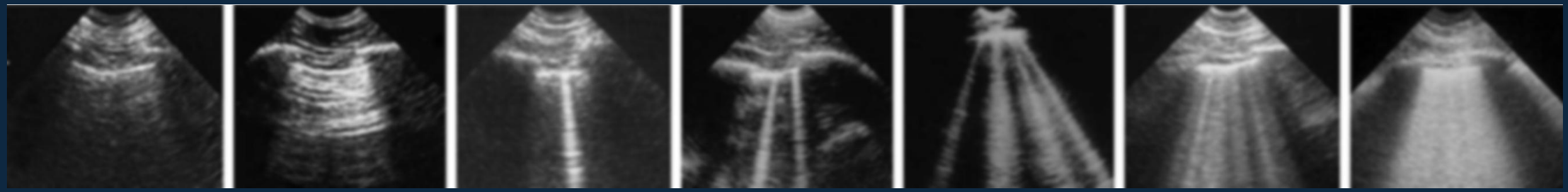


Fig. 14.5 Pathophysiology of the lung point. The probe is motionless. At the *left*, it faces the pneumothorax, on expiration. At the *right*, it faces the lung itself, on inspiration, which has slightly increased its volume

B-lines



"The B-lines are separated from each other by an average distance of 7 mm; this is the septal variant of the lung rockets, labeled *septal rockets*.
Lung rockets indicate interstitial syndrome.

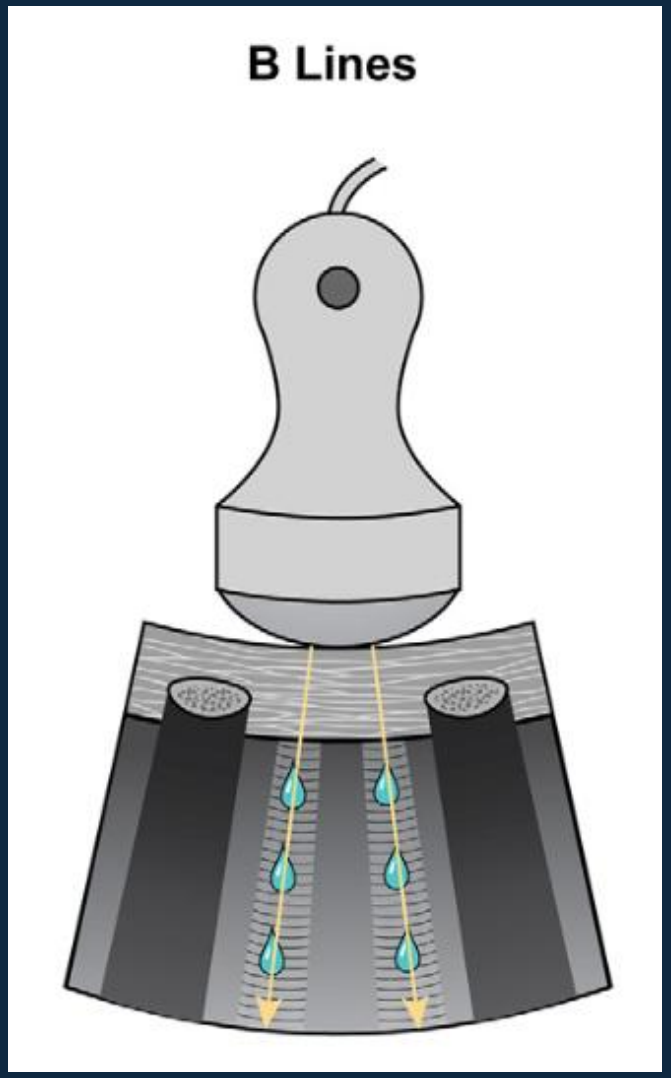


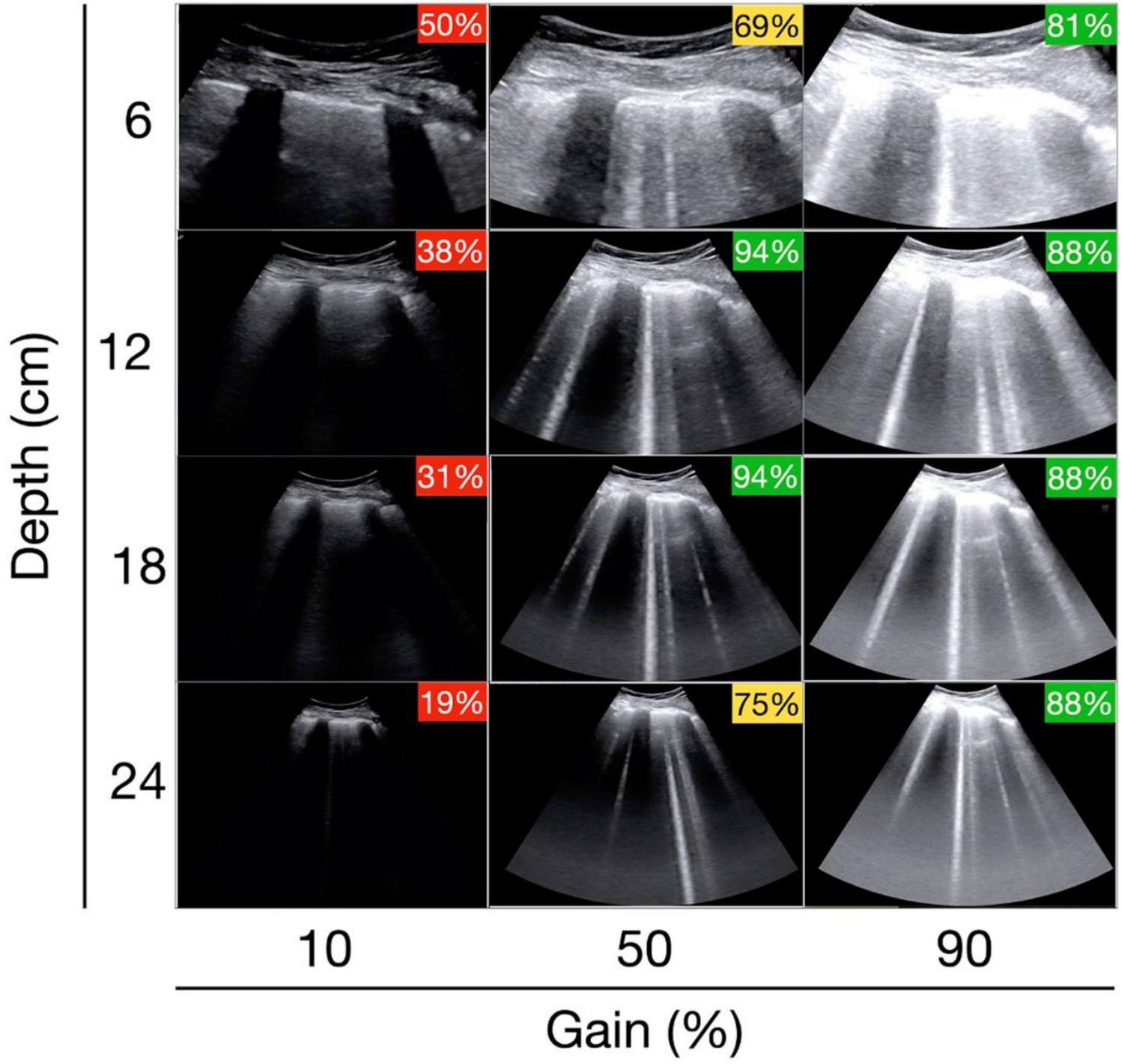
O-line | A-line | b-line | bb-line | septal | ground-glass | Birolleau

