Echographie pleuro- pulmonaire en consultation de cardiologie :

Complément utile pour dyspnée aigue et/ou insuffisance cardiaque chronique ... ou perte de temps ?

Dr F Tiger
Cardiologie/Imagerie/Réanimation
Centre Hospitalier Antibes

Echographie pleuro- pulmonaire :
Quelcques préjugés cardiologiques

Impossible d imager avec des ultra sons un organe rempli d air !

Déjà que la distension pulmonaire dégrade l échocardiographie .

Pas imagerie anatomique: ç' est que des **artefacts**, on comprends rien aux **queues de comètes** …

De toute façon , ça prend du temps et c est **soit redondant soit moins pertinent** que l ETT

D’ ou vient le terme de queue de comètes:
De l échographie abdominale !

M.C. Ziskin et al:

The comet tail artifact

Ultrasound Med J 1982

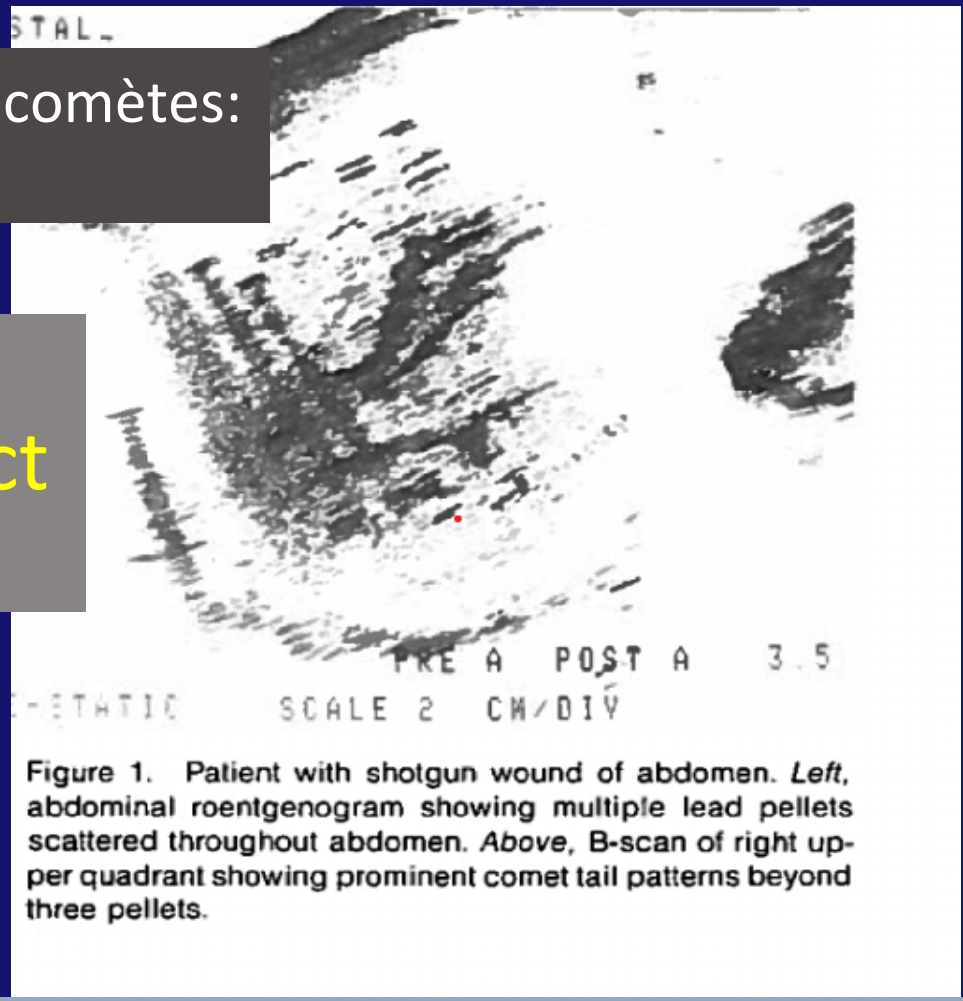
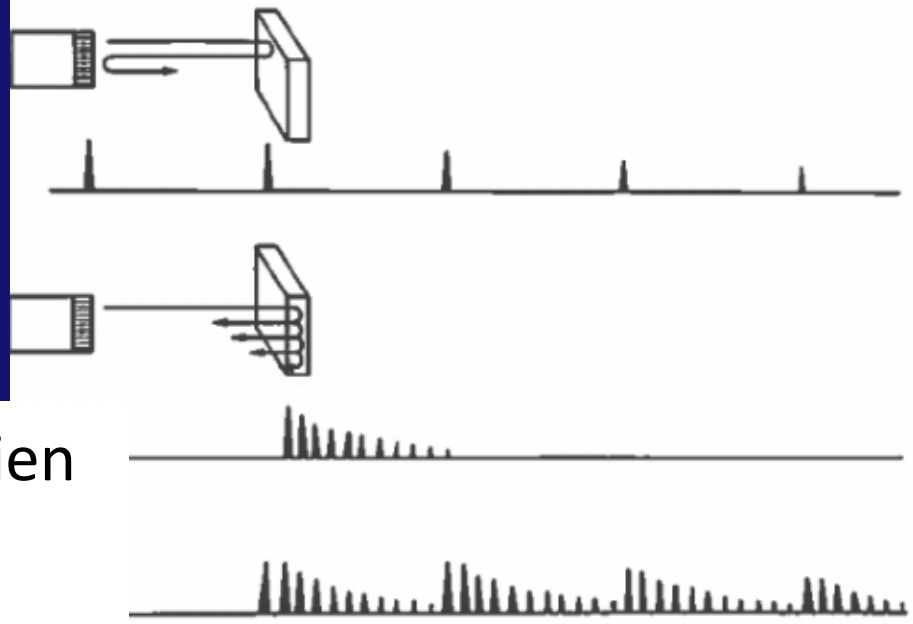


