

GAVeCeLT 2024 BOLOGNA

**Abbandonare la radiologia: utilizzo dell'ecografia
per escludere complicanze pleuropolmonari dopo
inserzione dei CICC**

Daniele G. Biasucci

Roma



TOR VERGATA
UNIVERSITÀ DEGLI STUDI DI ROMA

Outline

- **CICC related Complication Rates**
 - *PNX, Hemothorax*
- **Assessment of PNX and Hemothorax**
 - *Sonographic Signs*
 - *Diagnostic Algorithm*
 - *Differential Diagnosis*
- **Diagnostic Accuracy**
- **Limitations and Pitfalls**

Complication Rates of Central Venous Catheters A Systematic Review and Meta-Analysis

Bijan Teja, MD; Nicholas A. Bosch, MD, MSc; Calvin Diep, MD; Tiago V. Pereira, PhD; Paolo Mauricio, MD; Michael C. Sklar, MD; Ashwin Sankar, MD, MSc; Harindra C. Wijeyesundera, MD, PhD; Refik Saskin, MSc; Allan Walkey, MD; Duminda N. Wijeyesundera, MD, PhD; Hannah Wunsch, MD, MSc

From 2015 up to 2023

**Figure 2. Summary of Central Venous Catheter-Associated Complications
Based on Bayesian Random-Effects Meta-Analysis Models**

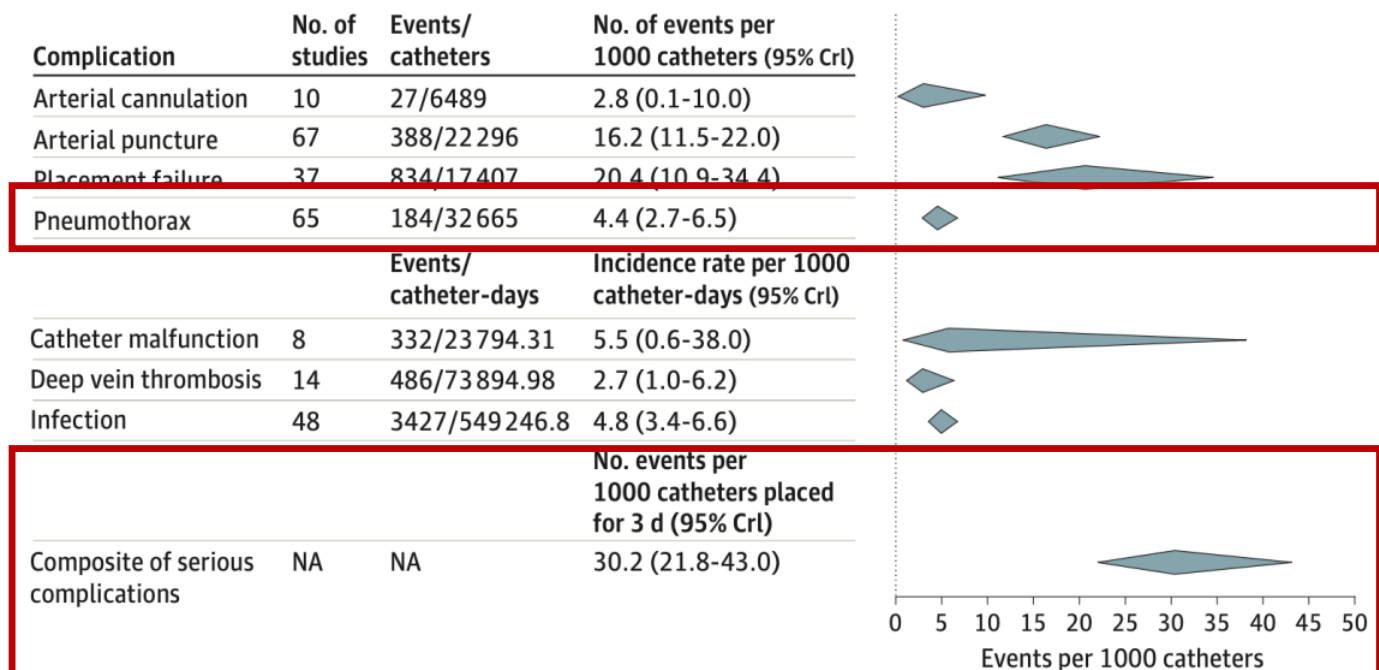


Figure 3. Central Venous Catheter-Associated Complication Rates by Catheter Insertion Site

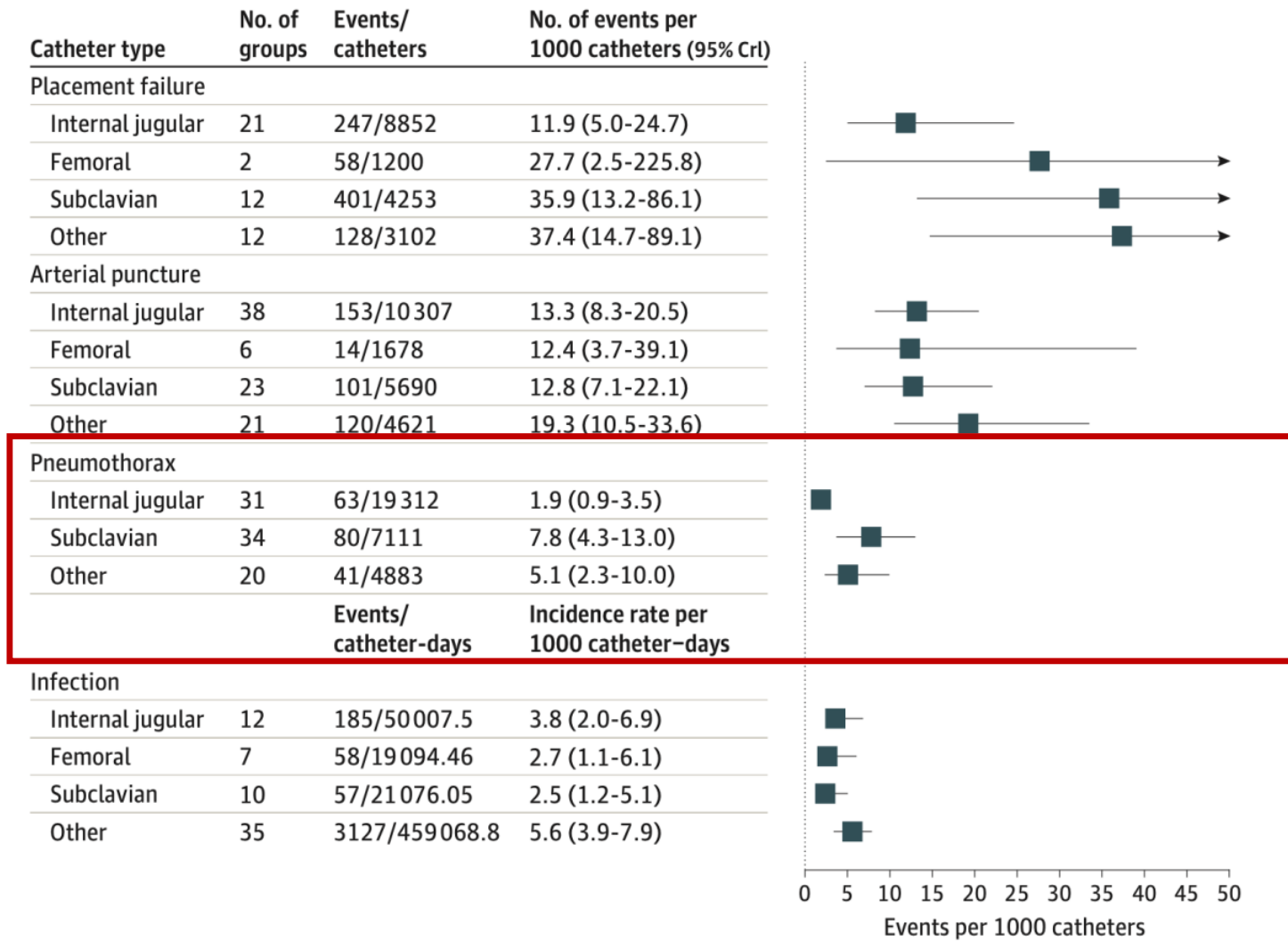
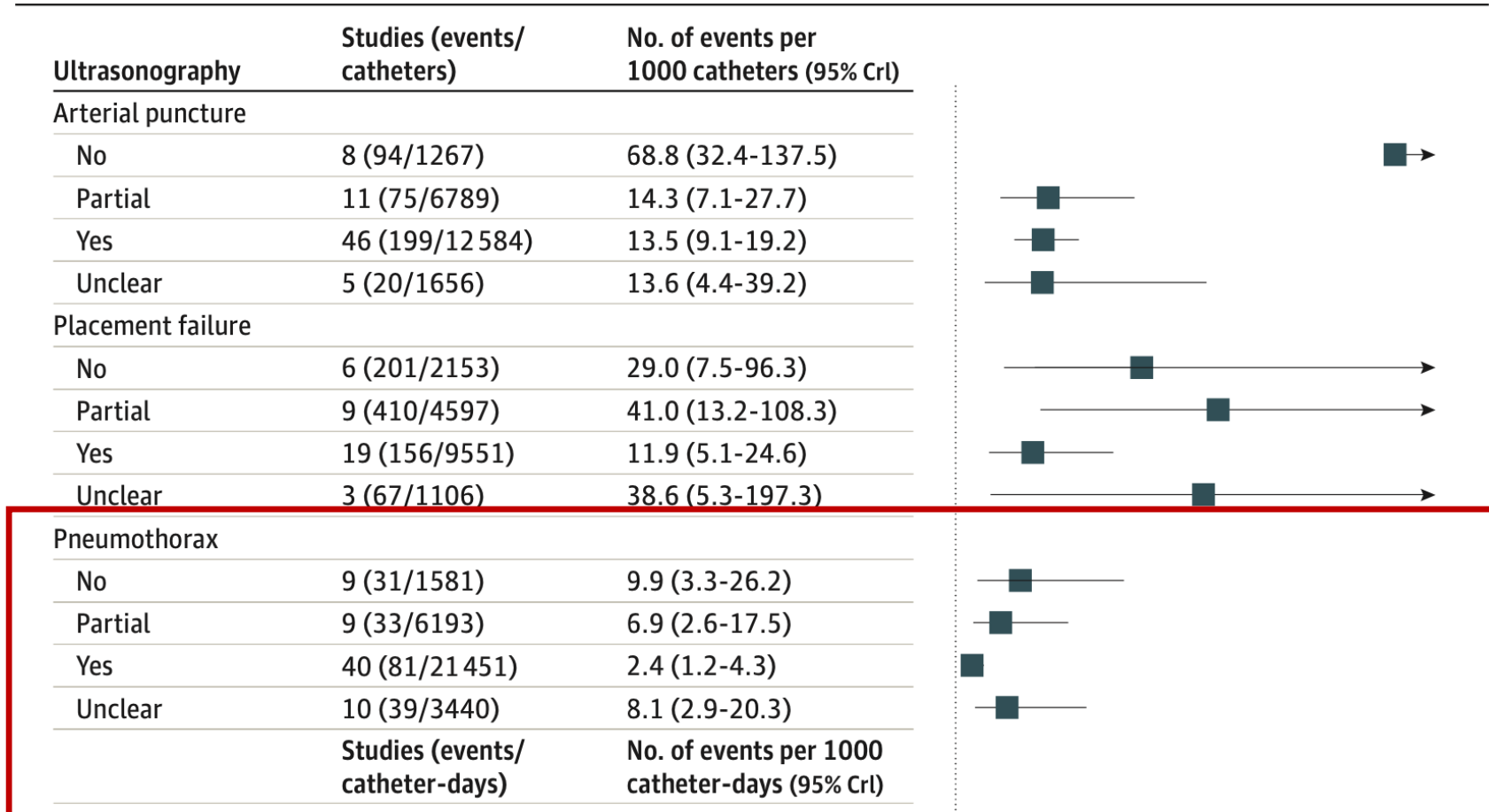
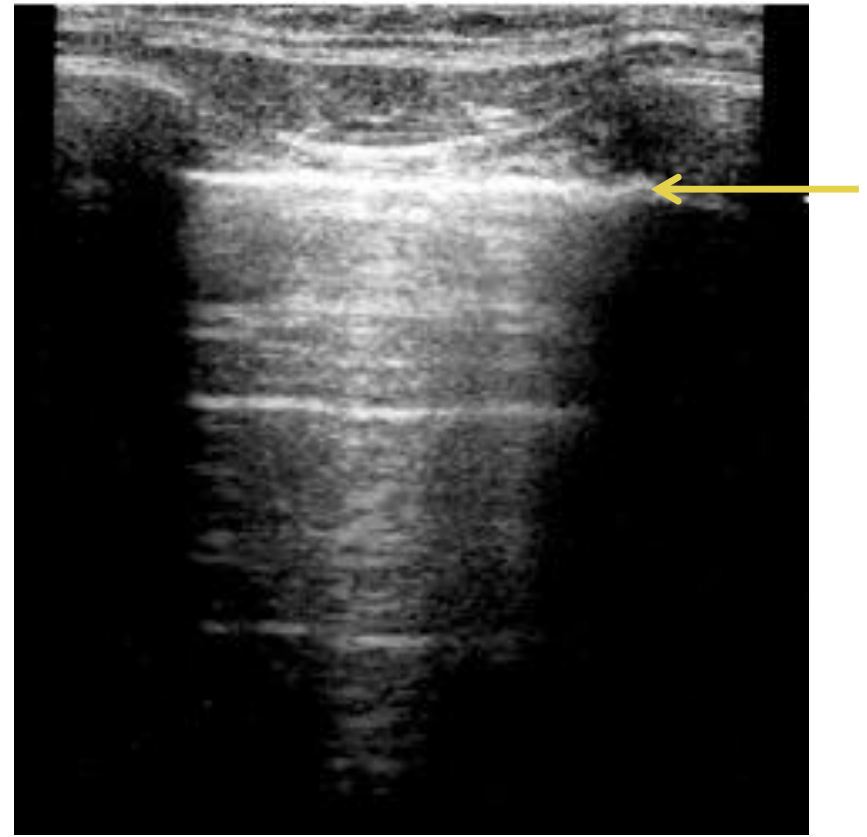
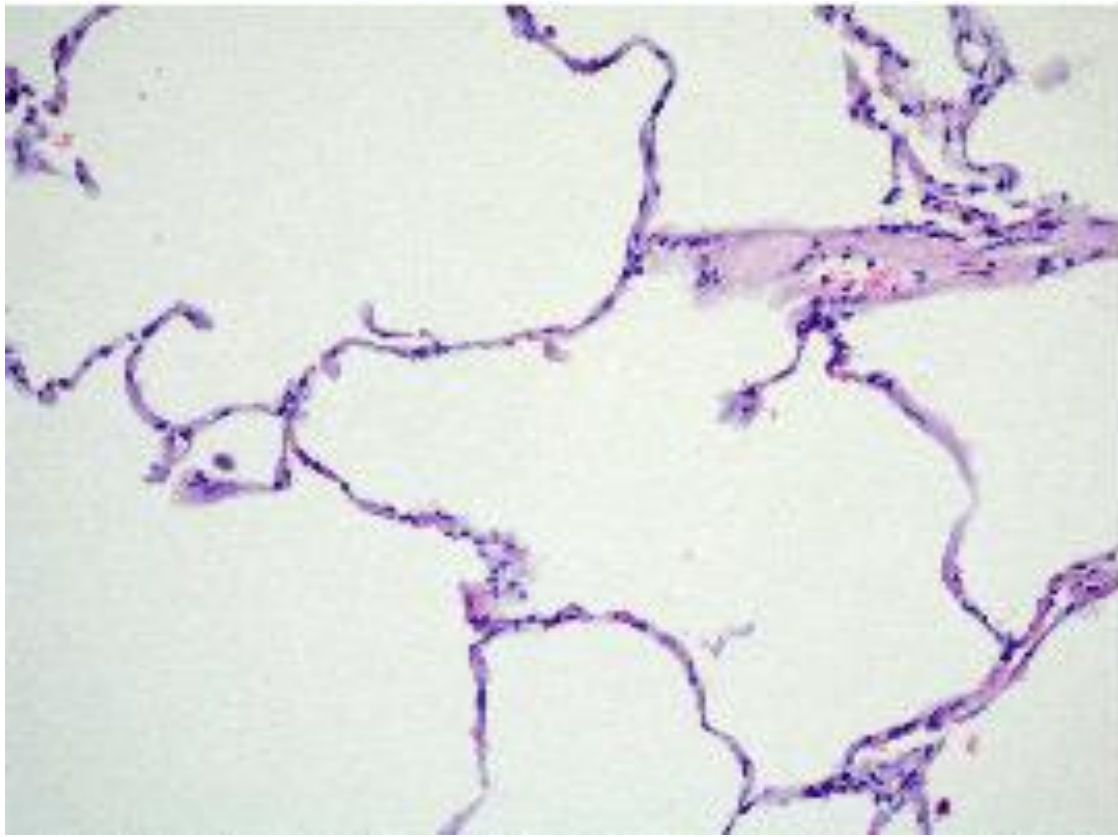


Figure 4. Estimates From Meta-Regression Models for the Association of Use of Ultrasonography With the Rate of Complications

