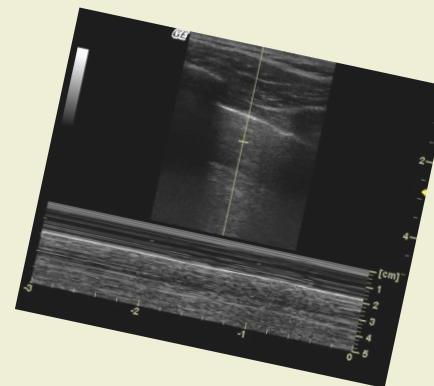


Syndromes interstitiels

TUSAR région Ouest
Tours, 16 décembre 2025



Pr F. Remérand
Anesthésie-Réanimation 2
C.H.R.U. de Tours, hôpital Trousseau
francis.remerand@univ-tours.fr



Pas de conflit d'intérêt.

Recommandations et échographie pleuropulmonaire

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

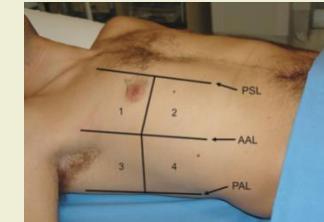
CONFERENCE REPORTS AND EXPERT PANEL

2012

Giovanni Volpicelli
Mahmoud Elbarbary
Michael Blaivas
Daniel A. Lichtenstein
Gebhard Mathis
Andrew W. Kirkpatrick

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

RP < écho (ligne B >> QDC) = TDM



European Heart Journal (2016) 37, 2129–2200
doi:10.1093/eurheartj/ehw128

Clinique bio RP et écho



2016 ESC Guidelines for the diagnosis and
treatment of acute and chronic heart failure



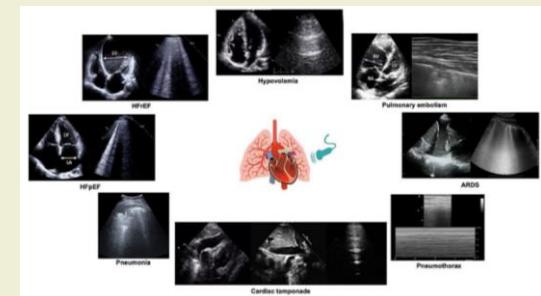
ESC

European Society
of Cardiology

European Heart Journal - Cardiovascular Imaging (2023) 24, 1569–1582
<https://doi.org/10.1093/ehjci/jead169>

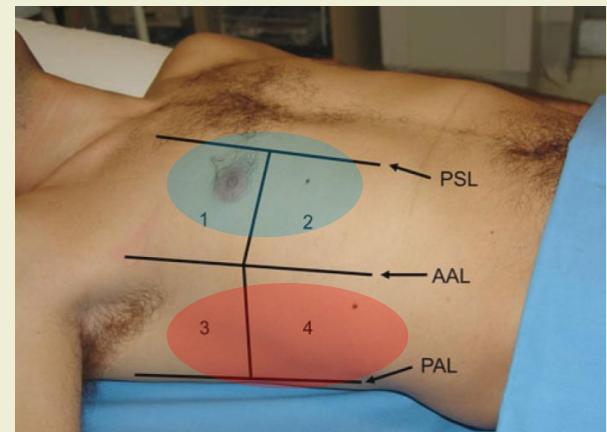
EACVI DOCUMENT

Lung ultrasound in acute and chronic heart
failure: a clinical consensus statement of the
European Association of Cardiovascular Imaging
(EACVI)



Plan

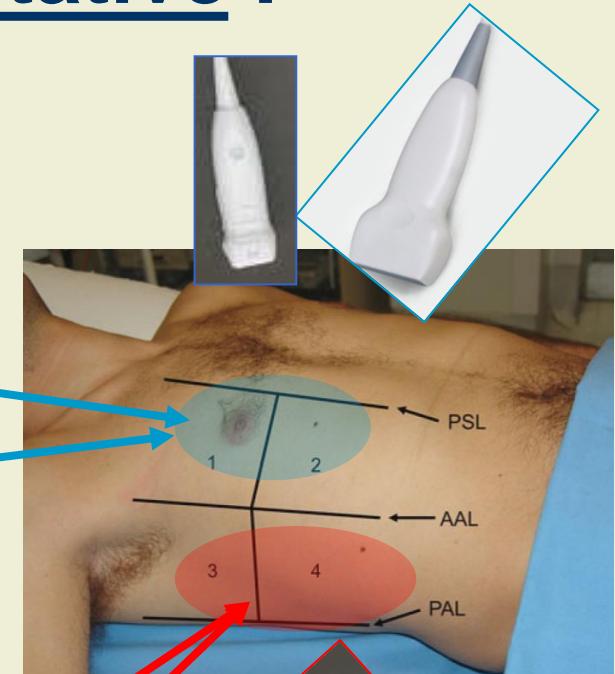
Sémiologie qualitative



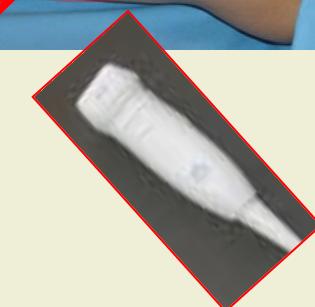
Sémiologie quantitative

Sémiologie qualitative :

- Pneumothorax
 - Syndrome interstitiel
- = analyse des artefacts



- Condensation pulmonaire
 - Épanchement liquidien
- = imagerie « anatomique »



Historique

- Première description artefact en queue de comète... intrahépatique !

J Ultrasound Med. 1982 Jan-Feb;1(1):1-7.

The comet tail artifact.

Ziskin MC¹, Thickman DI, Goldenberg NJ, Lapayowker MS, Becker JM.

- Description du syndrome alvéolo-interstitiel échographique

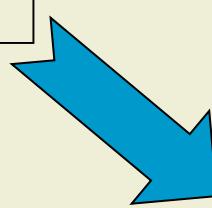
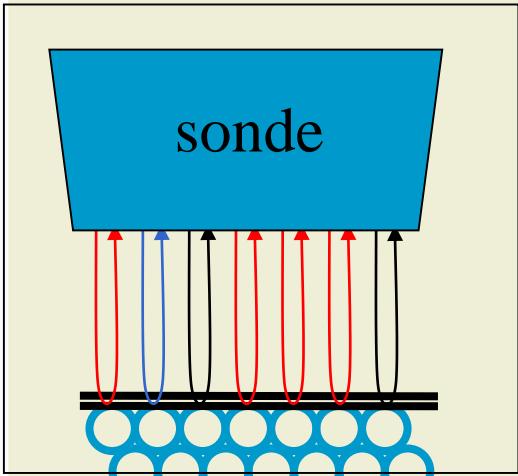
Am J Respir Crit Care Med. 1997 Nov;156(5):1640-6.