Figure 1. Patient with shotgun wound of abdomen. *Left*, abdominal roentgenogram showing multiple lead pellets scattered throughout abdomen. *Above*, B-scan of right upper quadrant showing prominent comet tail patterns beyond three pellets.

Echographie hépatique: trauma fermé abdomen par shotgun

Traits verticaux ne correspondant pas à une structure anatomique
mais à un artefact de réverbération qui se répète ,
du à une interface entre 2 milieux d impédance acoustique très différentes:
parenchyme hépatique et plombs de chasse



Artefact reproduit en laboratoire sur foie de chien
Puis bac plexiglax rempli d eau
avec billes de verre et différents matériaux:

la queue de comète se surimpose au cone d ombre

METHODS

A Rohe static B-scanner* was used with a 3.5-MHz or 5.0-MHz medium internally focused transducer 13 mm in diameter. Acoustic output with the 3.5-MHz transducer was measured to be 3 mW/cm² (SATA).

The liver of a dog being sacrificed for other purposes was shot with lead pellets 2 mm in diameter. Radiographs confirmed the presence of lead pellets within the liver. The liver was placed in a water tank and scanned.

In vitro examination of various physical objects was also performed in the water tank. The effect of

Développement Echo pleuro pulm : années 80

Description séméiologie en Réanimation/Services d urgence:

- du pneumothorax
- Epanchement pleural liquidien
- Atélectasies et condensation pulmonaire
- **Pathologies interstitielles** :

  initialement Comet Tail et Rings Down artifacts

  utilisés indifferement : actuellement **Lignes B**

  Infections pulmonaires , Insuffisance VG, ARDS

  étiologies les + fréquentes en Réa/soins intensifs/Urgence

Review

Med Ultrason 2018, Vol. 20, no. 3, 379-384
DOI: 10.11152/mu-1573

Précision terminologique importante

A common misunderstanding in lung ultrasound: the comet tail artefact

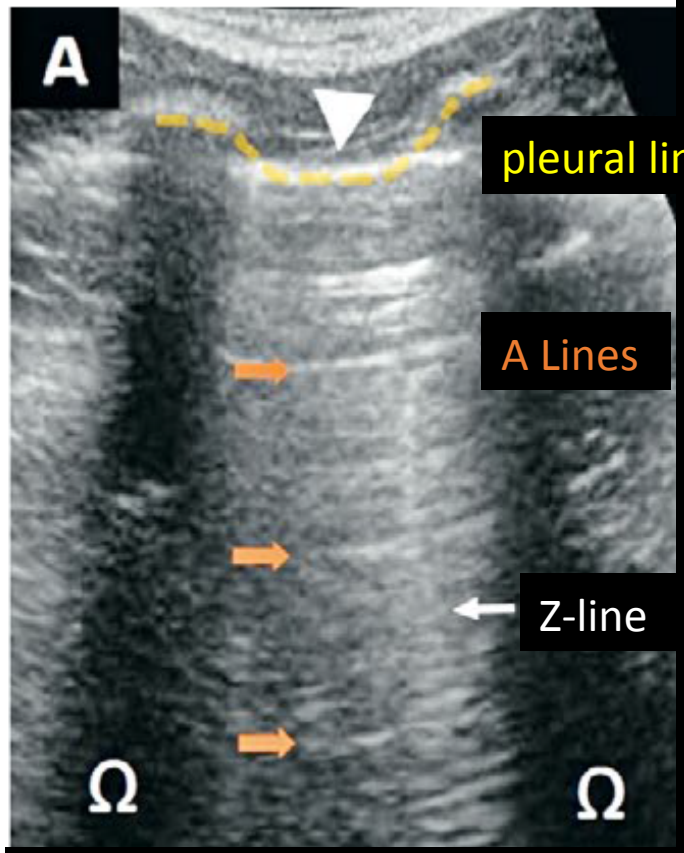
Francis Chun Yue Lee[1-3], Christian Jenssen[4], Christoph F Dietrich[5,6]

B-lines doit remplacer C.T.A.

