

FAMUS BLUE Protocol



Aims

- To understand how to identify BLUE points
- How to use the BLUE protocol to make a diagnosis

Background

- Physical examination and CXR have a poor diagnostic accuracy for acute respiratory failure (ARF).
- CT is impractical for most cases of ARF.
- Ultrasound has diagnostic accuracy approaching CT scan

US vs. CT

	Auscultation, %	Chest Radiography, %	Lung Ultrasonography, %
Pleural effusion			
Sensitivity	42	39	92
Specificity	90	85	93
Diagnostic accuracy	61	47	93
Alveolar consolidation			
Sensitivity	8	68	93
Specificity	100	95	100
Diagnostic accuracy	36	75	97
Alveolar-Interstitial syndrome			
Sensitivity	34	60	98
Specificity	90	100	88
Diagnostic accuracy	55	72	95

ARDS – acute respiratory distress syndrome.

Lichtenstein D et al. Comparative diagnostic performances of auscultation, chest radiography, and lung ultrasonography in acute respiratory distress syndrome. *Anesthesiology*. 2004; **100**: 9-15.2012

Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure*

The BLUE Protocol

Daniel A. Lichtenstein, MD, FCCP; and Gilbert A. Mezière, MD

Background: This study assesses the potential of lung ultrasonography to diagnose acute respiratory failure.

Methods: This observational study was conducted in university-affiliated teaching-hospital ICUs. We performed ultrasonography on consecutive patients admitted to the ICU with acute respiratory failure, comparing lung ultrasonography results on initial presentation with the final diagnosis by the ICU team. Uncertain diagnoses and rare causes (frequency < 2%) were excluded. We included 260 dyspneic patients with a definite diagnosis. Three items were assessed: artifacts (horizontal A lines or vertical B lines indicating interstitial syndrome), lung sliding, and alveolar consolidation and/or pleural effusion. Combined with venous analysis, these items were grouped to assess ultrasound profiles.

Results: Predominant A lines plus lung sliding indicated asthma (n = 34) or COPD (n = 49) with 89% sensitivity and 97% specificity. Multiple anterior diffuse B lines with lung sliding indicated pulmonary edema (n = 64) with 97% sensitivity and 95% specificity. A normal anterior profile plus deep venous thrombosis indicated pulmonary embolism (n = 21) with 81% sensitivity and 99% specificity. Anterior absent lung sliding plus A lines plus lung point indicated pneumothorax (n = 9) with 81% sensitivity and 100% specificity. Anterior alveolar consolidations, anterior diffuse B lines with abolished lung sliding, anterior asymmetric interstitial patterns, posterior consolidations or effusions without anterior diffuse B lines indicated pneumonia (n = 83) with 89% sensitivity and 94% specificity. The use of these profiles would have provided correct diagnoses in 90.5% of cases.

Conclusions: Lung ultrasound can help the clinician make a rapid diagnosis in patients with acute respiratory failure, thus meeting the priority objective of saving time.

(CHEST 2008; 134:117-125)

Key words: chest ultrasonography; COPD; ICU; interstitial syndrome; lung, ultrasound diagnosis; pneumothorax; pulmonary edema; respiratory failure

Abbreviations: BLUE = Bedside Lung Ultrasound in Emergency; PLAPS = posterolateral alveolar and/or pleural syndrome

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).