The comet-tail artifact. An ultrasound sign of alveolar-interstitial syndrome.

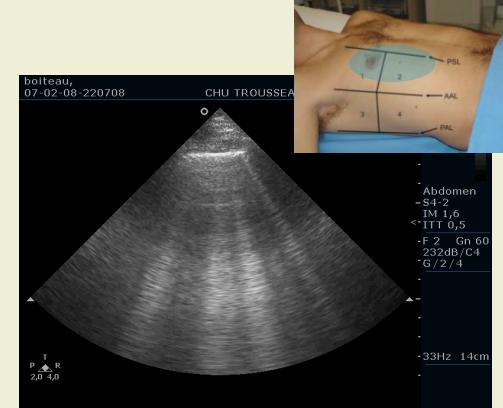
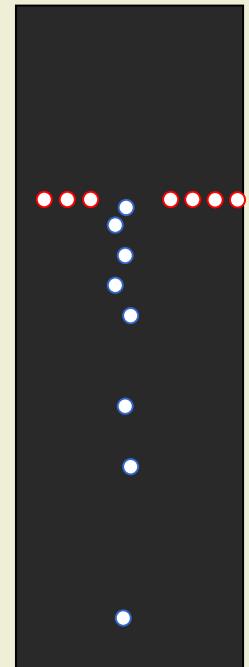
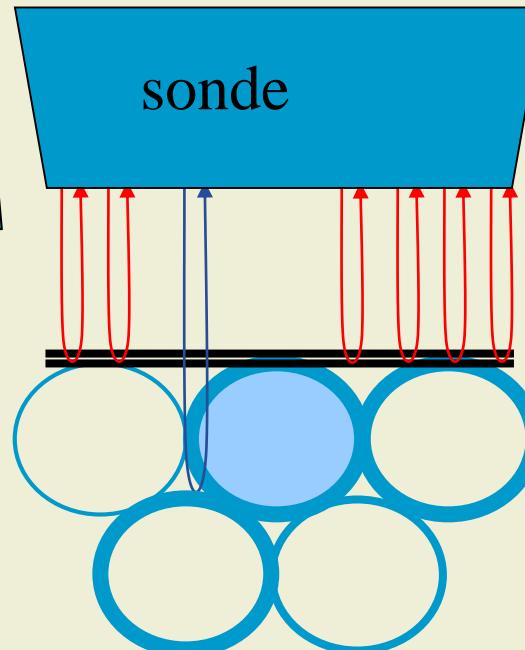
Lichtenstein D¹, Mézière G, Biderman P, Gepner A, Barré O.

Historique

« Queues de Comètes »

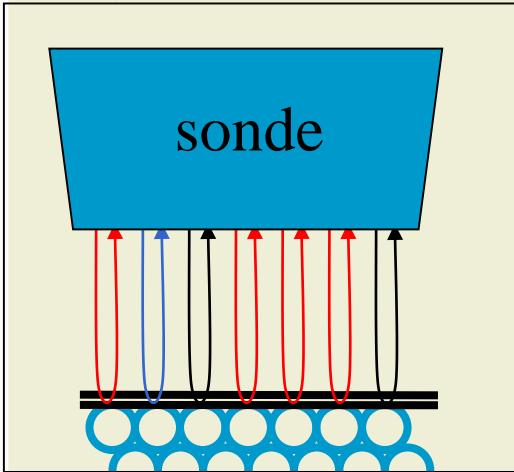


Formation de l'image :
Septas visibles (7 mm...) ?

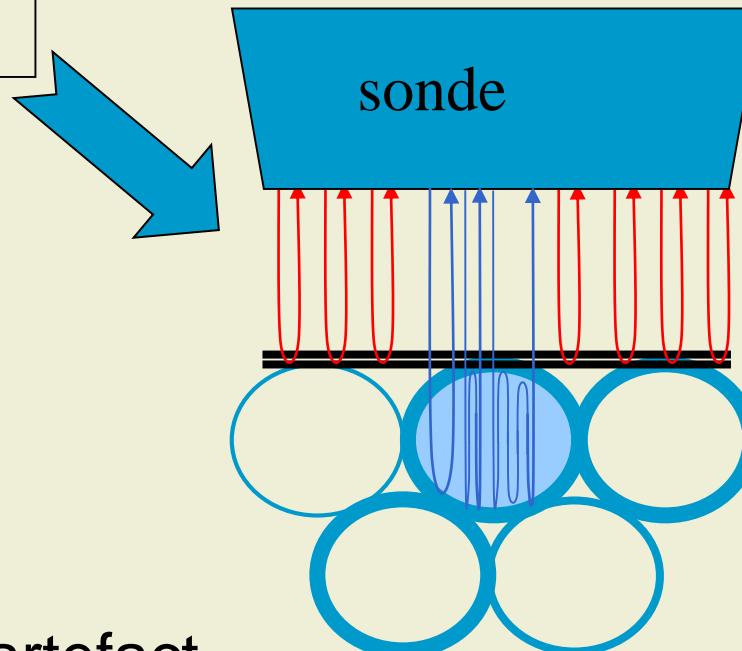


Actuellement :

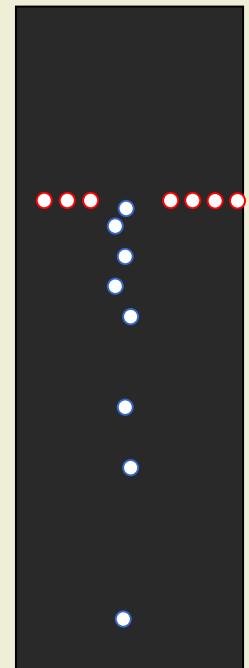
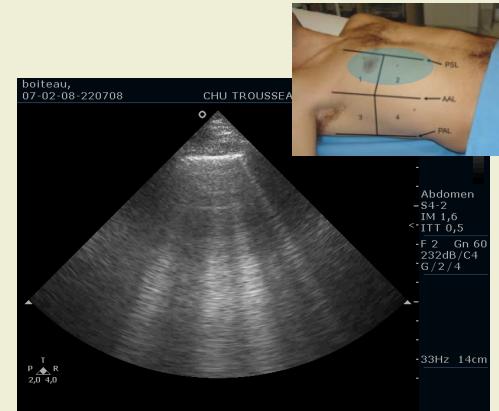
« Queues de Comètes » = « lignes B »