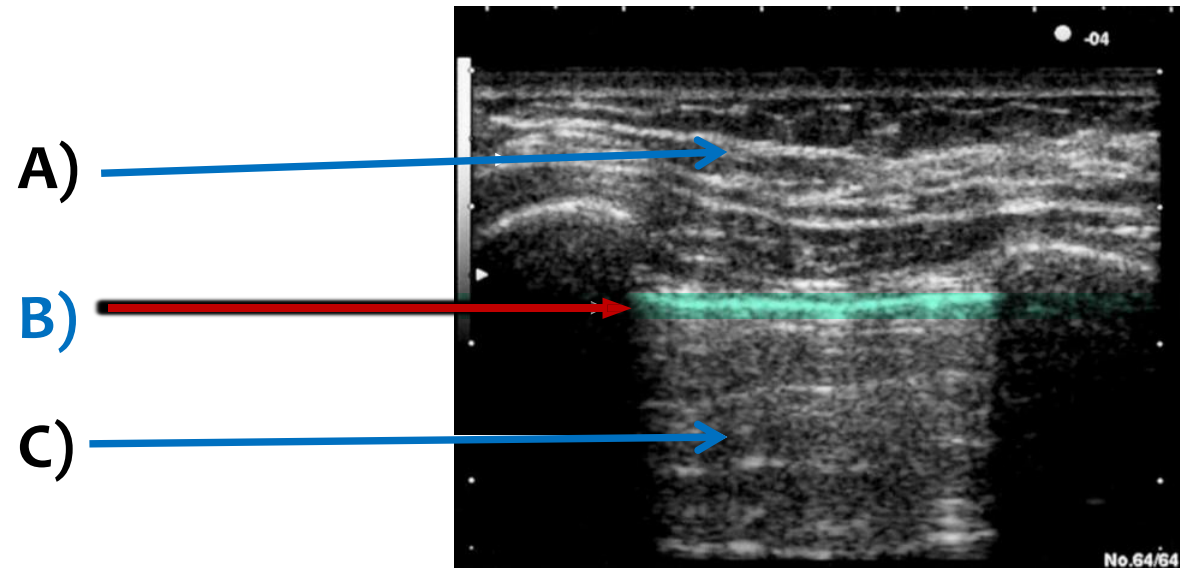
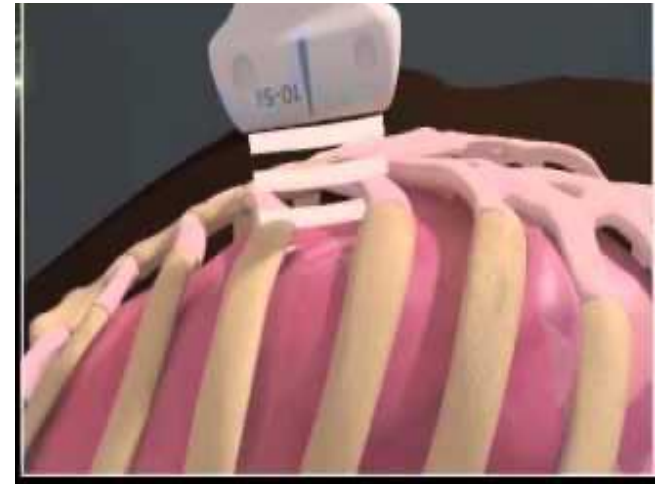


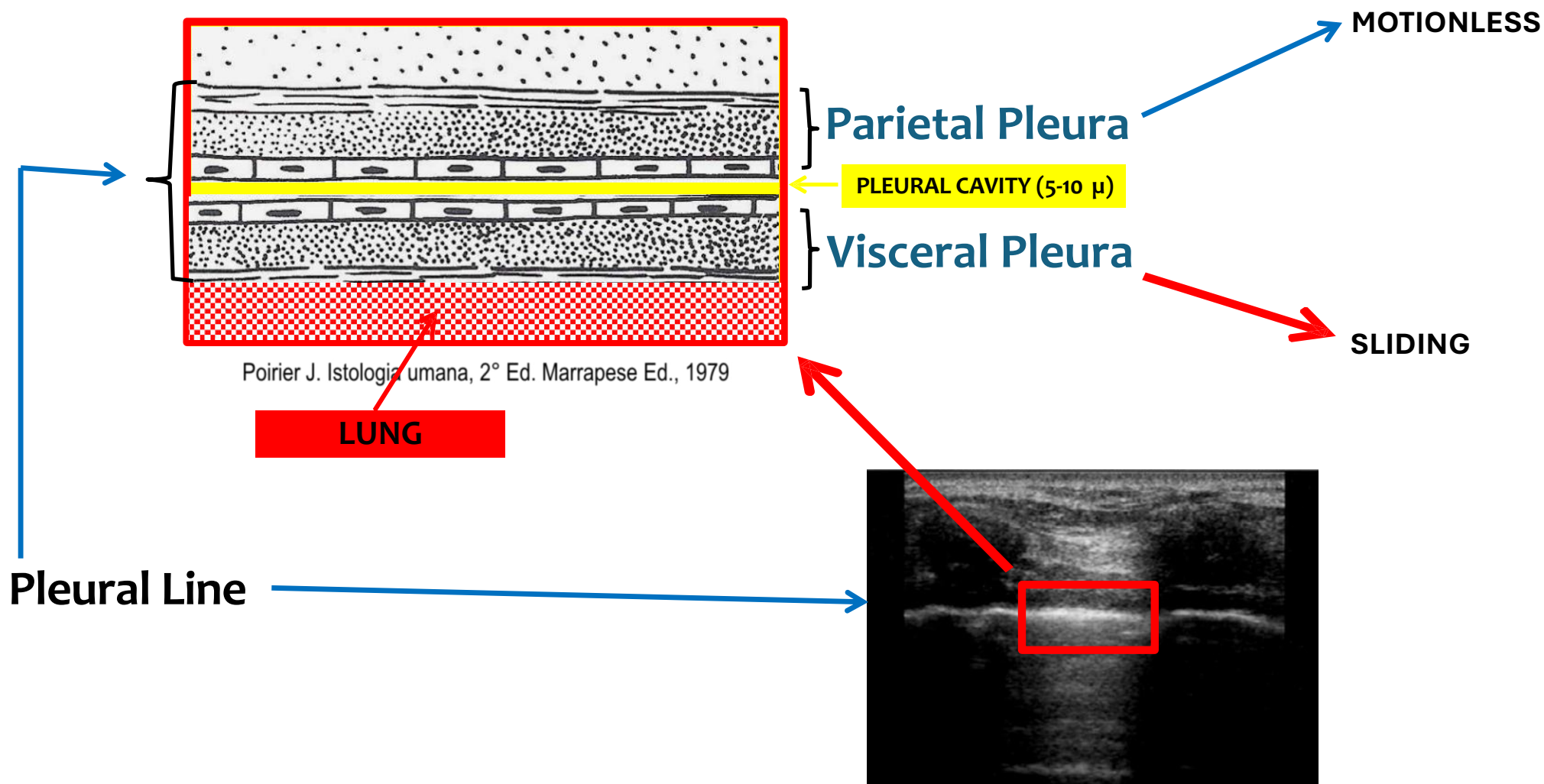


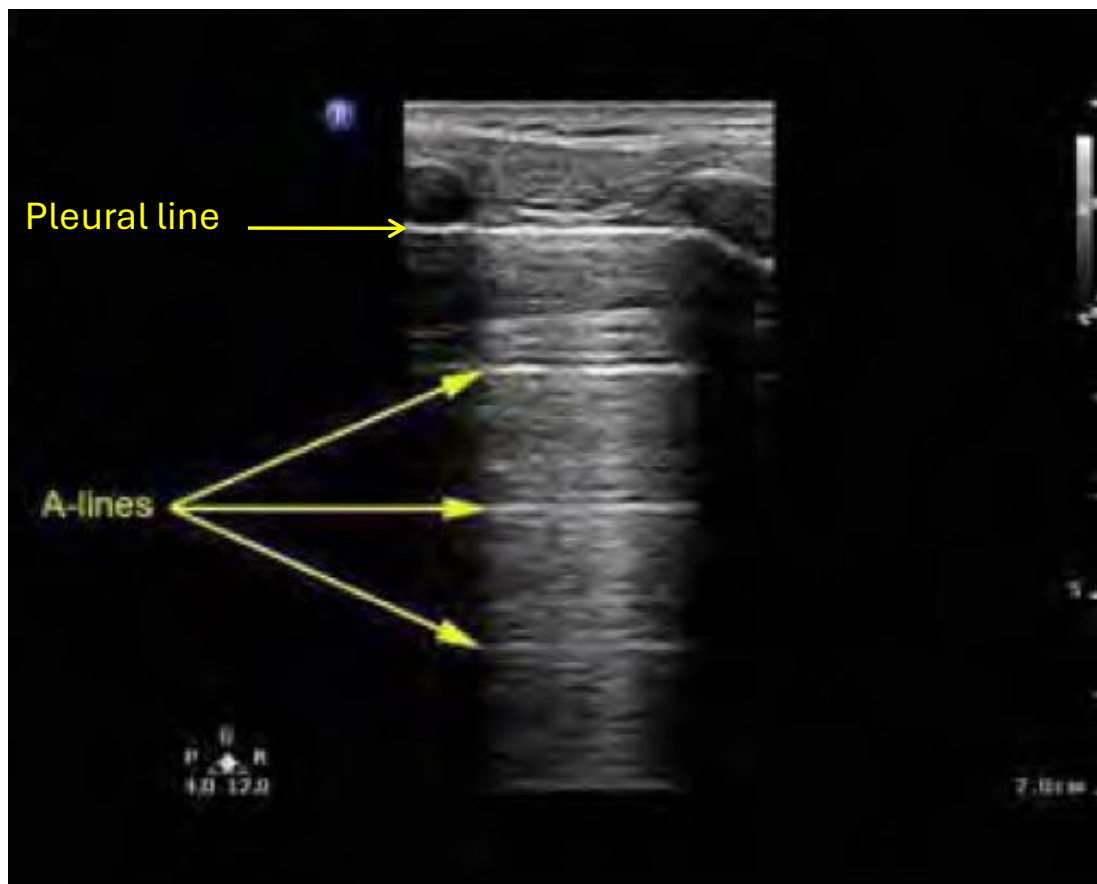
A. CHEST WALL

B. PLEURAL LINE

C. LUNG





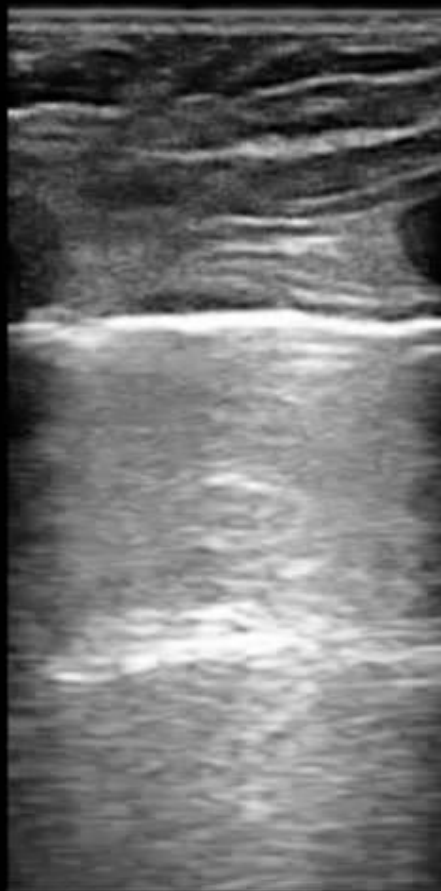


08 AGO 2014 19:29

0:00:00.32

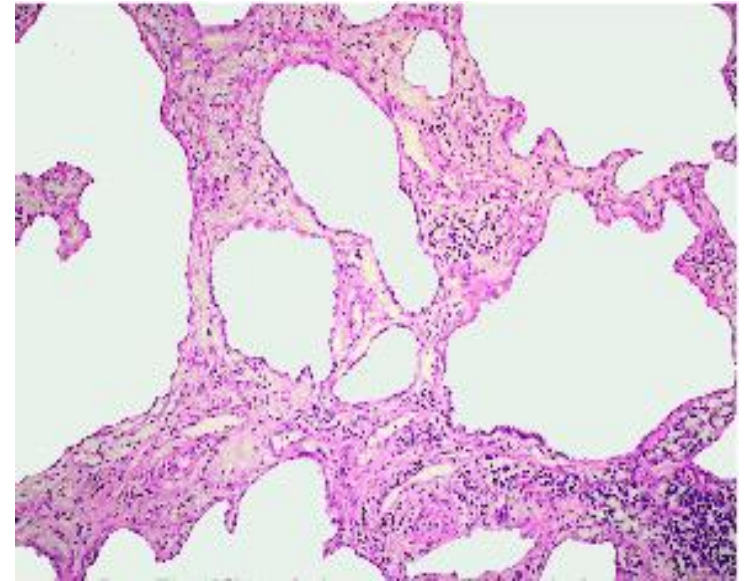
B F 6.6 MHz G 49%
P 7 cm XV C
PRC 9-3-B PRS 4
PST 3

ARTERIOS LA332



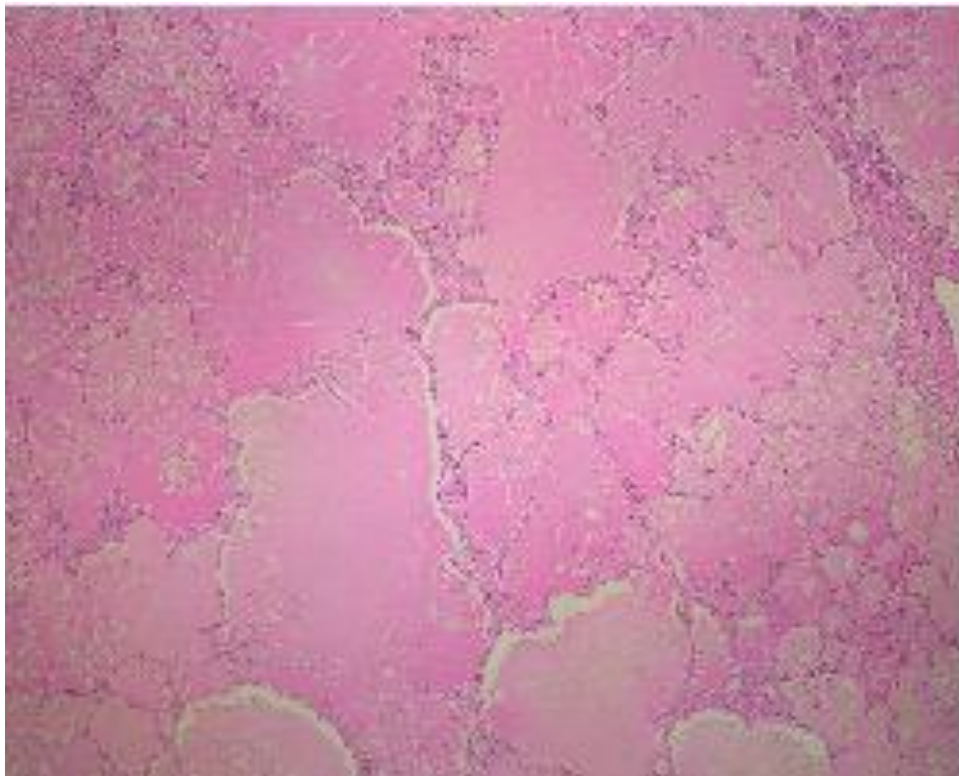
M-Mode



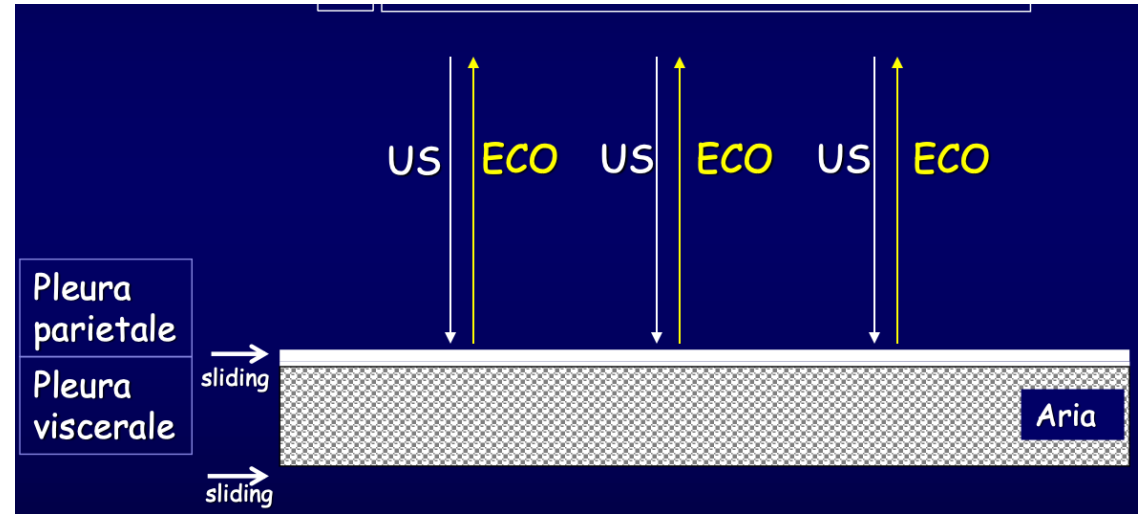
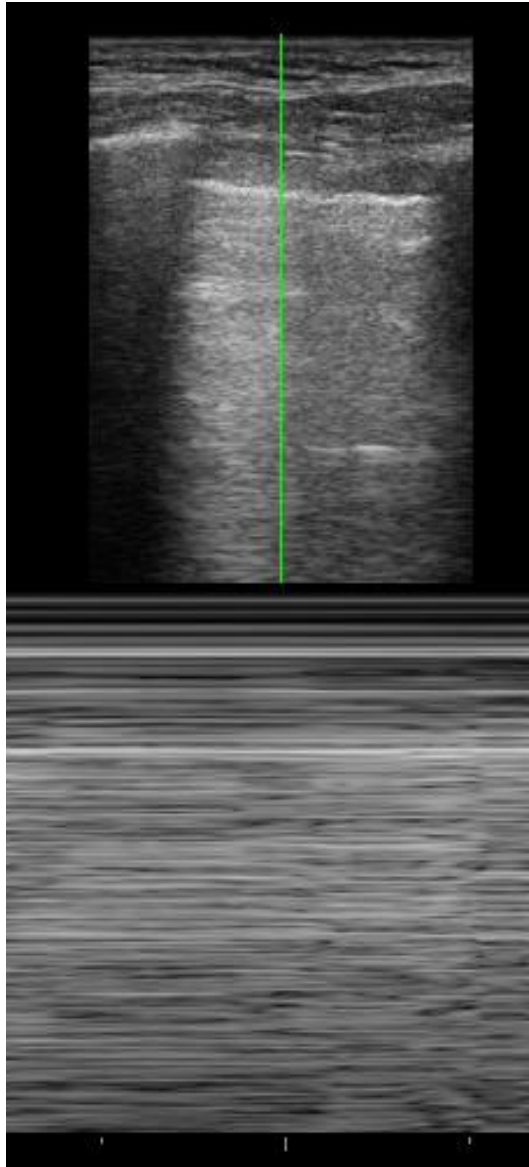