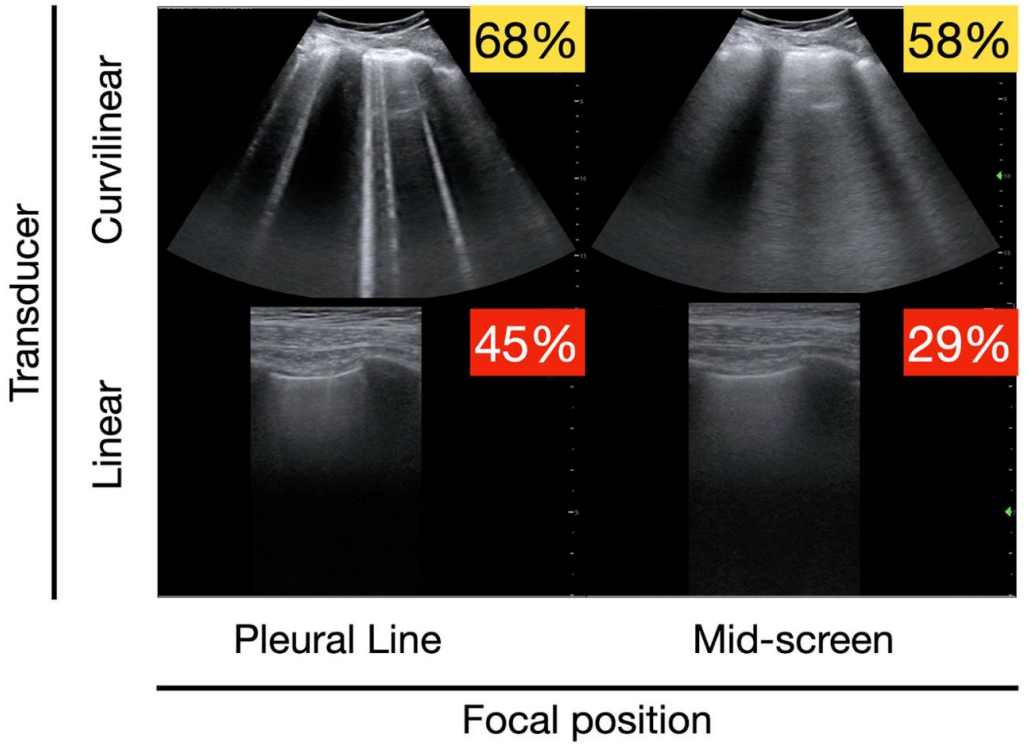
LUNG ROCKETS

>2 B-lines

SARS-CoV-2 pneumonia



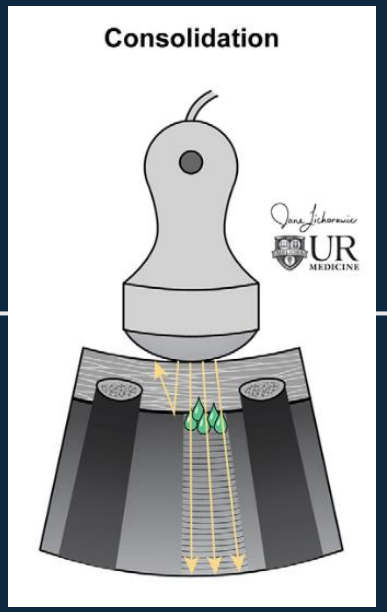


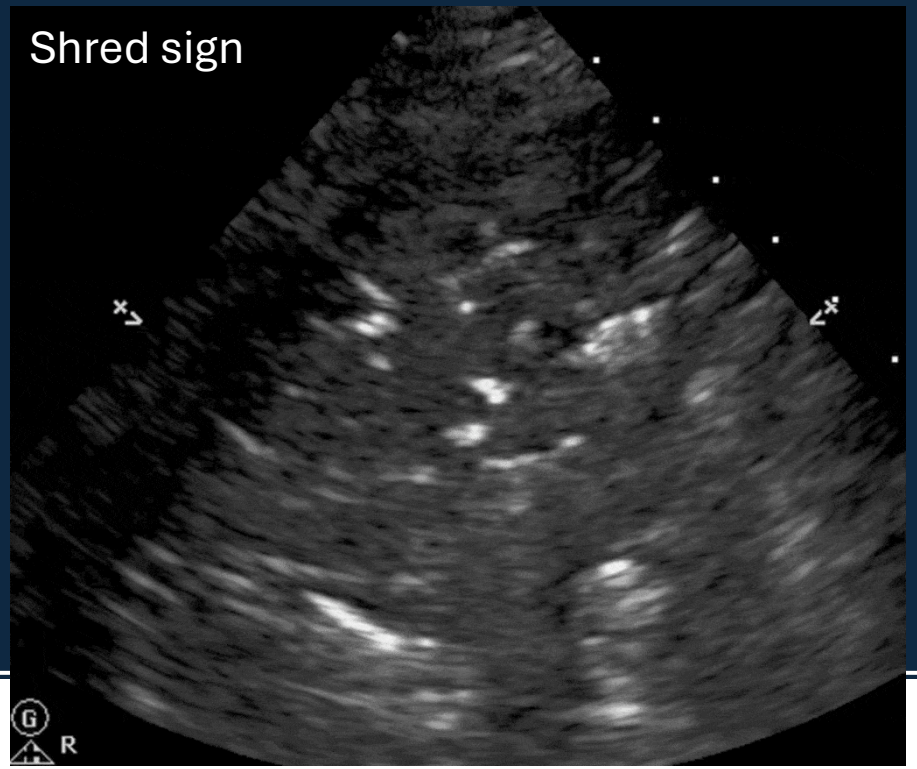


Depth – Gain – Focus
for B-lines

Ultrasound in Med. & Biol.,
Vol. 48, No. 8, pp. 1509-1517, 2022

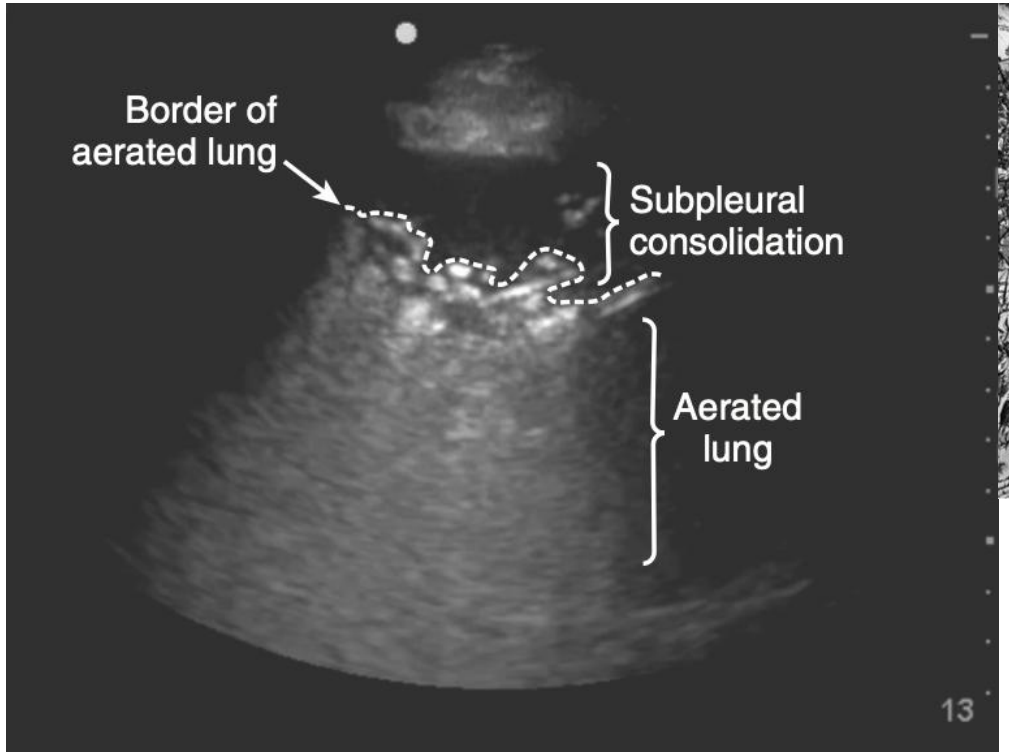
Consolidations





Dense lung consolidation
(Hepatization of the lung)

Shred/Fractal sign



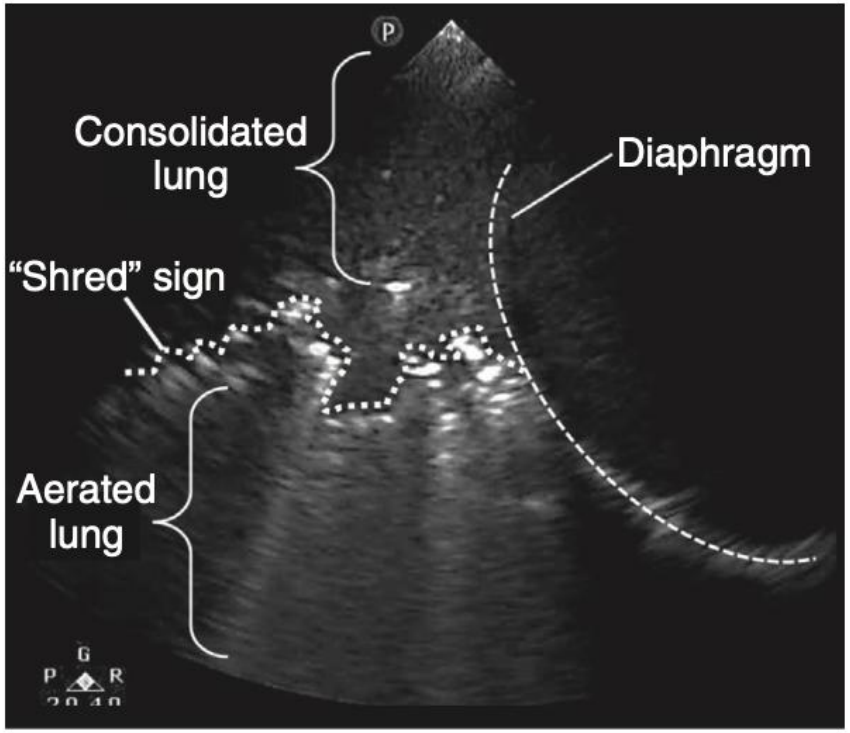


Figure 9.10 "Shred Sign." In the far field, an irregular jagged hyperechoic line traverses the lung at the interface of the aerated lung (far field) and consolidated lung (near field); this is called the "shred sign."

