Echographie pleuro-pulmonaire et diaphragmatique en situation d'urgence

Urgences respiratoires

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HÔPITAUX UNIVERSITAIRES PARIS CENTRE Cochin

Pourquoi en faire

- Diagnostic
- Pronostic
- Procédurale

- Examen facile et rapide
- Non irradiant
- Chez patient non transportable
- Peut être répété en fonction des besoins

Diagnostic

- Complément de l’examen clinique
- Répond à des questions simples
- Oriente le diagnostic

TABLE 4] Diagnostic Accuracy of Ultrasound Diagnoses

Variable	Sensitivity, % (95% CI)	Specificity, % (95% CI)	PPV, % (95% CI)	NPV, % (95% CI)	+LR (95% CI)	−LR (95% CI)
Heart failure	88 (85.1-90.6)	96 (95-96.8)	85.8 (82.8-88.5)	96.6 (95.8-97.4)	21.73 (17.61-26.82)	0.12 (0.10-0.16)
Acute coronary syndrome	47.6 (32-63.6)	99.6 (99.2-99.8)	62.5 (43.7-78.9)	99.2 (98.8-99.5)	104.8 (54.85-200.26)	0.53 (0.39-0.70)
Pneumonia	88.5 (86.4-90.3)	91.6 (90.1-92.9)	87.7 (85.6-89.6)	92.1 (90.7-93.4)	10.47 (8.90-12.32)	0.13 (0.11-0.15)
Pleural effusion	77.6 (68-85.4)	99.2 (98.8-99.5)	78.4 (68.8-86.1)	99.2 (98.7-99.5)	95.46 (61.54-148.09)	0.23 (0.16-0.33)
Pericardial effusion	86.4 (72.7-94.8)	99.7 (99.5-99.9)	84.4 (70.5-93.5)	99.8 (99.5-99.9)	325.59 (153.94-688.65)	0.14 (0.06-0.29)
COPD/asthma	86.8 (84.2-89.2)	96.1 (95.1-96.9)	89.7 (87.2-91.8)	94.9 (93.8-95.8)	21.98 (17.60-27.45)	0.14 (0.11-0.16)
Pulmonary embolism	40 (30.1-50.6)	99.9 (99.7-100)	92.7 (80.1-98.5)	97.8 (97.2-98.4)	345.07 (108.45-1097.94)	0.60 (0.51-0.71)
Pneumothorax	87.8 (75.2-94.5)	100 (99.8-100)	98.8 (89.1-99.9)	99.8 (99.5-99.9)	4634.67 (289.35-74236.28)	0.12 (0.06-0.27)
ARDS/ALI	43.8 (19.8-70.1)	99.5 (99.2-99.7)	35 (15.4-59.2)	99.7 (99.4-99.9)	89.75 (41.29-195.09)	0.57 (0.37-0.87)
Other causes	45.5 (36.4-54.8)	98.8 (98.3-99.2)	64 (52.9-74)	97.5 (96.8-98)	37.57 (25.16-56.08)	0.55 (0.47-0.65)

−LR = negative likelihood ratio; NPV = negative predictive value; PPV = positive predictive value; +LR = positive likelihood ratio.

TABLE 3] Concordance Between Ultrasound Diagnosis and ED Diagnosis

Diagnosis	κ
Heart failure	0.810
Acute coronary syndrome	0.706
Pneumonia	0.788
Pleural effusion	0.730
Pericardial effusion	0.858
COPD/asthma	0.845
Pulmonary embolism	0.549
Pneumothorax	0.903
ARDS/ALI	0.294
Other	0.628
Total	0.711

Temps moyen pour formuler le diagnostic

Échographie 24 +/- 10 min

Prise en charge standard 192 +/-72 min

Echographie pulmonaire et échographie cardiaque

Zanobetti *Chest* 2017

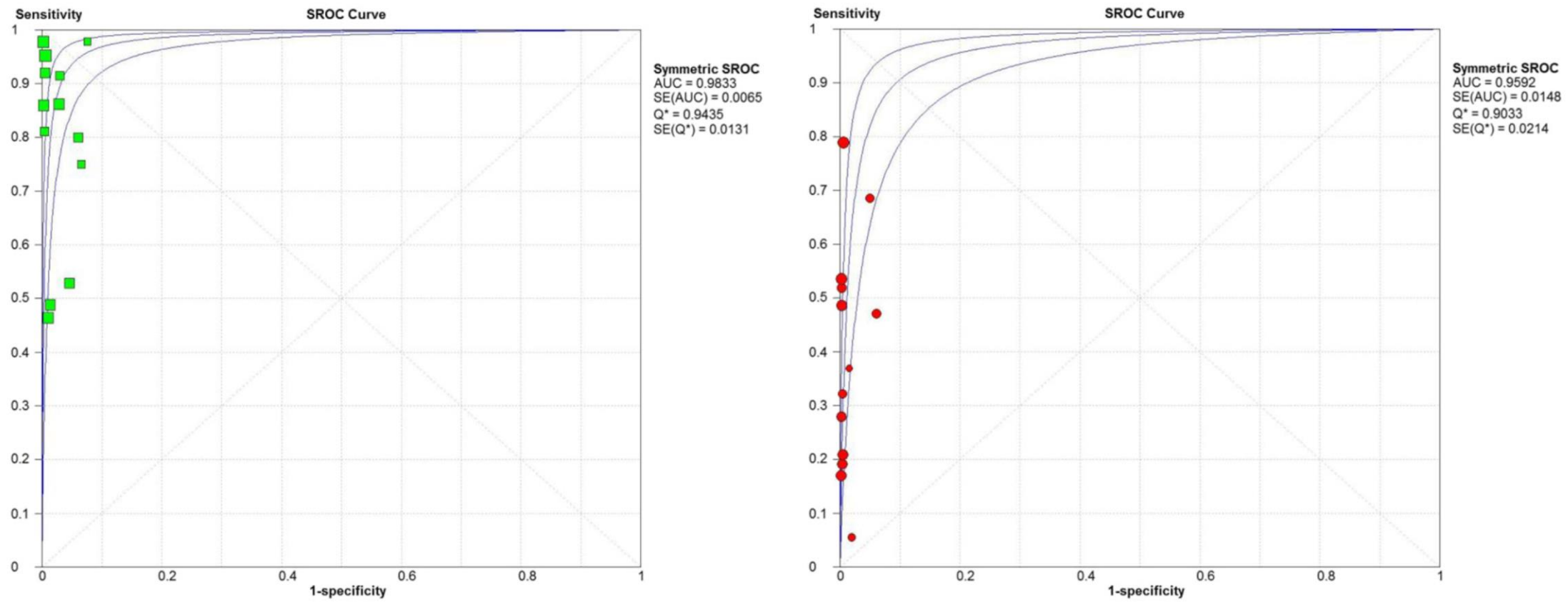


Figure 5 Summary receiver operative curves for US (left) and CXR (right). AUC, Area under the curve; SE, standard error.

RESPIRATORY RESEARCH

Lung ultrasound for the diagnosis of pneumonia in adults: a systematic review and meta-analysis

convex transducer and one used a 5–9 MHz convex probe. Pooled sensitivity and specificity for the diagnosis of pneumonia using LUS were 94% (95% CI, 92%-96%) and 96% (94%-97%), respectively; pooled positive and negative LRs were 16.8 (7.7-37.0) and 0.07 (0.05-0.10), respectively; and, the area-under-the-ROC curve was 0.99 (0.98-0.99).

Conclusions: Our meta-analysis supports that LUS, when conducted by highly-skilled sonographers, performs well for the diagnosis of pneumonia. General practitioners and Emergency Medicine physicians should be encouraged to learn LUS since it appears to be an established diagnostic tool in the hands of experienced physicians.