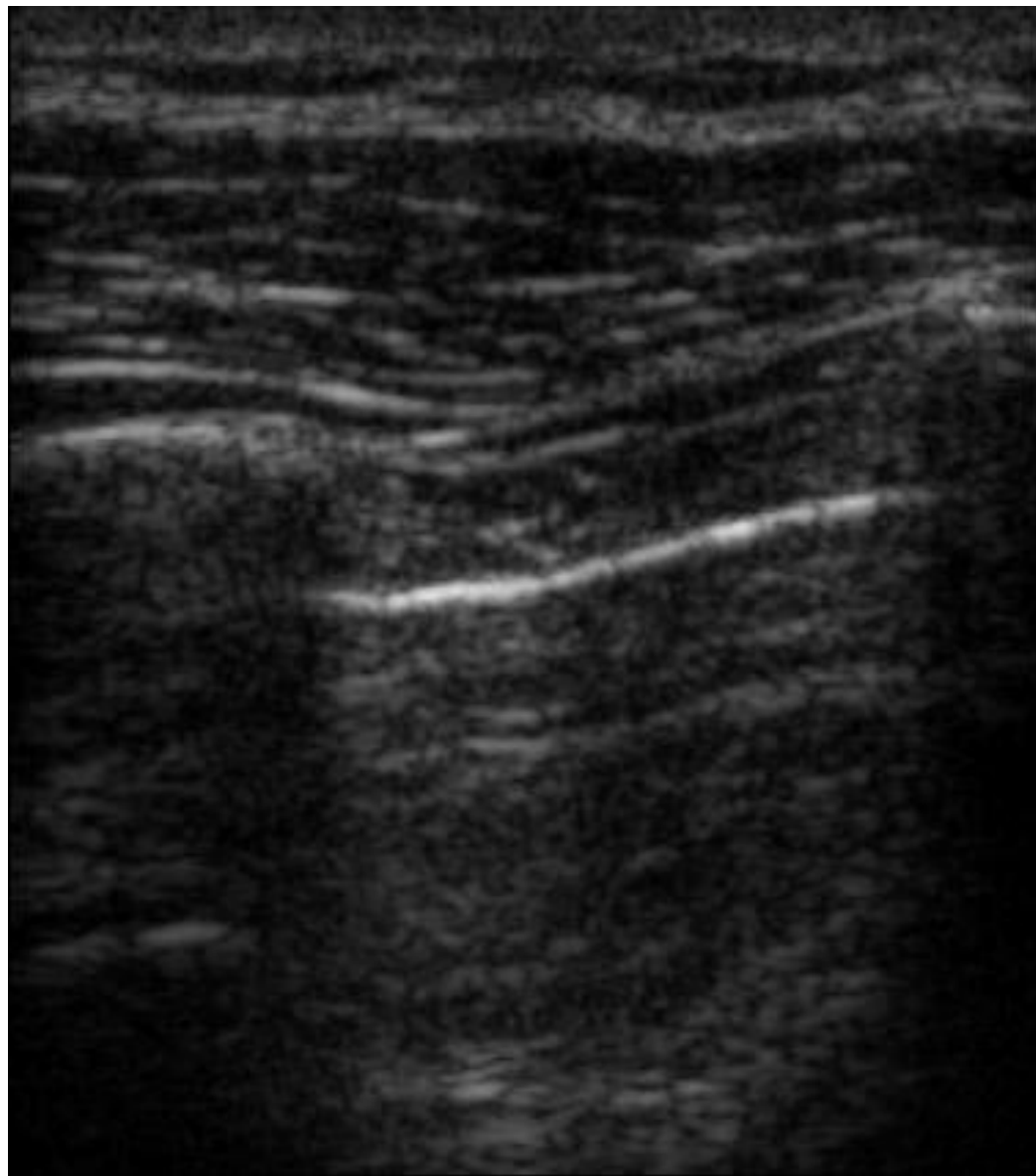
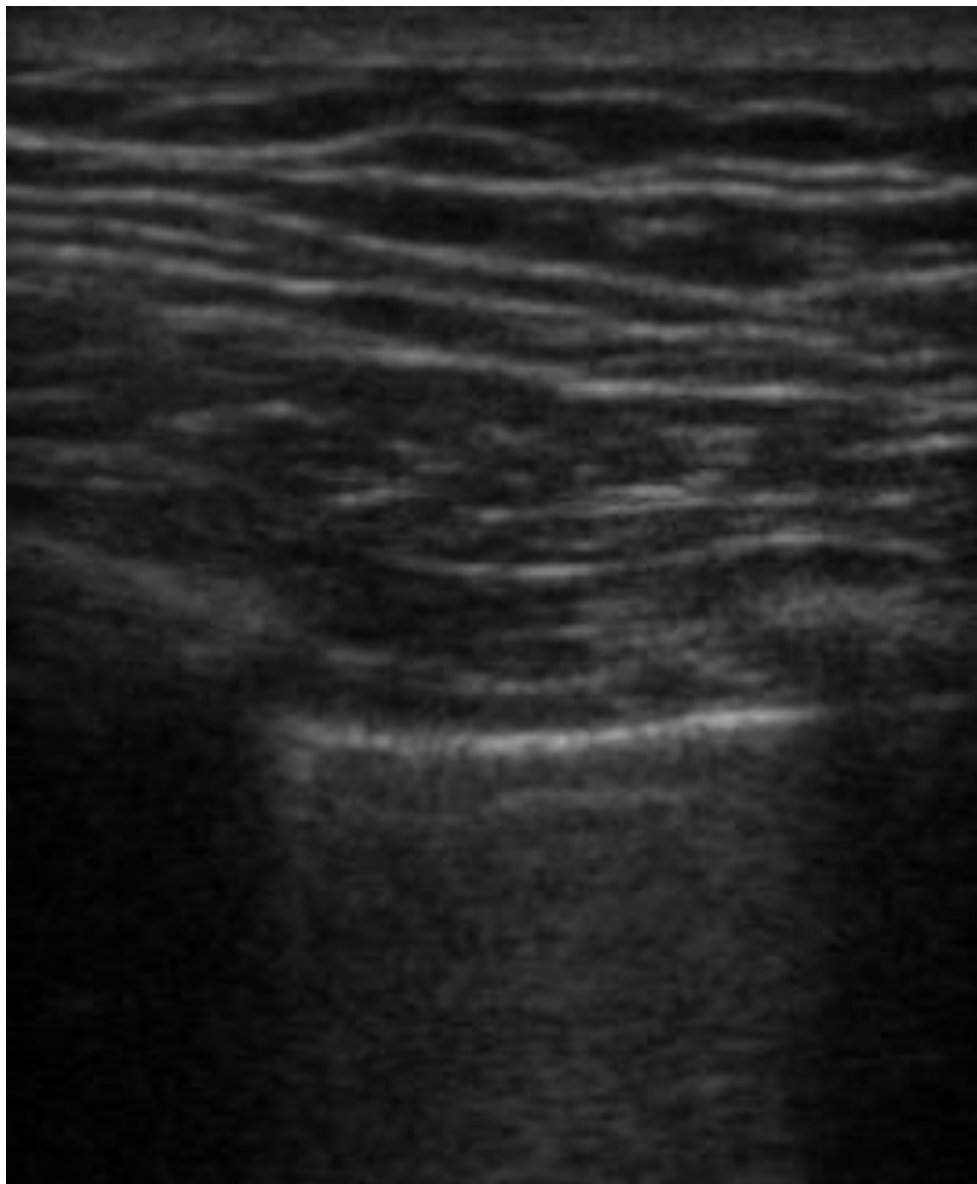
- B-LINES
- Alveolo-Interstitial Syndrome
- B-pattern (B1 or B2)



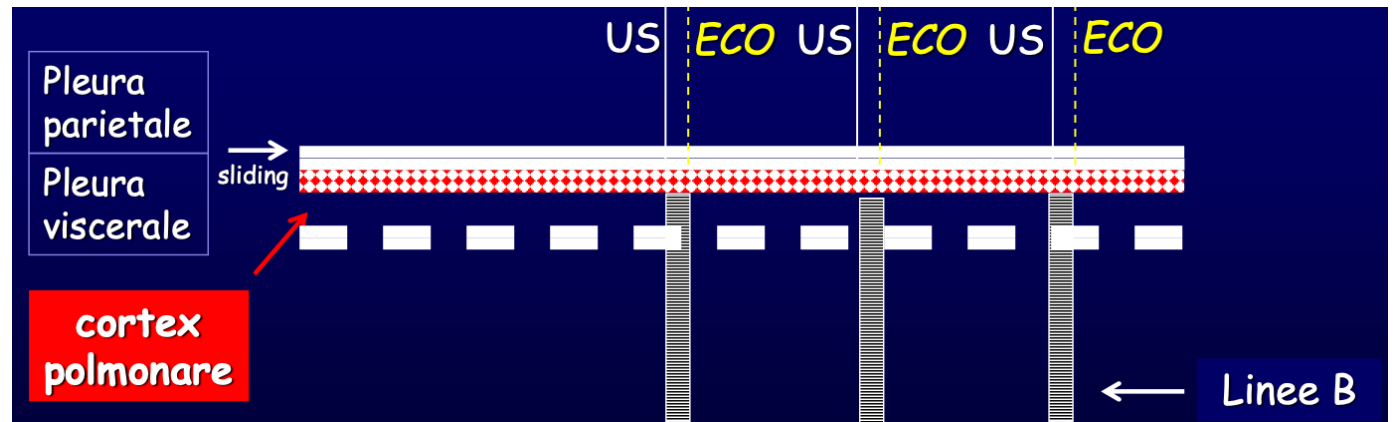


PNX

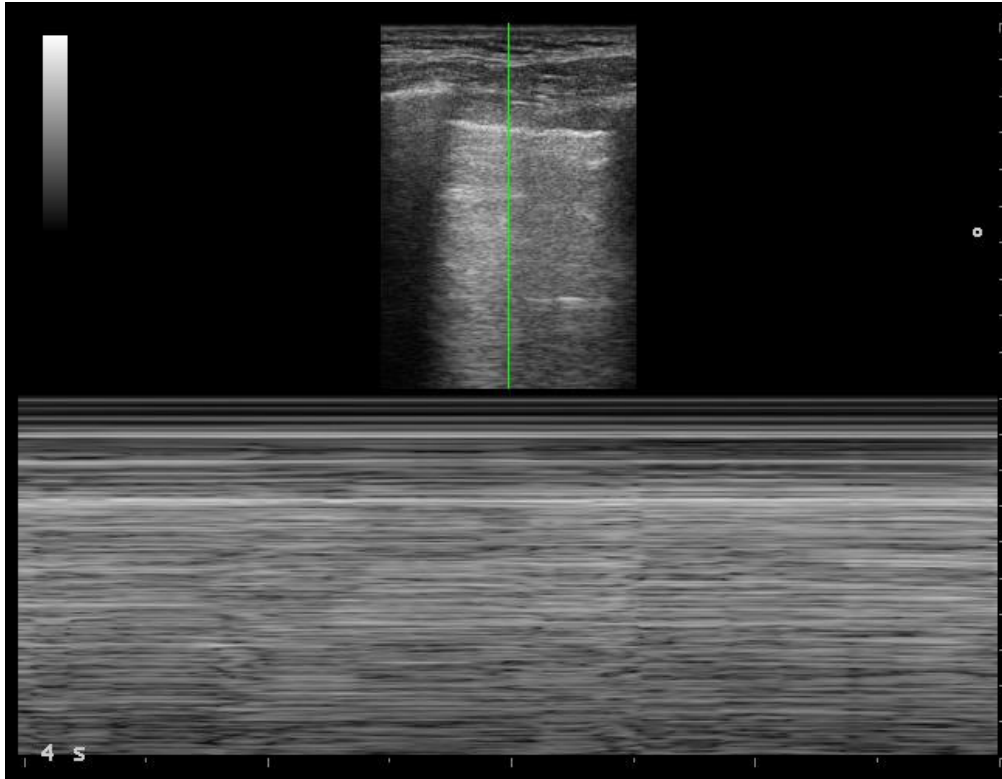




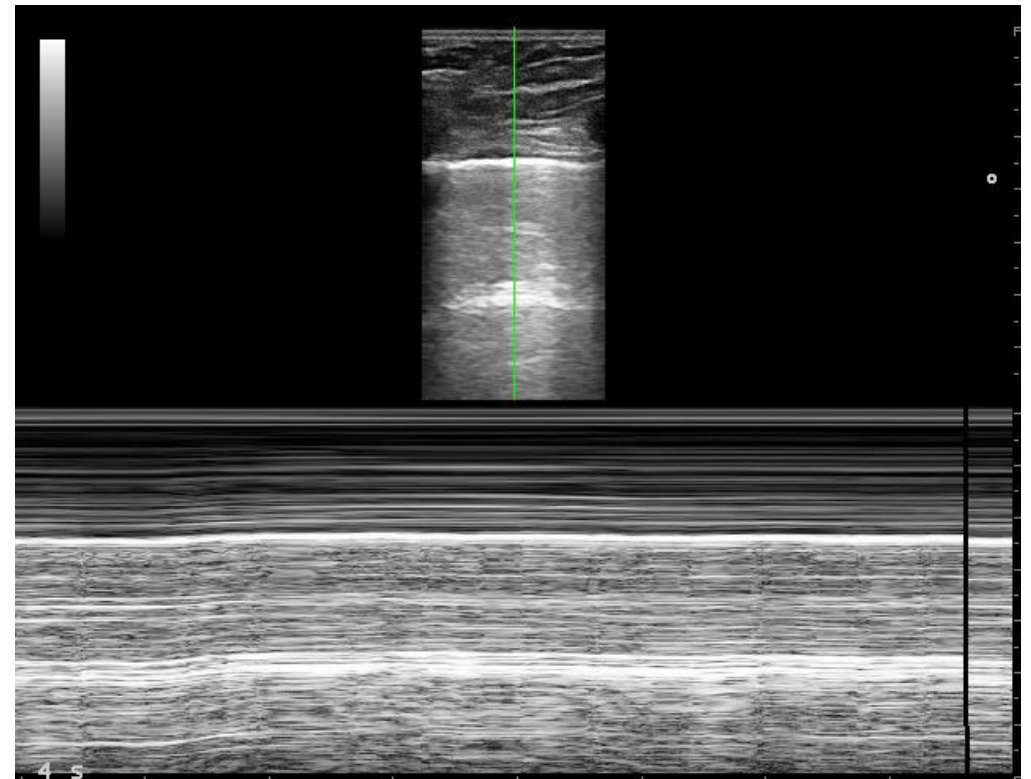
B LINES



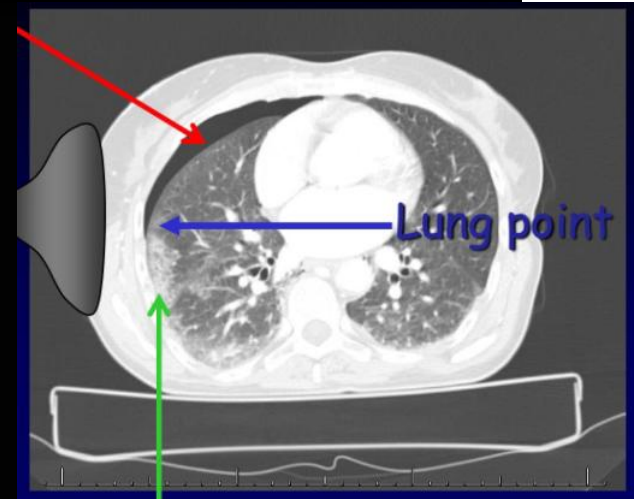
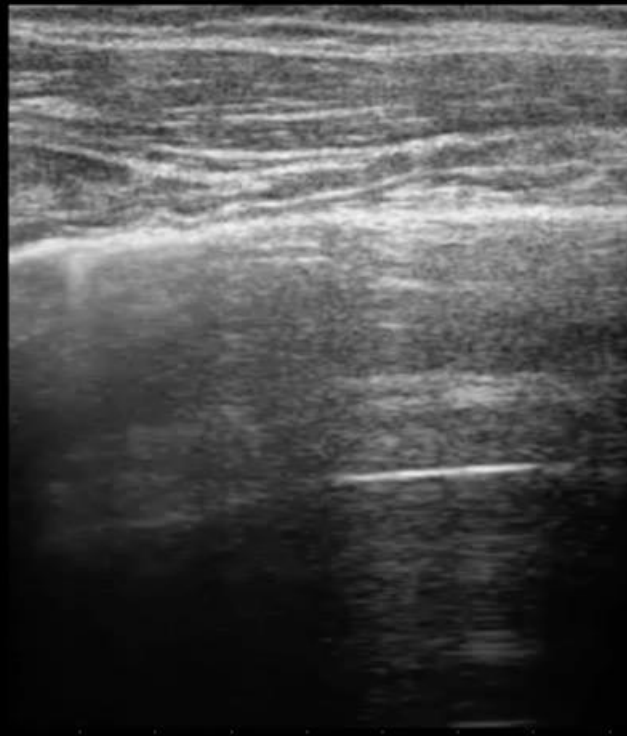
M - MODE