du fait d une confusion entre artefacts de réverbération: metal et foie

et rings down artefacts: bulles d air enserrant une colonne liquidienne

Normal lung Ultrasound:

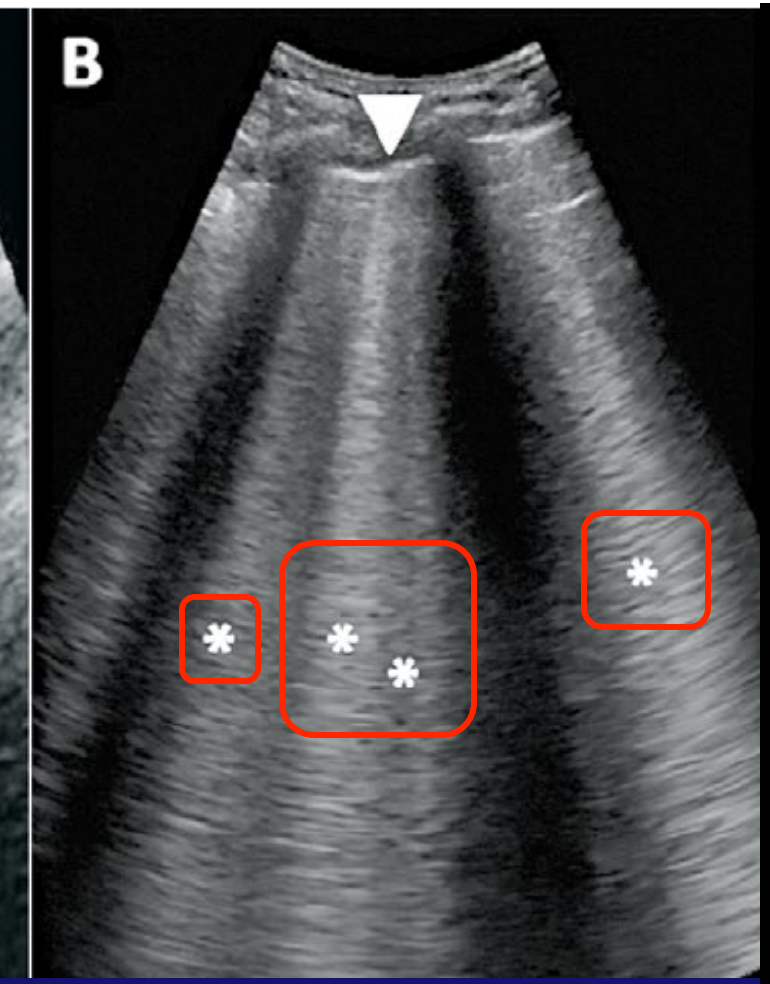


2 Yellow dotted line = bat sign :
pleural line (arrow head) + 2 ribs

2 Orange arrows: pleural horizontal reverberation
A Lines

3 Ω = ribs acoustic shadows

Thin vertical, weak and fading line (white small arrow): Z-line are reverberation type artifacts
Z Lines can be observed in in thin subjects without clinical significance
do not originate at pleural line
do not move with lung sliding
blend with surrounding A-lines



Interstitial syndrome : B lines
vertical ring down type artifacts:

Experiment: insonating 4 air bubbles in a tetrahedron formation, trapping a bugle-shaped column of fluid creates the RDA