Dense/Alveolar Consolidations

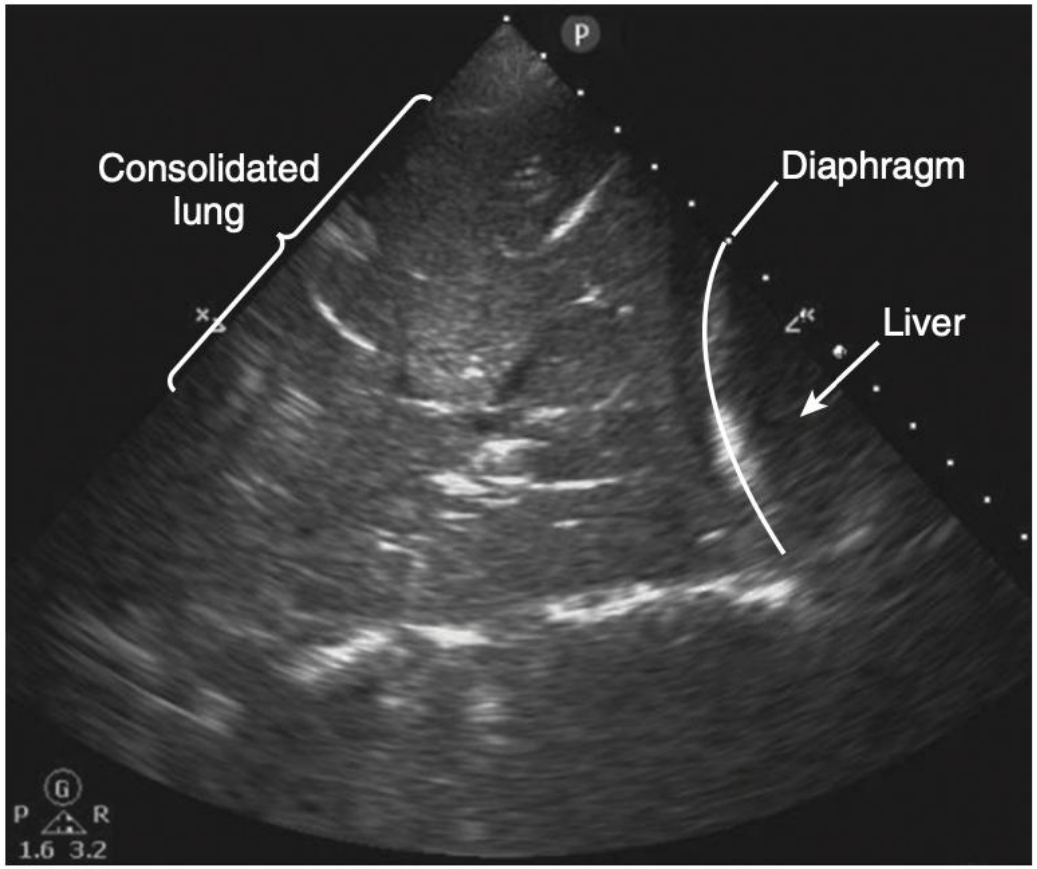
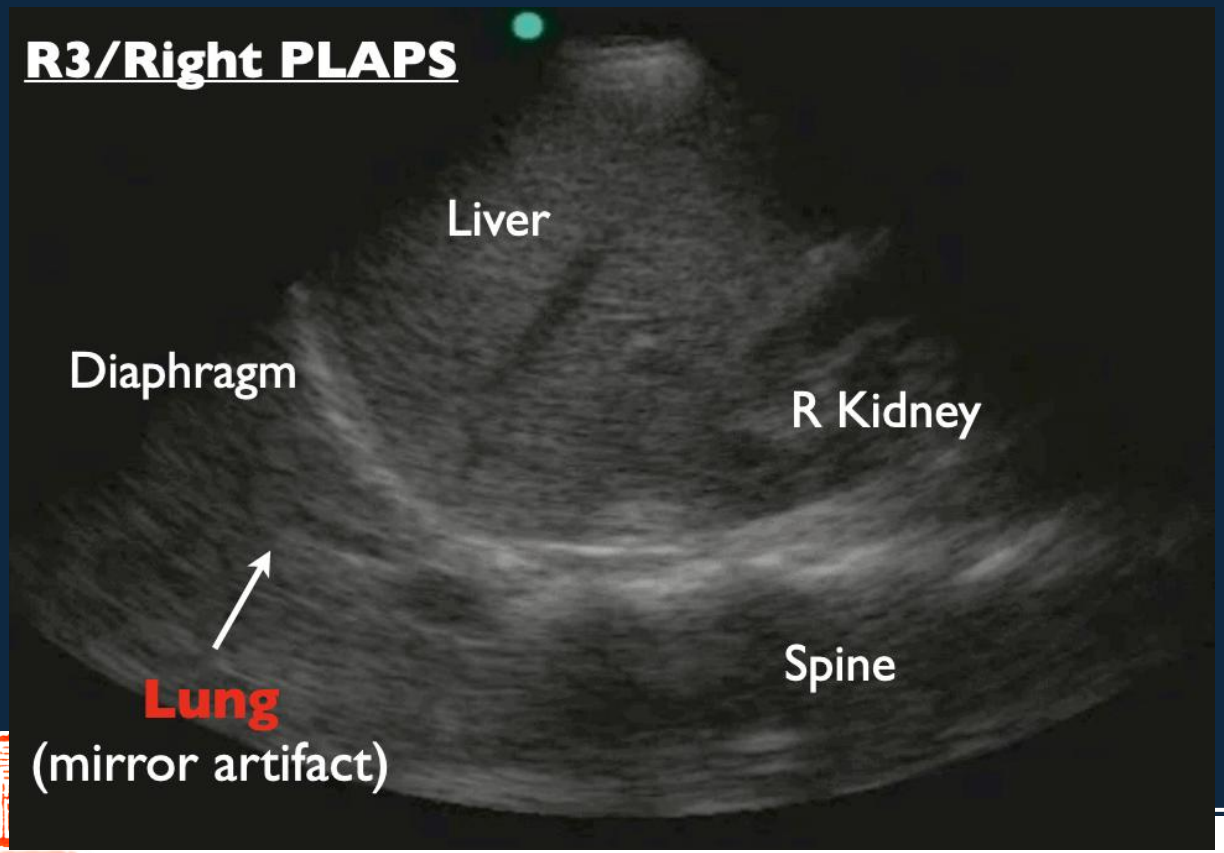
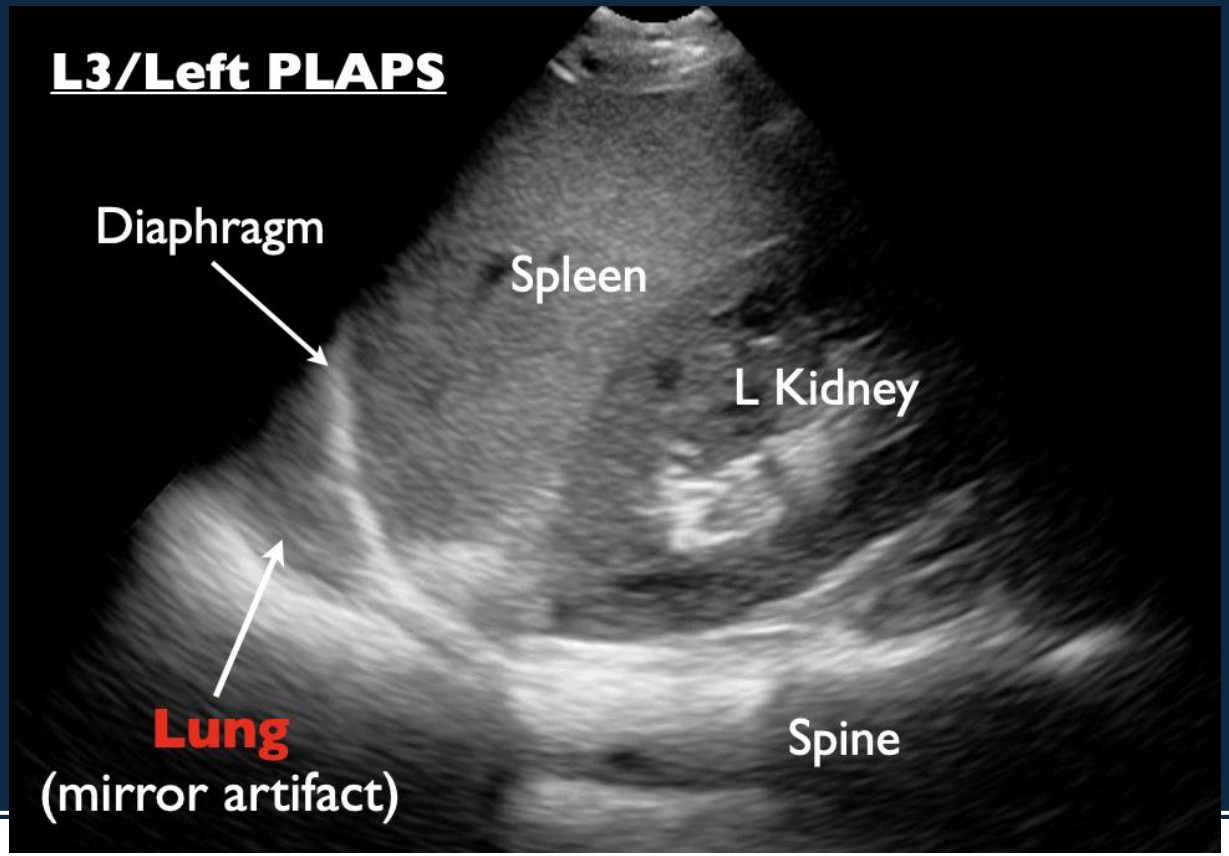


Figure 9.9 Alveolar Consolidation. A consolidation pattern is seen just above the diaphragm (left half of image). Echogenicity of the consolidated lung is similar to that of the liver; this is described as "hepatization" of the lung.