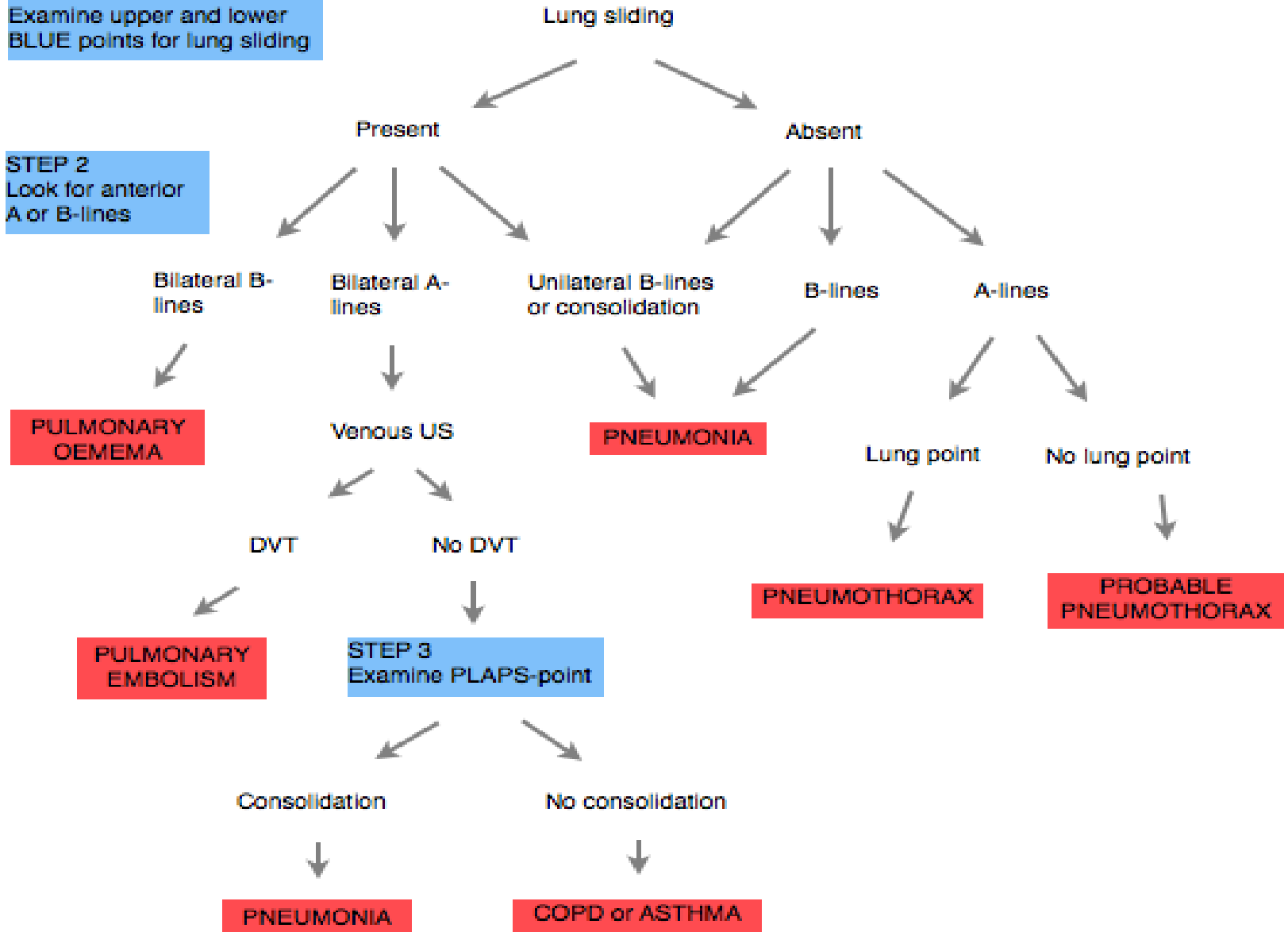
Summary

- Observational study of 260 patients with acute respiratory failure.
- 31% pneumonia, 24% pulmonary oedema, 18% COPD, 12% asthma, 8% PE, 3% pneumothorax.
- Specificity for each disease with US >90%.
- Diagnostic accuracy 90.5%.

The BLUE protocol

STEP 1
Examine upper and lower
BLUE points for lung sliding

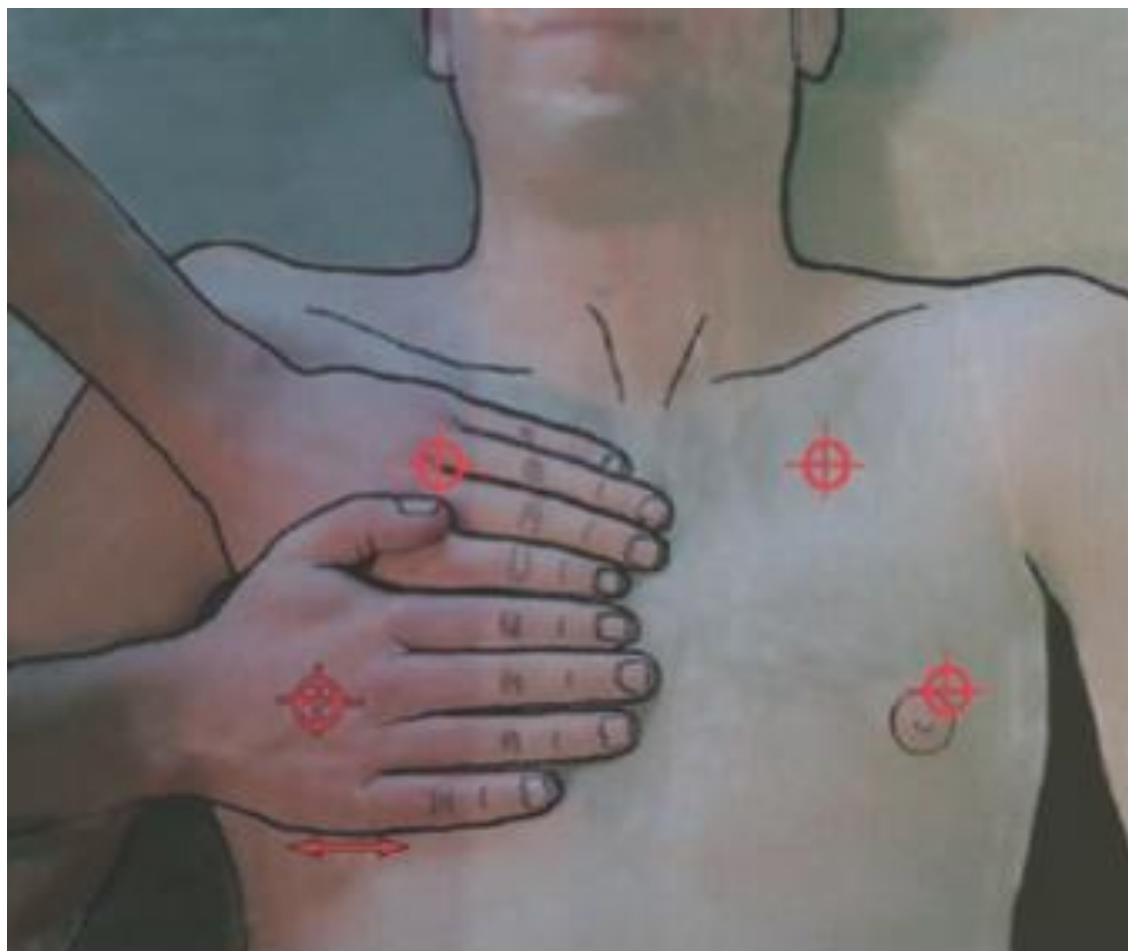
STEP 2
Look for anterior
A or B-lines



Step 1

- Examine the Upper and Lower BLUE points.
- Look for anterior lung sliding at these points.