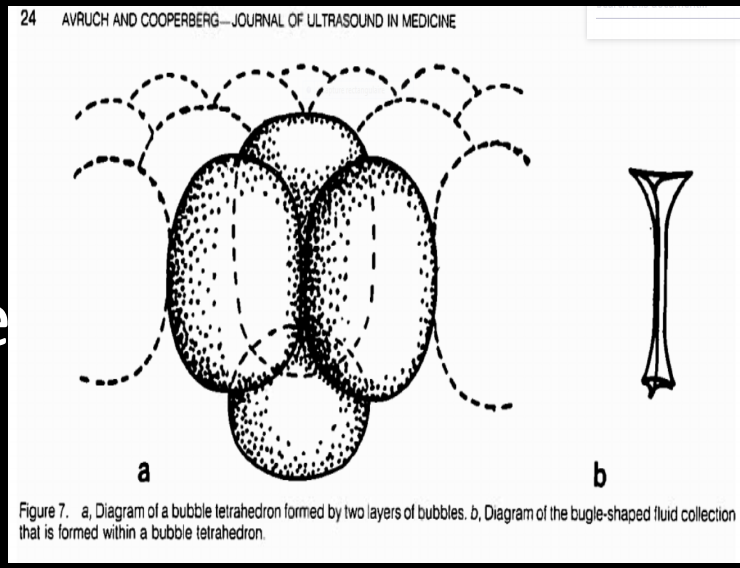
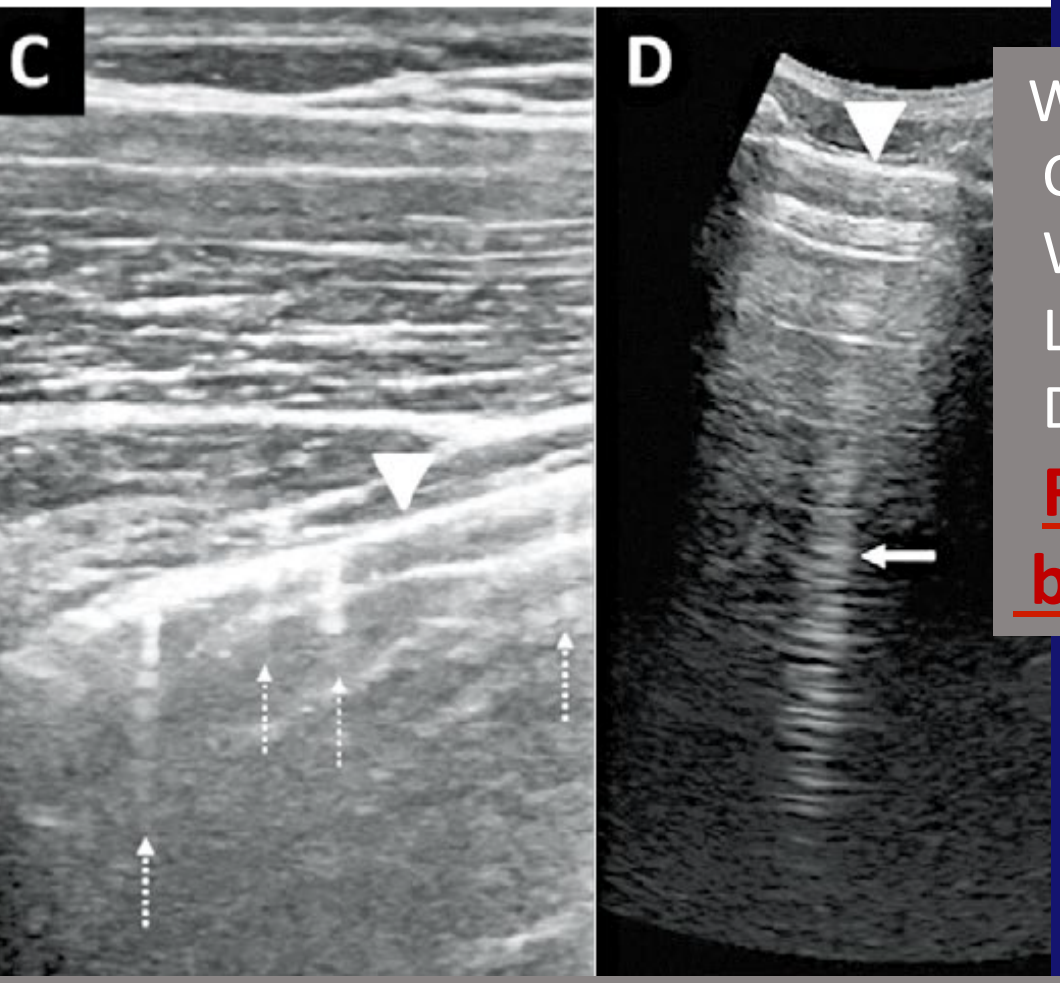


Figure 7. a, Diagram of a bubble tetrahedron formed by two layers of bubbles. b, Diagram of the bugle-shaped fluid collection that is formed within a bubble tetrahedron.

B lines start at the Pleural Line
are continuous,
radiate without fading
extend to limit of screen
move with the lung