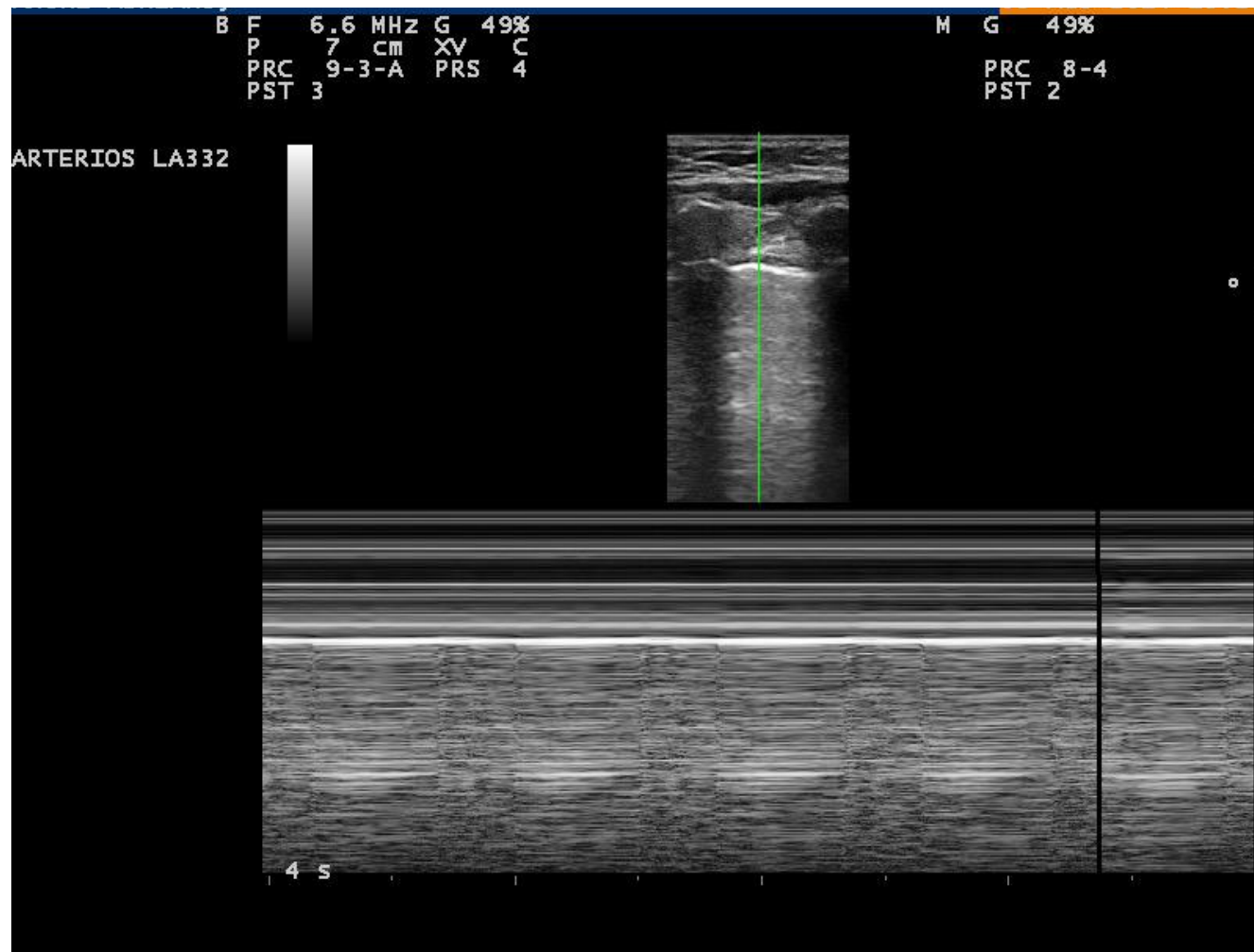


Stratosphere Sign → PNX



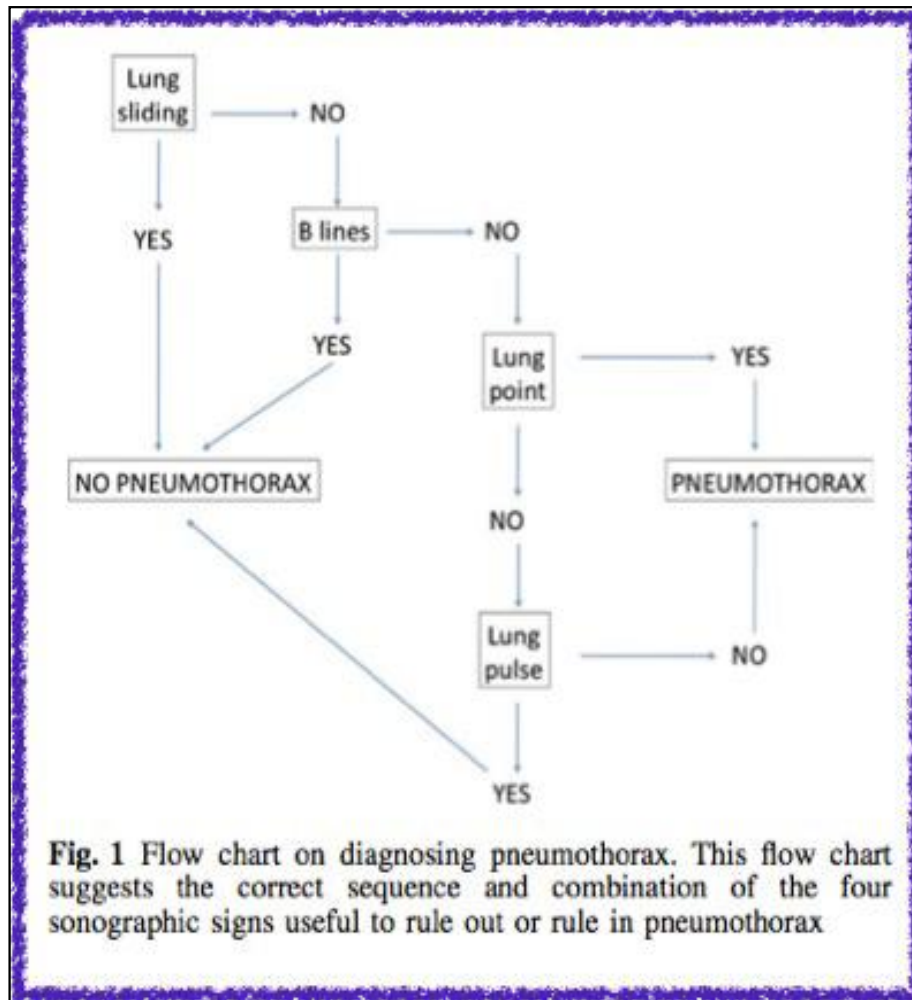
Seashore Sign → NO PNX





Lung Pulse

PNX: Diagnostic Algorithm



- US Signs of PNX:
 - Absence of lung sliding
 - Absence of B-lines
 - Absence of Lung Pulse
 - Presence of Lung Point

CONFERENCE REPORTS AND EXPERT PANEL

**International evidence-based
recommendations for point-of-care
lung ultrasound**

Intensive Care Med (2012) 38:577–591
DOI 10.1007/s00134-012-2513-4

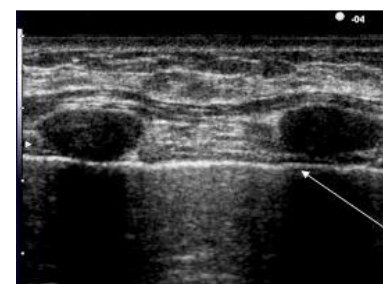
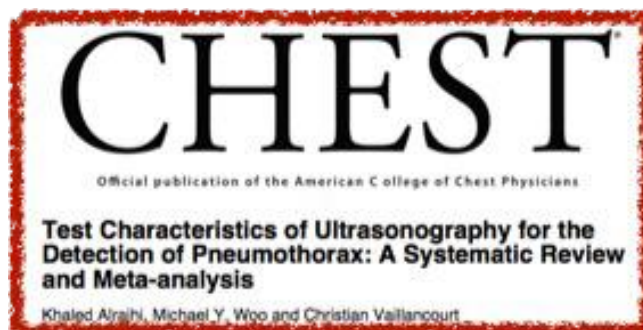
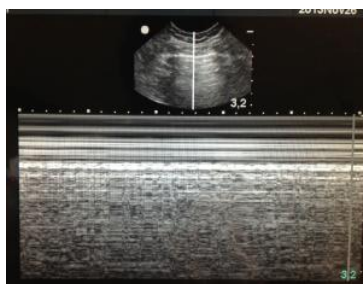


Table 2: Summary of sensitivity and specificity for included studies

Author	N	Ultrasonography		Chest X-ray	
		Sensitivity	Specificity	Sensitivity	Specificity
Blaivas ¹⁴	176	98.1%	99.2%	75.5%	100.0%
Chung ¹⁵	97	88.2%	89.3%	47.1%	94.0%
Garofalo ¹³	184	95.7%	100%	-	-
Kirkpatrick ¹¹	133	48.8%	98.7%	20.9%	99.6%
Rowan ¹⁶	27	100%	93.8%	36.4%	100.0%
Soldati ¹⁷	186	98.2%	100%	53.6%	100.0%
Soldati ¹⁸	109	92.0%	99.5%	52.0%	100.0%
Zhang ¹⁹	135	86.2%	97.2%	27.6%	100.0%

Chest ultrasonography versus supine chest radiography for diagnosis of pneumothorax in trauma patients in the emergency department (Review)



Chan KK, Joo DA, McRae AD, Takwoingi Y, Premji ZA, Lang E, Wakai A

CUS

Study	TP	FP	FN	TN	Trauma type	Sensitivity (95% CI)	Specificity (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)
Blaivas 2005	52	1	1	122	Blunt	0.98 [0.90, 1.00]	0.99 [0.96, 1.00]		
Ojaghi Haghighi 2014	50	0	2	98	Blunt	0.96 [0.87, 1.00]	1.00 [0.96, 1.00]		
Soldati 2006	55	0	1	130	Blunt	0.98 [0.90, 1.00]	1.00 [0.97, 1.00]		
Uz 2013	27	1	6	73	Blunt	0.82 [0.65, 0.93]	0.99 [0.93, 1.00]		
Zhang 2006	25	3	4	103	Blunt	0.86 [0.68, 0.96]	0.97 [0.92, 0.99]		
Abbasi 2013	32	0	5	109	Penetrating & blunt	0.86 [0.71, 0.95]	1.00 [0.97, 1.00]		
Nagarsheth 2011	18	0	4	57	Penetrating & blunt	0.82 [0.60, 0.95]	1.00 [0.94, 1.00]		
Vafaei 2016	46	2	9	95	Penetrating & blunt	0.84 [0.71, 0.92]	0.98 [0.93, 1.00]		
Karimi 2013	62	3	11	64	Unclear	0.85 [0.75, 0.92]	0.96 [0.87, 0.99]		

Lung US

Summary Sensitivity 0.91 (95% CI 0.85 - 0.94)

Summary Specificity 0.99 (95% CI 0.97- 1.00)

CXR

Study	TP	FP	FN	TN	Trauma type	Sensitivity (95% CI)	Specificity (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)
Blaivas 2005	40	0	13	123	Blunt	0.75 [0.62, 0.86]	1.00 [0.97, 1.00]		
Ojaghi Haghighi 2014	18	2	34	96	Blunt	0.35 [0.22, 0.49]	0.98 [0.93, 1.00]		
Soldati 2006	30	0	26	130	Blunt	0.54 [0.40, 0.67]	1.00 [0.97, 1.00]		
Uz 2013	3	0	30	74	Blunt	0.09 [0.02, 0.24]	1.00 [0.95, 1.00]		
Zhang 2006	8	0	21	106	Blunt	0.28 [0.13, 0.47]	1.00 [0.97, 1.00]		
Abbasi 2013	18	0	19	109	Penetrating & blunt	0.49 [0.32, 0.66]	1.00 [0.97, 1.00]		
Nagarsheth 2011	7	0	15	57	Penetrating & blunt	0.32 [0.14, 0.55]	1.00 [0.94, 1.00]		
Vafaei 2016	37	7	18	90	Penetrating & blunt	0.67 [0.53, 0.79]	0.93 [0.86, 0.97]		
Karimi 2013	55	1	18	66	Unclear	0.75 [0.64, 0.85]	0.99 [0.92, 1.00]		

CXR

Summary Sensitivity 0.47 (95% CI 0.31 - 0.63)

Summary Specificity 1.00 (95% CI 0.97- 1.00)

Diagnostic Accuracy of Central Venous Catheter Confirmation by Bedside Ultrasound Versus Chest Radiography in Critically Ill Patients: A Systematic Review and Meta-Analysis

Enyo A. Ablordeppey, MD, MPH^{1,2}; Anne M. Drewry, MD, MSCI¹; Alexander B. Beyer, MD, MPHS³; Daniel L. Theodoro, MD, MSCI²; Susan A. Fowler, MLIS⁴; Brian M. Fuller, MD, MSCI^{1,2}; Christopher R. Carpenter, MD, MSCI²

Critical Care
Medicine

- **12 pneumothoraces (1.1%)**
 - All were identified on LUS
 - Whereas only 10 were identified on CXR
 - Additional two pneumothoraces were identified on CT
- **Time to completion: US vs CXR**
 - US average mean time → 5.6 min
 - CXR average mean time completion → 63.9 min
 - CXR average mean time interpretation → 143.4 min
- **Unable to calculate LUS sensitivity for PNx detection**

TABLE 3. Primary and Secondary Outcome Results of Included Studies

Reference	Feasibility (%) ^a	Incidence of Central Venous Catheter Malposition	Sensitivity (95% CI) ^a	Specificity (95% CI) ^a	Incidence of Pneumothorax	Chest Radiograph time (Minutes), Mean (so)	Ultrasound time (Minutes), Mean (so)
Vezzani et al (30)	89.2	0.28	0.93 (0.76–0.99)	0.96 (0.88–0.99)	0.04	83.0 (79.0) ^c	10.0 (5.0)
Maury et al (16)	98.8	0.11	1.00 (0.66–1.00)	1.00 (0.95–1.00)	0.01	80.3(66.7) ^d	6.8 (3.5)
Zanobetti et al (31)	100	0.55	0.92 (0.85–0.96)	0.89 (0.81–0.95)	0.02	65.0 (74.0) ^a	5.0 (3.0)
Cortellaro et al (32)	100	0.085	0.33 (0.04–0.78)	0.98 (0.92–1.00)	–	288.0 (216.0) ^e	4.0 (1.0)
Matsushima and Frankel (33)	71	0.17	0.50 (0.19–0.81)	0.98 (0.89–1.00)	0.00	75.3 (–) ^f	10.8 (–)
Bedel et al (34)	96	0.06	0.83 (0.36–1.00)	1.00 (0.96–1.00)	0.00	103.0 (81.0) ^f	1.76 (1.3)
Baviskar et al (35)	100	0.00	–	–	–	–	0.75 (–)
Duran-Gehring et al (36)	92	0.065	0.33 (0.01–0.91)	1.00 (0.92–1.00)	0.04	299.0 (–) ^a	5.0 (–)
Weekes et al (37)	96.6	0.03	0.75 (0.19–0.99)	1.00 (0.97–1.00)	–	–	–
Wen et al (38)	100	0.01	1.00 (0.16–1.00)	1.00 (0.98–1.00)	–	28.3 (25.7) ^c	3.2 (1.1)
Syed et al (39)	100	0.50	1.00 (0.16–1.00)	1.00 (0.16–1.00)	–	–	–
Madhulika et al (40)	100	0.24	1.00 (0.86–1.00)	1.00 (0.95–1.00)	0.00	–	–
Gekle et al (41)	100	0.00	–	–	–	30.0 (–) ^f	8.9 (–)
Weekes et al (42)	97.4	0.03	0.75 (0.19–0.99)	1.00 (0.98–1.00)	0.00	20.0 (30.0) ^c median (IQR)	1.1 (0.7) median (IQR)
Meggiolaro et al (43)	100	0.45	0.53 (0.38–0.68)	0.95 (0.86–0.99)	0.00	67.0 (42.0–84.0) ^a median (IQR)	10.0 (7.0–20.0) median (IQR)

IQR = 25th–75th Interquartile range

ANESTHESIOLOGY

Ultrasound to Detect Central Venous Catheter Placement Associated Complications

A Multicenter Diagnostic Accuracy Study

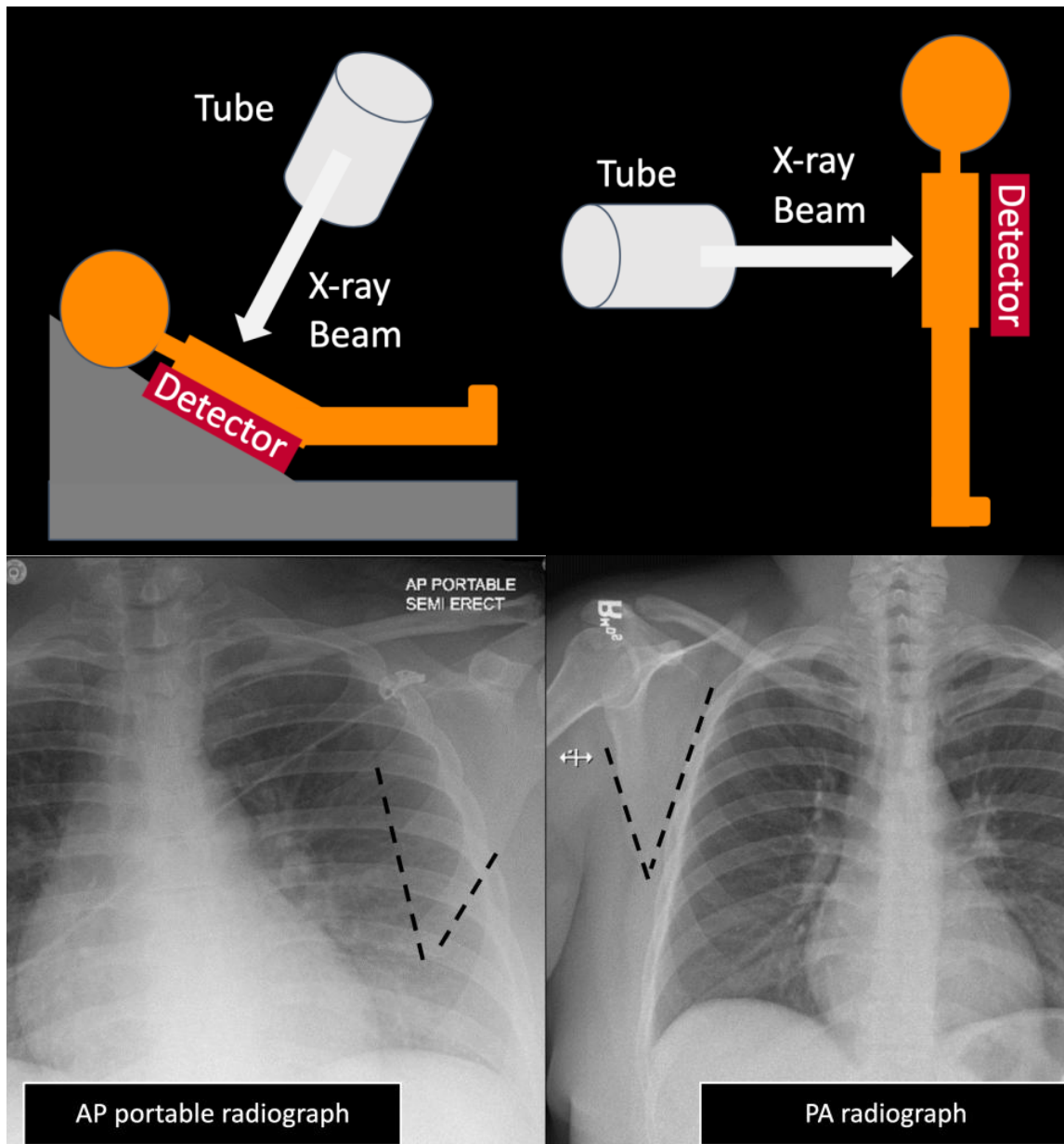
Jasper M. Smit, M.D., Mark E. Haaksma, M.D.,
Endry H. T. Lim, M.D., Thei S. Steenvoorden, B.Sc.,
Michiel J. Blans, M.D., Frank H. Bosch, M.D., Ph.D.,
Manfred Petjak, M.D., Ben Vermin, M.D.,
Hugo R. W. Touw, M.D., Ph.D., Armand R. J. Girbes, M.D., Ph.D.,
Leo M. A. Heunks, M.D., Ph.D., Pieter R. Tuinman, M.D., Ph.D.