Formation de l'image :
Artefact de réverbération



+/- Ring down artefact

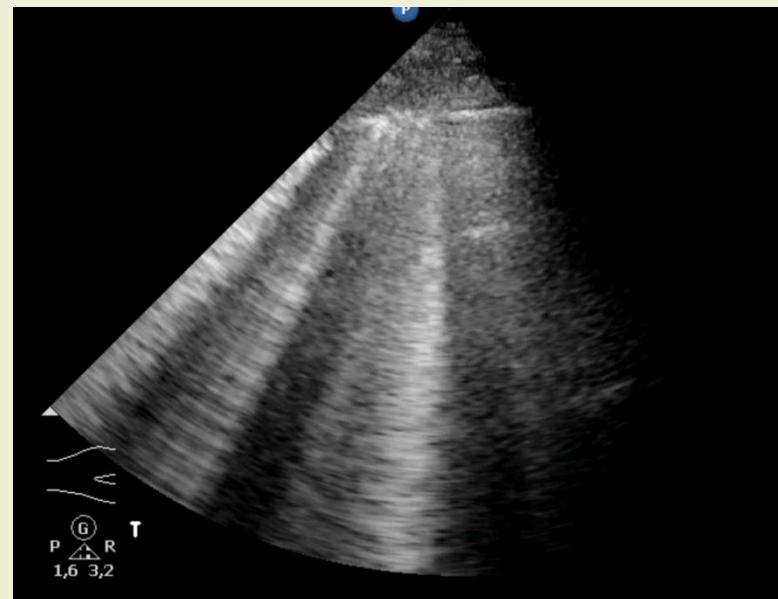


Ligne B

= artefact de type queue de comète, en échographie pleuropulmonaire, avec

7 caractéristiques :

- nait de la plèvre
- Vertical (ou axe des US)
- hyperéchogène
- bien défini
- traverse l'écran
- efface les lignes A
- suit le glissement pleural

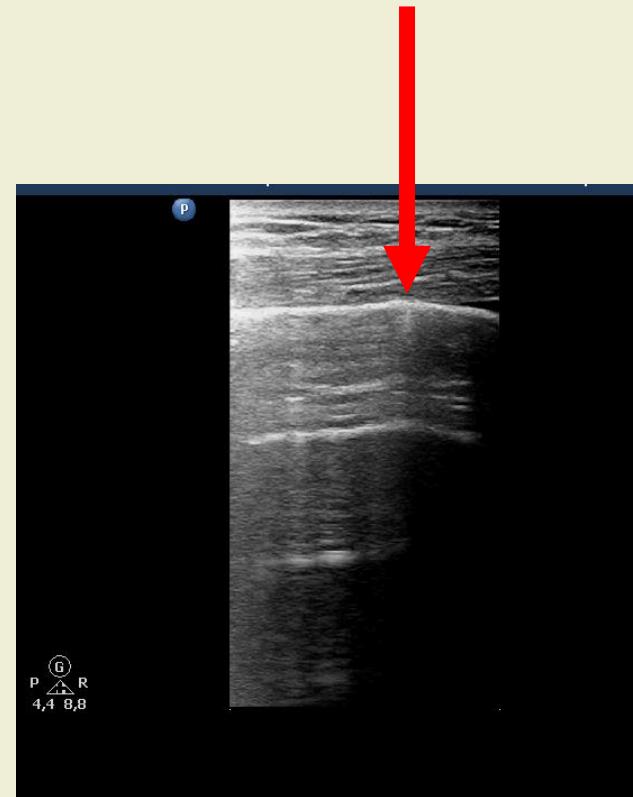


À analyser seulement en antérieur (= en zone non déclive +++)

Ligne Z

7 caractéristiques :

- naît de la plèvre
- verticale (dans l'axe des US)
- hyperéchogène
- **Plus ou moins bien** définie
- **Ne traverse pas** l'écran
- **N'efface pas** les lignes A
- suit le glissement pleural



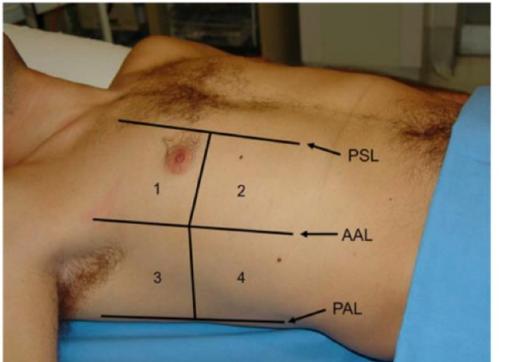
Surtout avec sondes linéaires > abdo >> cardio

sd interstitiel localisé

- Au moins 3 lignes B par scan gd axe
- Au moins 2 scan du même coté ?
- Scan positifs uni ou bilatéraux



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



P-D2-S2 (strong: level B)

- Regarding B-lines, focal multiple B-lines may be present in a normal lung, and a focal (localized) sonographic pattern of interstitial syndrome may be seen in the presence of any of the following:
 - Pneumonia and pneumonitis de ville >> PAVM
 - Atelectasis déclives +++
 - Pulmonary contusion
 - Pulmonary infarction en ville >> hopital
 - Pleural disease en médecine >> soins critiques
 - Neoplasia

définition du sd interstitiel

(examen à 8 régions antérieures latérales ou 2 anterieures)

B-D2-S2 (strong: level A)

- In the evaluation of interstitial syndrome, the sonographic technique ideally consists of scanning eight regions, but two other methods have been described:
 - A more rapid anterior two-region scan may be sufficient in some cases.
 - The evaluation of 28 rib interspaces is an alternative.

- Au moins 3 lignes B par scan gd axe
- Au moins 2 scan du même coté
- Scans positifs bilatéraux
- Sensibilité 86%, spécificité 98%



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

Volpicelli et al, ICM 2012

Gargani et al, EHJ 2023

Sensibilité diagnostique

- Echo > RP dans le **SDRA**

Table 1. Sensitivity and Specificity of Auscultation, Chest Radiography, and Lung Ultrasonography for Diagnosing Pleural Effusion, Alveolar Consolidation, and Alveolar-Interstitial Syndrome in 384 Lung Regions in 32 Critically Ill Patients with ARDS

	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 et al, Anesthesiology 2004



Sensibilité/spécificité comparées au TDM en traumatologie

Contusion pulmonaire = sd interstitiel (pas condensation !!!)