Med Ultrason 2018; 20(3): 379-384



White horizontal arrow: Z Line

Common long reverberation artefact ending before screen

Weak vertical line blending with A lines

Lack of relationship with the Pleural line

Do **not move with lung sliding.**

Risk of confusion with B-lines by inexperienced lung sonographers

Normal lung Ultrasound Variants

White vertical dotted arrows: lung comets

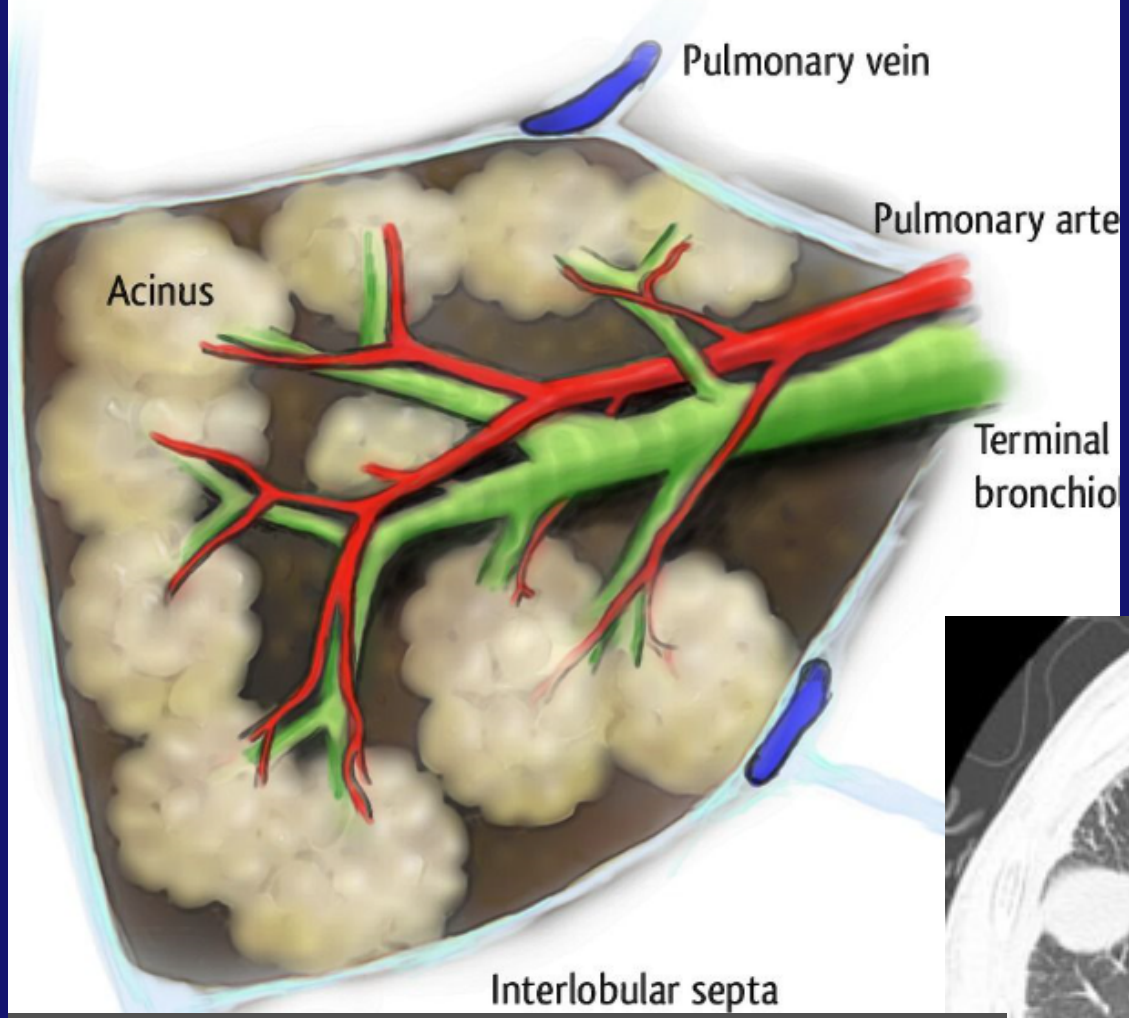
short reverberation artefacts starting from the Pleural line moving with lung sliding.

Echographie pleuro pulmonaire et pathologies intersticielles

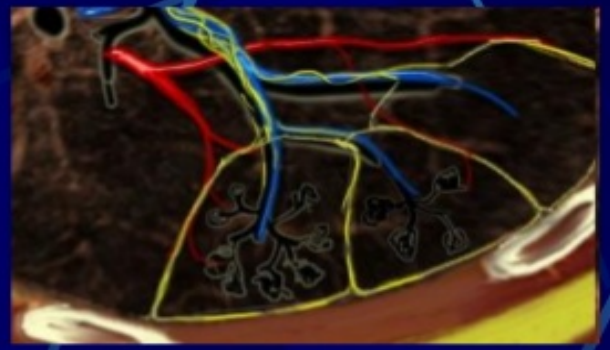
Ligne B: Artefact de type bulles air enserrant une colonne liquide.

- rayon Dense
  Intensité constante de la plèvre jusqu en fonds d écran,
  Efface les autres images
  Mobile avec le glissement pulmonaire.
- Physiologiques seulement si < 3 par espace intercostal
  chez le sujet jeune (1 sur 10): 1 à 2 lignes B, transitoires, varient avec la position thorax
  Un sujet age sur 3 : épaississement septa interlobulaires
- Convention: si une seule large colonne par espace intercostal: comptez comme 10 lignes B

Ligne Z:: Artefact de réverbération, peu dense , naissant à distance de la plèvre
s effacant vers la profondeur, n efface pas les lignes A
plutot sujets minces , non pathologique, artefact de type reverberation.