Diaphragm

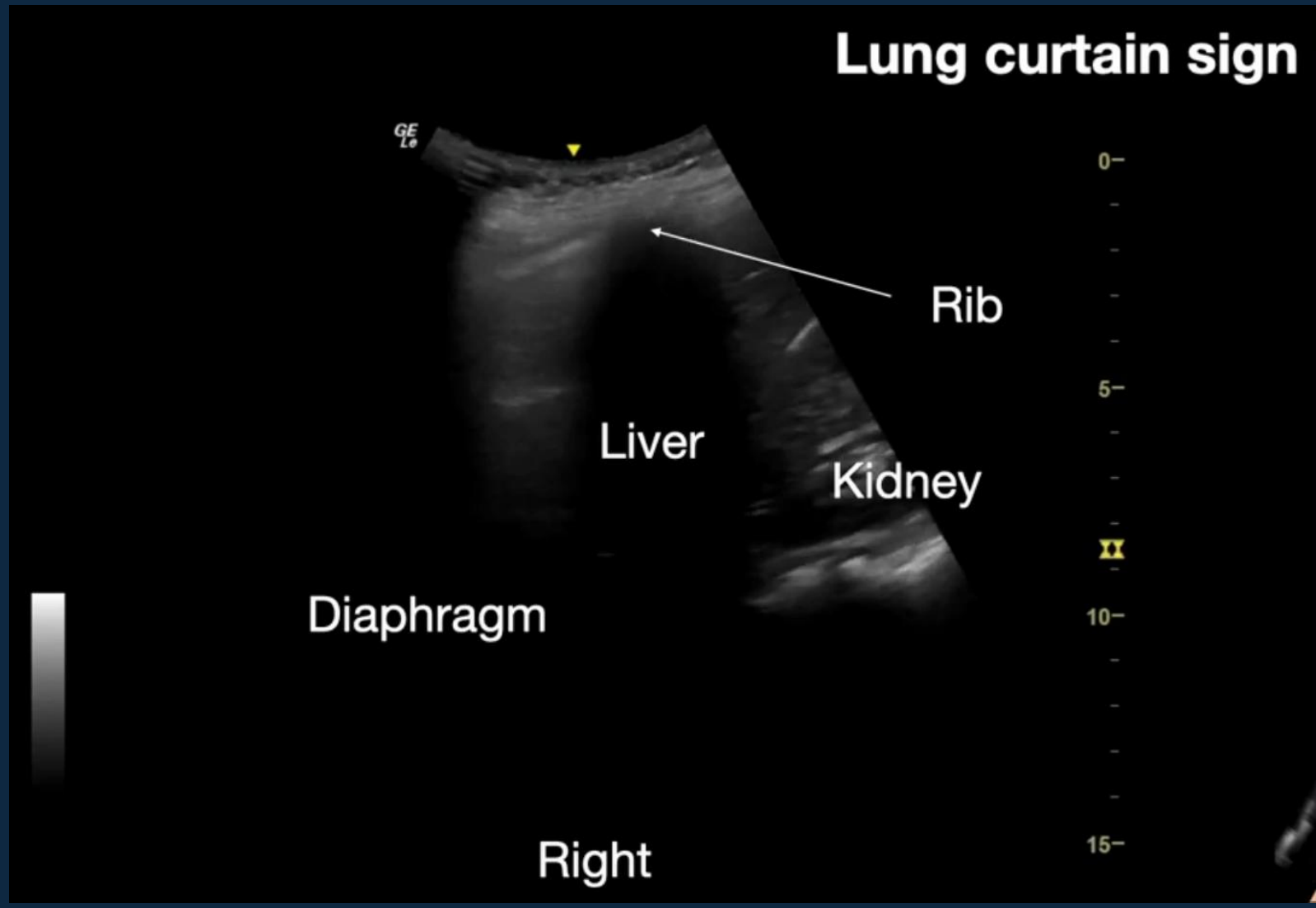
Mirror artifact + Curtain sign



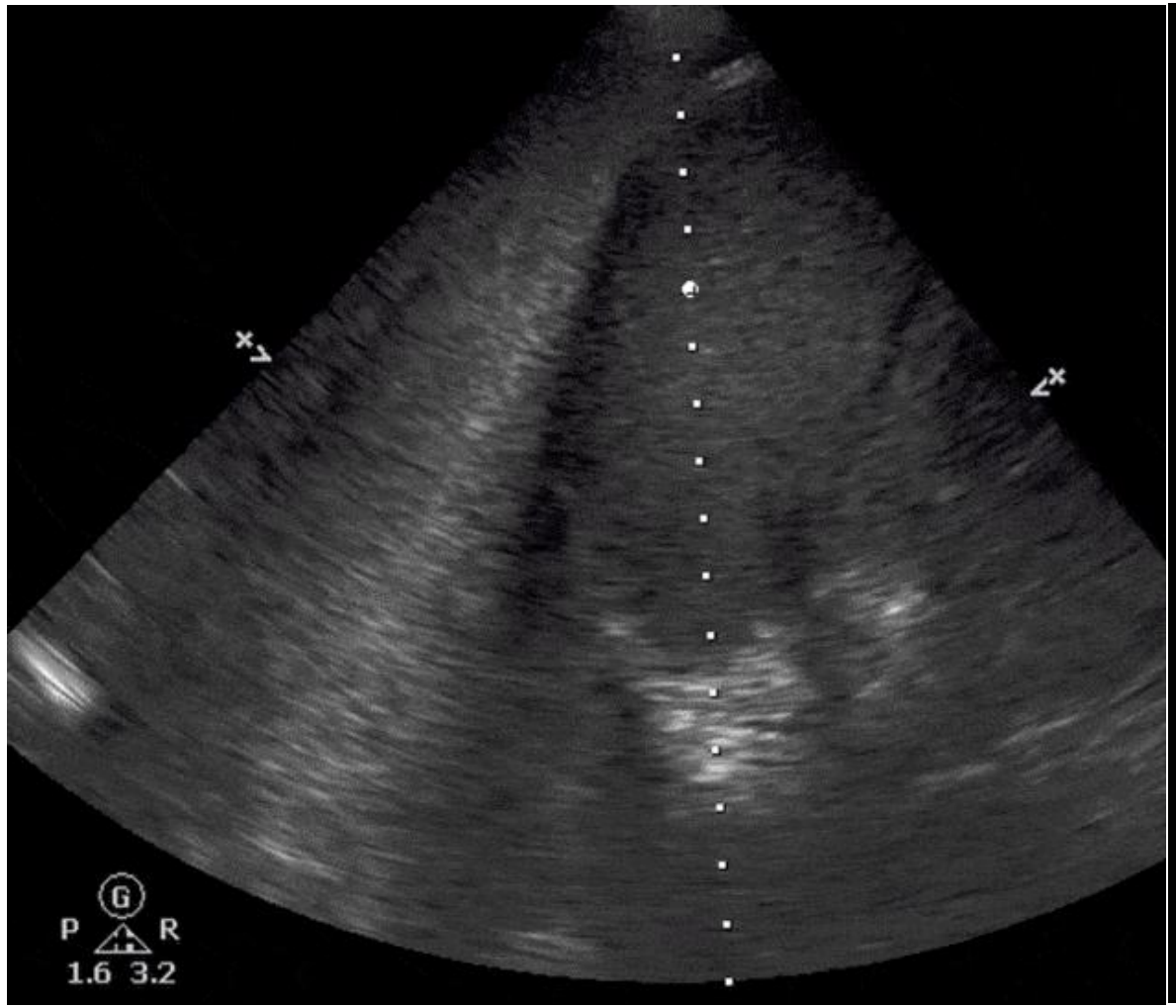


Curtain sign

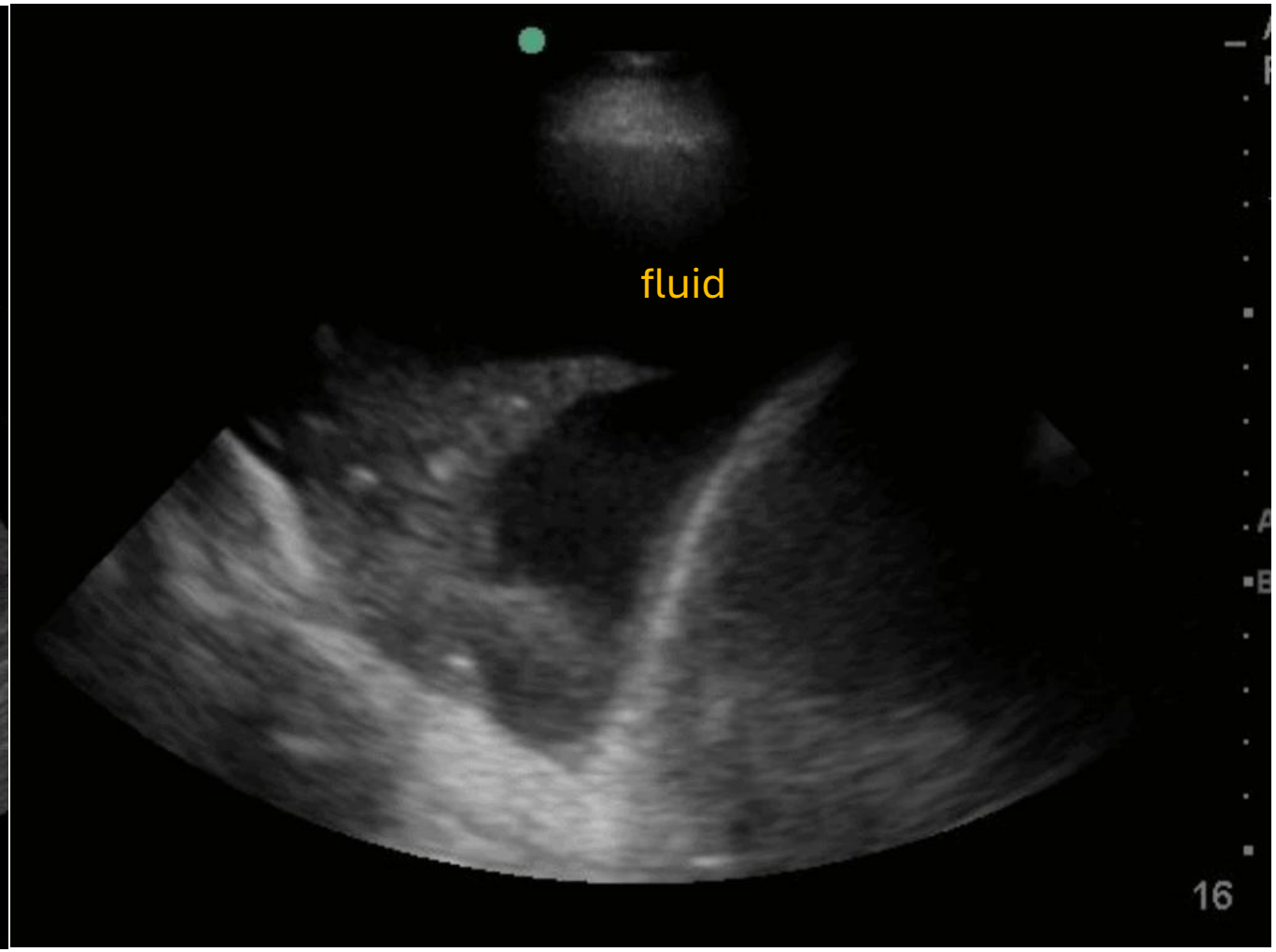
Air within the descending lung base obscures the area above the descending diaphragm as the lung descends during inspiration



Absence of mirror actifact and curtain sign



Dynamic air bronchograms at PLAPS point



Pleural Effusion

Effusion

- Spine sign
- Jellyfish sign
- Sinusoid sign
- Quad sign
- Plankton sign
- Hematocrit sign
- Loculated Pleural Effusions
- Empyema