Chavez *Respiratory Research* 2014

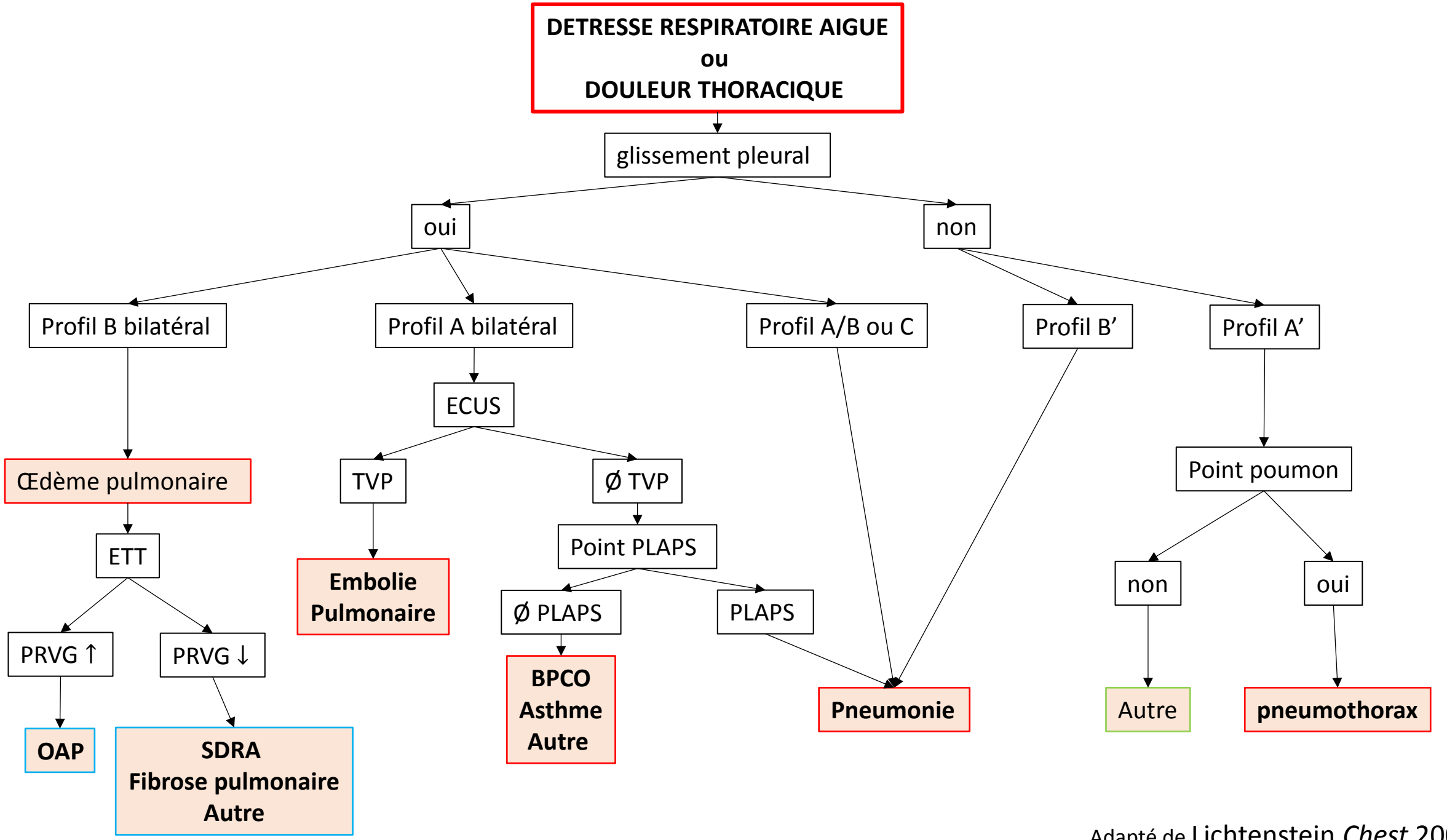
Table 3. Test Characteristics of Lung Ultrasonography and Chest Radiography[a]

Index Test	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)	PPV (95% CI)[b]	NPV (95% CI)[b]	Sensitivity (95% CI)[c]	Specificity (95% CI)[c]
CXR	7.36 (2.70-20.07)	0.30 (0.26-0.35)	0.86 (0.69-0.95)	0.80 (0.75-0.83)	0.73 (0.70-0.76)	0.90 (0.75-0.97)
LUS	8.63 (6.93-10.74)	0.14 (0.06-0.29)	0.88 (0.83-0.90)	0.90 (0.81-0.95)	0.88 (0.75-0.95)	0.90 (0.88-0.92)

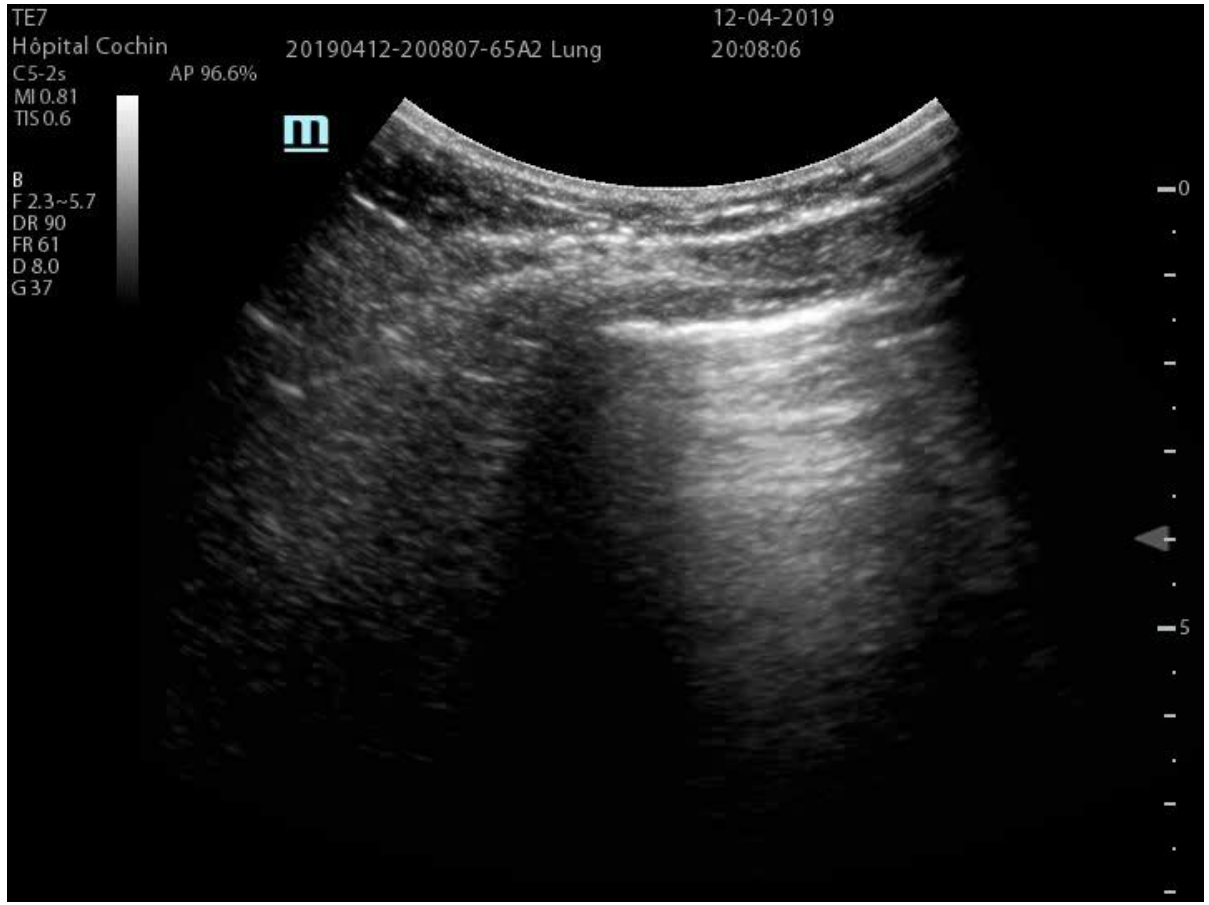
Diagnostic Accuracy of Point-of-Care Lung Ultrasonography and Chest Radiography in Adults With Symptoms Suggestive of Acute Decompensated Heart Failure A Systematic Review and Meta-analysis,
Maw *JAMA* 2019

Diagnostic

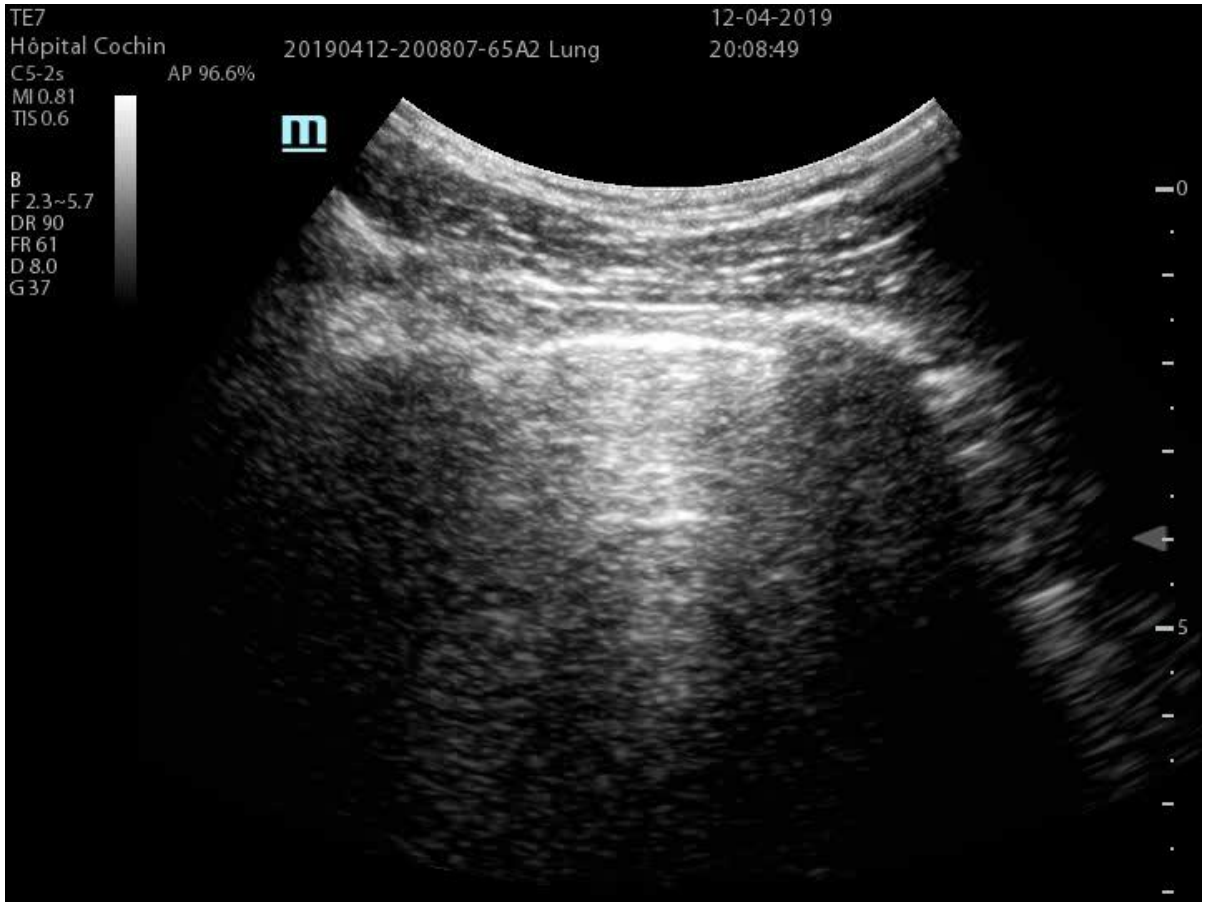
- Lichtenstein *Chest* 2008
- Blue protocol
  - Après l'interrogatoire et l'examen clinique
  - Echographie pulmonaire 2D et TM
  - Echographie de compression des MI