ANESTHESIOLOGY 2020; 132:781–94

Pneumothorax

	Chest X-ray Film +	Chest X-ray Film –	Chest X-ray Film Total
Ultrasound +	4	7	11
Ultrasound –	1	744	745
Ultrasound total	5	751	756
Cohen's κ test	$\kappa = 0.50$ (95% CI, 0.19–0.80)		
Overall agreement	98.9%		

Clinically Relevant Malposition



• Bedside CXR Limitations

- Antero-Posterior (AP)
- Heart Magnification
- Smaller Lung Volumes
- Supine or Semi-Erect Position
- Challenging Lateral View
- *Poor inspiration, which tends to accentuate all markings (both normal and abnormal)*

Portable Chest Radiography: Must-Know Findings and Mimics

[Leah R. Strickland](#), [Travis S. Henry](#), [H. Page McAdams](#), [Tina D. Tailor](#),
[Bryan O'Sullivan-Murphy](#), [Laura E. Heyneman](#)



CHEST

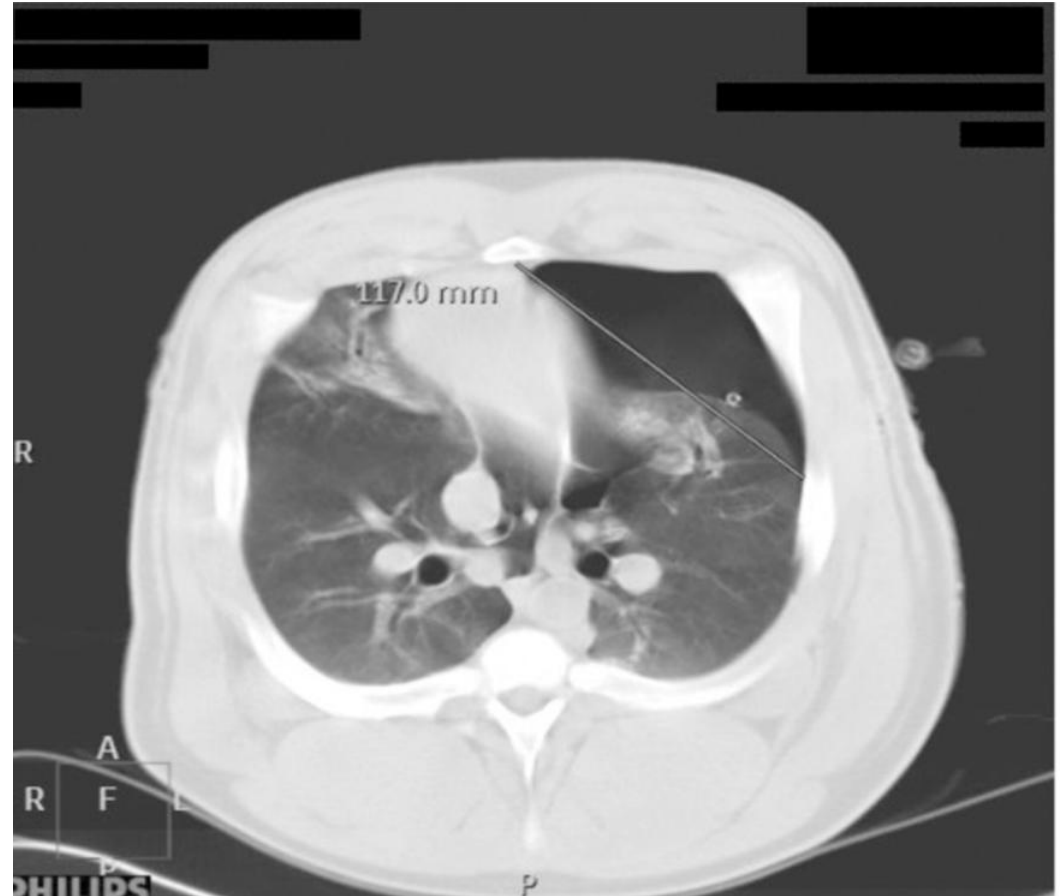
Original Research

INTERVENTIONAL PULMONOLOGY

Using Thoracic Ultrasonography to Accurately Assess Pneumothorax Progression During Positive Pressure Ventilation

A Comparison With CT Scanning

Nils Petter Oveland, MD; Hans Morten Lossius, MD, PhD; Kristian Wemmelund, cand med; Paal Johan Stokkeland, MD; Lars Knudsen, MD, PhD; and Erik Sloth, MD, PhD, DMSc



S-LP distance
(millimetres)

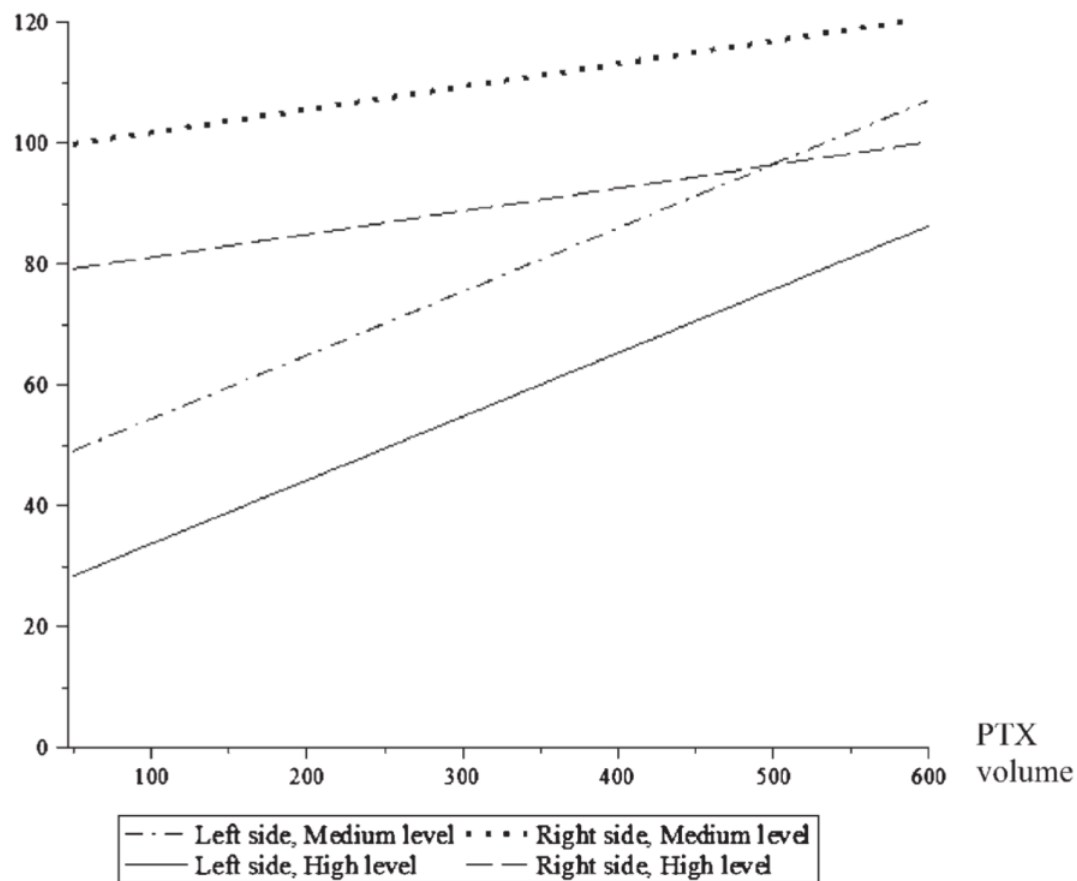


FIGURE 6. Graph illustrating the mixed linear model of the S-LP relative to the PTX volume. See Figure 2 and 4 legends for expansion of abbreviations.



CHEST

Original Research

INTERVENTIONAL PULMONOLOGY

Using Thoracic Ultrasonography to Accurately Assess Pneumothorax Progression During Positive Pressure Ventilation

A Comparison With CT Scanning

Nils Petter Oveland, MD; Hans Morten Lossius, MD, PhD; Kristian Wemmelund, cand med; Paal Johan Stokkeland, MD; Lars Knudsen, MD, PhD; and Erik Sloth, MD, PhD, DMSc

Giovanni Volpicelli
Enrico Boero
Nicola Sverzellati
Luciano Cardinale
Marco Busso
Francesco Boccuzzi
Mattia Tullio
Alessandro Lamorte
Valerio Stefanone
Giovanni Ferrari
Andrea Veltri
Mauro F. Frascisco

Semi-quantification of pneumothorax volume by lung ultrasound

Table 3 Concordance between lung ultrasound and societal chest radiography criteria for classification of large sized pneumothorax, versus CT scan

Criteria for large PTX	Cohen <i>k</i>
ACCP	0.05 (poor)
BTS	0.11 (poor)
BSP	0.33 (fair)
Lung ultrasound	0.64 (good)

Table 2 Performance of lung ultrasound (LP projections) to predict large sized pneumothorax in comparison to the three classification criteria of societal guidelines based on chest radiography reading

	ACCP	BTS	BSP
Large/small (% of large)	60/34 (63.8)	34/60 (32.8)	43/51 (45.7)
LP projection for large PTX	On MAL or more posterior	Between MAL and PAL or more posterior	Between MAL and PAL or more posterior
Sensitivity	81.7 % (69.6–90.5 %)	88.2 % (72.5–96.7 %)	81.4 % (66.6–91.6 %)
Specificity	64.7 % (46.5–80.3 %)	68.3 % (55.0–79.7 %)	72.6 % (58.3–84.1 %)
Positive predictive value	80.3 % (68.0–89.5 %)	61.2 % (46.2–74.8 %)	71.4 % (56.7–83.4 %)
Negative predictive value	66.7 % (47.9–82.3 %)	91.1 % (78.8–97.5 %)	82.2 % (67.9–92.0 %)
Positive likelihood ratio	2.31 (1.4–3.7)	2.79 (1.9–4.1)	2.97 (1.9–4.7)
Negative likelihood ratio	0.28 (0.2–0.5)	0.17 (0.07–0.4)	0.26 (0.1–0.5)

Data of 94 cases were evaluated by ROC curve analysis. Unless otherwise indicated, numbers in brackets refer to 95 % confidence interval

ACCP American College of Chest Physicians, BTS British Thoracic Society, BSP Belgium Society of Pulmonology, LP lung point, PTX pneumothorax, MAL mid axillary line, PAL posterior axillary line

Table 4 Performance of LUS in differentiating two lung collapse cut-offs measured by volumetric CT scans in 58 patients with pneumothorax

Cut-off lung collapse	Sensitivity	Specificity	PPV	NPV	+LR	−LR	AUC
10 %	76.7 % (57.7–90.1)	89.3 % (71.8–97.7)	88.5 % (69.8–97.6)	78.1 % (59.7–90.9)	7.16 (2.4–21.2)	0.26 (0.1–0.5)	0.877 (0.77–0.95)
30 %	90.0 % (55.5–99.7)	81.3 % (67.4–91.1)	50.0 % (26.0–74.0)	97.5 % (86.6–99.9)	4.8 (2.6–9.0)	0.12 (0.02–0.8)	0.919 (0.82–0.97)

For PTX larger than 10 %, the corresponding LP is on the MAL or posterior; for PTX larger than 30 %, the corresponding LP is posterior to the MAL

predictive value, +*LR* positive likelihood ratio, −*LR* negative likelihood ratio, *AUC* area under the curve

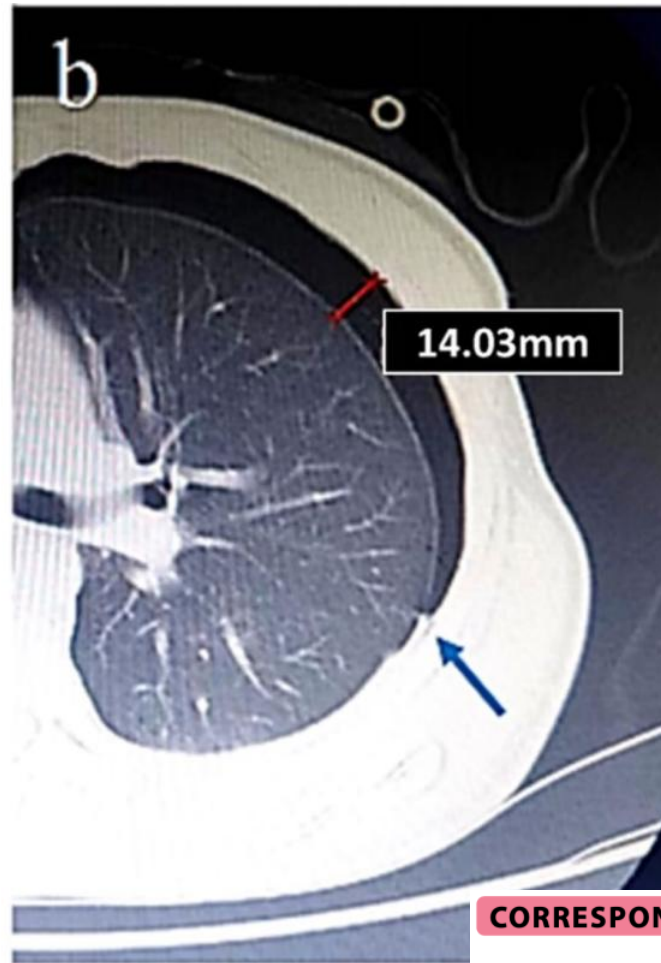
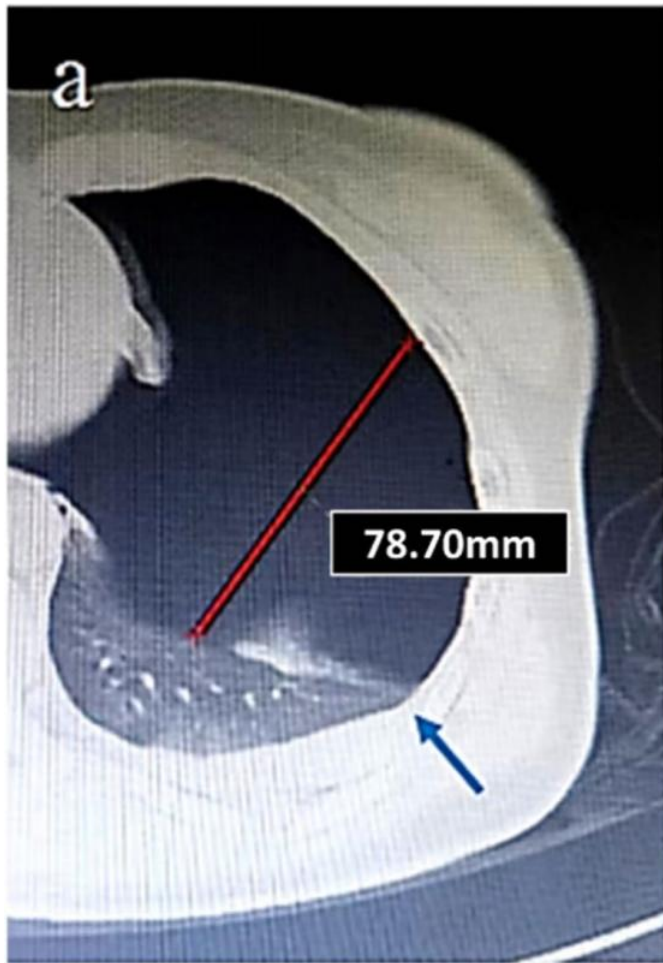
LUS lung ultrasound, *CT* computerized tomography, *PTX* pneumothorax, *MAL* mid axillary line, *PPV* positive predictive value, *NPV* negative

Table 5 Accuracy of different LP projections in predicting classes of PTX size measured by CT scan

CT scan lung collapse (%)	<i>N</i>	Lung US LP projection	Predictive value (95 % CI)
Class 1 (<10 %)	28	Anterior to MAL	78.1 % (59.7–90.9)
Class 2 (11–30 %)	20	On MAL	Between 88.5 % (69.8–97.6 %) and 97.5 % (86.6–99.9)
Class 3 (>30 %)	10	Posterior to MAL	50 % (26.0–74.0)

The best LP projections were identified by ROC curve analysis in 58 patients with pneumothorax. Pneumothorax size is expressed as percentage of lung collapse

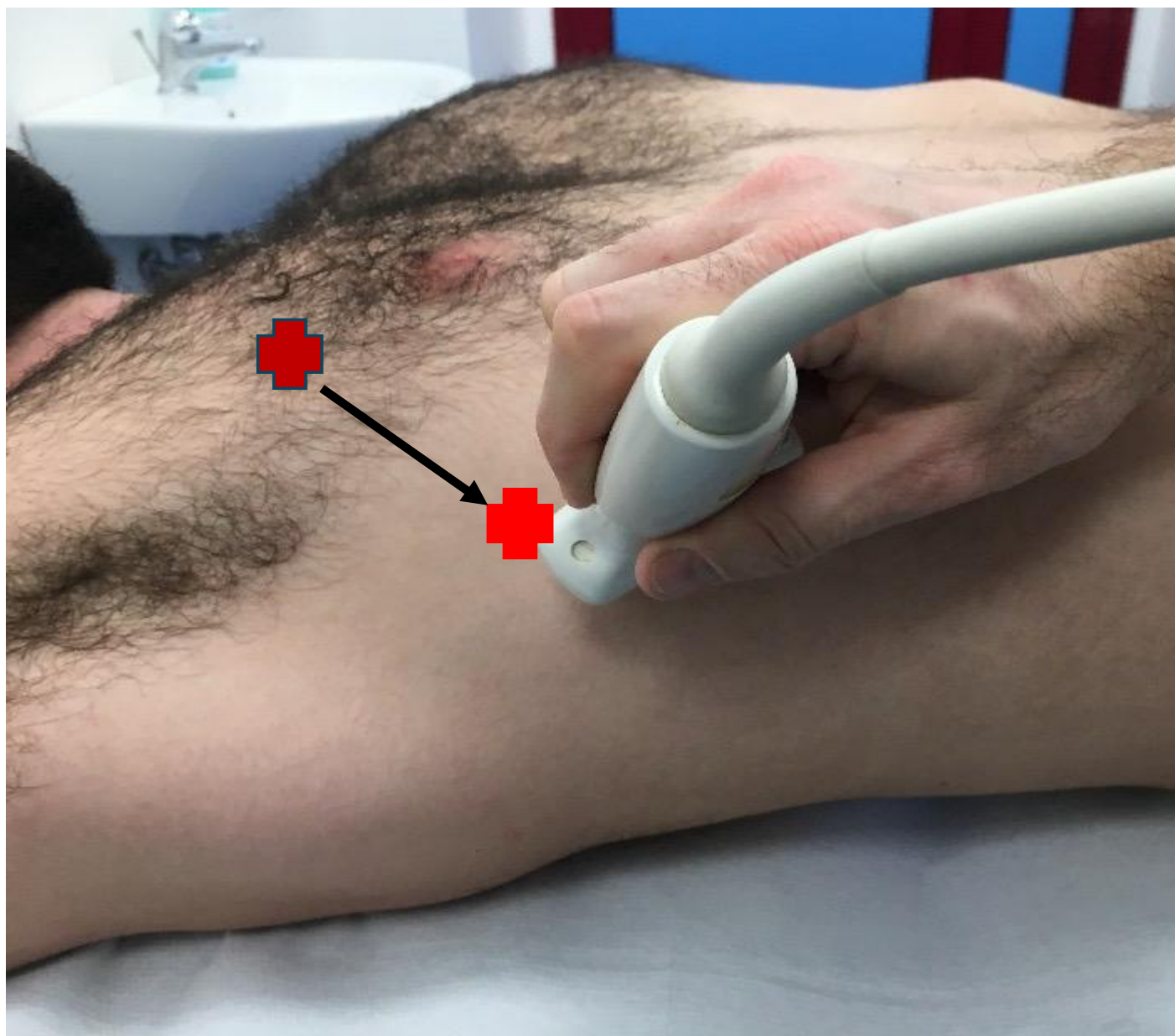
N number of cases for each class, *PTX* pneumothorax, *CT* computerized tomography, *LP* lung point, *US* ultrasound, *MAL* mid axillary line, *CI* confidence interval