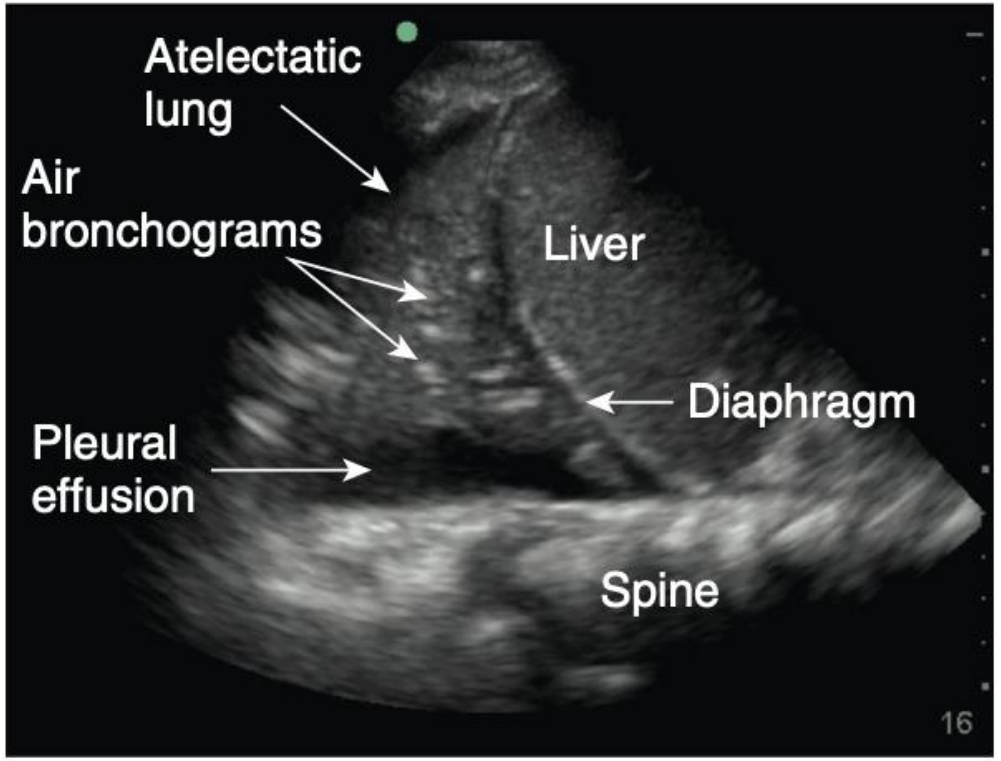
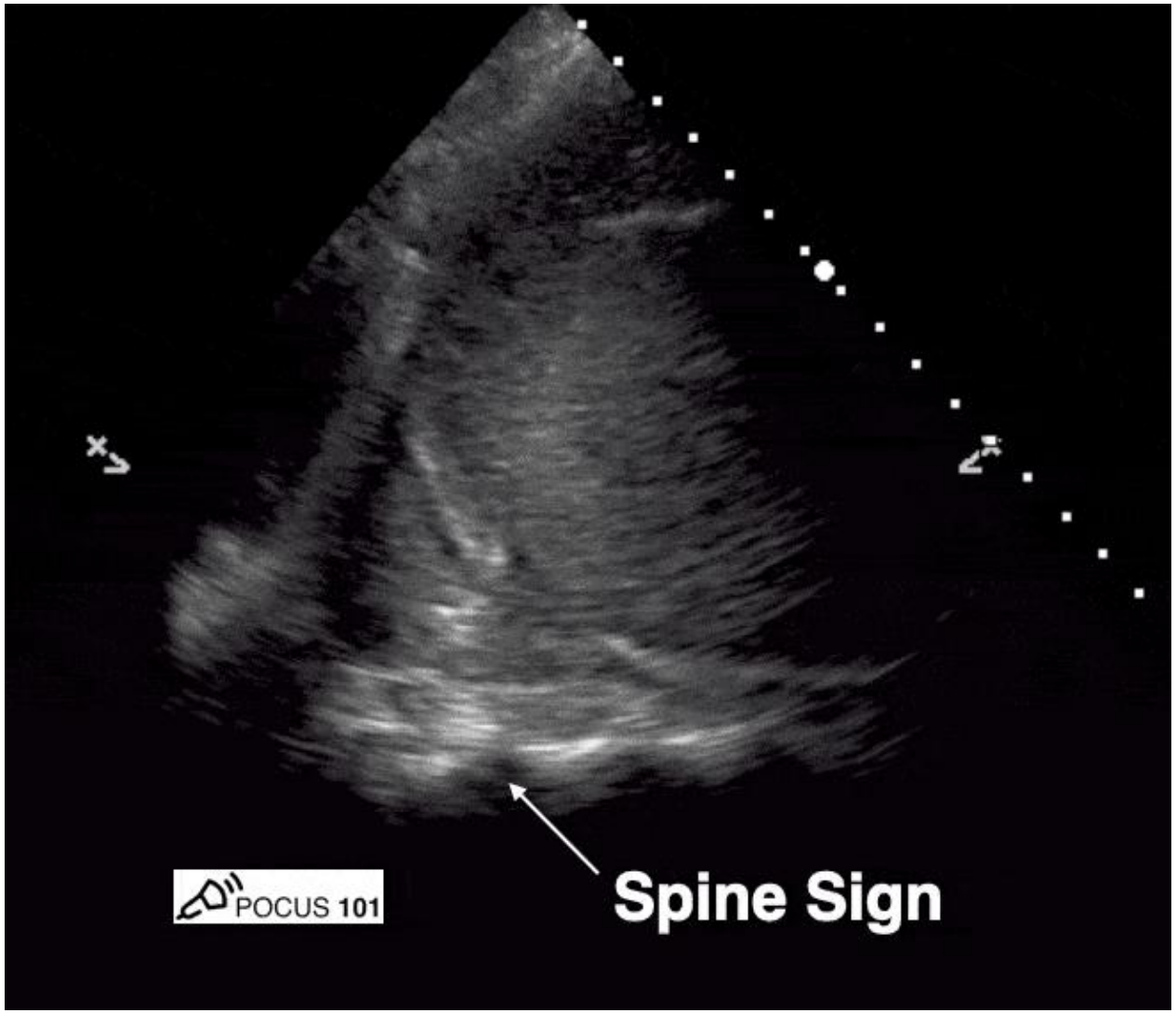