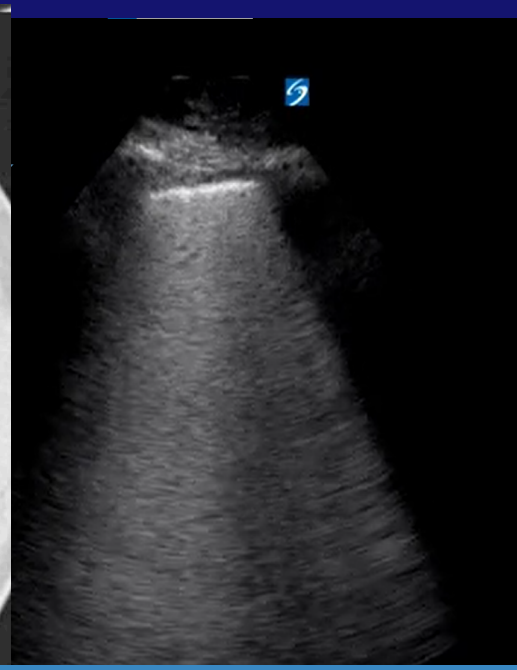
Secondary lobule



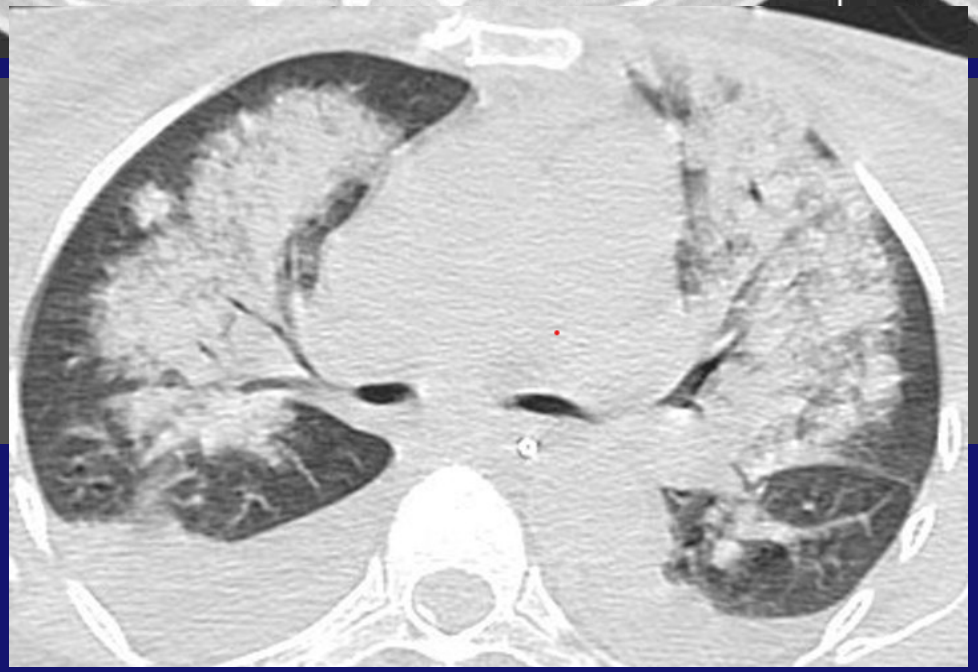
- Basic anatomic unit of pulmonary structure and function.
- 1-2 cm and is made up of 5-15 pulmonary acini
- Supplied by a small bronchiole (terminal bronchiole) in the center, that is parallelled by the centrilobular artery.
- Pulmonary veins and lymphatics run in the periphery
- Two lymphatic systems:
  - central network
  - peripheral network

Oedeme intersticiel cardiogénique:

Épaississement septa interlobulaires
(anciennes lignes de Kerley B sur Rx Thorax)



Glass rockets : Lignes B coalescentes



OAP cardiogénique:

Épaississements septa interlobulaires et péri-bronchiques

Verre dépoli + Crazy paving

Nodules alvéol. + condensation + ép. pleuraux

Echographie pleuro- pulmonaire

Pionnier francais: D.A. Lichtenstein
Service de réanimation médicale
Hopital Ambroise Paré
Boulogne