CORRESPONDENCE

Pitfall of lung ultrasound in the quantification of pneumothorax

Haotian Zhao^{1†}, Kai Liu^{2†}, Li Li^{1*} and Heling Zhao^{3*}



Is Routine Chest X-Ray After Ultrasound-Guided Central Venous Catheter Insertion Choosing Wisely? A Population-Based Retrospective Study of 6,875 Patients

Jason Chui, MBChB; Rasha Saeed, MD; Luke Jakobowski, MD; Wanyu Wang; Basem Eldeyasty, MD
Fang Zhu, MD, PhD; LeeAnne Fochesato, MSc; Ronit Lavi, MD; and Daniel Bainbridge, MD

Predictor	Pneumothorax	
	OR (95% CI)	P Value
Female (reference)		
Male	2.43 (0.98-6)	.055
ASA score I-II (reference)		
ASA score III	0.86 (0.24-3.09)	.822
ASA score IV	0.63 (0.16-2.48)	.513
ASA score V	1 (1-1)	...
Right IJV (reference)		
Left IJV	1 (1-1)	...
Left subclavian	6.58 (2.38-18.19)	< .001
Right subclavian	1.2 (0.16-9.09)	.863

Total cost of performing CXR
screening was \$790,625 to
\$1,375,000

Per year: \$105,417 to \$183,333

The number needed to detect 1
case of pneumothorax was 299

The cost to diagnose 1 case of
PNX was \$34,375 to \$59,783



Influence of intercostal muscles contraction on sonographic evaluation of lung sliding: a physiological study on healthy subjects

Daniele Guerino Biasucci^{1,2*}, Alessandro Cina², Claudio Sandroni^{2,3}, Umberto Moscato³, Mario Dauri¹, Luigi Vetrugno⁴ and Franco Cavaliere^{2,3}

	Rater 1 vs expected			Rater 2 vs expected			Rater 3 vs expected		
	Agreement % (95% CI)	Uncertain % (95% CI)	Error % (95% CI)	Agreement % (95% CI)	Uncertain % (95% CI)	Error % (95% CI)	Agreement % (95% CI)	Uncertain % (95% CI)	Error % (95% CI)
Lung sliding									
Tidal breathing	58.3 (43.7–61.2)	14.6 (7–28)	27.1 (16.2–41.6)	6.2 (2.0–17.7)	54.2 (40.0–67.6)	42 (28.6–56)	70.1	27.1 (16.4–41.3)	2.1 (0.3–13.5)
Apnea	100	0	0	85.4 (72.3–92.9)	12.5 (5.7–25.2)	2.1 (0.3–13.4)	100	0	0
Muller	23 (13–37)	4 (1.0–15.3)	73 (58.7–83.6)	31.2 (19.7–45.6)	56.2 (42.0–69.5)	14.5 (7.1–27.6)	54.2 (40.0–67.6)	25 (14.7–39.1)	20.8 (11.5–34.6)
Valsalva	27.1 (16.4–41.3)	4.2 (1.1–15.3)	68.7 (54.4–80.2)	64.6 (50.1–76.8)	31.2 (19.7–45.6)	4.2 (1.0–15.2)	60.4 (46.0–73.2)	27.1 (16.4–41.3)	14.6 (7.1–27.6)
Hyper-ventilation	100	0	0	52.1 (38.1–65.7)	35.4 (23.2–49.8)	12.5 (5.7–25.2)	68.7 (54.4–80.2)	27.1 (16.4–41.3)	4.2 (1.0–15.3)
Lung pulse									
Tidal breathing	91.7 (79.7–96.8)	0	8.3 (3.1–20.3)	81.2 (67.6–89.9)	0	18.8 (10.0–32.3)	70.8 (56.5–82.0)	0	29.2 (18.0–43.5)
Apnea	100	0	0	97.9 (86.5–99.7)	0	2.1 (0.3–13.4)	93.7 (82.2–98.0)	0	6.2 (2.0–17.7)
Muller	50 (36.1–63.8)	0	50 (36.1–63.8)	83.3 (70.0–91.4)	0	16.7 (8.5–30.0)	31.3 (19.7–46.6)	0	68.7 (54.4–80.2)
Valsalva	39.5 (26.8–52.2)	0	60.5 (46.0–73.2)	87.5 (75.0–94.3)	0	12.5 (5.7–25.2)	25 (14.7–39.1)	0	75 (61.0–85.2)
Hyper-ventilation	4.2 (1.0–15.5)	0	95.8 (84.7–98.9)	43.7 (30.5–58.0)	0	56.3 (42.0–69.5)	0	0	100

Influence of intercostal muscles contraction on sonographic evaluation of lung sliding: a physiological study on healthy subjects

Daniele Guerino Biasucci^{1,2*}, Alessandro Cina², Claudio Sandroni^{2,3}, Umberto Moscato³, Mario Dauri¹, Luigi Vetrugno⁴ and Franco Cavaliere^{2,3}



Table 3 Intra-rater agreement for the assessment of lung sliding and lung pulse based on the integration of B-mode and M-mode imaging

	Cohen's <i>k</i>		
	Rater 1	Rater 2	Rater 3
Lung sliding			
Tidal breathing	0.41	0.93	0.85
Apnea	0	1	0
Muller	0.47	0.85	0.55
Valsalva	0.46	0.96	0.53
Hyperventilation	0	1	0.58
Lung pulse			
Tidal breathing	0.10	1	0.81
Apnea	0	1	0.54
Muller	0.58	1	0.65
Valsalva	0.61	1	0.83
Hyperventilation	0.25	1	0

Table 2 Inter-rater agreement for the assessment of lung sliding and lung pulse based on the integration of B-mode and M-mode imaging

	Cohen's <i>k</i>		
	Rater 1 vs 2	Rater 2 vs 3	Rater 1 vs 3
Lung sliding			
Tidal breathing	0.12	0.11	0.12
Apnea	0.46	0.41	1
Muller	0.10	0.25	0.23
Valsalva	0.13	0.10	0.10
Hyperventilation	0	0.31	0.10
Lung pulse			
Tidal breathing	0.54	0.16	0.12
Apnea	0.48	0.40	0.23
Muller	0.10	0	0.35
Valsalva	0.10	0.10	0.61
Hyperventilation	0.14	0	0

Hemothorax & Effusions

- Hemothorax
- Chylothorax
- ...

Mechanical Complications of Central Venous Catheters

[Lewis A. Eisen, MD](#), [Mangala Narasimhan, DO](#), [...], and [Roslyn F. Schneider, MD](#)

[Volume 21, Issue 1](#) | <https://doi.org/10.1177/0885066605280884>

Journal of Intensive Care Medicine

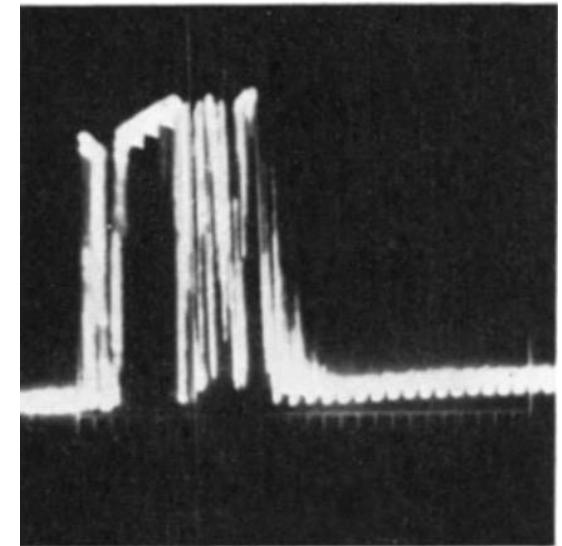
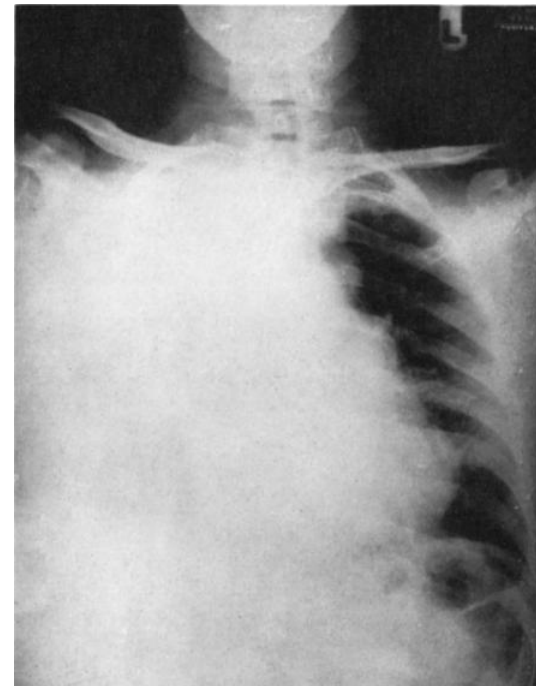
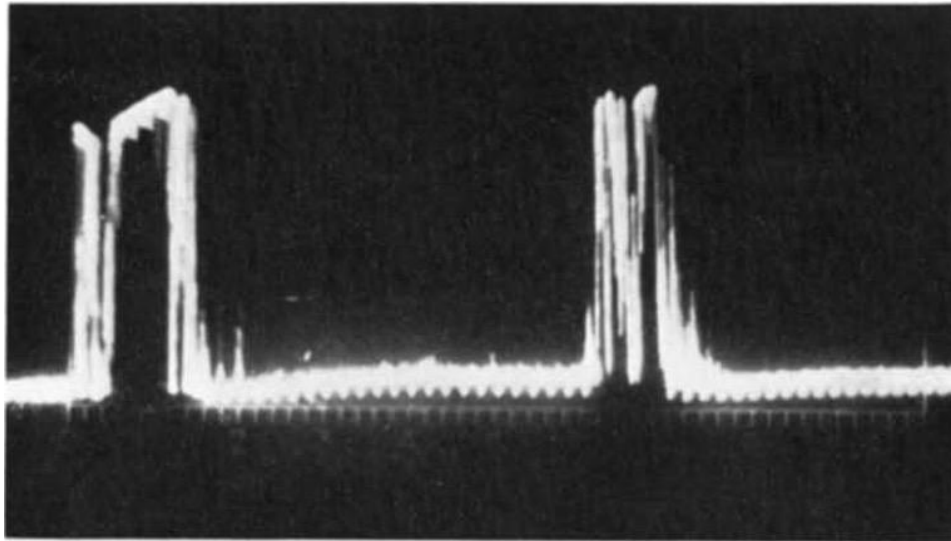
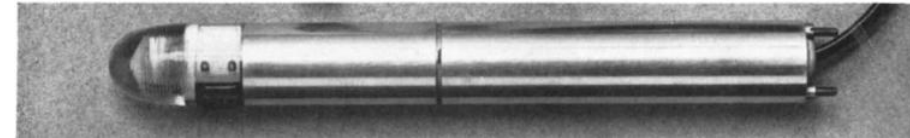
- Rare complications
- Mainly Case Reports
- Incidence estimated in < 1%

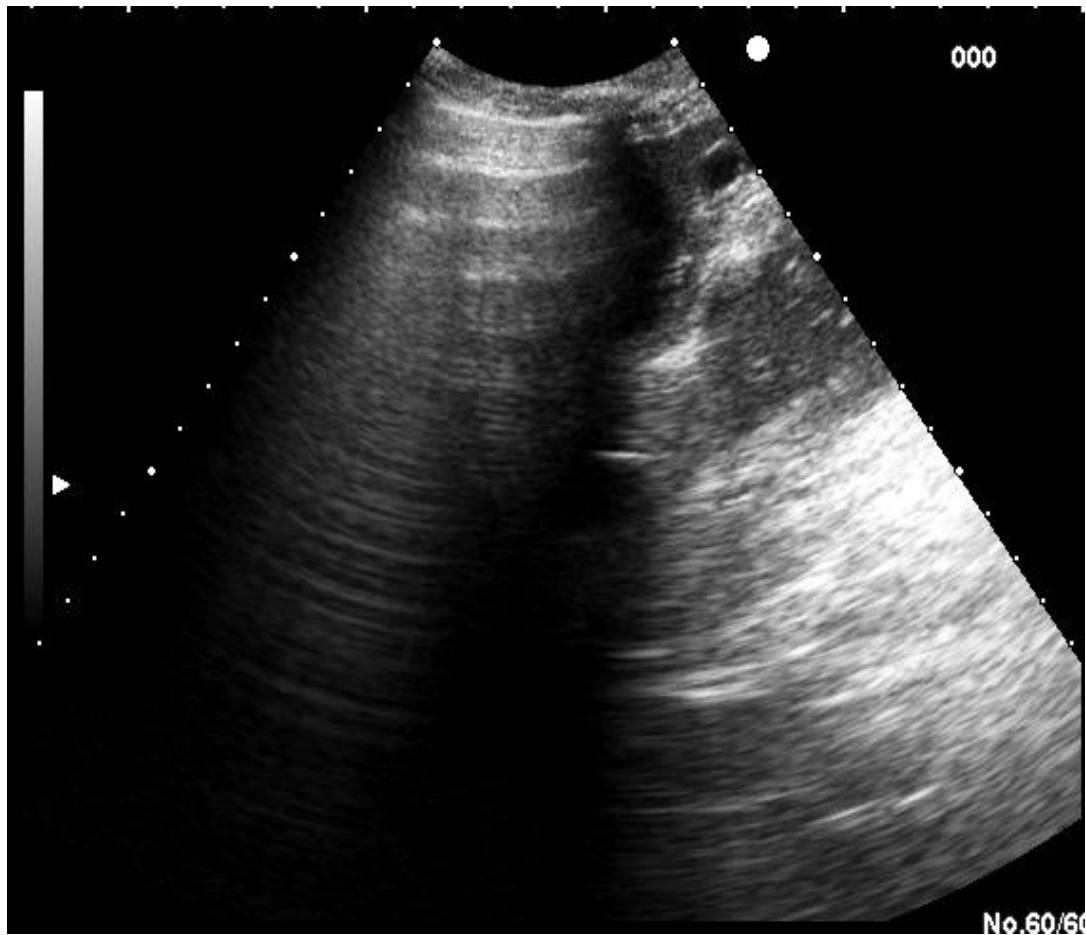
ULTRASOUND FOR ROUTINE CLINICAL INVESTIGATIONS

by R. L. Pell*

Trial diagnoses of pleural effusion and carcinoma of the prostate gland have yielded echograms from which both conditions can be recognized. This preliminary report shows typical A-scan traces and indicates how the work could develop into routine techniques. Mid-line shift of the brain has also been detected