Table 2 Sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy of CXR and lung ultrasound (LU) compared to CT scan for each abnormality and for each hemithorax

Pathology	LU/CXR	CT +	CT -	Sensitivity (%) ^a	Specificity (%) ^b	PPV (%) ^c	NPV (%) ^d	DA (%) ^e
Consolidation	LU +	66	4	100	78	94	100	95
	LU -	0	14					
	CXR +	25	2	38	89	93	28	49
	CXR -	41	16					
Pneumothorax	LU +	6	5	75	93	55	97	92
	LU -	2	71					
	CXR +	0	1	0	99	0	90	89
	CXR -	8	75					
Pleural effusion	LU +	63	0	100	100	100	100	100
	LU -	0	21					
	CXR +	41	4	65	81	91	44	69
	CXR -	22	17					
Interstitial syndrome	LU +	51	2	94	93	96	90	94
	LU -	3	28					
	CXR +	25	6	46	80	81	45	58
	CXR -	29	24					

Each hemithorax was characterized as positive (+) or negative (-) for the abnormality by the presence or absence of a single positive region, respectively

TP true positive, TN true negative, FP false positive, FN false negative

^a Sensitivity = $[TP/(TP + FN)] \times 100$

^b Specificity = $[TN/(TN + FP)] \times 100$

^c Positive predictive value (PPV) = $[TP/(TP + FP)] \times 100$

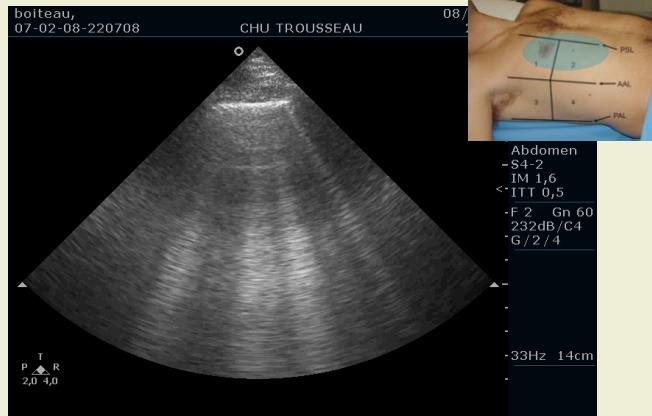
^d Negative predictive value (NPV) = $[TN/(TN + FN)] \times 100$

^e Diagnostic accuracy (DA) = $[(TP + TN)/(TP + TN + FP + FN)] \times 100$

Xirouchaki et al, ICM 2011

Les syndromes interstitiels

Différencier OAP
et SDRA / contusion +++



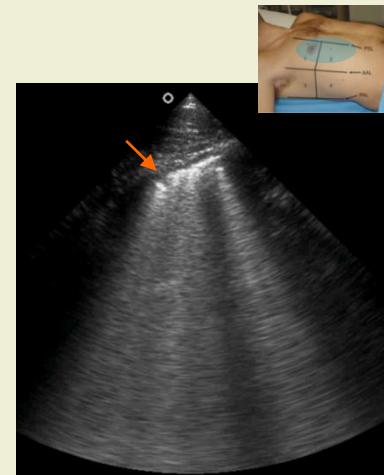
Œdème cardiogénique :

>3 QDC fines, diffuses, homogènes, antérieures

ALI ou SDRA ou contusion pulmonaire

= idem MAIS non fines, avec

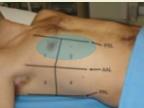
- alternance de zones avec ou sans QDC
- des zones avec glissement pleural réduit ou nul
- aspect en motte de certaines QDC
- zones de condensation associées



Copetti *Cardiovasc Ultrasound* 2008

Les syndromes interstitiels

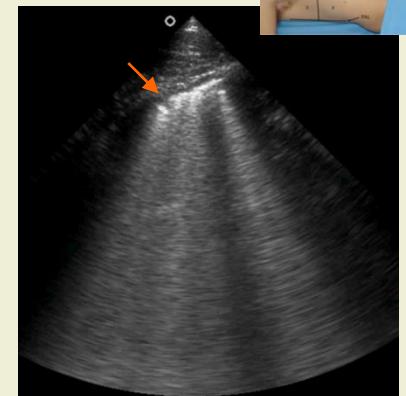
Différencier OAP et SDRA et contusion... et fibrose ?



ALI ou SDRA ou contusion pulm

= idem MAIS non fines, avec

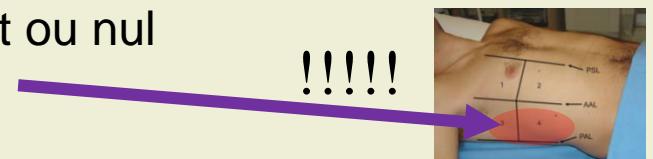
- alternance de zones avec ou sans QDC
- des zones avec glissement pleural réduit ou nul
- aspect en motte de certaines QDC
- zones de condensation associées



Copetti *Cardiovasc Ultrasound* 2008

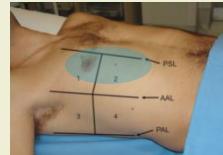
Fibrose pulmonaire = QDC postérieures >> antérieures

- Avec épaississement pleural irrégulier > 3 mm
- Avec des zones avec glissement pleural réduit ou nul
- Avec aspect de kystes sous pleuraux
- Sans zone de condensation



Sperandeo *Ultrasound Med Biol* 2009

Les syndromes interstitiels

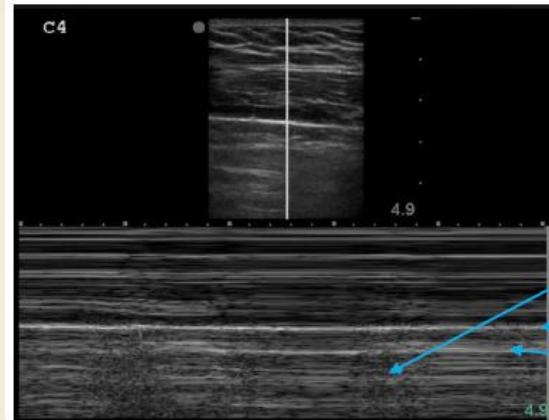


Différencier OAP et SDRA +++
En mode TM

Normal :

ligne pleurale continue,
motifs sous pleuraux « horizontaux »