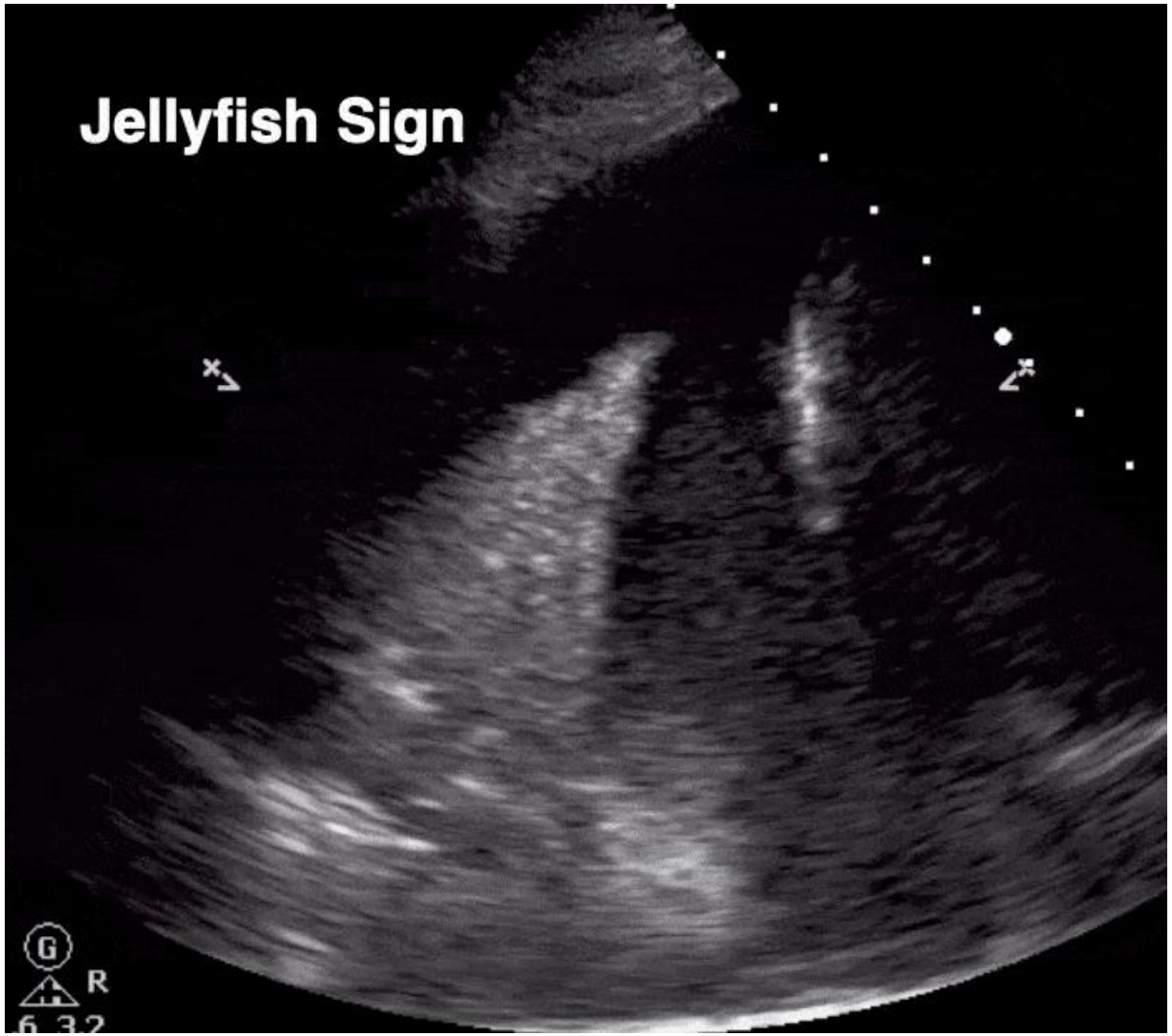
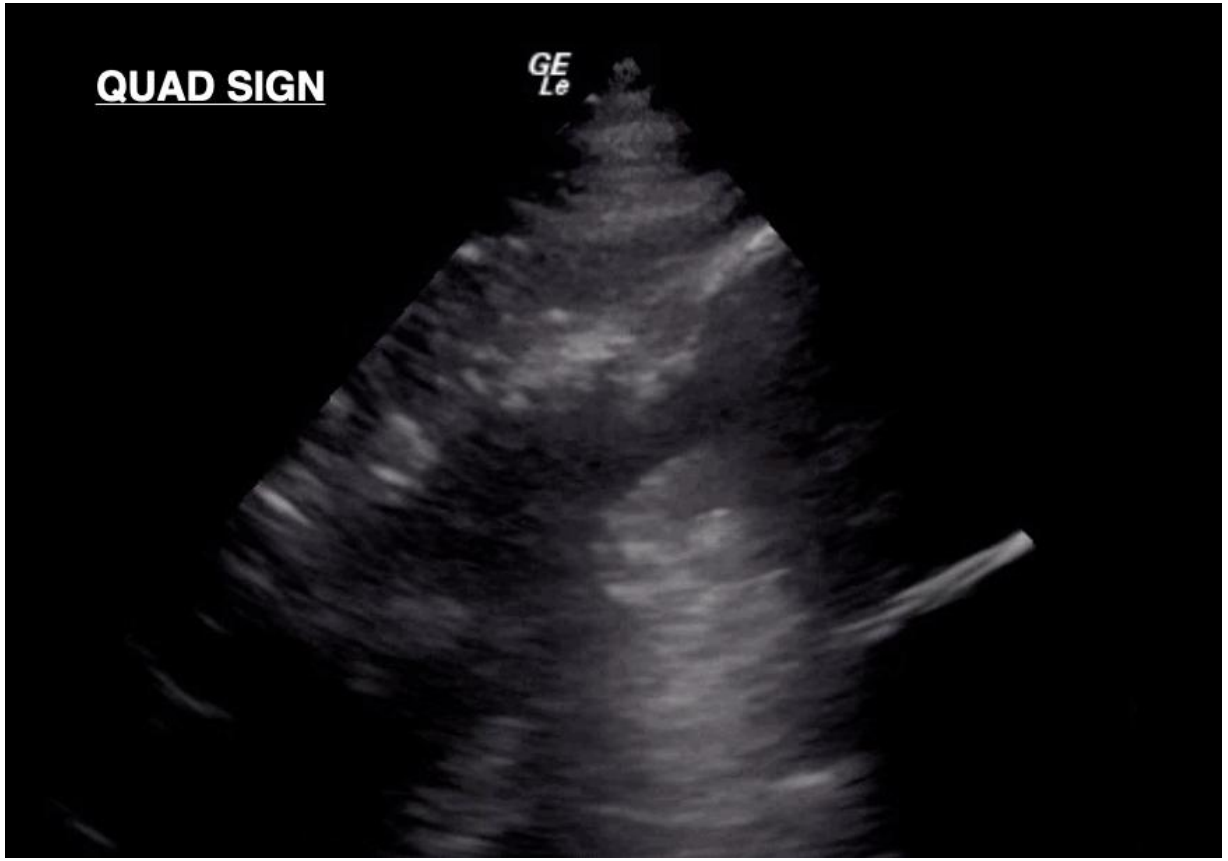