Upper and Lower BLUE points



Lung sliding

B	F	R	G	52%
TEI	D	8 cm	XV	1
	PRC	15-2-H	PRS	3
	PST	2		

FACTORY CA431

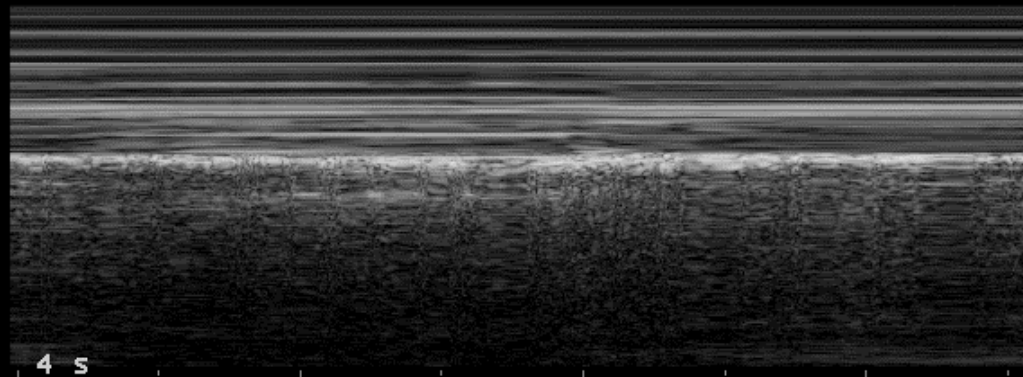
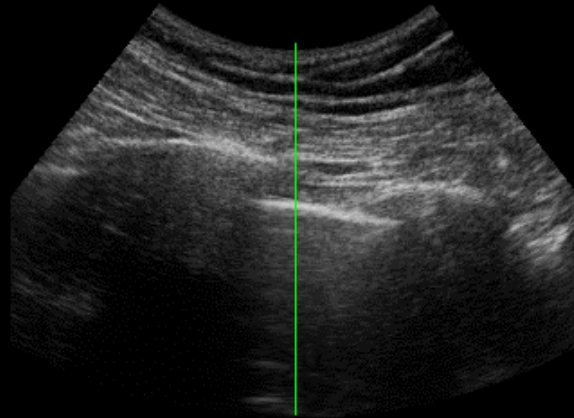


SLIDING LEFT

B F R G 52%
TEI D 8 cm XV 1
PRC 15-2-H PRS 3
PST 2

M G 52%
PRC 15-2
PST 2

FACTORY CA431



Absent sliding

saote MyLab

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B	F	R	G	52%
TEI	D	8 cm	XV	1
	PRC	15-2-H	PRS	3
	PST	2		

FACTORY CA431

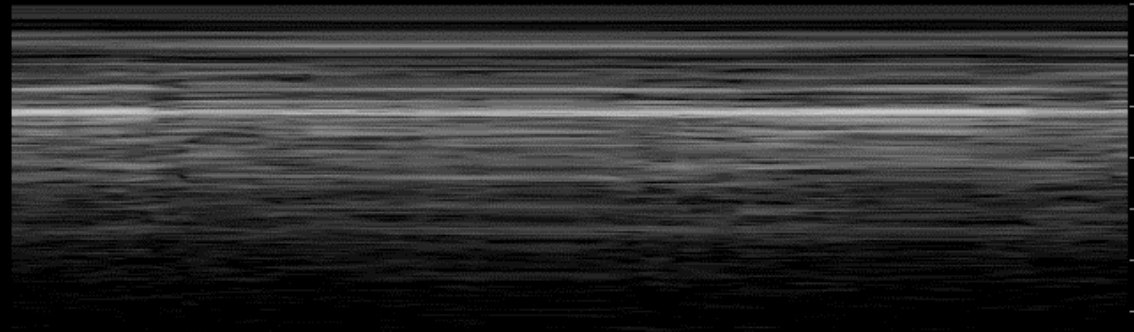
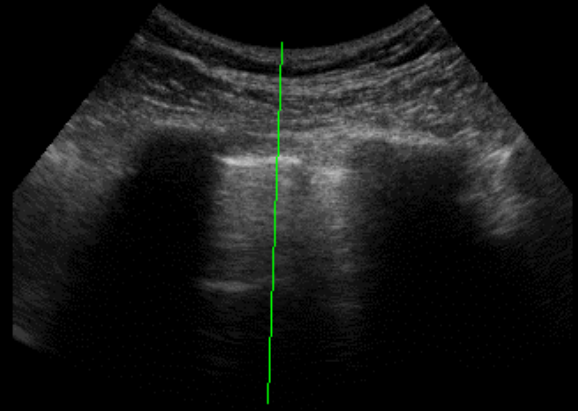
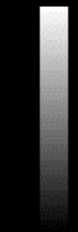