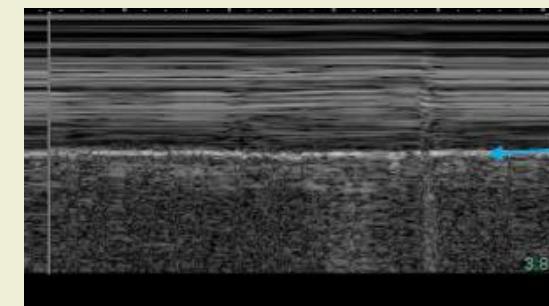
N=14



Œdème cardiogénique :

ligne pleurale continue,
motifs sous pleuraux « verticaux »

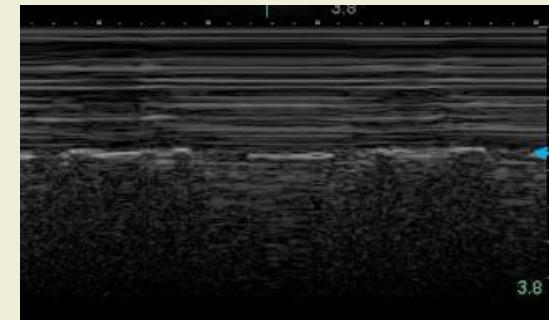
N=12



ALI ou SDRA =

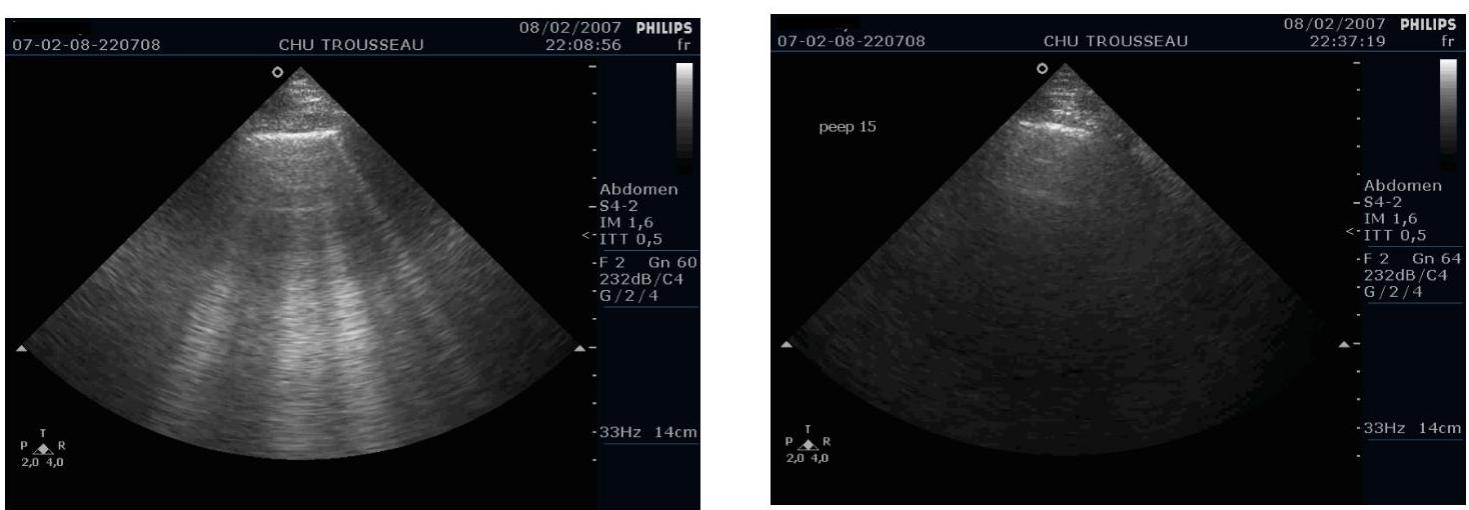
ligne pleurale discontinue,
motifs sous pleuraux « verticaux »

N=17



- 3 pièges :

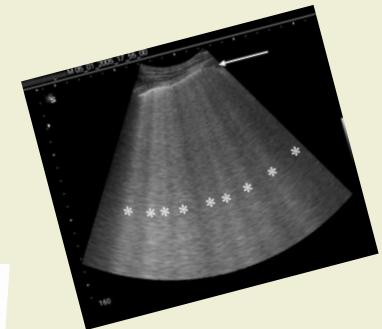
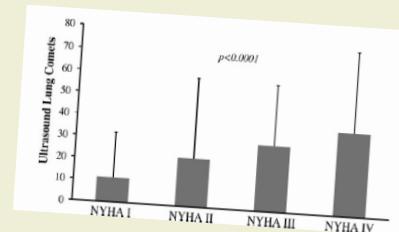
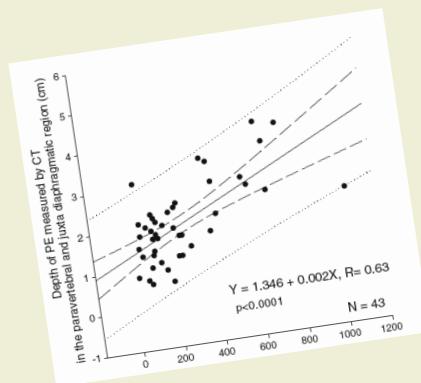
1- Pressions respiratoires : ZEEP vs PEEP 15



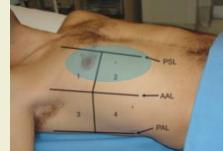
2- Lignes B post déclives = anodin !

3- Lignes Z...