ULTRASONICS / *April-June* 1964





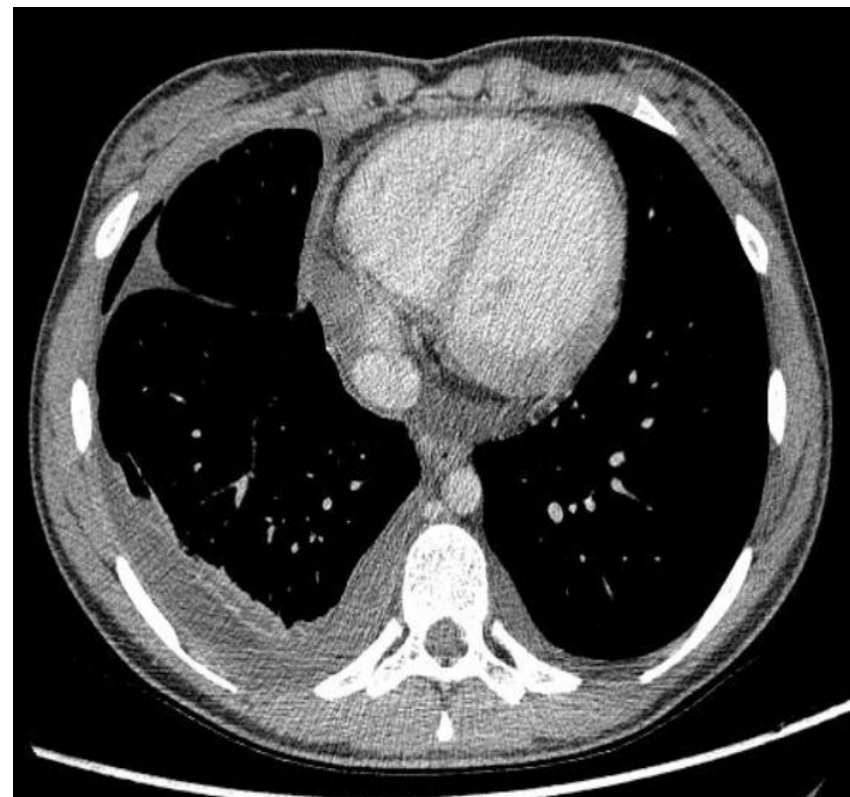
Curtain Sign → No Effusion

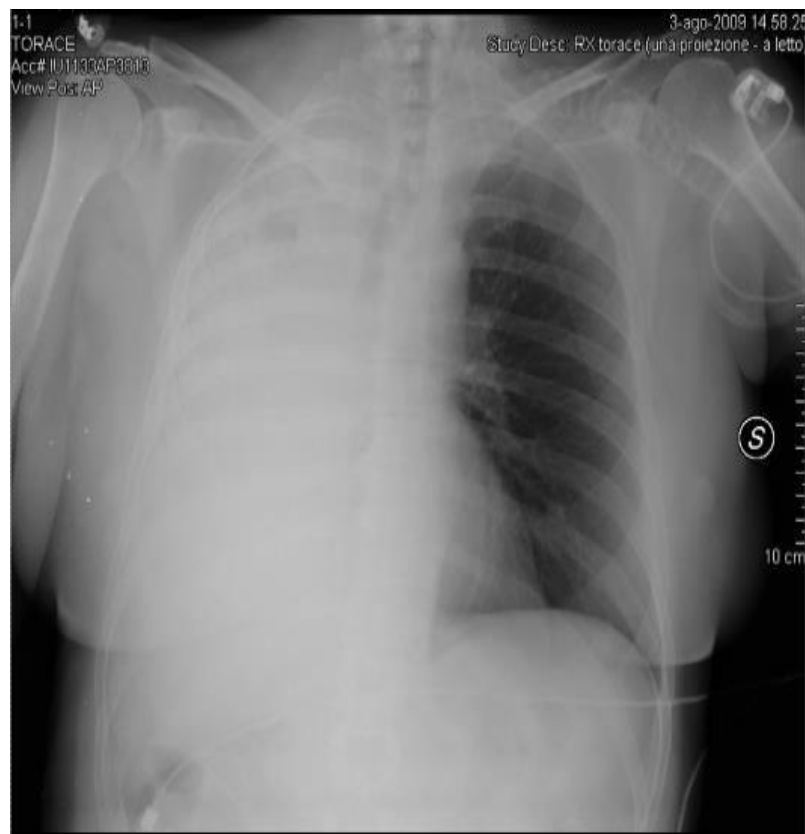


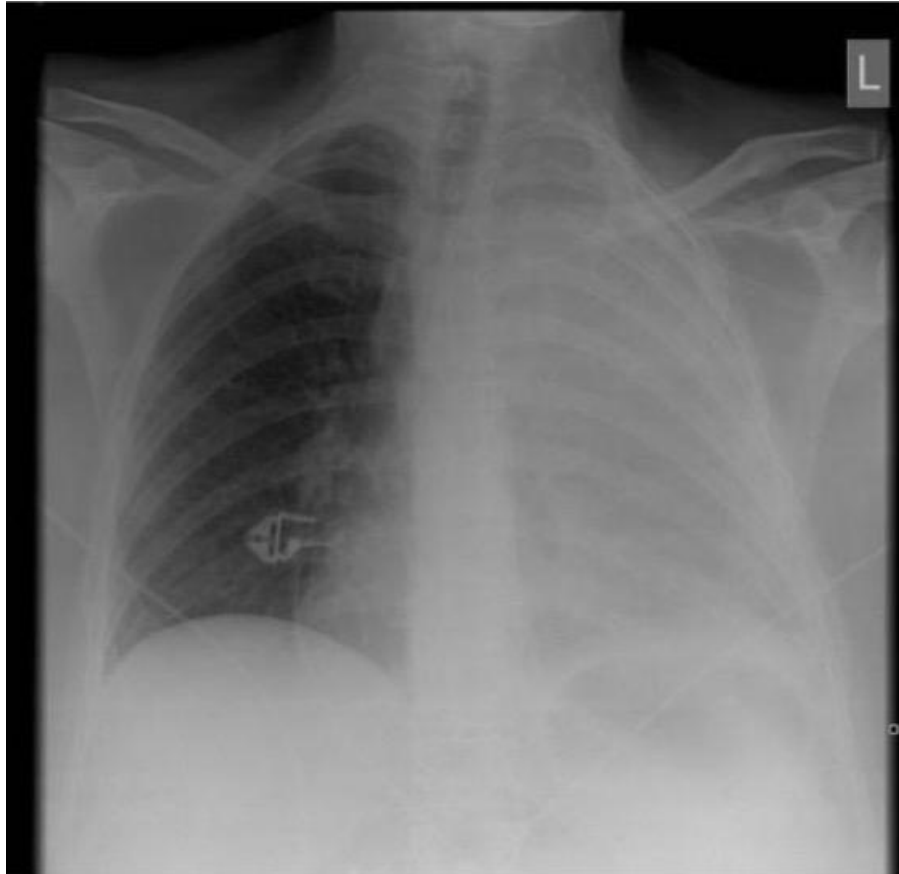
Presence of Effusion











Koeze et al. *Critical Ultrasound Journal* 2012, **4**:1
<http://www.criticalultrasoundjournal.com/content/4/1/1>

Table 3 Ultrasound scan to define the nature of pleural effusion

	Exudate	Transudate	Hemothorax	Empyema	Malignant effusion
Internal echogenicity: Anechoic Complex non-septated Complex septated	Septation, non -septated or anechoic	Anechoic	Hyperechogenic	Often septated	Complex septation, non-septated
Echogenicity: Homogeneity or not	Homogeneity or not	Not	Homogeneity	Homogeneity	Homogeneity
Pleural thickness	Thickened	Normal	Thickness	Thickness	Irregular pleural thickness
Other findings	Based on the etiologies	General bilaterally, echocardiography findings	Pneumothorax, atelectasis, consolidation	Pulmonary consolidation and air bronchograms	Liver metastasis; presence of pleural or diaphragmatic nodules

REVIEW

Open Access

Thoracic ultrasound for pleural effusion in the intensive care unit: a narrative review from diagnosis to treatment

E. Brogi^{1*}, L. Gargani², E. Bignami³, F. Barbariol⁴, A. Marra⁵, F. Forfori¹ and L. Vetrugno⁴



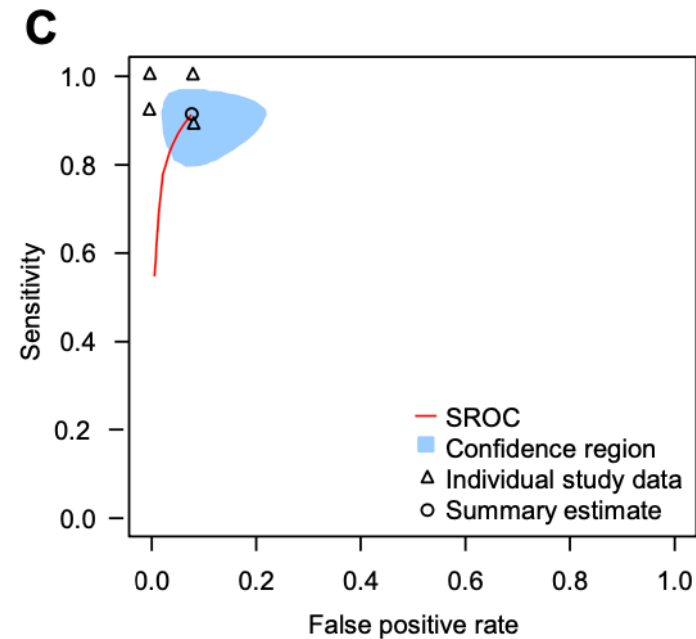
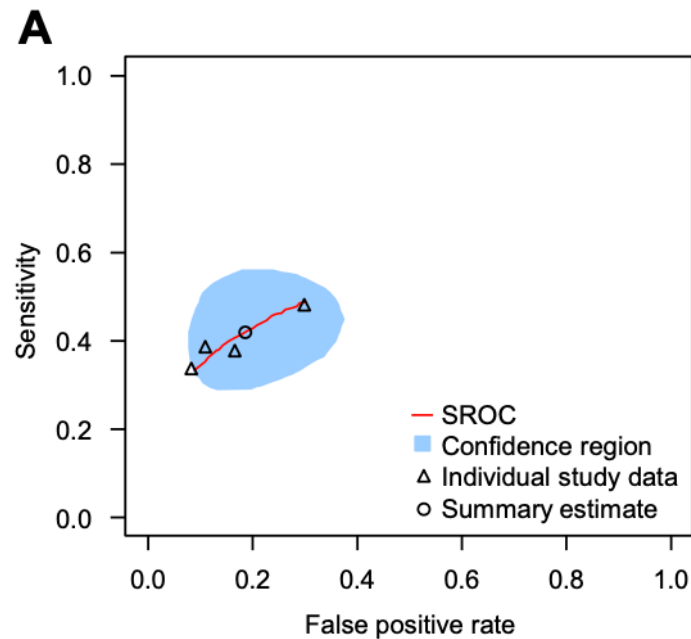


Table 3
Pooled results for the diagnostic accuracy of CXR and LUS in the diagnosis of consolidation and pleural effusion, using CT as the reference standard.

Pathology	Test	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	DOR	AUC
Consolidation	CXR	53 (35 to 70)	78 (53 to 91)	4.29	0.69
	LUS	92 (78 to 97)	92 (70 to 98)	160.22	0.96
Pleural effusion	CXR	42 (32 to 53)	81 (67 to 90)	2.79	0.57
	LUS	91 (83 to 96)	92 (82 to 97)	134.61	0.96

Research

Lung ultrasound has greater accuracy than conventional respiratory assessment tools for the diagnosis of pleural effusion, lung consolidation and collapse: a systematic review

Louise Hansell ^{a,b}, Maree Milross ^a, Anthony Delaney ^{c,d,e,f}, David H Tian ^g, George Ntoumenopoulos ^h

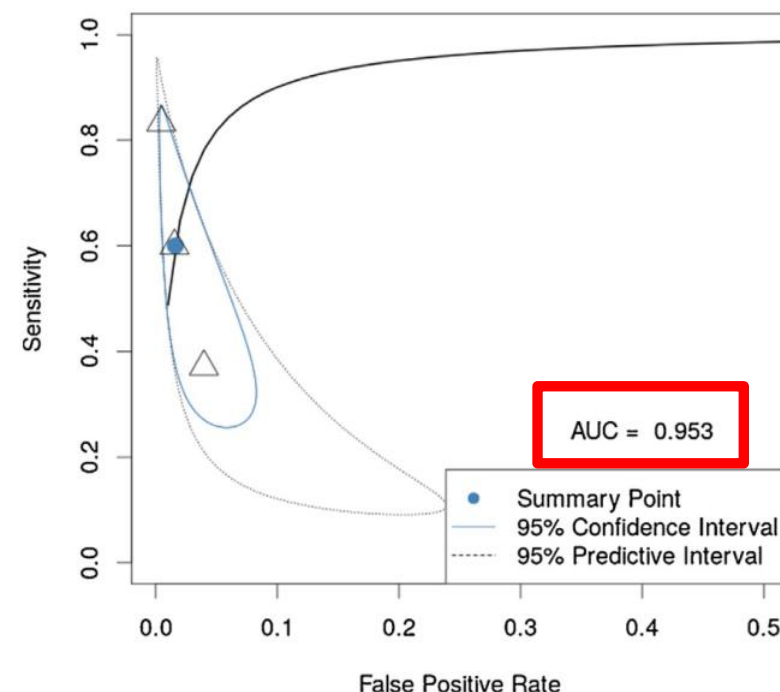
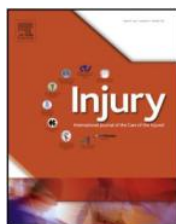
Journal of Physiotherapy 67 (2021) 41–48

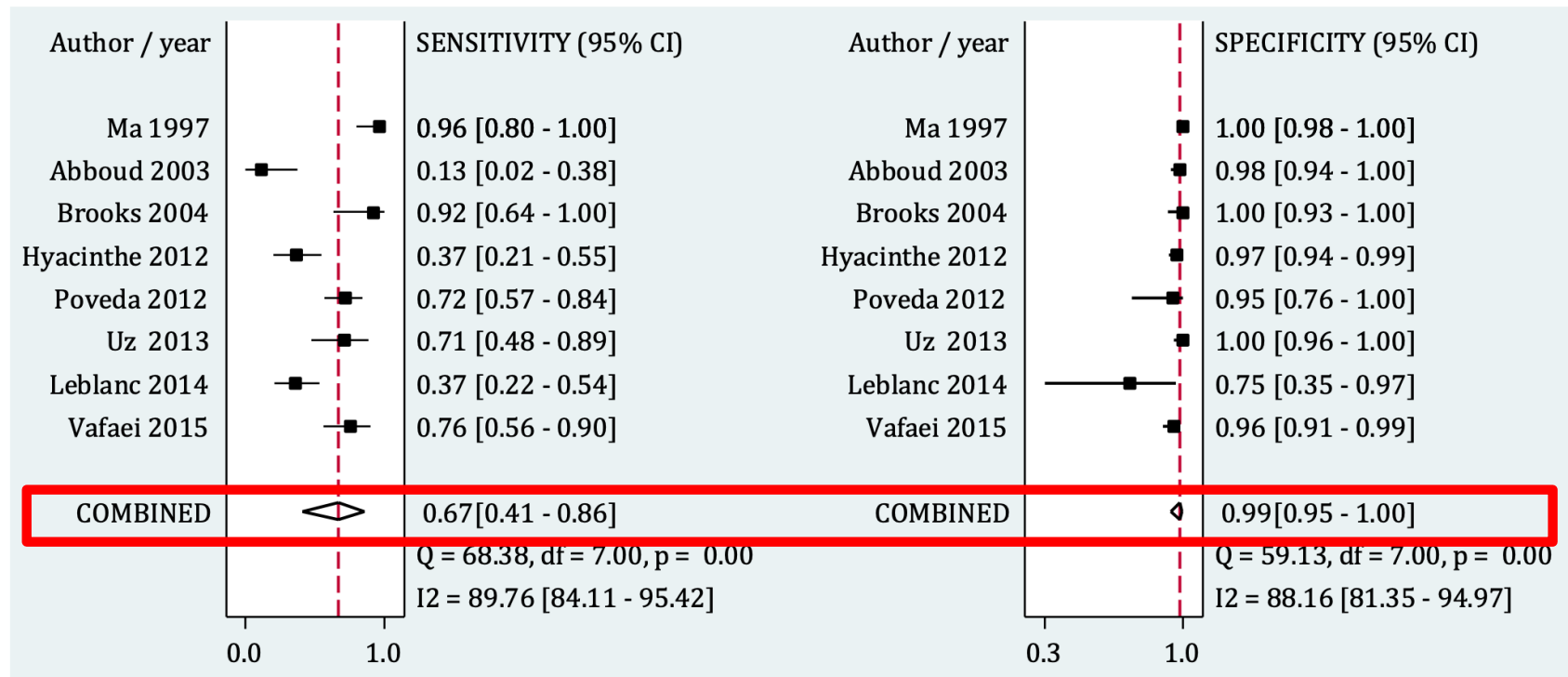
Diagnostic accuracy of the chest ultrasonography* for traumatic haemothorax.

Analysis	Source	Confirmed/total analysed	Sensitivity (95%CI)	Specificity (95%CI)	Positive likelihood ratio (95%CI)	Negative likelihood ratio (95%CI)
Primary (by hemithorax)	Brooks et al. [32]	14/122	0.83 (0.58–0.94)	0.99 (0.95–0.99)	181.7 (11.3–2913)	0.16 (0.05–0.51)
	Hyacinthe et al. [16]	35/237	0.37 (0.23–0.53)	0.96 (0.92–0.97)	9.37 (4.2–21)	0.65 (0.5–0.84)
	Leblanc et al. [10]	25/90	0.60 (0.40–0.76)	0.98 (0.91–0.99)	39 (5.43–280)	0.40 (0.25–0.65)
	Summary^a	74/449	0.60 (0.31–0.86)	0.98 (0.94–0.99)	37.5 (5.26–207.5)	0.40 (0.17–0.72)
Secondary (by patients)	Brooks et al. [32]	13/61	0.89 (0.64–0.97)	0.98 (0.91–0.99)	87.5 (5.51–1387)	0.10 (0.02–0.49)
	Ojaghi-Haghighi et al. [29]	47/150	0.82 (0.69–0.91)	0.98 (0.93–0.99)	42.7 (10.7–169)	0.17 (0.09–0.32)
	Ma et al. [33]	26/240	0.94 (0.79–0.98)	0.99 (0.97–1.0)	406 (25.4–6482)	0.05 (0.01–0.26)
	Summary^a	86/451	0.88 (0.76–0.94)	0.99 (0.96–1.0)	98.2 (19–474)	0.11 (0.05–0.25)

Chest ultrasonography for the emergency diagnosis of traumatic pneumothorax and haemothorax: A systematic review and meta-analysis

Leonardo Jönck Staub^{a,f,*}, Roberta Rodolfo Mazzali Biscaro^b, Erikson Kaszubowski^e, Rosemeri Maurici^{c,d}