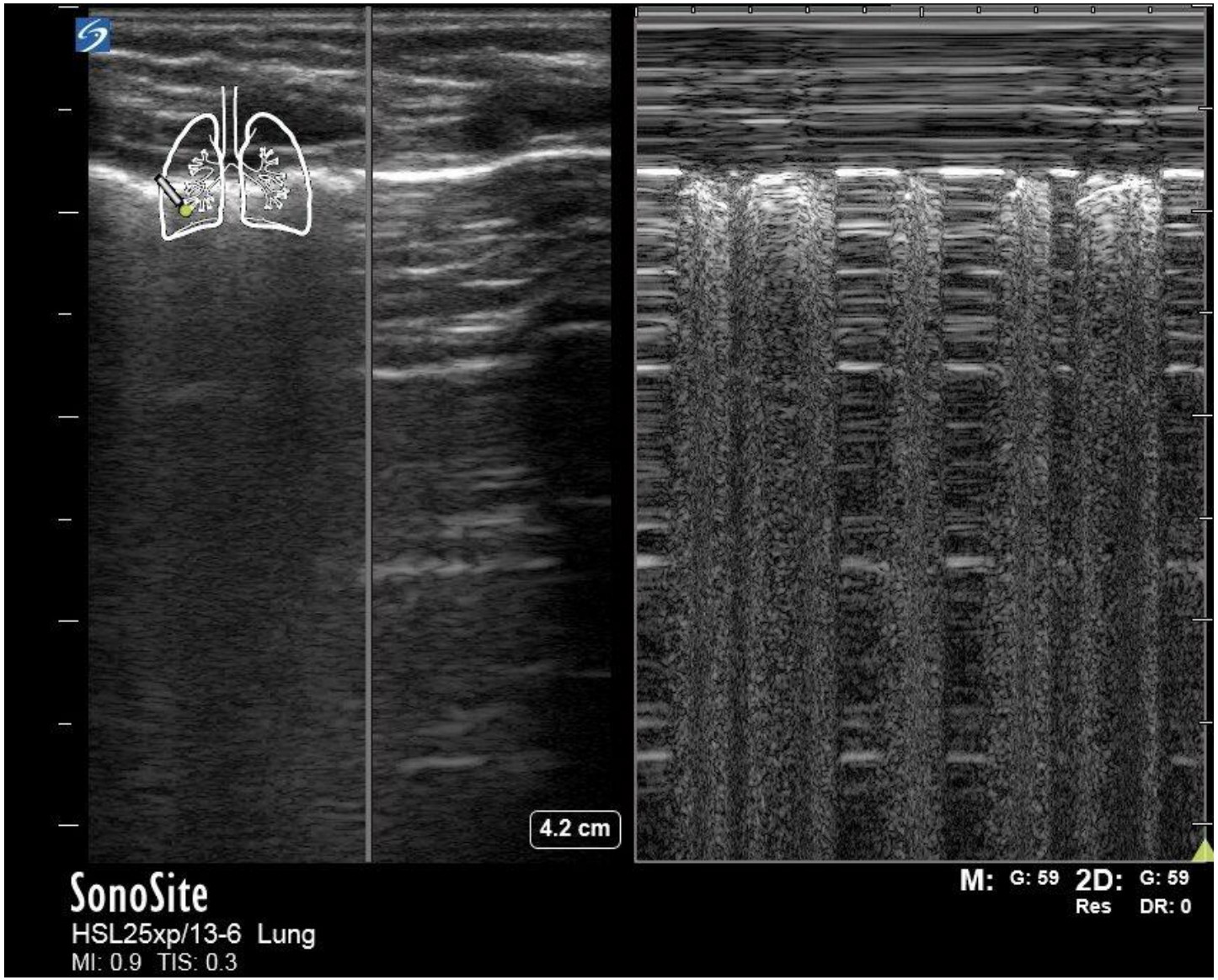
Adapté de Lichtenstein *Chest* 2008



Glissement pleural, lignes A



Absence de glissement pleural, lignes A



Point poumon

Michael Griksaitis
@MJGriksaitis

Glissement pleural, lignes B

Condensation sous pleurale, lignes B

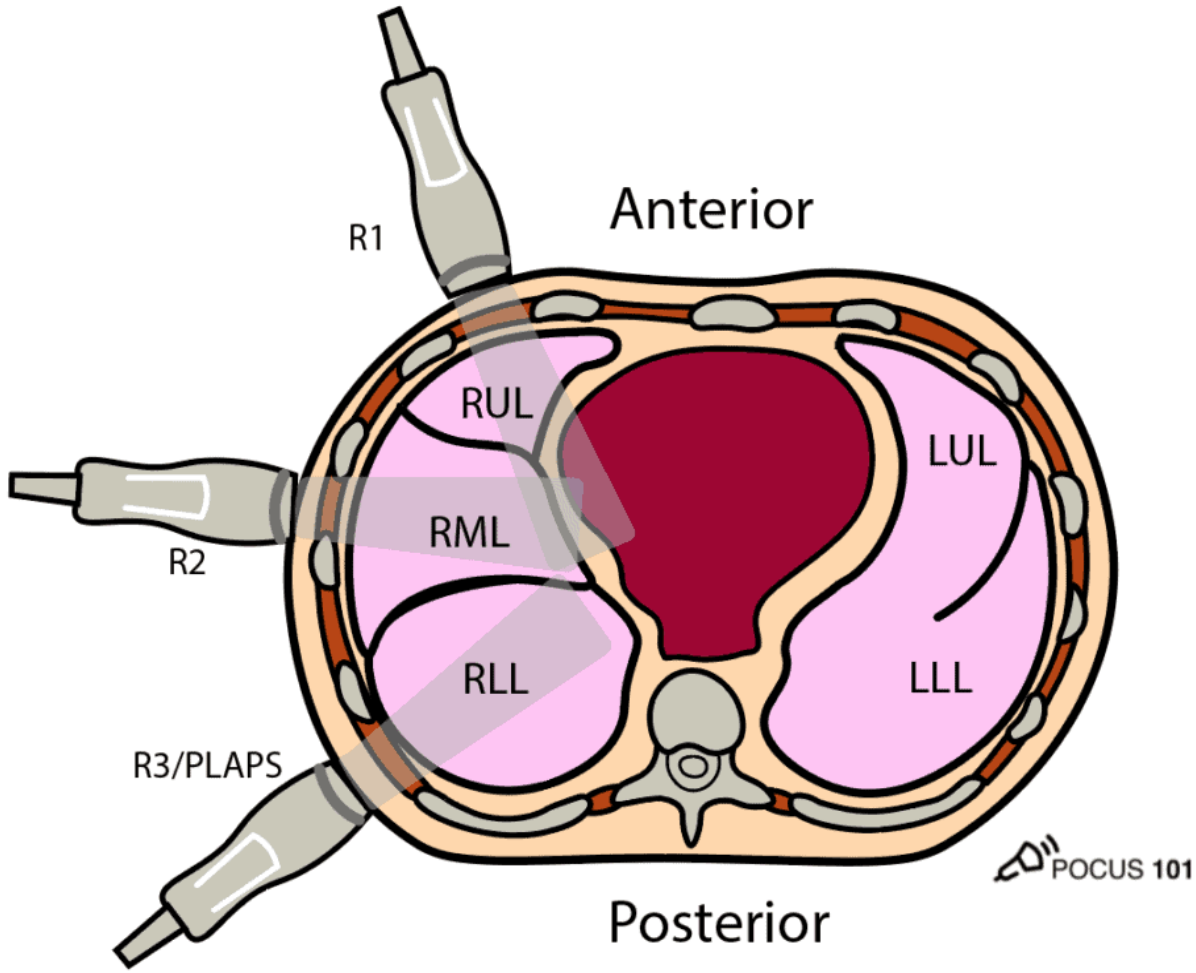

Anterior
R1
RUL
LUL
RML
R2
RLL
LLL
R3/PLAPS
POCUS 101
Posterior

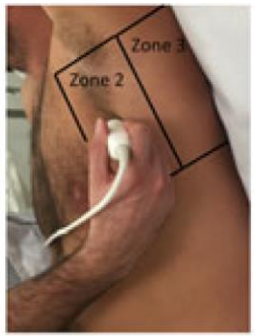
Table 1 *Accuracy of BLUE protocol*

Mechanism of dyspnoea	BLUE protocol profile	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Acute haemodynamic pulmonary oedema	B-profile	97%	95%	87%	99%
Exacerbated COPD or severe acute asthma	Nude profile (A-profile with no DVT and no PLAPS)	89%	97%	93%	95%
Pulmonary embolism	A-profile with DVT	81%	99%	94%	98%
Pneumothorax	A′-profile (with lung point)	88%	100%	100%	99%
Pneumonia	All profiles‡	89%	94%	88%	95%
	B′-profile	11%	100%	100%	70%
	A/B-profile	14.5%	100%	100%	71.5%
	C-profile	21.5%	99%	90%	73%
	A-V-PLAPS profile	42%	96%	83%	78%