ABSENT SLIDING RIGHT

B F R G 52%
TEI D 8 cm XV 1
PRC 15-2-H PRS 3
PST 2

M G 52%
PRC 15-2
PST 2

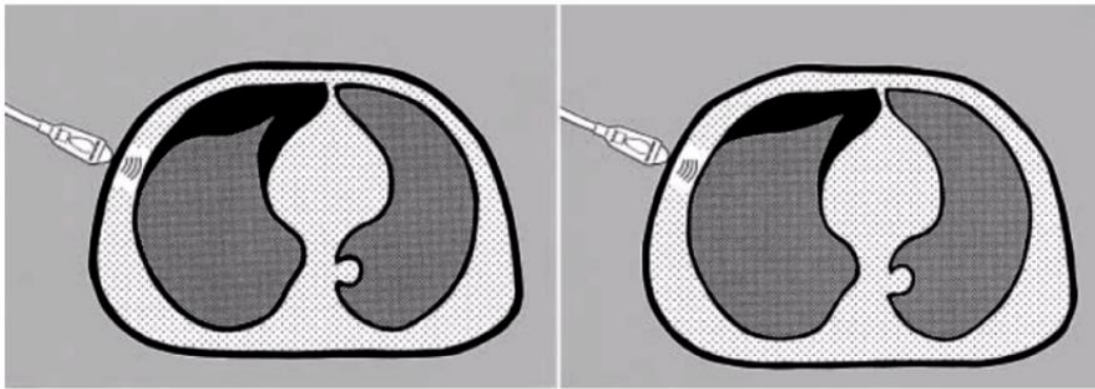
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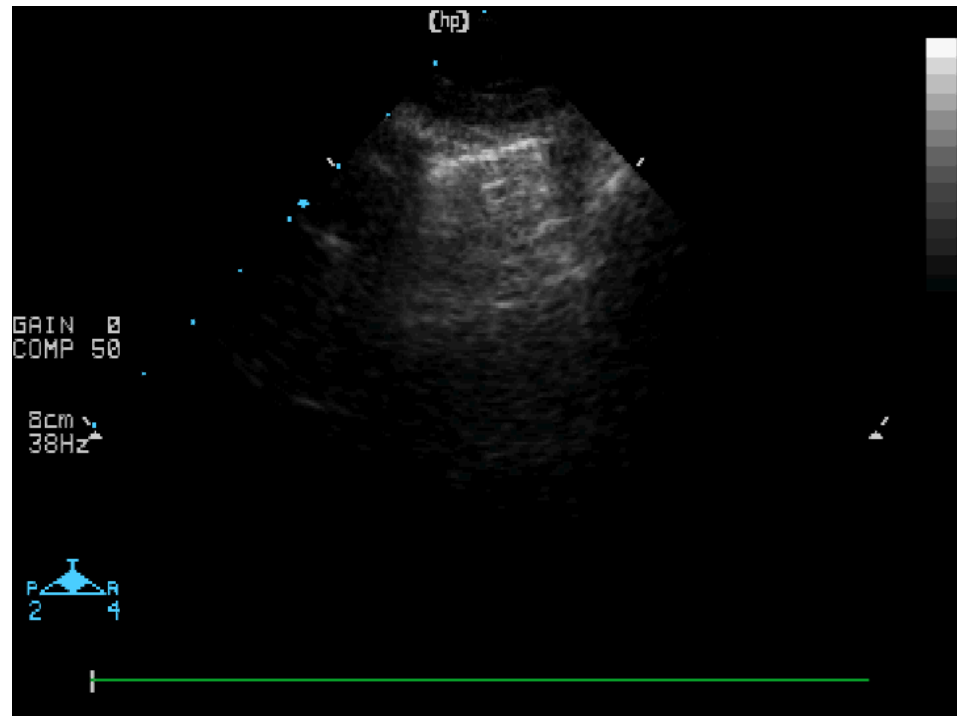
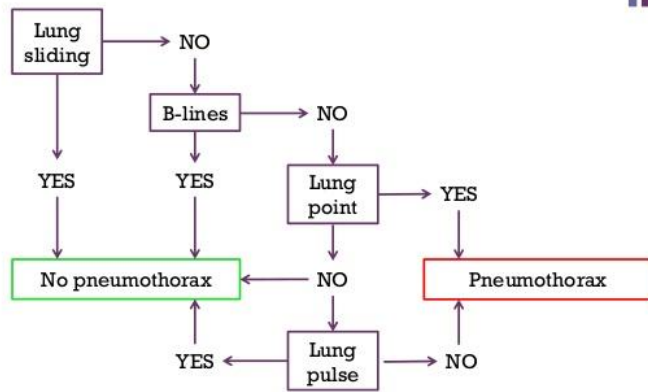
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Lung sliding

- Present:
 - Normal lung surface (pneumothorax ruled out).
- Absent:
 - Pneumothorax, ARDS, pneumonia, one lung intubation, pneumonectomy.