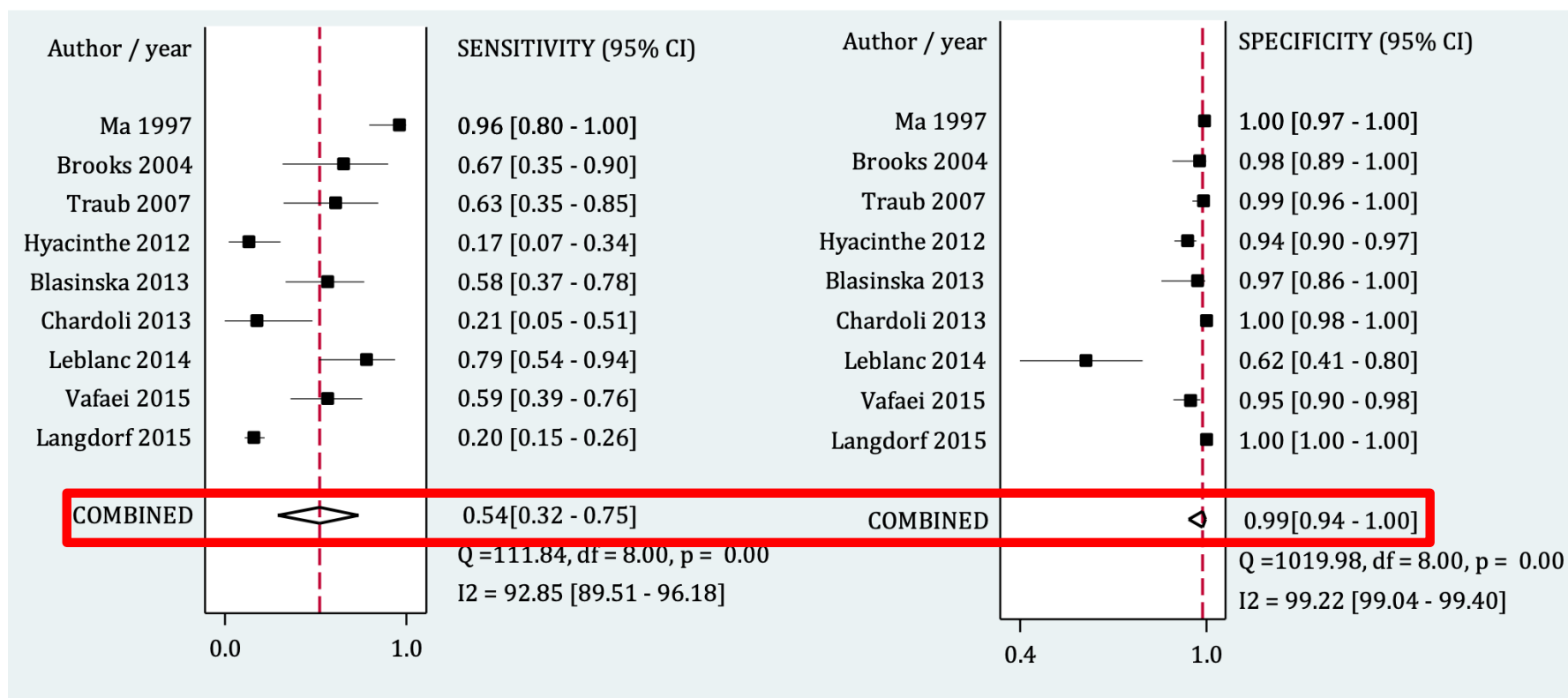


Emergency (2016); 4 (3): 116-126

Application of Ultrasonography and Radiography in Detection of Hemothorax; a Systematic Review and Meta-Analysis

Vafa Rahimi-Movaghar¹, Mahmoud Yousefifard², Parisa Ghelichkhani³, Masoud Baikpour⁴, Abbas Tafakhori^{5,6}, Hadi Asady⁷, Gholamreza Faridaalae⁸, Mostafa Hosseini^{9*}, Saeed Safari¹⁰

CXR



Emergency (2016); 4 (3): 116-126

Application of Ultrasonography and Radiography in Detection of Hemothorax; a Systematic Review and Meta-Analysis

Vafa Rahimi-Movaghar¹, Mahmoud Yousefifard², Parisa Ghelichkhani³, Masoud Baikpour⁴, Abbas Tafakhori^{5,6}, Hadi Asady⁷, Gholamreza Faridaalae⁸, Mostafa Hosseini^{9*}, Saeed Safari¹⁰

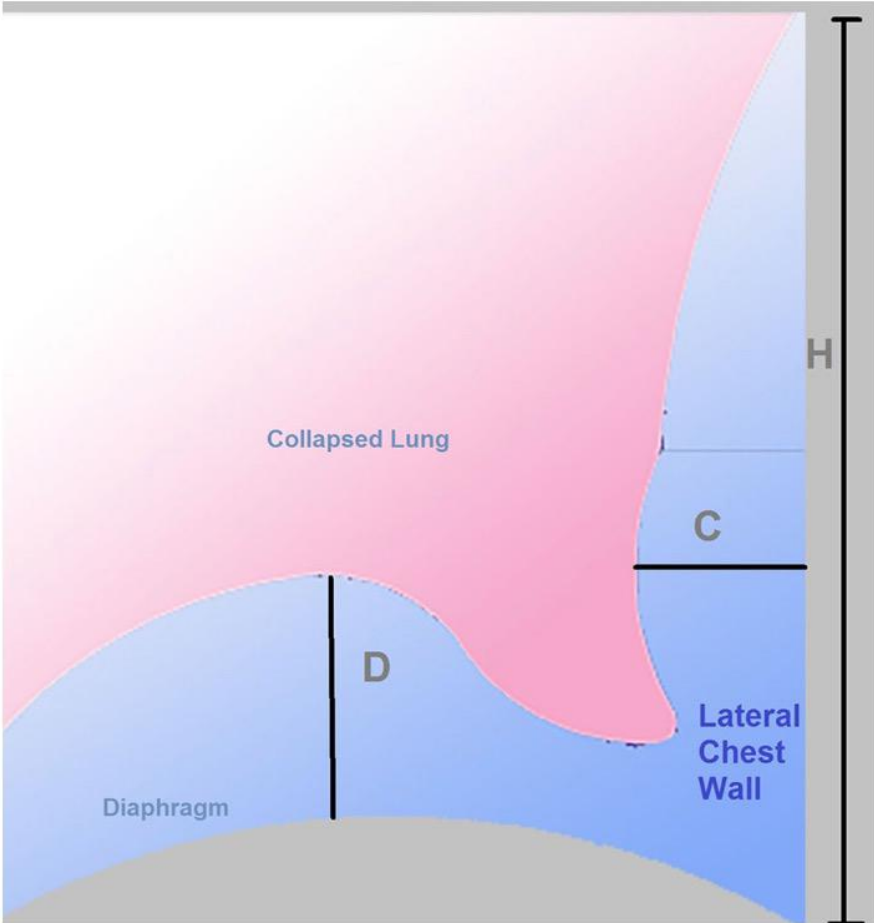


Validation of equations for pleural effusion volume estimation by ultrasonography

Maged Hassan^{1,2} · Rana Rizk² · Hatem Essam² · Ahmed Abouelnour²

Authors	Setting	Probe used	Equation	R^2
Goecke and Schwerk [14]	Wards, outpatients	Curvilinear	$H \times 90$	0.68
Goecke and Schwerk [14]	Wards, outpatients	Curvilinear	$(H + D) \times 70$	0.87
Balik et al. [12]	ICU	Sector	$C \times 20$	0.52
Usta at al [13]	Post-cardiac surgery	Sector	$D \times 16$	0.79
Remérand et al. [15]	ICU	Curvilinear	Paravertebral effusion area $\times H$	0.70

C chest wall, D diaphragm, H lateral height, R^2 squared regression coefficient



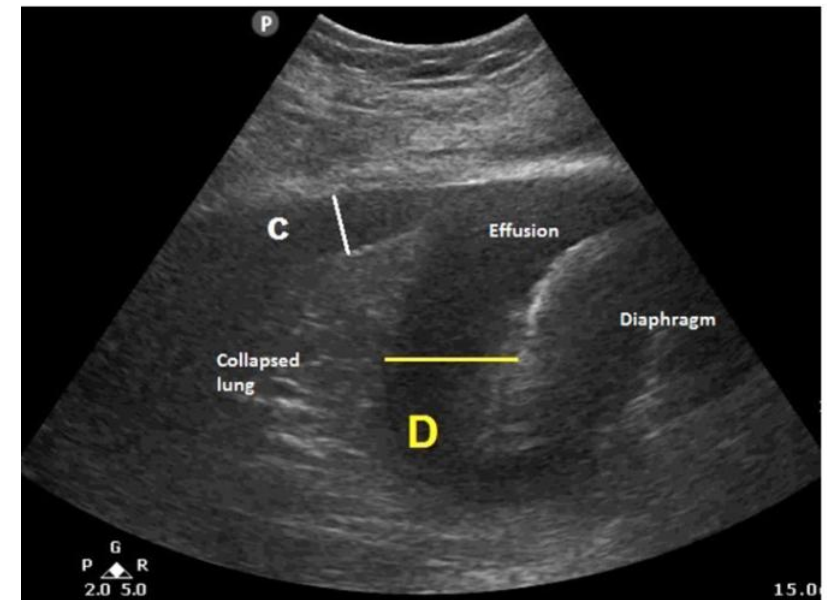
Validation of equations for pleural effusion volume estimation by ultrasonography

Maged Hassan^{1,2} · Rana Rizk² · Hatem Essam² · Ahmed Abouelnour²

Table 2 ICC with 95% confidence intervals for the five tested equations against measured volume

Equation	ICC	95% confidence interval	
		Upper limit	Lower limit
$C \times 20$	0.342	– 0.103	0.679
$D \times 16$	0.382	– 0.103	0.719
$H \times 90$	0.773	0.452	0.894
$(H + D) \times 70$	0.835	0.687	0.913
$H \times 100$	0.798	0.651	0.888

C chest wall, D diaphragm, H lateral height, ICC intra-class correlation coefficient



Level of agreement was defined as being:

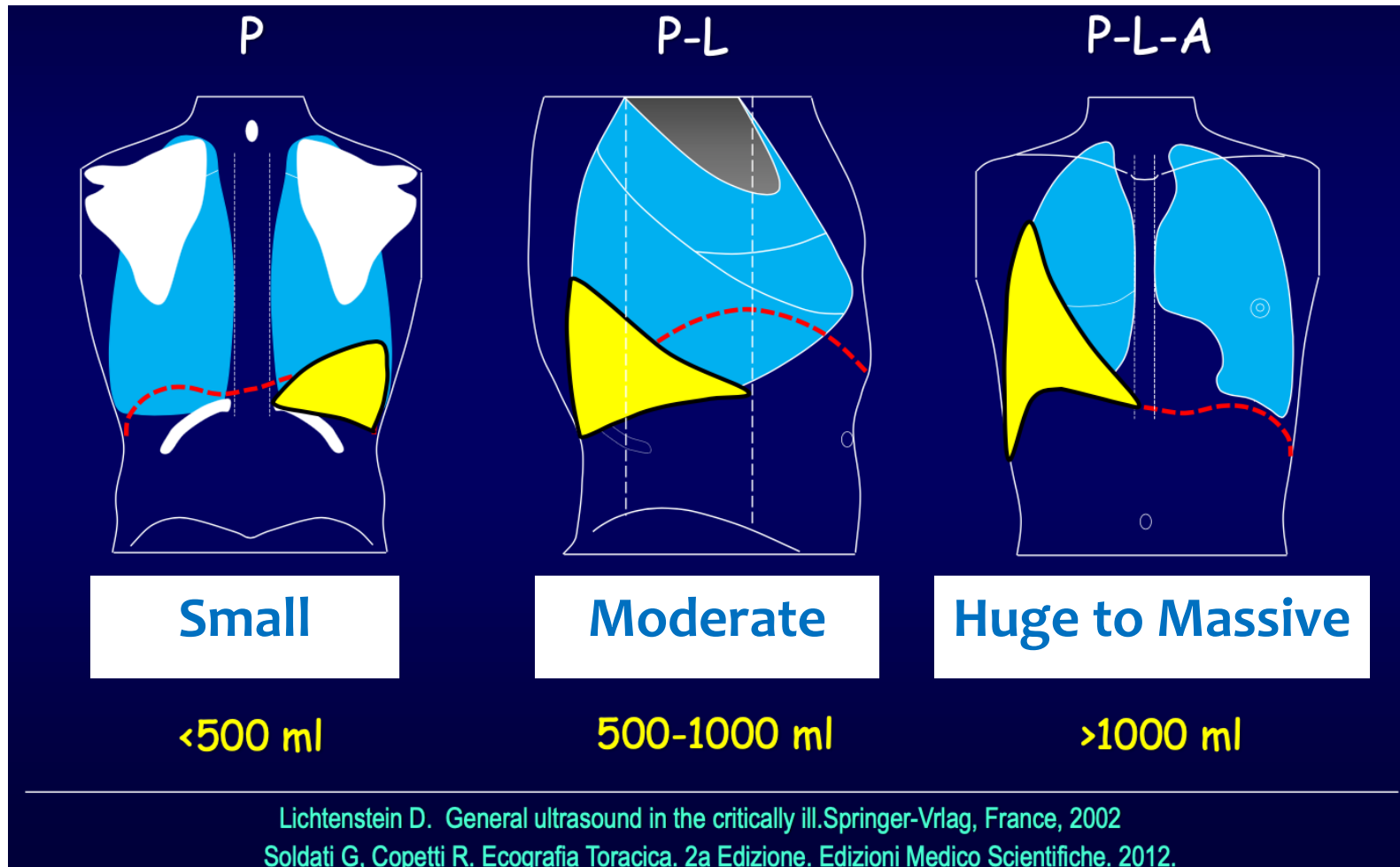
Poor for $ICC < 0.5$

Moderate for $ICC 0.5–0.75$

Good for $ICC 0.75–0.9$

Excellent for $ICC > 0.9$ [18].

Semiquantitative Assessment



GUIDELINES

European Society of Anaesthesiology guidelines on peri-operative use of ultrasound-guided for vascular access (PERSEUS vascular access)

Massimo Lamperti, Daniele Guerino Biasucci, Nicola Disma, Mauro Pittiruti, Christian Breschan, Davide Vailati, Matteo Subert, Vilma Traškaitė, Andrius Macas, Jean-Pierre Estebe, Regis Fuzier, Emmanuel Boselli and Philip Hopkins

Grade of Recommendation	Clarity of risk/benefit
1A. Strong recommendation, high quality evidence	Benefits clearly outweigh risk and burdens, or vice versa.
1B. Strong recommendation, moderate quality evidence	Benefits clearly outweigh risk and burdens, or vice versa.
1C. Strong recommendation, low quality evidence	Benefits appear to outweigh risk and burdens, or vice versa.
2A. Weak recommendation, high quality evidence	Benefits closely balanced with risks and burdens.
2B. Weak recommendation, moderate quality evidence	Benefits closely balanced with risks and burdens, some uncertainty in the estimates of benefits, risks and burdens.
2C. Weak recommendation, low quality evidence	Uncertainty in the estimates of benefits, risks, and burdens; benefits may be closely balanced with risks and burdens.

Should ultrasound be used for verification of immediate postprocedural life-threatening complications after central venous catheterisation?**Recommendations**

- (1) The quality of evidence on which to base recommendations is generally weak, with prospective cohort studies with a high degree of heterogeneity.
- (2) We recommend performing PLUS to rule out potential pleural-pulmonary complications (mainly pneumothorax) soon after the procedure in any difficult puncture of the subclavian or axillary vein and, particularly, if the patient complains of shortness of breath or discomfort that worsens after catheter placement **(1B)**.
- (3) We recommend using PLUS to monitor the development of a confirmed pleural-pulmonary complication or for follow-up of treatment **(1B)**.
- (4) We recommend ultrasound for diagnosis and follow-up of catheter-related thrombosis **(1C)**.

RESEARCH

Open Access



International evidence-based guidelines on Point of Care Ultrasound (POCUS) for critically ill neonates and children issued by the POCUS Working Group of the European Society of Paediatric and Neonatal Intensive Care (ESPNIC)

- | | |
|---|------------------|
| 17. POCUS is helpful to accurately detect pneumothorax in neonates and children | Strong agreement |
| 18. POCUS is helpful to insert chest tube or perform needle aspiration in neonatal tension pneumothorax | Strong agreement |
| 19. POCUS is helpful to detect pleural effusions in neonates and children | Strong agreement |
| 20. POCUS is helpful to guide thoracentesis in neonates and children | Strong agreement |

POCUS is helpful to accurately detect pneumothorax in neonates and children—*strong agreement (quality of evidence B)*. In adults, LUS has a high diagnostic accuracy for the diagnosis of pneumothorax [88, 89] and has been reported to be more sensitive than conventional radiology [90]. Neonatal data confirm this high diagnostic performance for tension pneumothorax [91].

POCUS is helpful to detect pleural effusions in neonates and children—*strong agreement (quality of evidence B)*. Policy statements in adults recommend the use of LUS for the detection of effusions and evaluation of pleural fluid volume to guide management [55, 92, 93]. In children, LUS shows high accuracy in the diagnosis of pneumonia-related pleural effusion [47].

AHRQ recommendations

Annals of Internal Medicine

SUPPLEMENT

The Top Patient Safety Strategies That Can Be Encouraged for Adoption Now

2013

Paul G. Shekelle, MD, PhD; Peter J. Pronovost, MD, PhD; Robert M. Wachter, MD; Kathryn M. McDonald, MM; Karen Schoelles, MD, SM; Sydney M. Dy, MD, MSc; Kaveh Shojania, MD; James T. Reston, PhD, MPH; Alyce S. Adams, PhD; Peter B. Angood, MD; David W. Bates, MD, MSc; Leonard Bickman, PhD; Pascale Carayon, PhD; Sir Liam Donaldson, MChB, MSc, MD; Naihua Duan, PhD; Donna O. Farley, PhD, MPH; Trisha Greenhalgh, BM BCh; John L. Haugom, MD; Eileen Lake, PhD, RN; Richard Lilford, PhD; Kathleen N. Lohr, PhD, MA, MPhil; Gregg S. Meyer, MD, MSc; Marlene R. Miller, MD, MSc; Duncan V. Neuhouser, PhD, MBA, MHA; Gery Ryan, PhD; Sanjay Saint, MD, MPH; Stephen M. Shortell, PhD, MPH, MBA; David P. Stevens, MD; and Kieran Walshe, PhD

Encouraged

- Multicomponent interventions to reduce falls
- Use of clinical pharmacists to reduce adverse drug events
- Documentation of patient preferences for life-sustaining treatment
- Obtaining informed consent to improve patients' understanding of the potential risks of procedures
- Team training
- Medication reconciliation
- Practices to reduce radiation exposure from fluoroscopy and CT
- The use of surgical outcome measurements and report cards, such as those from ACS NSQIP
- Rapid-response systems
- Use of complementary methods for detecting adverse events or medical errors to monitor for patient safety problems
- Computerized provider order entry
- Use of simulation exercises in patient safety efforts



Choose Wisely: Avoid Unnecessary CXR!

There is enough evidence to abandon the routine use of CXR after CICC placement

However, CXR or CT scan should be performed in dyspneic patients when LUS examination is uncertain or when unfeasible as in case of subcutaneous emphysema

4 Ways UVA Fights Unnecessary Radiation



Monitoring Equipment

Our in-house, licensed state inspectors regularly monitor and test all radiation equipment to ensure patient and staff safety.

Choosing the Best Exam for You

Our radiologists work with your physician to determine the best exam for you. Sometimes it is only necessary to have an MRI or Ultrasound rather than an exam involving radiation.



Avoiding Repeat Exams

We work to obtain accurate copies of your medical imaging history to avoid repeating exams you've had in the past. Our technologists are also highly trained so that correct images are taken the FIRST time.

Meeting Accreditation Standards

UVA limits any kind of unsafe radiation exposure by providing necessary protection near radiation equipment and always following accreditation guidelines set forth by the American College of Radiology.



Thanks a Lot

danielebiasucci@gmail.com