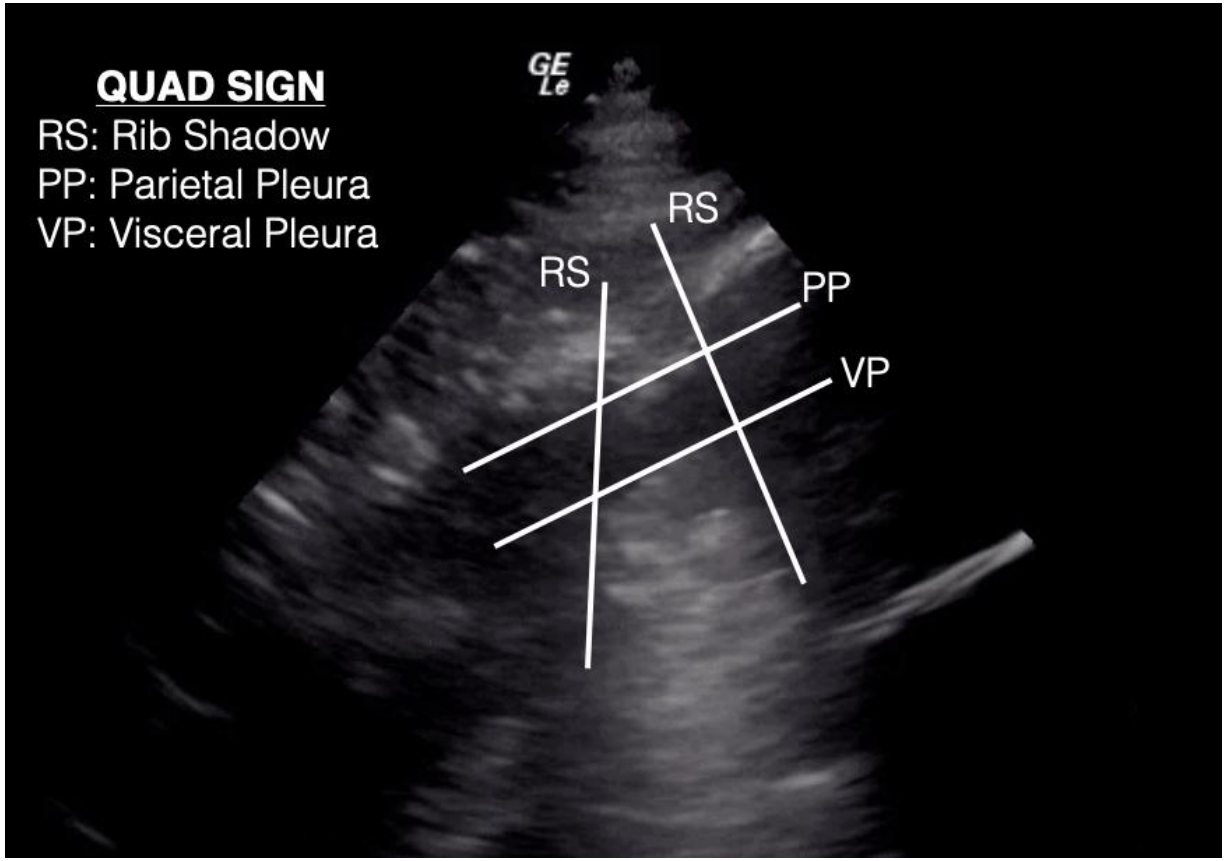
Figure 9.14 Compressive Atelectasis. A pleural effusion is compressing the lower lobe, causing atelectasis with air bronchograms.


POCUS 101
Spine Sign


Jellyfish Sign
G
R

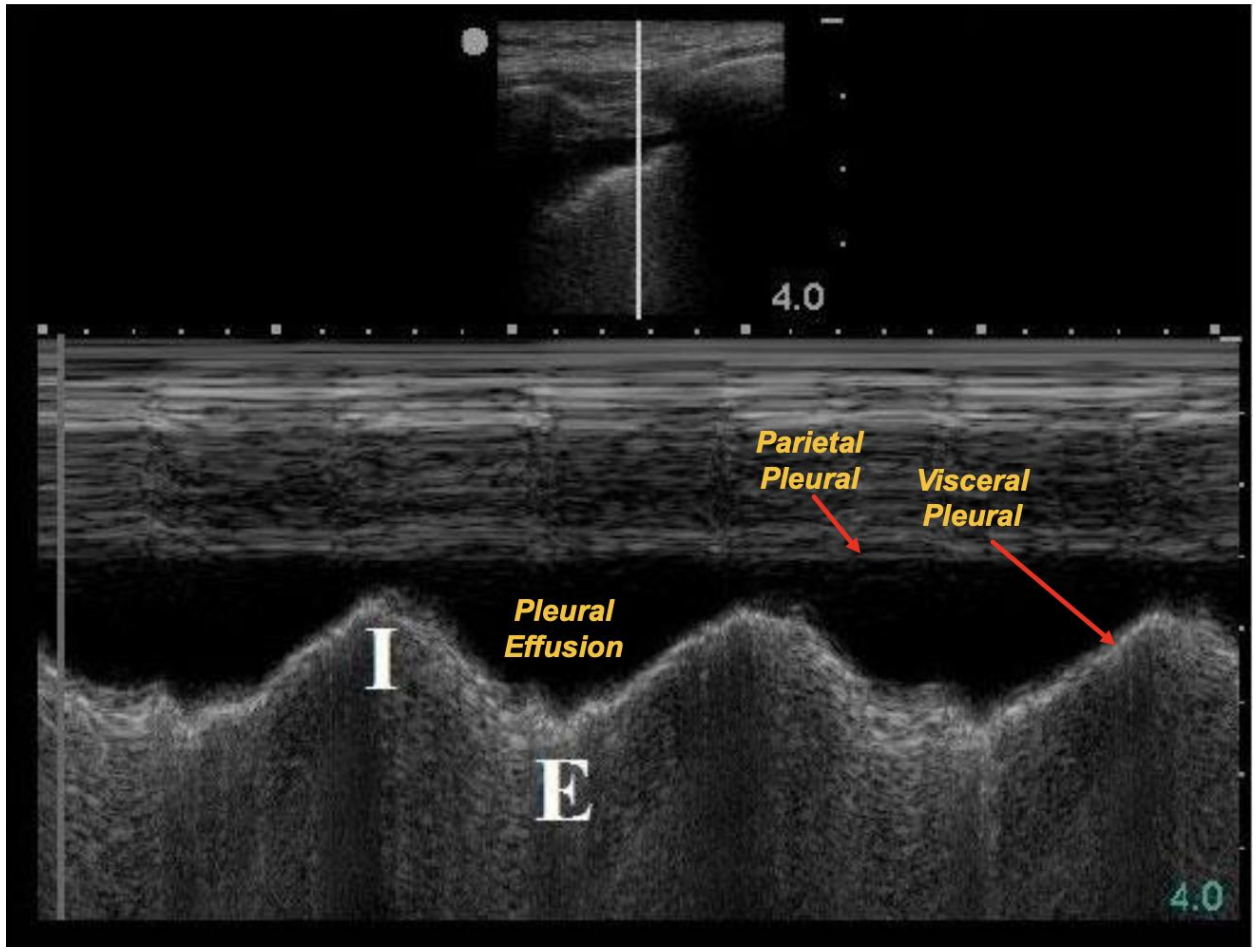
Quad Sign


QUAD SIGN
GE
Le


QUAD SIGN
RS: Rib Shadow
PP: Parietal Pleura
VP: Visceral Pleura
GE
Le
RS
RS
PP
VP

Sinusoid Sign

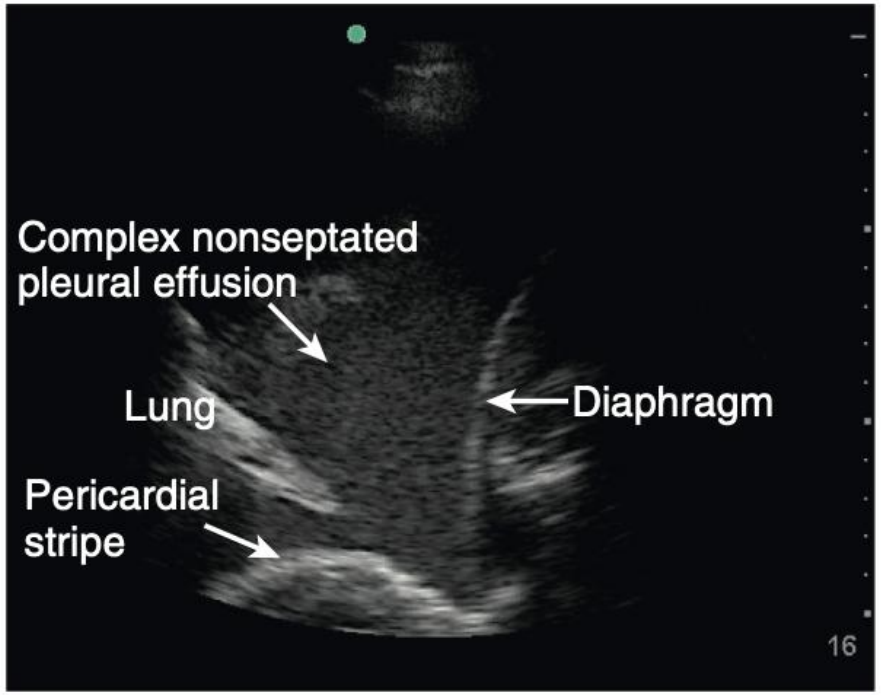
- It is equivalent to an M-mode view of the jellyfish sign
- Differentiating factor between pleural effusion and thick pleuritis