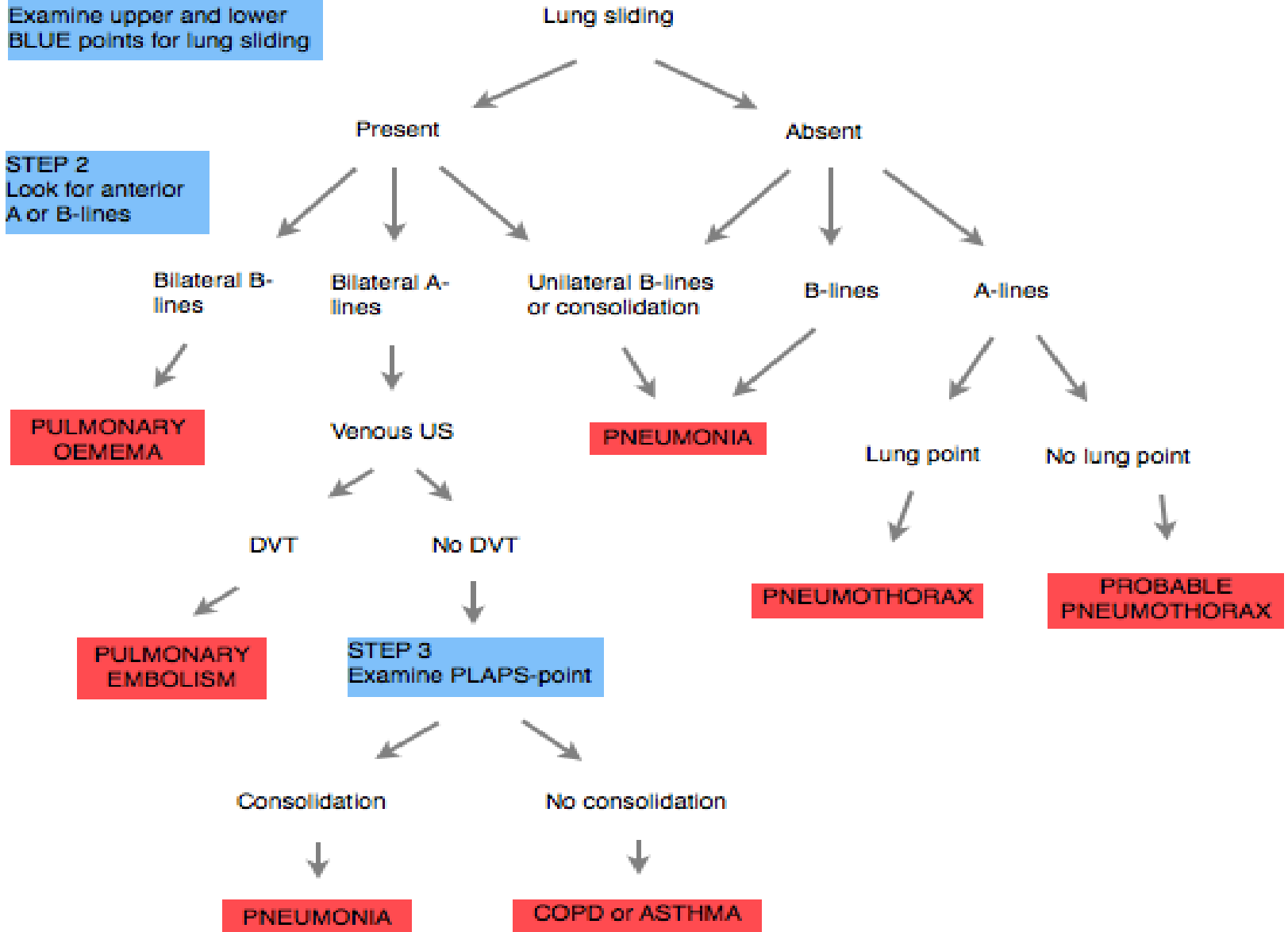


+ Pneumothorax US algorithm



STEP 1
Examine upper and lower
BLUE points for lung sliding

STEP 2
Look for anterior
A or B-lines



Step 2

- Look for anterior A-lines or B-lines

A lines

@saote MyLab

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B F 5.0 MHz G 85%
D 12 cm XV C
PRC 13-4-L PRS 3
PST 2

ABDO

CA431



B lines

P-----

05 AUG 2012 10:20

B F 3.5 MHz G 94%
D 13 cm XV C
PRC 13-4-L PRS 3
PST 2

0:00:00.36

ABDO

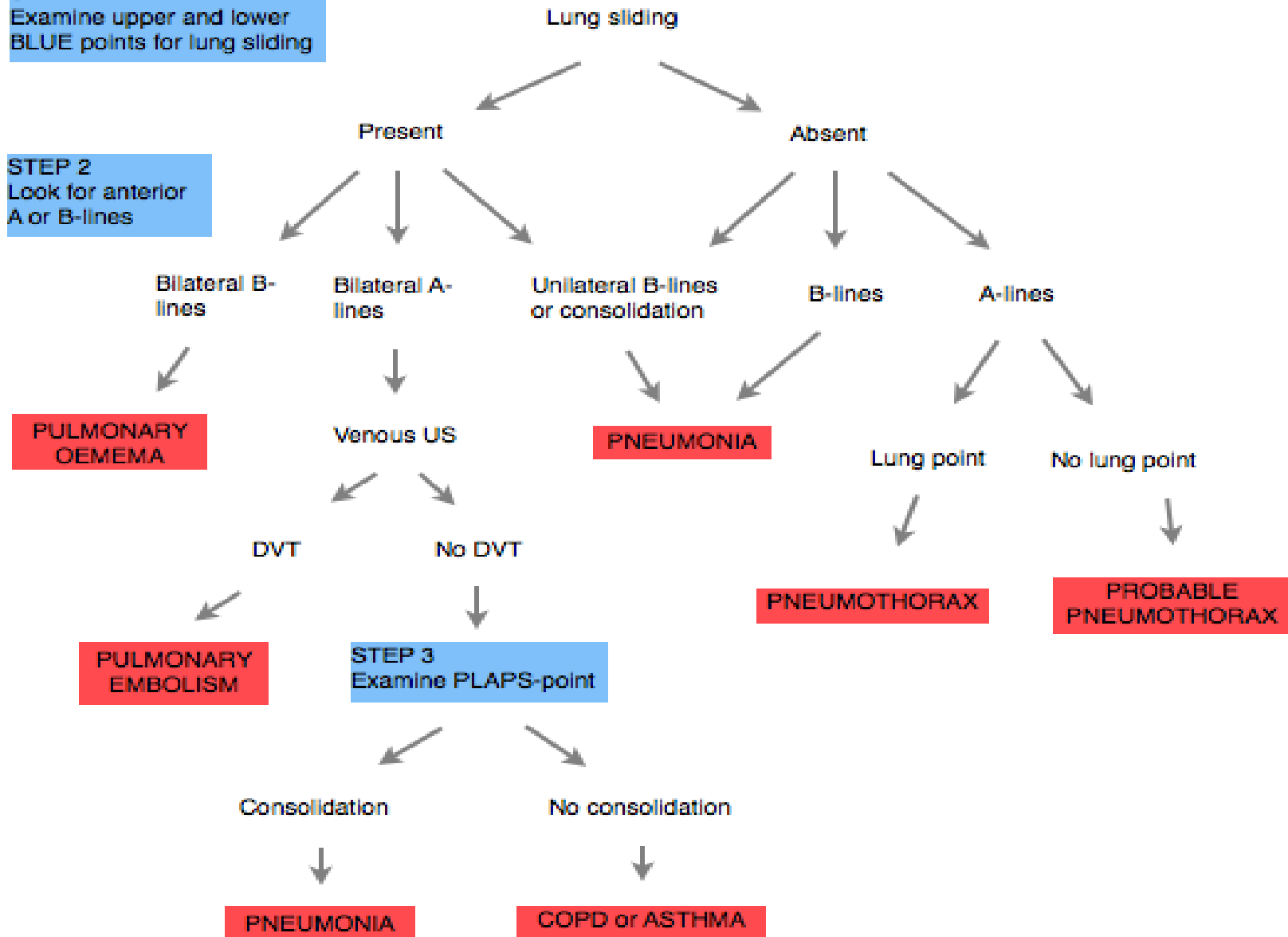
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RIGHT BASE