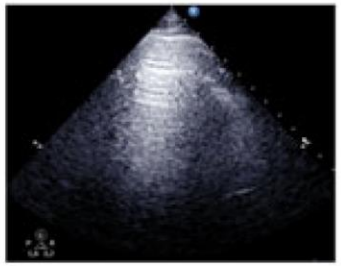
Lichtenstein, Chest, 2015

Pronostic

- Diagnostic de gravité
- Prédire le besoin de ventilation invasive
- Guider le sevrage ventilatoire



		RIGHT Lung	LEFT Lung
Anterior Chest Wall (zone 1)	UPPER		
	LOWER		
Lateral Wall (zone 2)	UPPER		
	LOWER		
Posterolateral Wall (zone 3)	UPPER		
	LOWER		
TOTAL		/ 36	

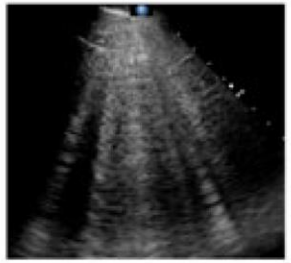


normal aeration

0

moderate damage

1



serious damage

2

pulmonary consolidation

pleural effusion

3

Markarian *CJEM* 2019

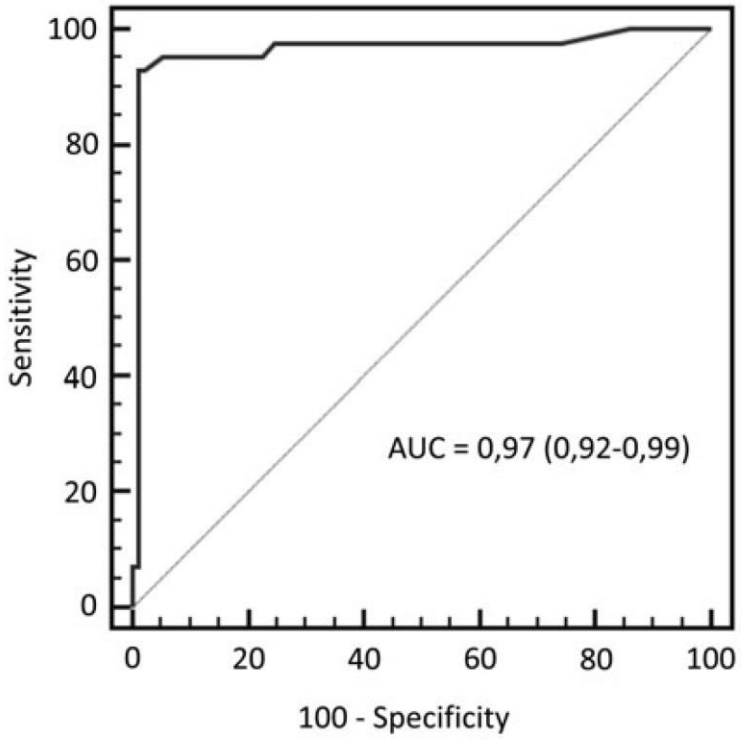


Figure 2. Receiver operating characteristic curve depicting the relationship between the modified lung ultrasound score with a cut-off set strictly above 17 and the critical care group.

Cut off

17

Se 93% [81 ; 99]

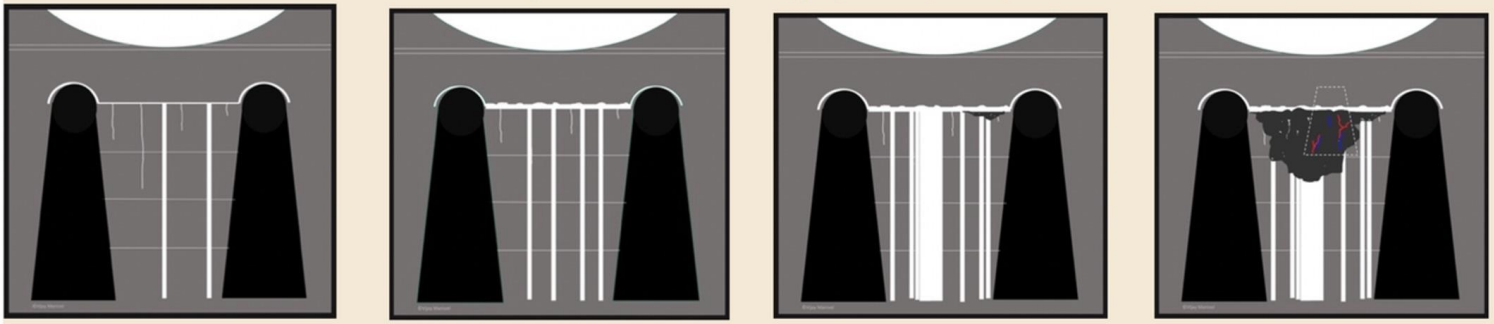
Sp 99% [94 ; 100]

Markarian *CJEM* 2019

CLUE PROTOCOL

COVID19 Lung Ultrasound in Emergency Department

Lung Ultrasound Scoring System (LUSS)



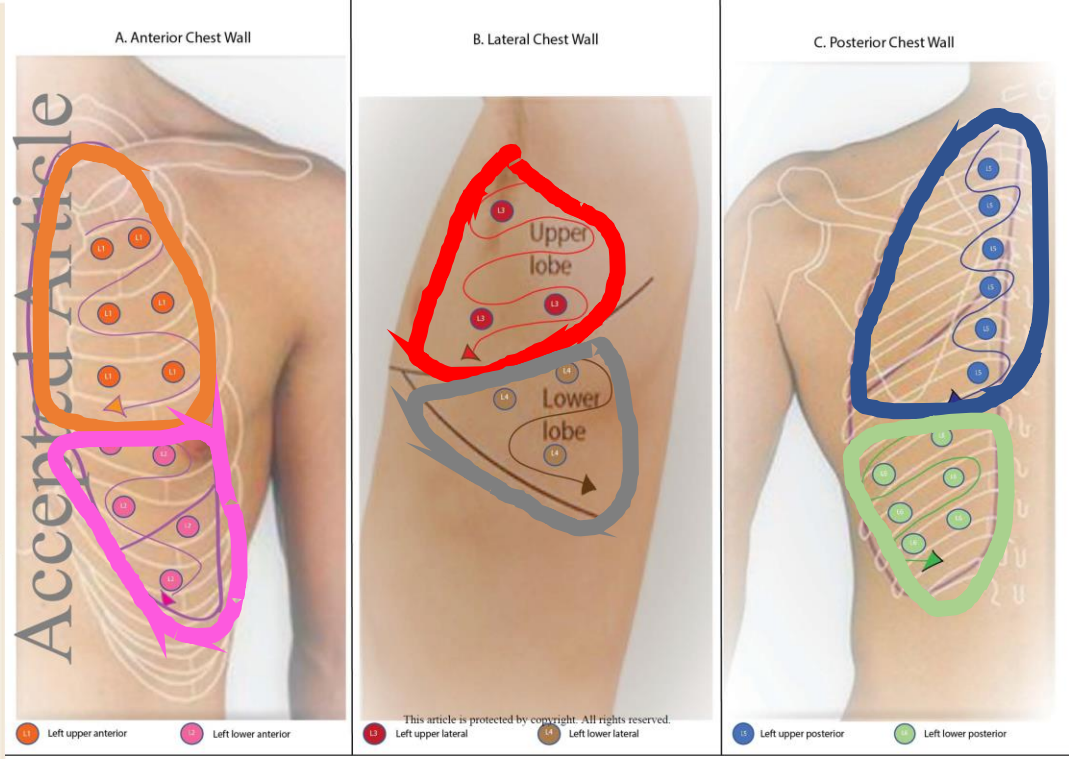
LUSS 0	LUSS 1	LUSS 2	LUSS 3
A lines, 1or2 B-lines, Smooth thin pleural line	>2 B-lines but discrete, Irregular/ thickened pleura	Confluent B-lines, subpleural consolidations (height <1cm)	Large consolidations (height >1cm) +/- air bronchogram +/- vascularity

CLUE protocol

Classification	Total LUSS Score from 12 zones	Clinician's decision to supplement oxygen?	Disposition from Emergency Department	
Normal	0	No	Home	
		Yes	Consider alternate cause & appropriate disposition	
Mild	1-5	No	Home + follow-up monitoring	
		Yes	Home with SPO_2 monitoring +/- Oxygen (or) Consider admission to ward	
Moderate	>5 - 15	No		
		Yes	Admit to Ward/ Consider ICU	
Severe	>15	No	Admit to Ward	
		Yes	Admit to ICU	

Involve Respiratory / ICU Physician

LUSS= Lung Ultrasound Scoring System, Ward = Respiratory or other appropriate ward, ICU = Intensive care unit, SPO_2 = Pulse Oximetry.