Plankton Sign

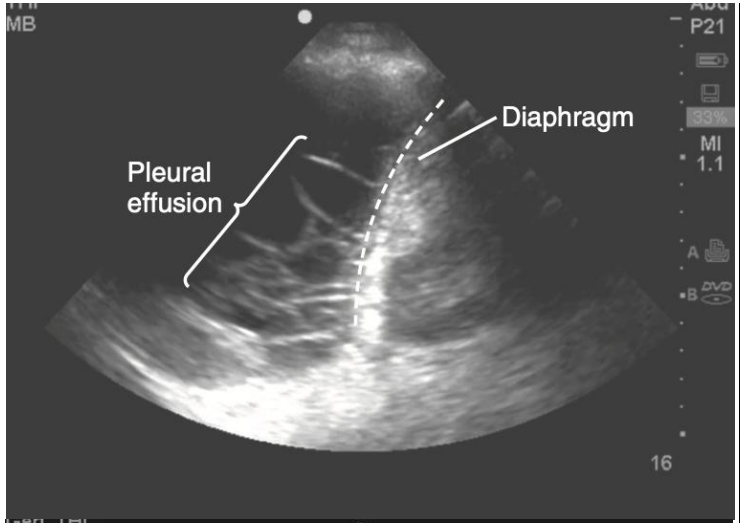
Hematocrit Sign

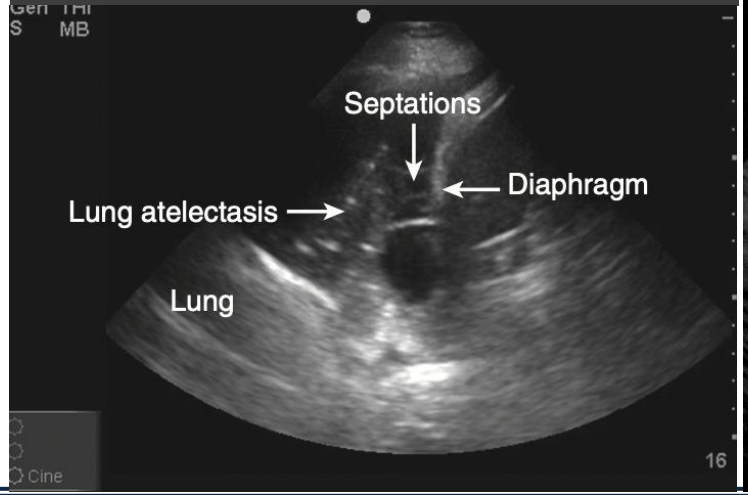
- **Exudative Pleural Effusion**: Present plankton sign/hematocrit sign

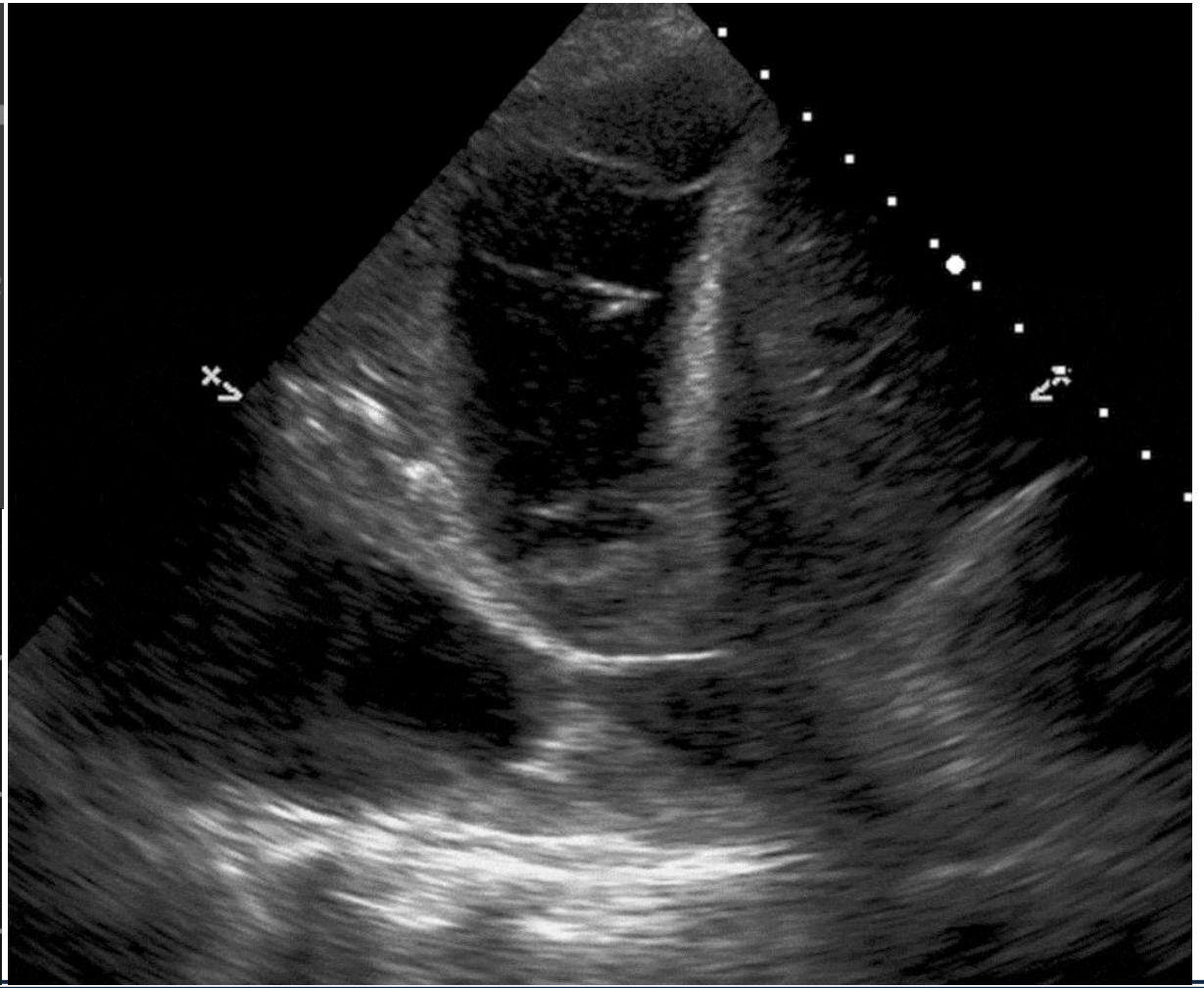


Loculated Pleural Effusion

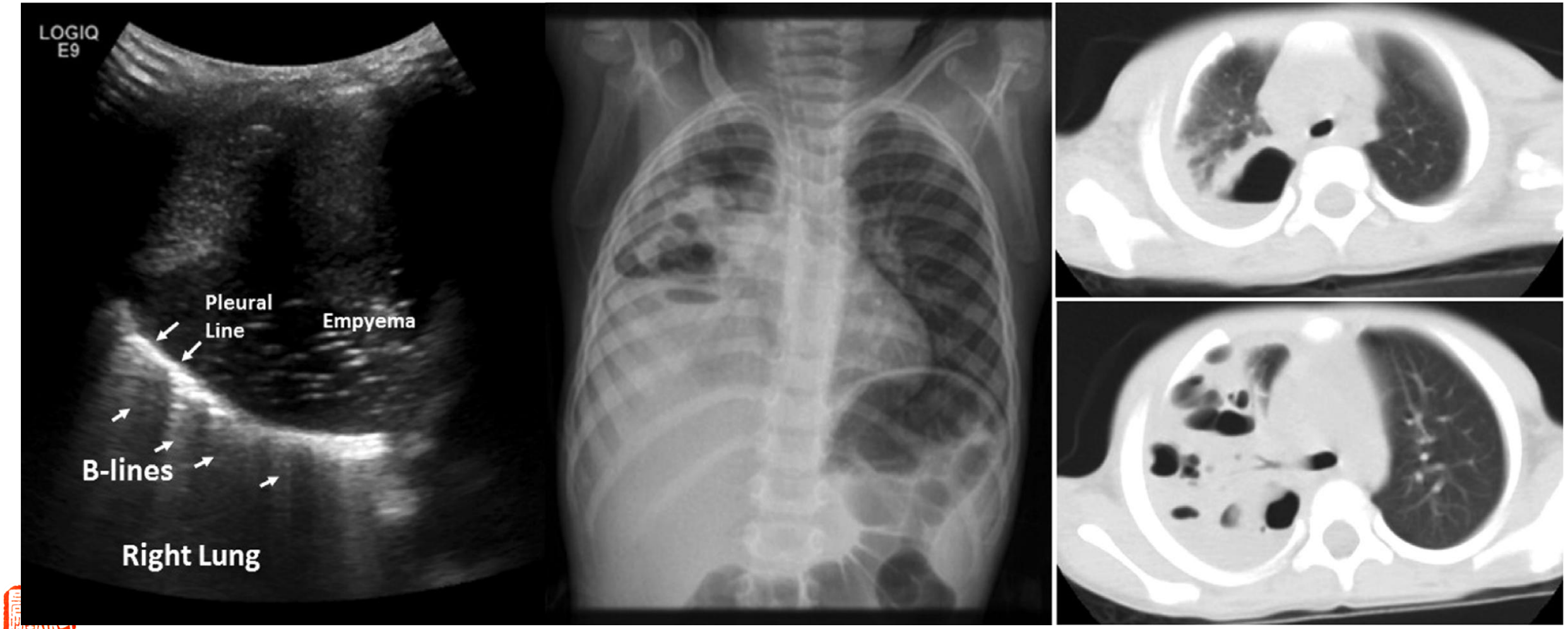
Septated Pleural Effusion







Empyema



Take home messages

- LUS nên là một kỹ năng cần thiết của BS phổi/hô hấp
- LUS giúp giải quyết câu hỏi lâm sàng tại giường
- Hiểu được LUS:
  - Phân tích xảo ảnh
  - Phổi là cơ quan trộn lẫn giữa nước và khí
  - Nhìn tất cả thông qua màng phổi
- Tiếp cận đơn giản, hệ thống (A-B-C-D-E)

thank you

觀音

WATCHING THE SOUND