STEP 1
Examine upper and lower
BLUE points for lung sliding

STEP 2
Look for anterior
A or B-lines





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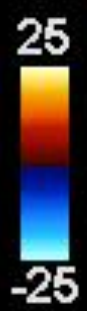
RWH

ASH

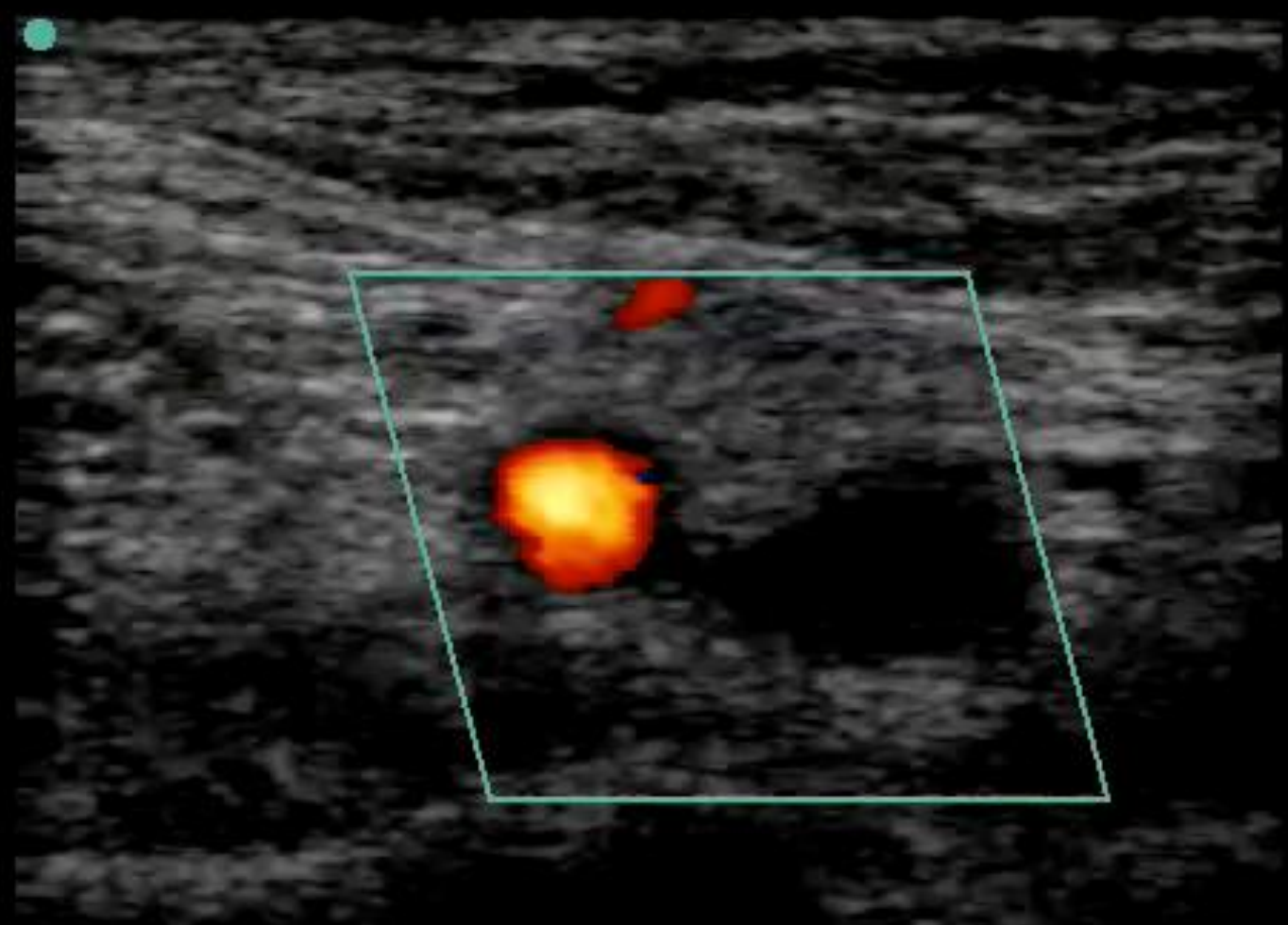
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Color
3472Hz



+15°



Vas
HFL

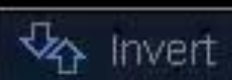
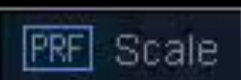