EMA Emergency Medicine Australasia

Emergency Medicine Australasia (2020) **32**, 694–696 doi: 10.1111/1742-6723.13546

PERSPECTIVE

CLUE: COVID-19 lung ultrasound in emergency department

Vijay MANIVEL,[1] Andrew LESNEWSKI,[1] Simin SHAMIM,[1] Genevieve CARBONATTO[2] and Thiru GOVINDAN[2]

Ultrasound in Med. & Biol., Vol. 46, No. 11, pp. 2938–2944, 2020

0301-5629/$ - see front matter

Intensive Care Med
https://doi.org/10.1007/s00134-020-06212-1

ORIGINAL

Lung ultrasound predicts clinical course and outcomes in COVID-19 patients

Yael Lichter[1], Yan Topilsky[1], Philippe Taieb[1], Ariel Banai[1], Aviram Hochstadt[1], Ilan Merdler[1], Amir Gal Oz[1], Jacob Vine[1], Or Goren[1], Barak Cohen[1], Orly Sapir[1], Yoav Granot[1], Tomer Mann[1], Shirley Friedman[1], Yoel Angel[1], Nimrod Adi[1], Michal Laufer-Perl[1], Merav Ingbir[1], Yaron Arbel[1], Idit Matot[1] and Yishay Szekely[1,2*]

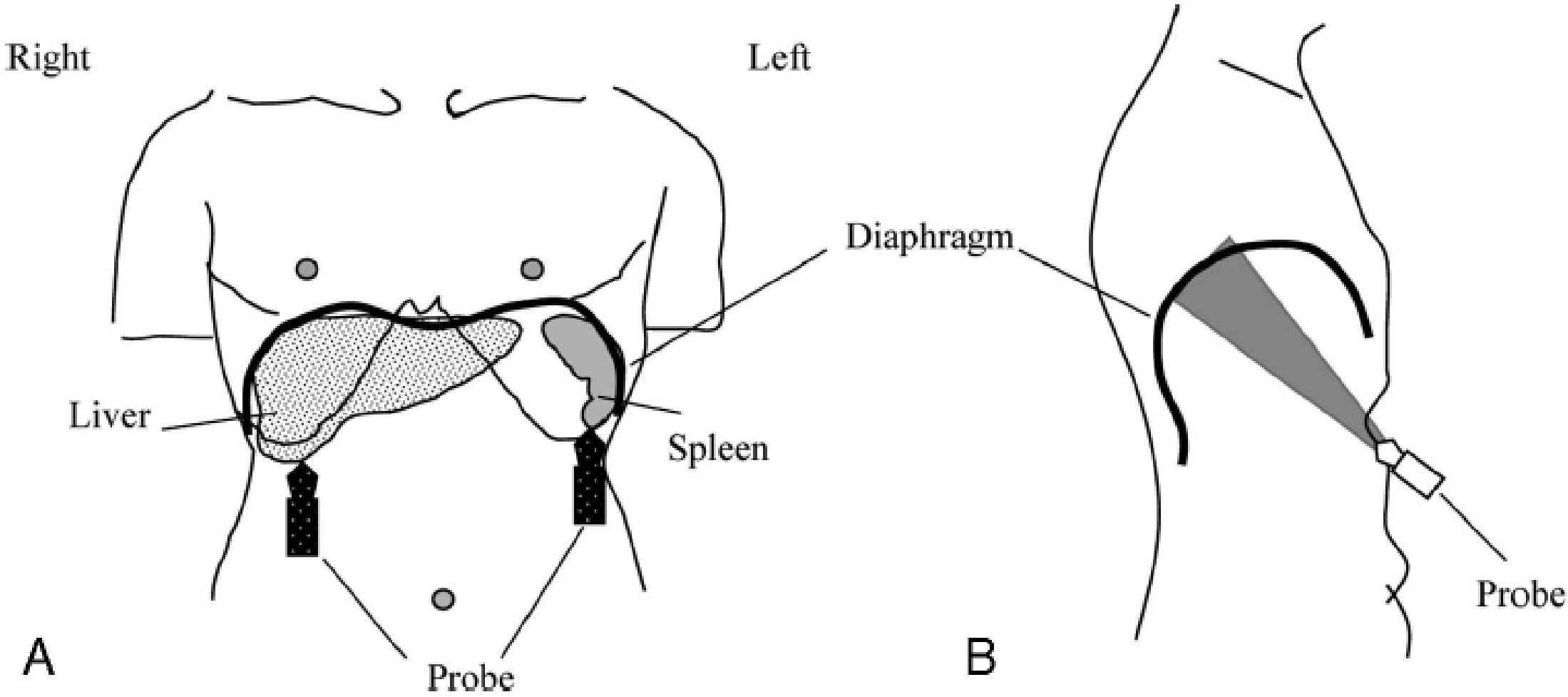
LINA ZHAO,*,2 KANGLO... GUO...

* Department of Emergency and Critical Care, Sh...
† Department of Respiratory and Critical Care, Shang...

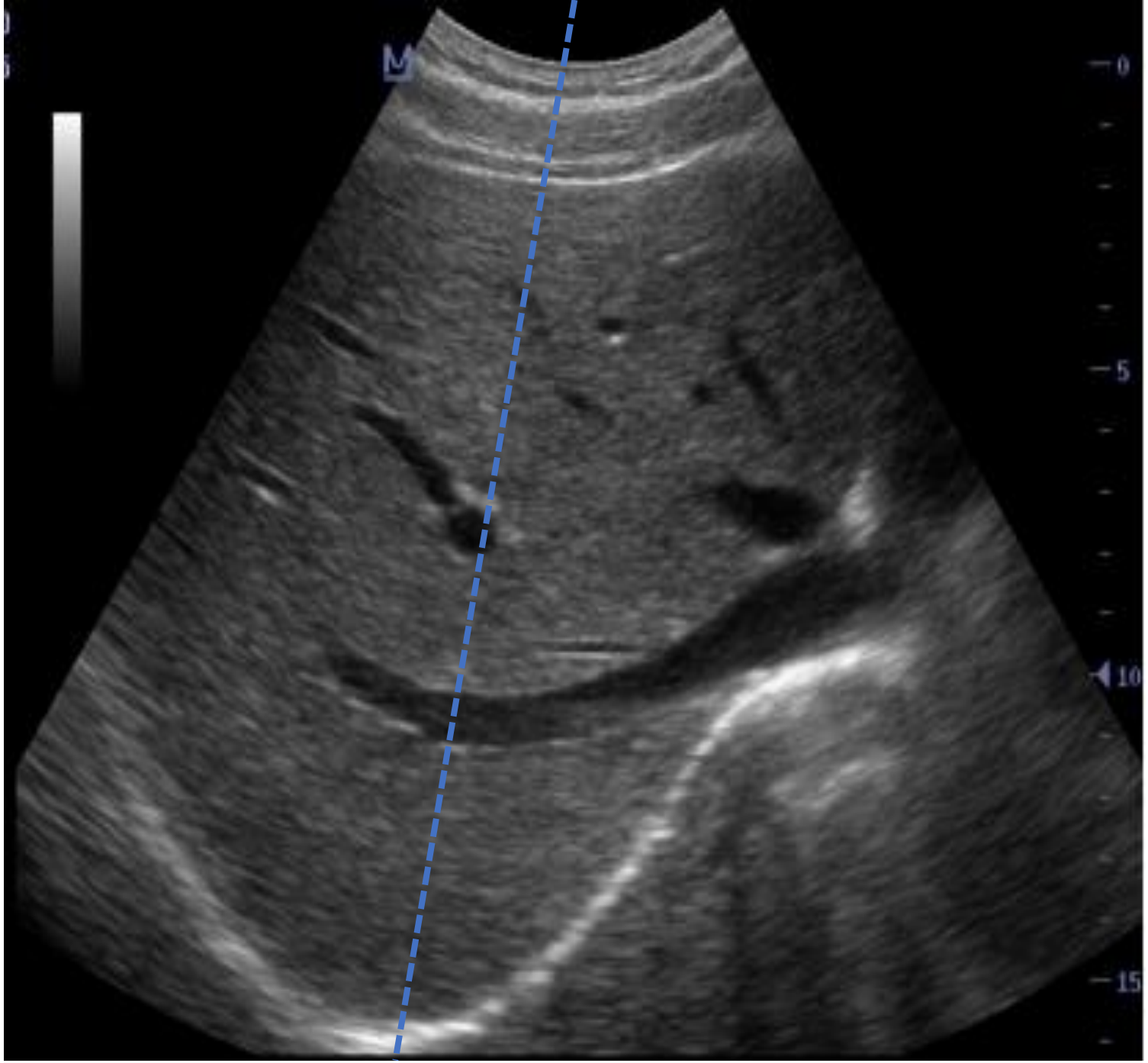
...this mean?]. It ...ted and so should not be used to