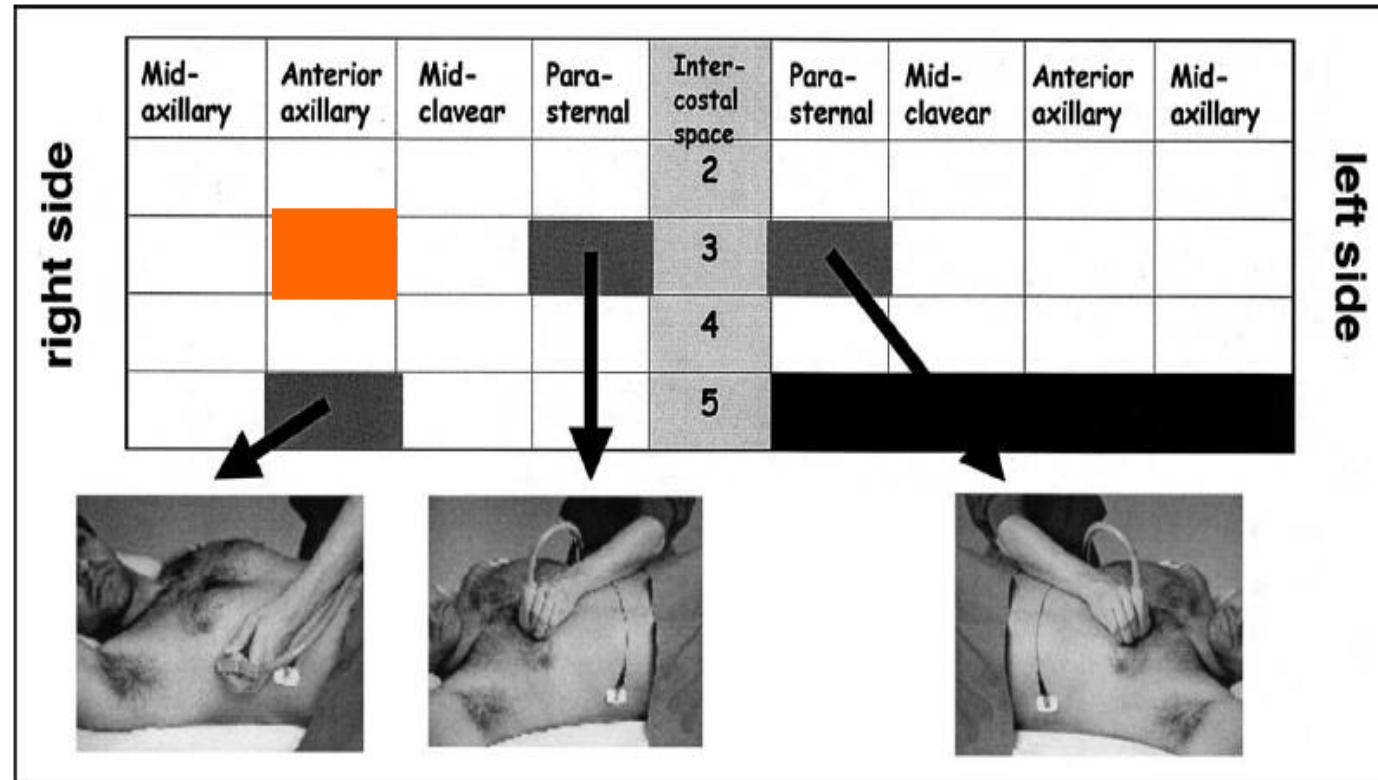
Échographie pulmonaire: sémiologie quantitative



Syndromes interstitiels

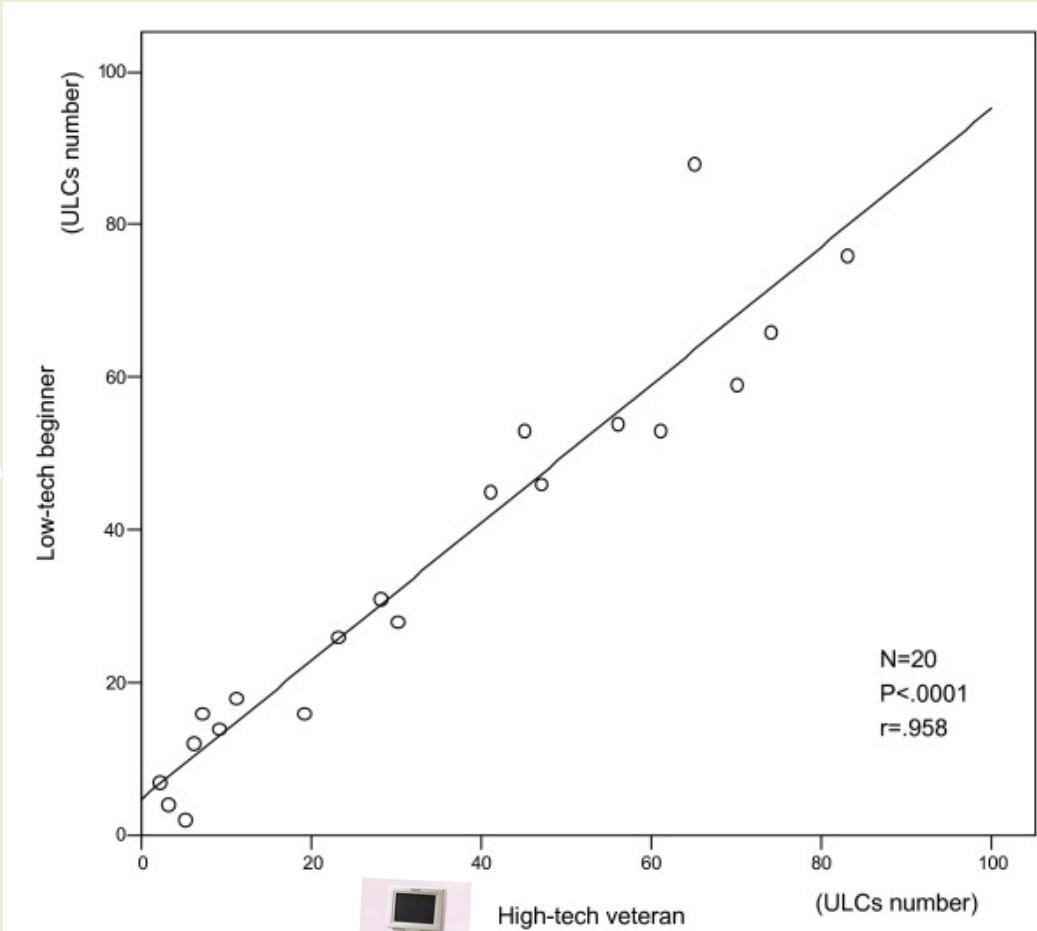


= comptage des lignes B = détection de la congestion pulmonaire infra clinique ?



Comptage des lignes B **automatisé** ?

Reproductibilité / Apprentissage



Bedetti et al, Cardiovasc ultrasound 2006



Aspect quantitatif : 28 quadrants

28 quadrants



right side

Mid-axillary	Anterior axillary	Mid-clavicular	Para-sternal	Inter-costal space	Para-sternal	Mid-clavicular	Anterior axillary	Mid-axillary
				II				
				III				
				IV				
				V				

Jambrik Z, Monti S, Coppola V, Agricola E, Mottola G, Miniati M, Picano
Usefulness of ultrasound lung comets as a nonradiologic sign of
extravascular lung water. *Am J Cardiol* 2004; 93:1265-1270.