71%

TIS
0.5

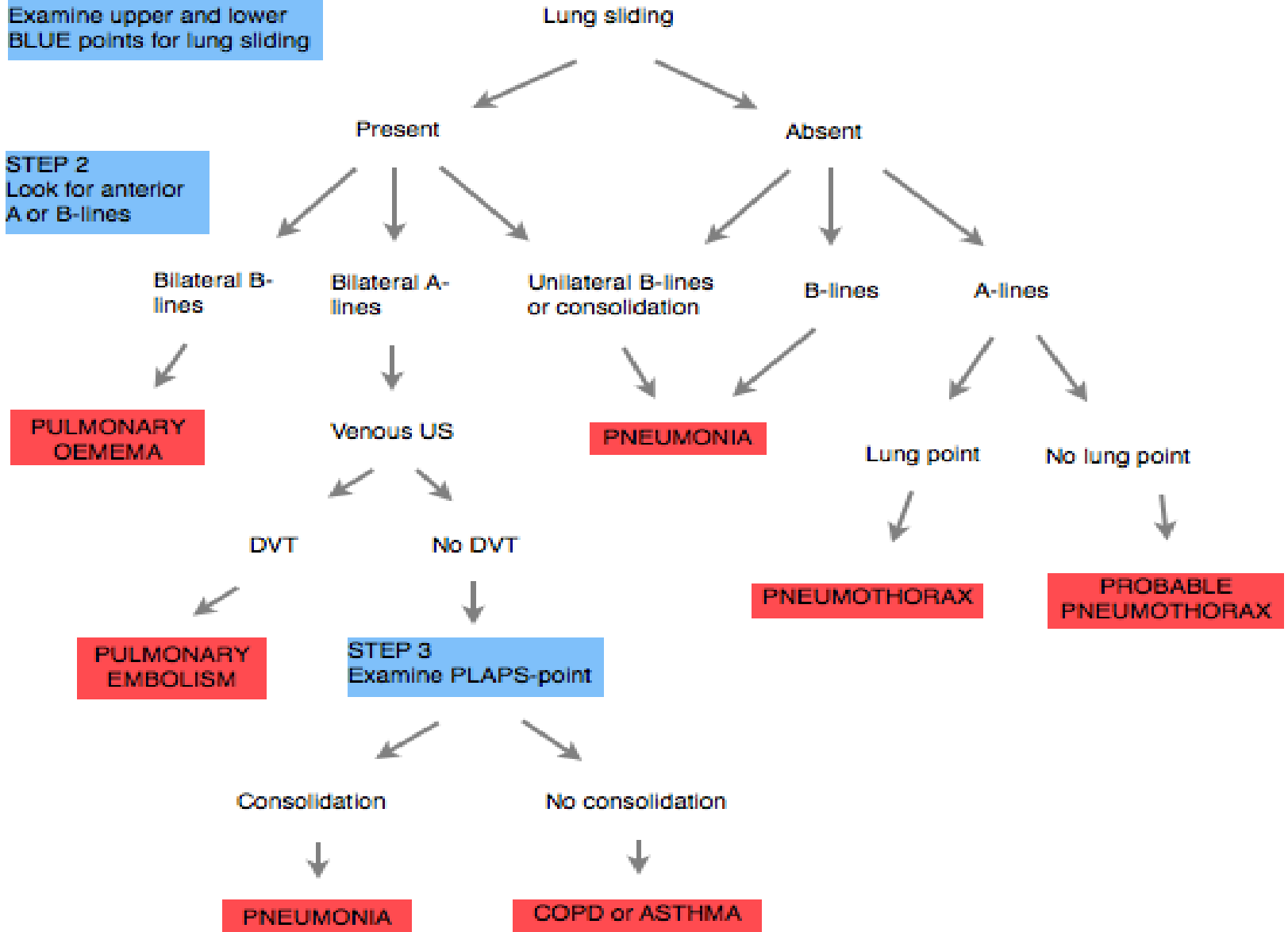


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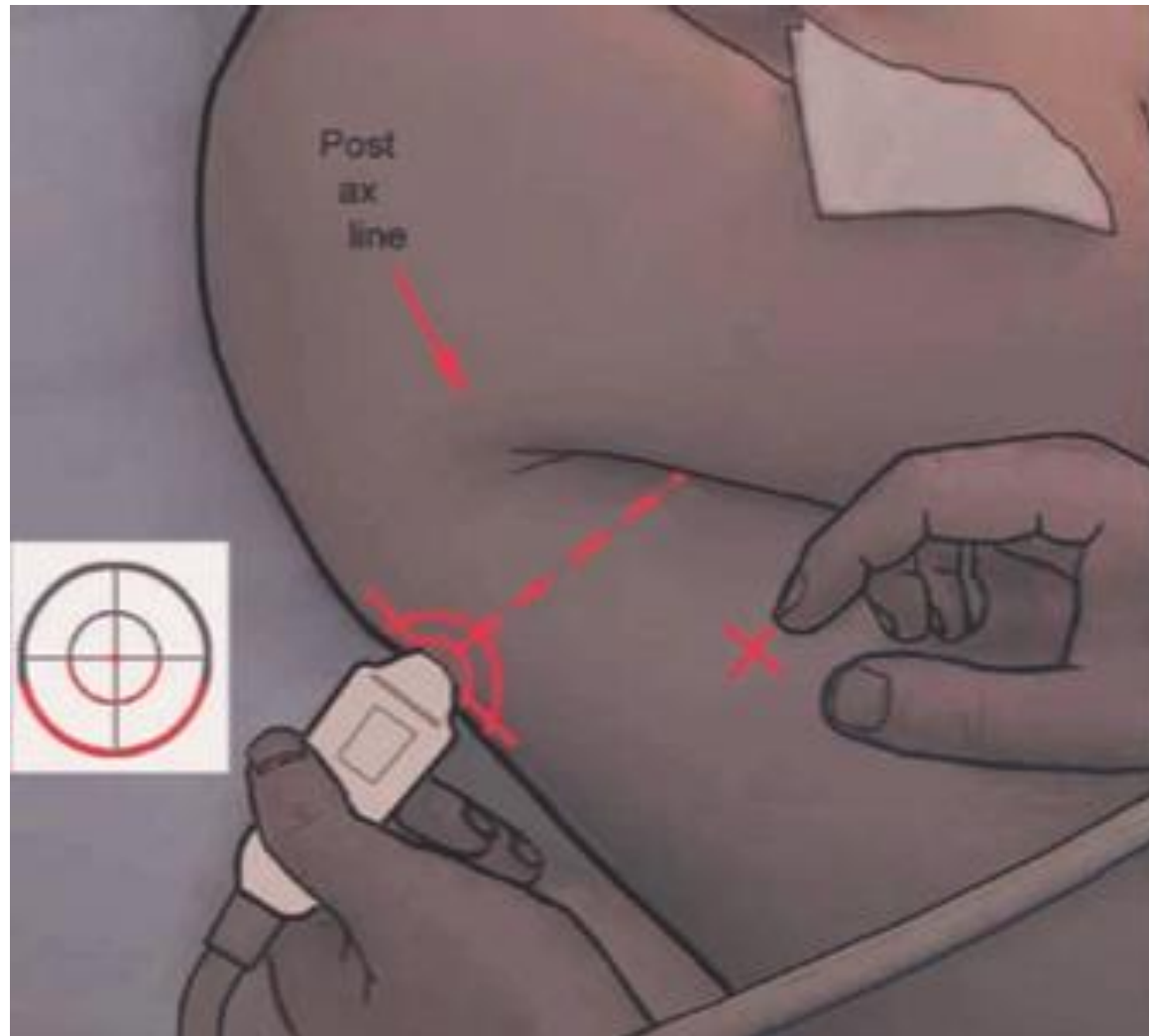