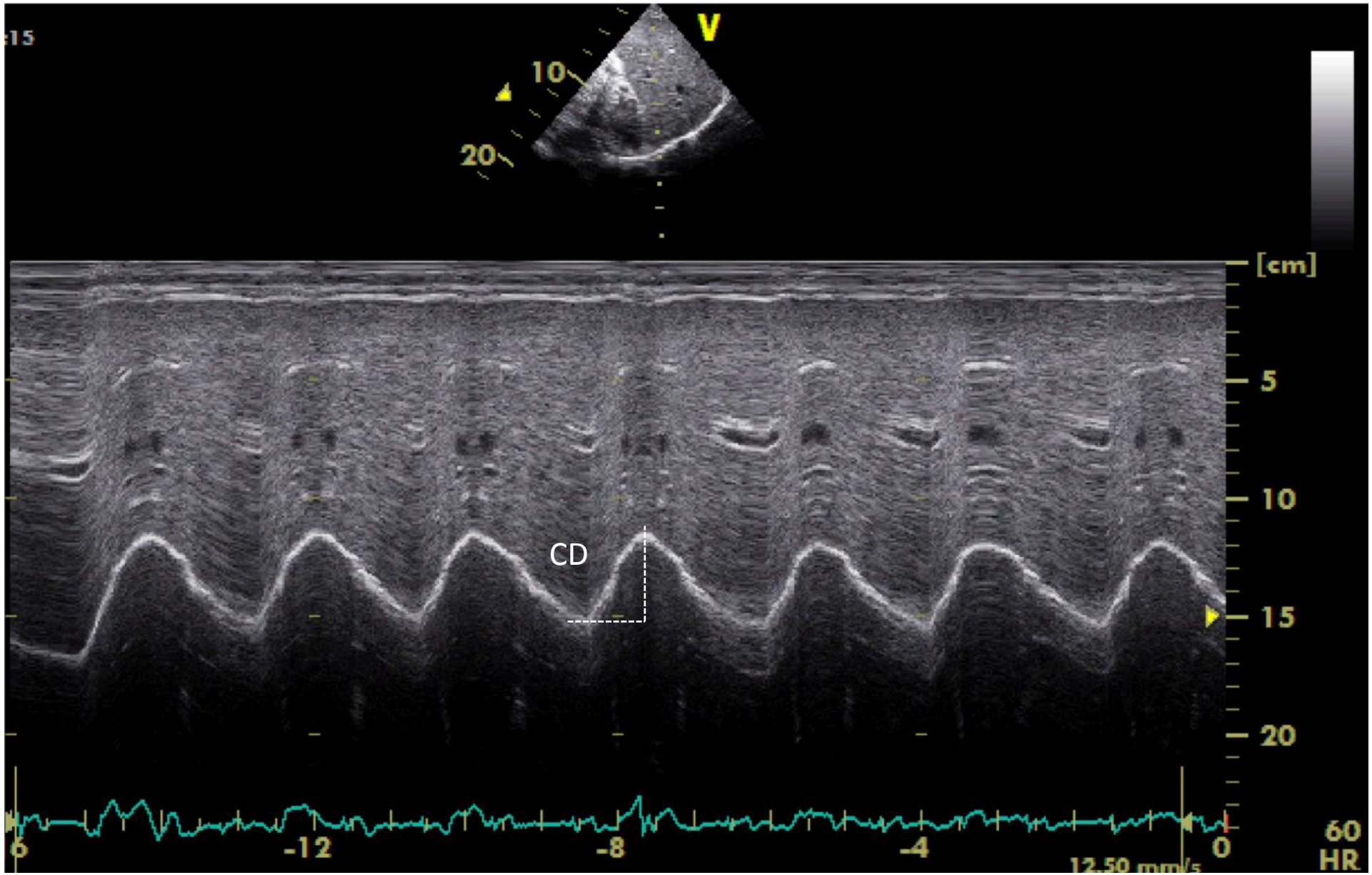
Echo diaphragmatique

- En situation d'urgence, pas de place claire dans la pratique courante, plutôt recherche pour le moment, recherche de l'épuisement respiratoire
- Prédire échec NIV et besoin en IOT
- Guider l'extubation
- Diagnostic de paralysie diaphragmatique



Boussuges *Chest* 2009

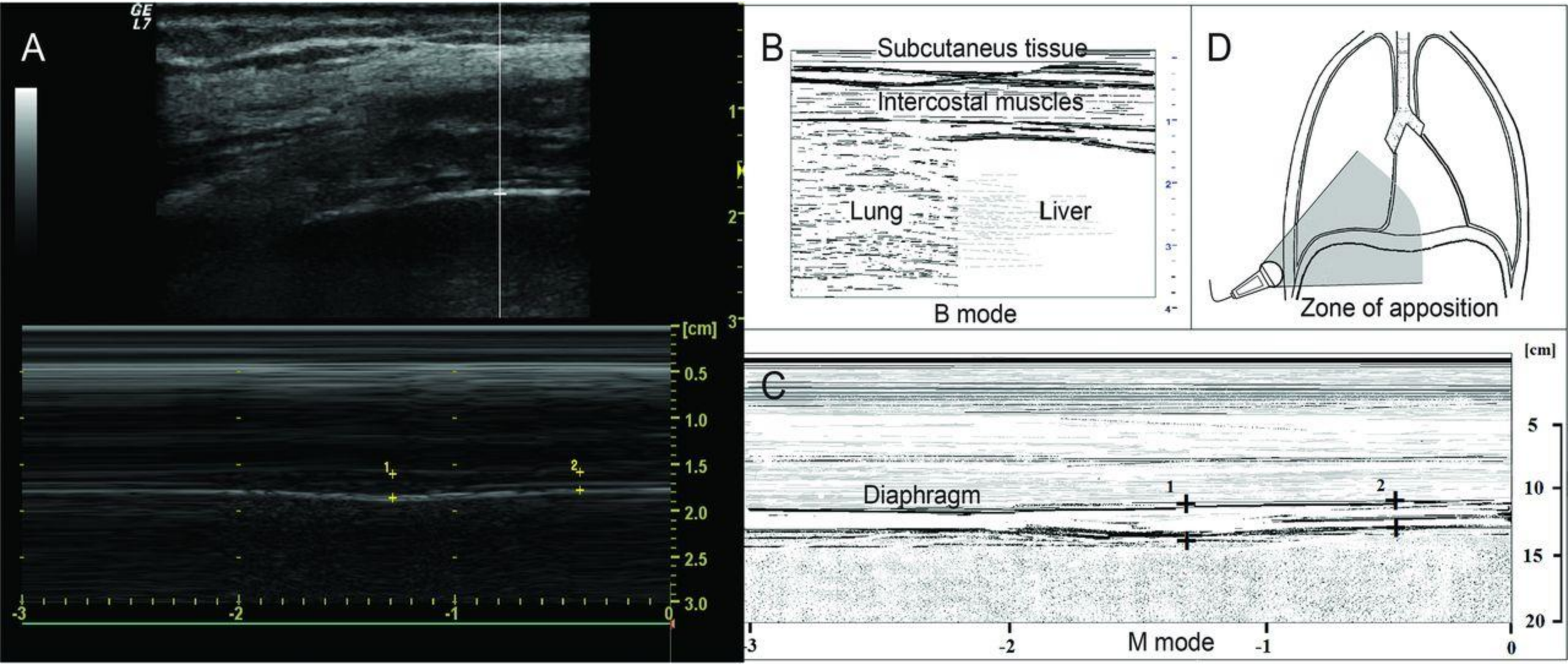

0
5
10
15


V
10
20
[cm]
5
10
15
20
CD
-12
-8
-4
0
60
HR

24 patients en détresse respiratoire aigue

	Droite	Gauche
Faisabilité	96%	67%
Variabilité intra observateur	0,89 (0,81 ; 0,94)	0,90 (0,82 ; 0,95)
Variabilité inter observateur	0,80 (0,59 ; 0,91)	0,59 (0,19 ; 0,82)