Score	Number of Comet Tails	EVLW
0	<5	No Signs
1	5-15	Mild
2	15-30	Moderate
3	/>30	Severe

Cotation de la sévérité du syndrome interstitiel

Table 2. Semiquantitative classification of the Comet Tail Score (CTS) as proposed by Picano and colleagues.

Aspect quantitatif : 4-6-8-28 quadrants ?

Cotation de la sévérité du syndrome interstitiel

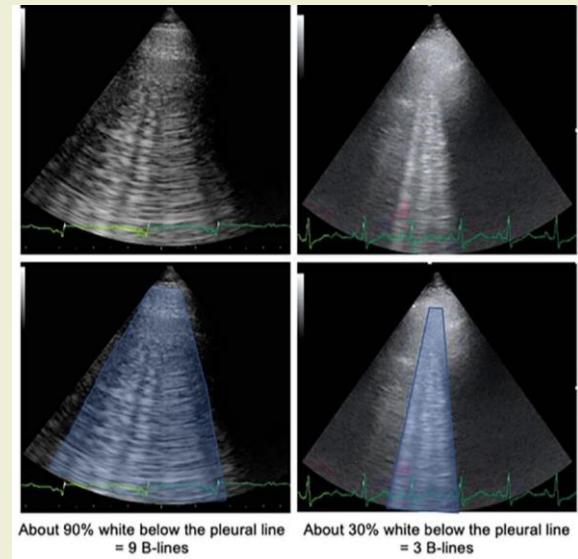


Table 2 Overview of select pre-discharge imaging protocols and cut-off values in acute HF

Number of zones	B-line cut-off	Ultrasound equipment	HF readmission or death	Reference
4	≥7 B-lines	High-end system; phased-array	90 days: Adj. HR 3.03 (95% CI 1.45 to 6.31)	Platz 2019 ²⁷
8	≥1 zone with ≥3 B-lines (one positive zone) on each hemithorax	High-end system; phased-array	90 days: Adj. HR 3.30 (95% CI 1.00 to 10.91)	Coiro 2015 ³⁵
28	>15 B-lines	High-end system; phased-array	180 days: Adj. HR 11.74 (95% CI 1.30 to 106.16)	Gargani 2015 ³⁶

Adj., adjusted; CI, confidence interval; HF, heart failure; HR, hazard ratio.

Aspect quantitatif : quadrants postérieurs pour pneumopathie interstitielle

44 quadrants...

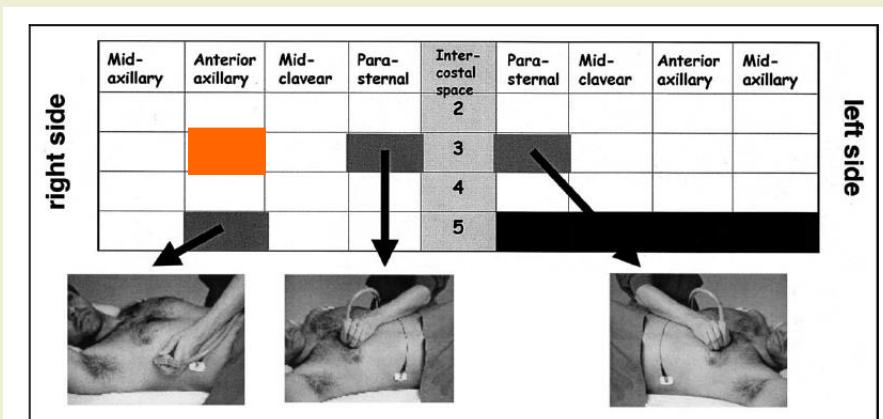


Gargani et al, *Rheumatology* 2009

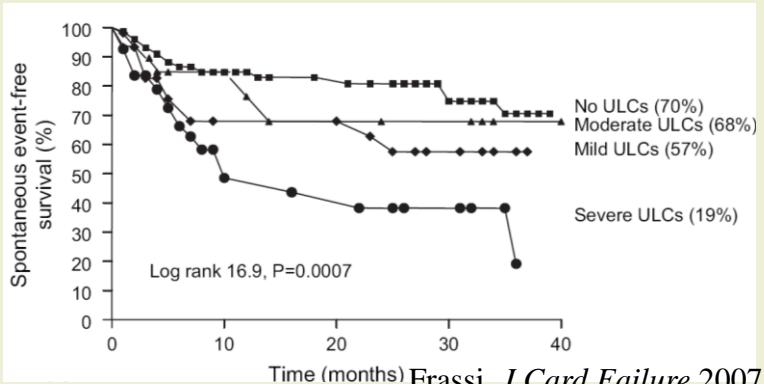
Syndromes interstitiels



= comptage des lignes B = détection de la congestion pulmonaire infra clinique ?