STEP 1
Examine upper and lower
BLUE points for lung sliding

STEP 2
Look for anterior
A or B-lines



PLAPS point



PLAPS

- A normal PLAPS will show sliding and A-lines.
- An abnormal PLAPS means consolidation and/or an effusion.

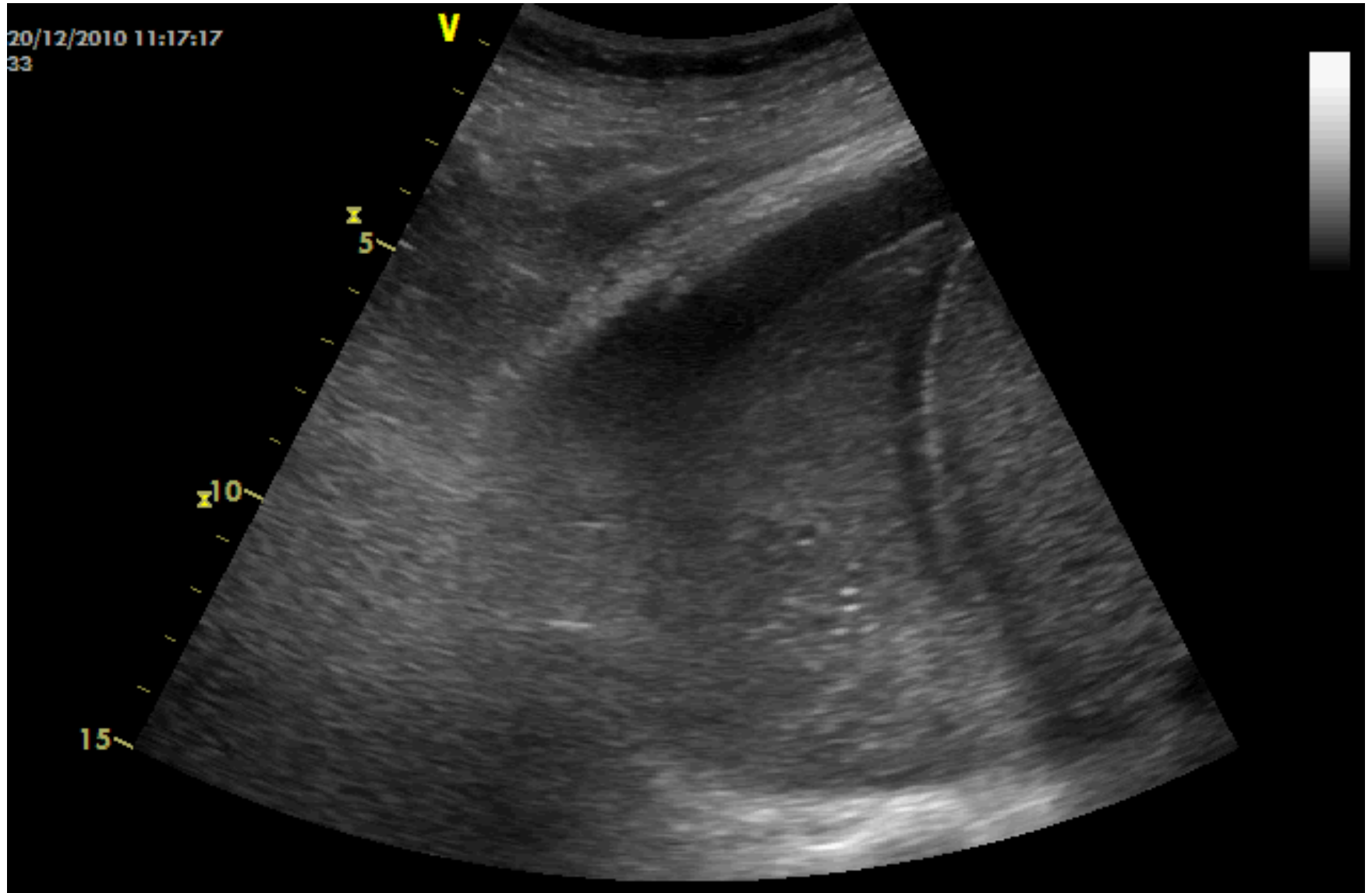
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V

x5

x10

15



PULM OEDEMA

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Gen THI
S MB



Nrv
- C60



92%

MI

1.0

TIS

0.2

A

B

11



Gen



0



Guide



MB On



THI On

Page 1/3

When to use the BLUE protocol?

- Any patient with acute respiratory failure.
- Do as part of the physical exam before other tests.
- 90.5% accuracy is from US alone. Combination with the history and other investigations will improve accuracy to close to 100%.

Questions