Bobbia *Am J Emerg Med* 2016



Umbrello and Formenti *Respiratory Care* 2016

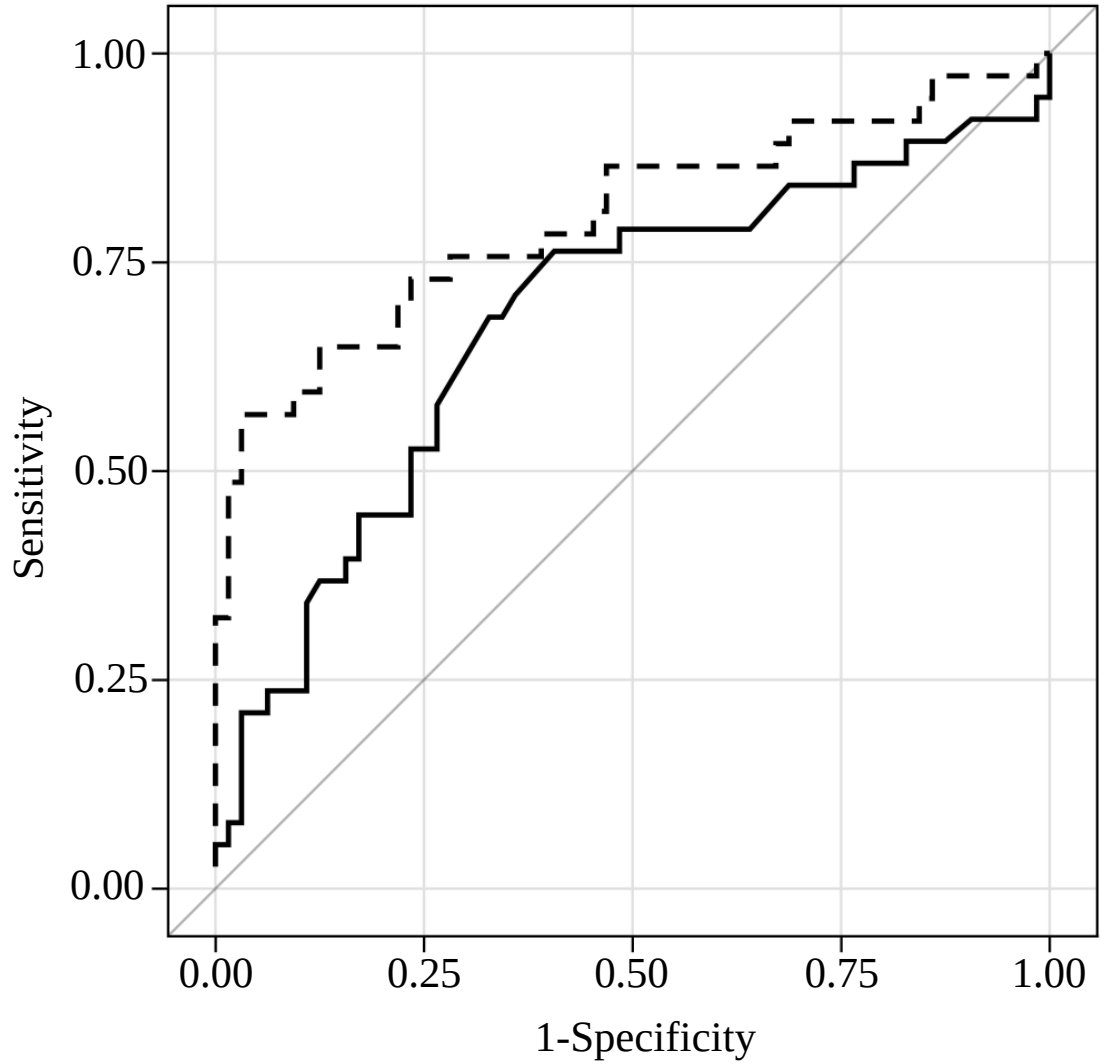
Echo diaphragmatique

- 3 meta analyses récentes
  - Prédiction d'échec de sevrage ventilatoire
  - Sensibilité 75-85% et spécificité 75 % pour les deux indicateurs

Llamas-Alvarez AM, Tenza-Lozano EM, Latour-Perez J. Diaphragm and lung ultrasound to predict weaning outcome: systematic review and meta-analysis. *Chest* 2017

Zambon M, Greco M, Bocchino S, *et al*. Assessment of diaphragmatic dysfunction in the critically ill patient with ultrasound: a systematic review. *Intensive Care Med* 2017

Qian Z, Yang M, Li L, Chen Y. Ultrasound assessment of diaphragmatic dysfunction as a predictor of weaning outcome from mechanical ventilation: a systematic review and meta-analysis. *BMJ Open* 2018



103 patients en détresse respiratoire aigue
37% ventilés à H4

Cut Off 2 cm

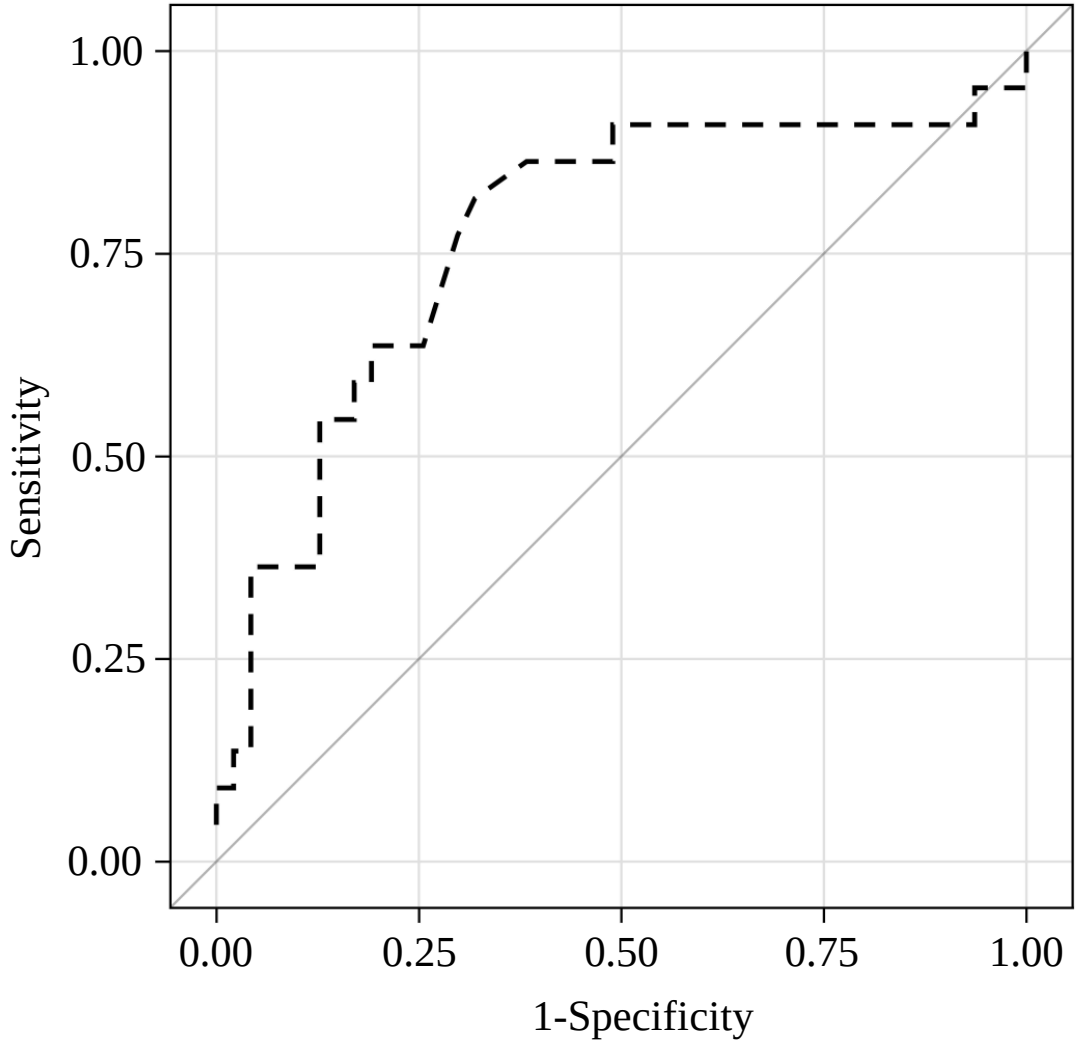
Se 76% [60% ; 89%]

Sp 59% [46% ; 71%]

VPN 81% [67% ; 91%]

VPP 53% [39% ; 66%]

Clement *American Journal of Emergency Medicine* 2020



Non BPCO

Cut Off 2,18 cm

Se 91% [71% ; 99%]

Sp 51% [36% ; 66%]

VPN 92% [75% ; 99%]

VPP 54% [38% ; 69%]

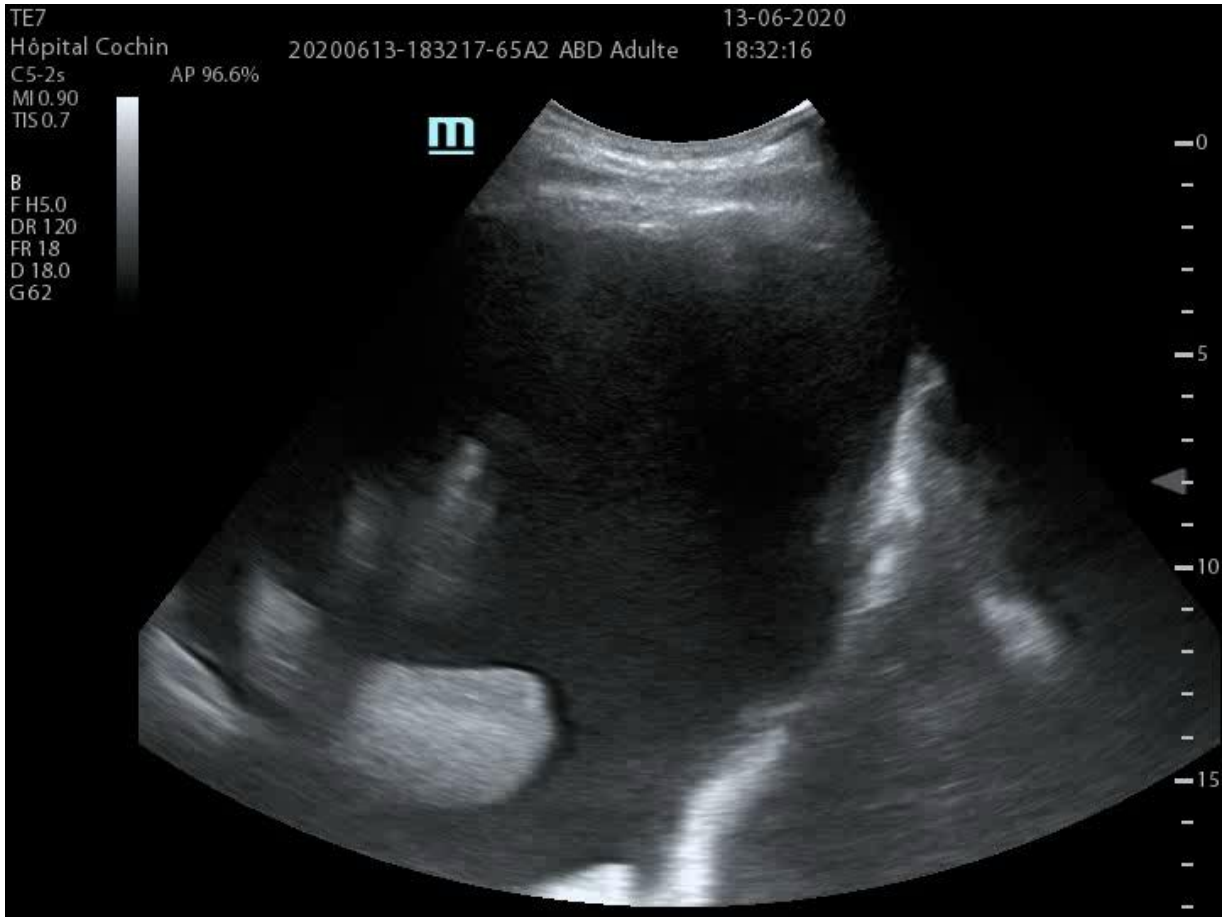
Clement *American Journal of Emergency Medicine* 2020