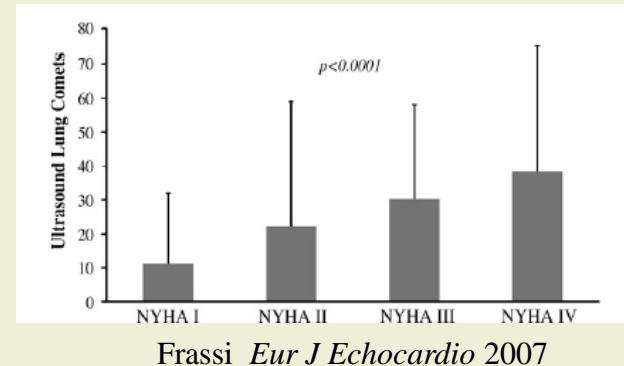


Cardio, N=290, suivis 3-30 mois



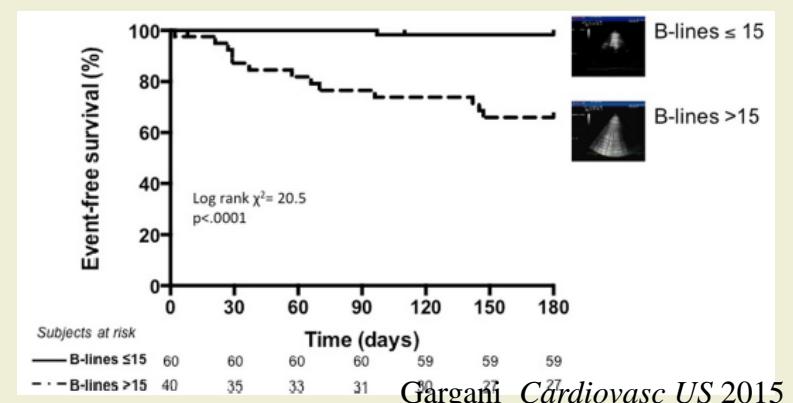
Frassi J Card Failure 2007

Cardio, N=340



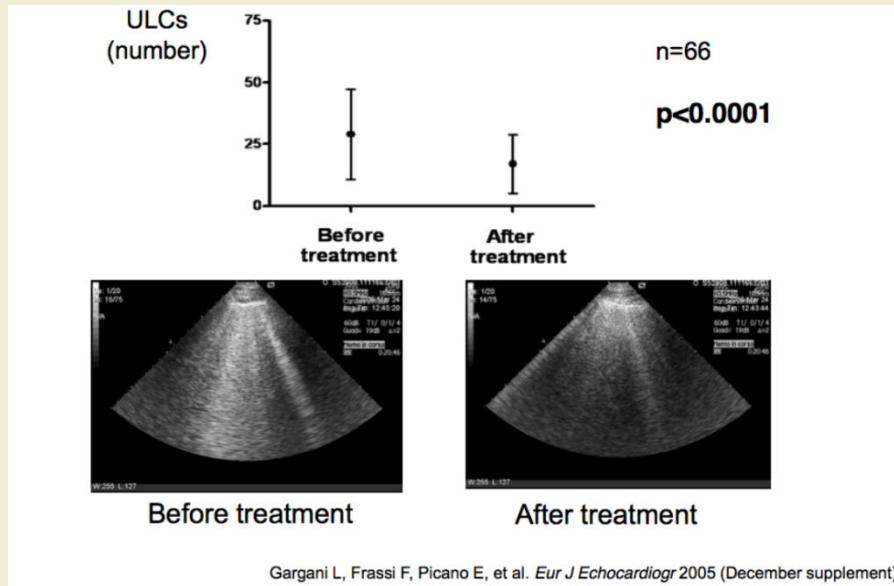
Frassi Eur J Echocardiogr 2007

Cardio, N=100, suivis 6 mois



Monitorage déplétion

➤ Dialyse guidée par ultra-sons, prévention des complications graves



Clin J Am Soc Nephrol. 2016 Nov 7;11(11):2005-2011. Epub 2016 Sep 22.

The Agreement between Auscultation and Lung Ultrasound in Hemodialysis Patients: The LUST Study.

Torino C¹, Gargani L¹, Sicari R¹, Letachowicz K¹, Ekart R¹, Fliser D¹, Covic A¹, Siamopoulos K¹, Stavroulopoulos A¹, Massy ZA¹, Fiaccadori E¹, Caiazza A¹, Bachelet T¹, Slotki I¹, Martinez-Castelao A¹, Coudert-Krier MJ¹, Rossignol P¹, Gueler F¹, Hannedouche T¹, Panichi V¹, Wiecek A¹, Pontoriero G¹, Sarafidis

Semin Dial. 2017 Jan;30(1):6-9. doi: 10.1111/sdi.12559. Epub 2016 Nov 6.

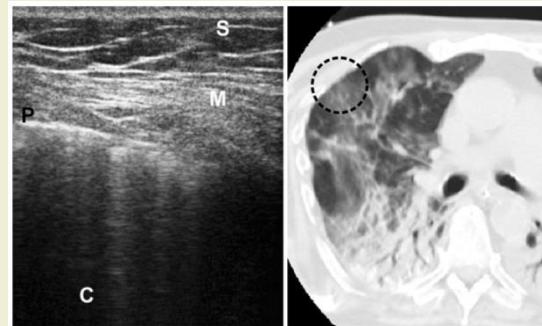
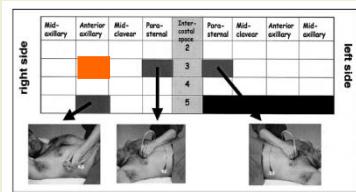
Lung Ultrasound in the Management of Fluid Volume in Dialysis Patients: Potential Usefulness.

Zoccali C¹.

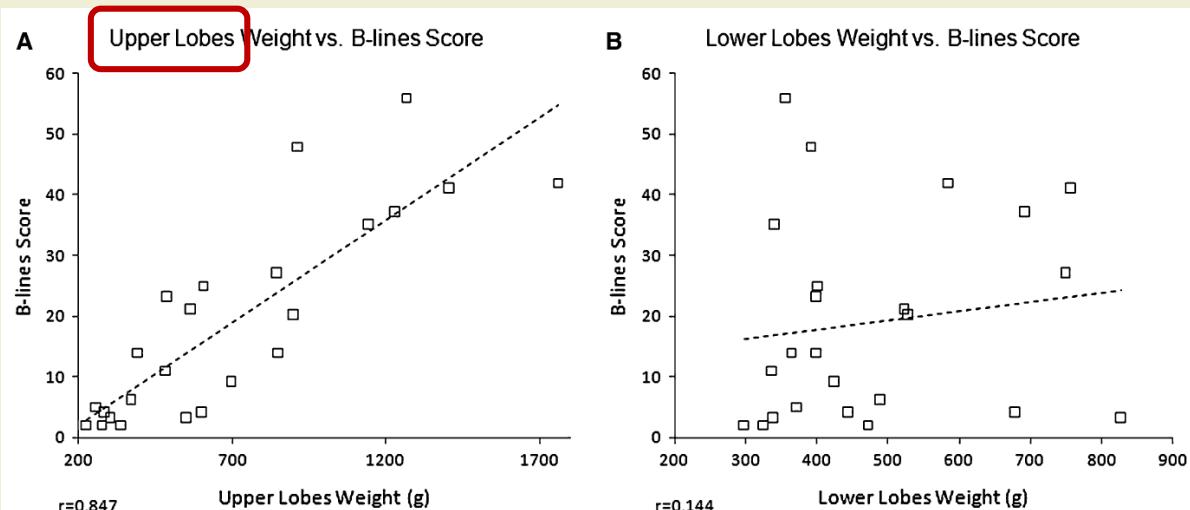
Syndromes interstitiels



= comptage des queues de comètes



En réanimation, N=20



Baldi ICM 2013

CONCLUSION

- Identifier :
- Ligne B = 7 caractéristiques
- Sd interstitiel : ≥ 3 lignes B par quadran sur ≥ 2 quadrans du même côté
- Différencier sd interstitiel cardiogénique ou pas
- Quantifier = diagnostic, pronostic, monitorage et dépistage de sub OAP cardiogéniques infracliniques