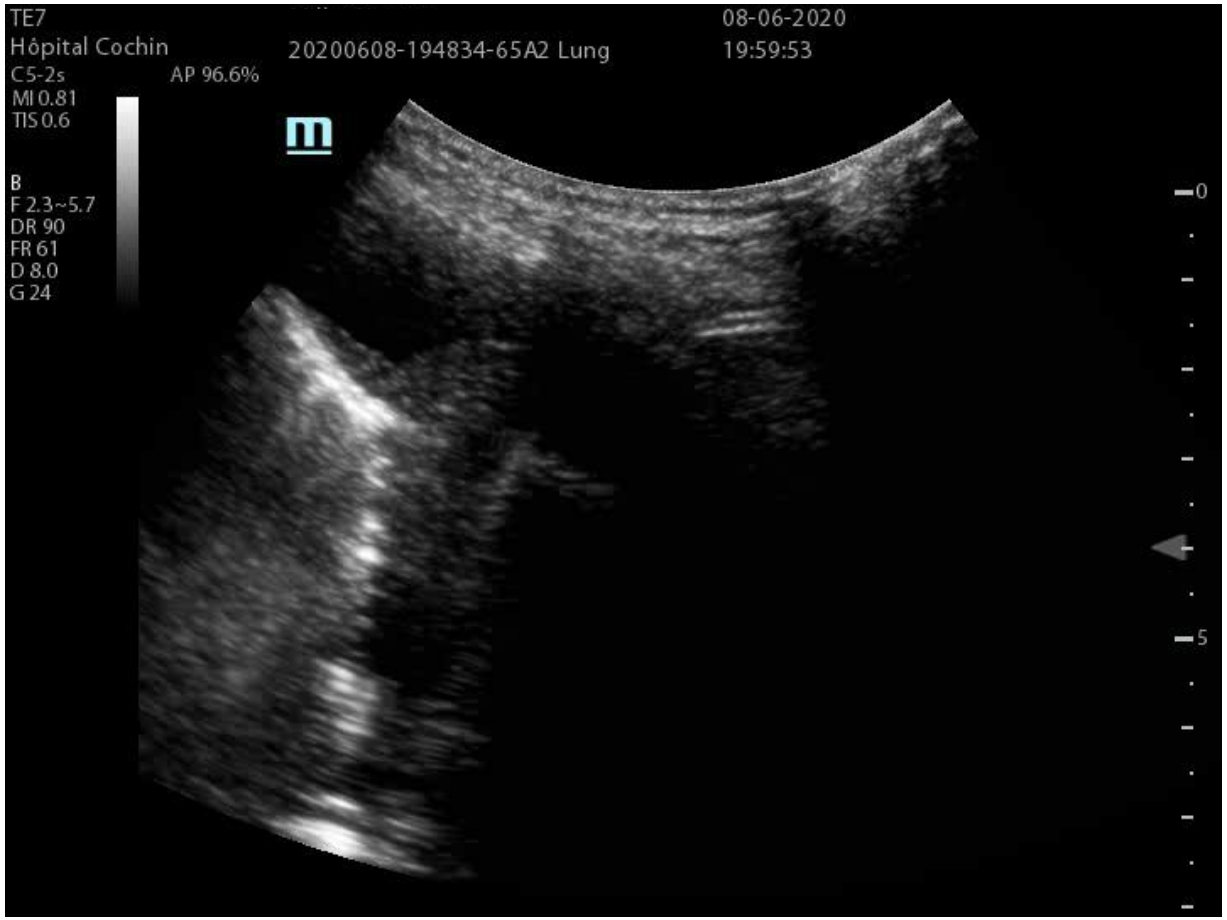
Echo diaphragmatique

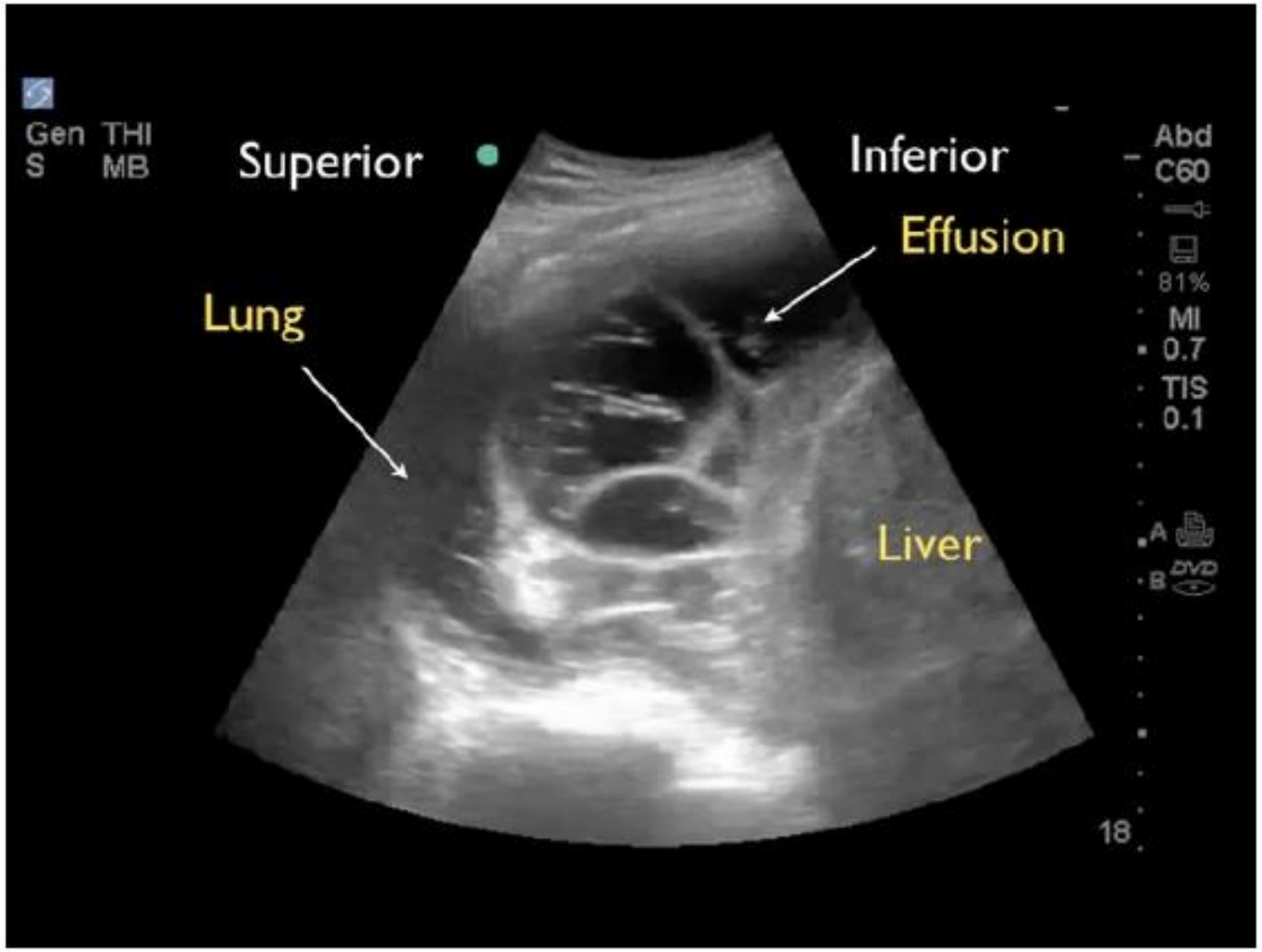
- Reproductibilité acceptable surtout à droite
- Utilisable pour le guidage du sevrage ventilatoire
- Pas de place en urgence pour le moment
- Techniques encore expérimentales
- Intérêt pour qualifier la dysfonction diaphragmatique dans d'autres pathologies ? (paralysie diaphragmatique …)

Procédurale

- Echo Guidage
- Echo repérage
- Principalement ponction ou drainage d’épanchement liquidien, rend la ponction d’épanchement de petite taille cloisonné réalisable
- Améliore précision et diminution effets secondaires


TE7
Hôpital Cochin
C5-2s
AP 96.6%
MI 0.90
TIS 0.7
B
F H5.0
DR 120
FR 18
D 18.0
G62
20200613-183217-65A2 ABD Adulte
13-06-2020
18:32:16
0
5
10
15


TE7
Hôpital Cochin
C5-2s
AP 96.6%
MI 0.81
TIS 0.6
B
F 2.3~5.7
DR 90
FR 61
D 8.0
G 24
20200608-194834-65A2 Lung
08-06-2020
19:59:53
0
5



Sikora *ISNR emergency medecine* 2012

Procédurale

- Succès proche de 100%
- Moins de complications (ponction artérielle, pneumothorax, hématome, infections)
- Plus de confort pour le patient et l'opérateur
- **Plus rapide !!!**