The Comet –tail Artifact

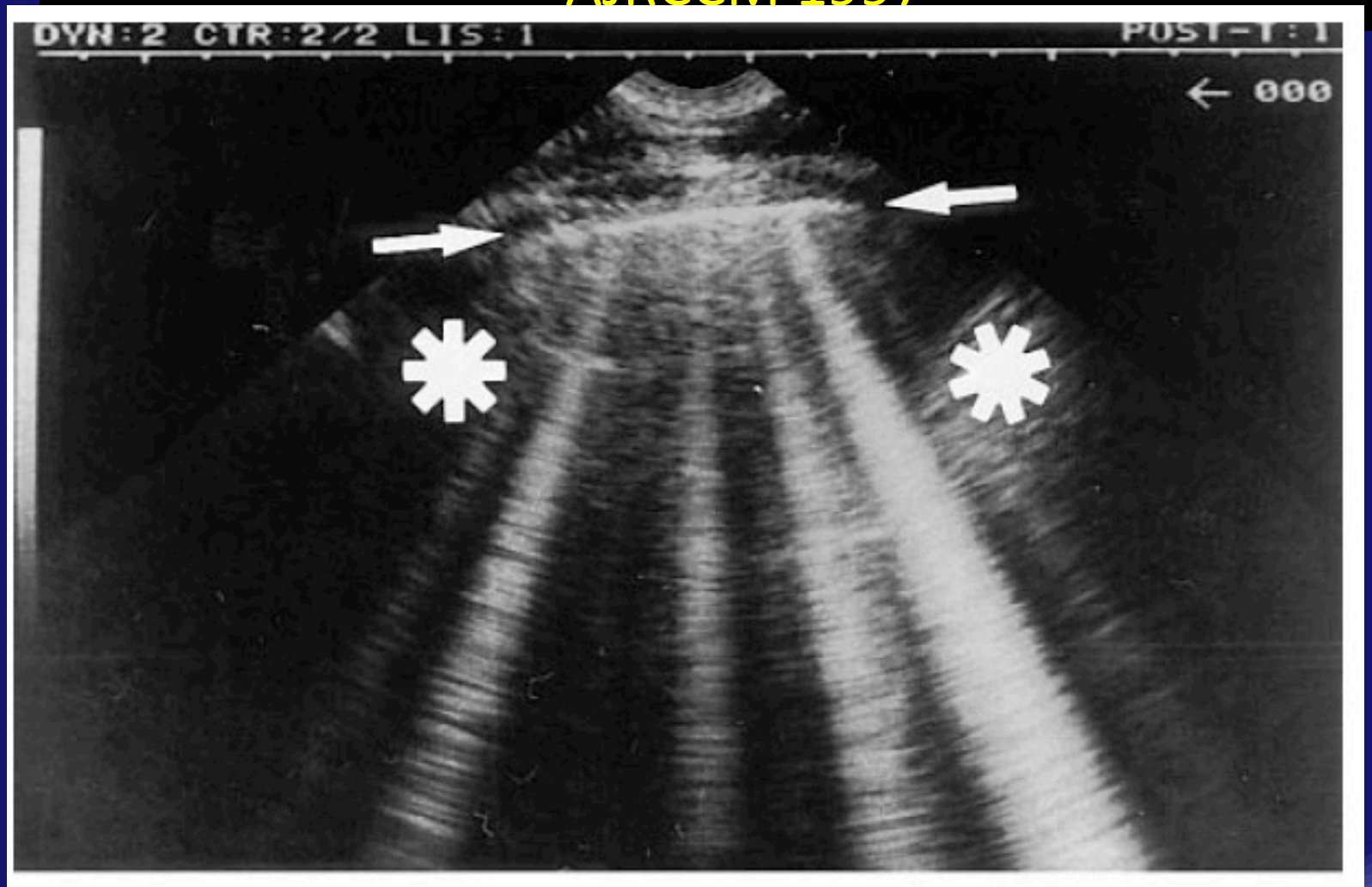
An ultrasound sign of Alveolar- Intersticial Syndrome
Daniel Lichstenstein et al
AJRCCM 1997

The Comet –tail Artifact

An ultrasound sign of Alveolar- Interstitial Syndrome

Daniel Lichstenstein et al

AJRCCM 1997



The Comet-Tail artifact

Diagnosis of alveolar-interstitial syndrome?

Prospective study, MICU , 250 pts :

121 pts with radiologic alveolar-interstitial syndrome / 129 pts without .

Antero-lateral chest wall US

CTA in 86 /92 pts with diffuse alveolar-interstitial syndrome: sensitivity of 93.4%

CTA absent or confined to the last lateral intercostal space in 120/129 pts with normal chest X-ray specificity of 93.0%

The Comet-Tail artifact

AJRCCM 1997

CTA correlations with TDM aspect of pulmonary oedema :

- sub-pleural interlobular septa
- ground-glass areas

In conclusion, presence of the comet-tail artifact allowed diagnosis of alveolar-interstitial syndrome

Depuis nombreux protocoles de réanimation/urgences/ pré hospitalier pour le diagnostic étiologique (IVG) par Ultrasons d une dyspnée aigue:

- Bedside Lung Ultrasound Emergency: BLUE protocol

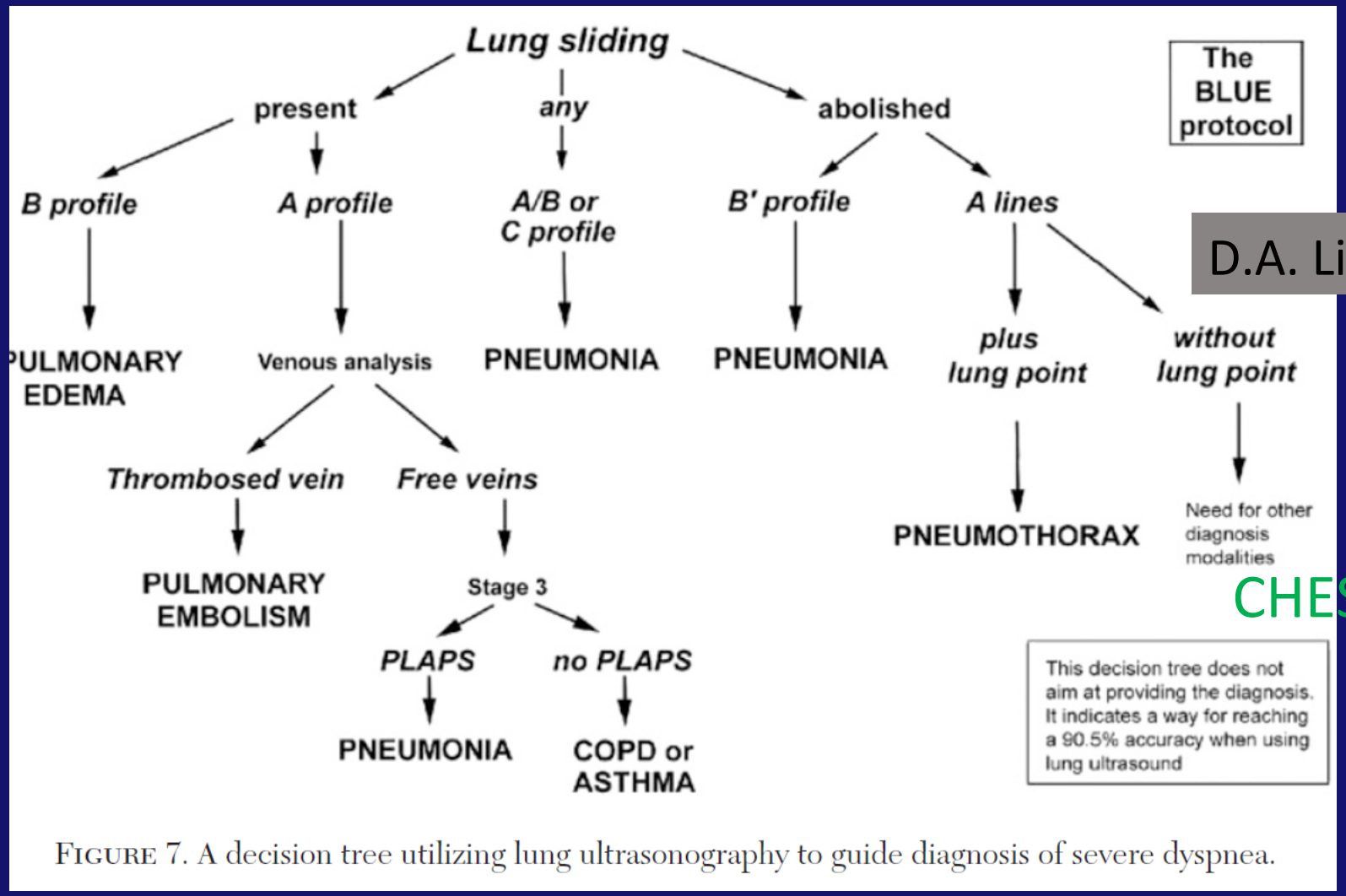


FIGURE 7. A decision tree utilizing lung ultrasonography to guide diagnosis of severe dyspnea.

D.A. Lichtenstein and G.A. Mezière

CHEST 2008; 134 : 117 – 125

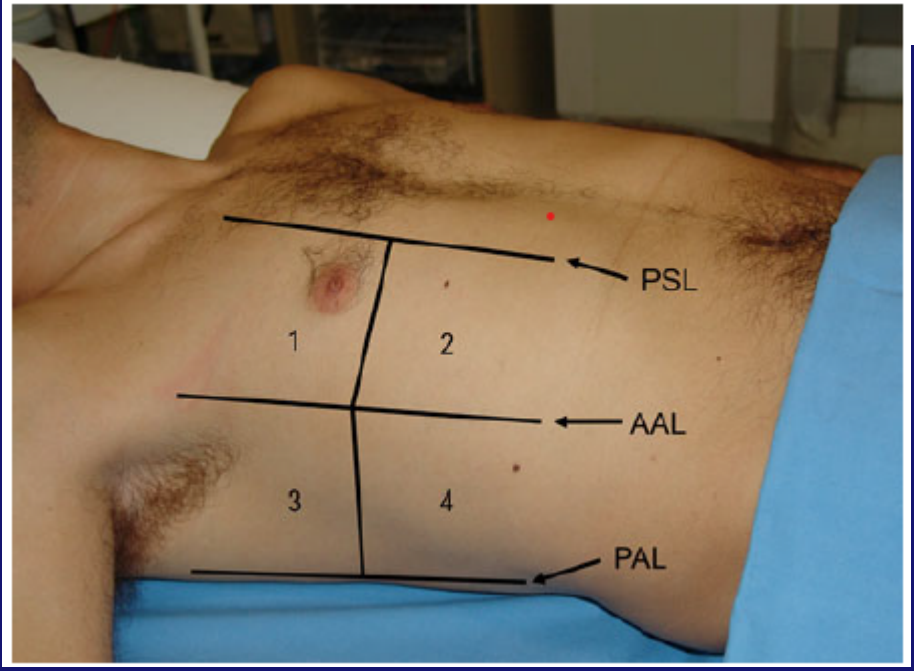
Second protocole echo pleuro pumonaire au lit patient: Volpicelli

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

CONFERENCE REPORTS AND EXPERT PANEL

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

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



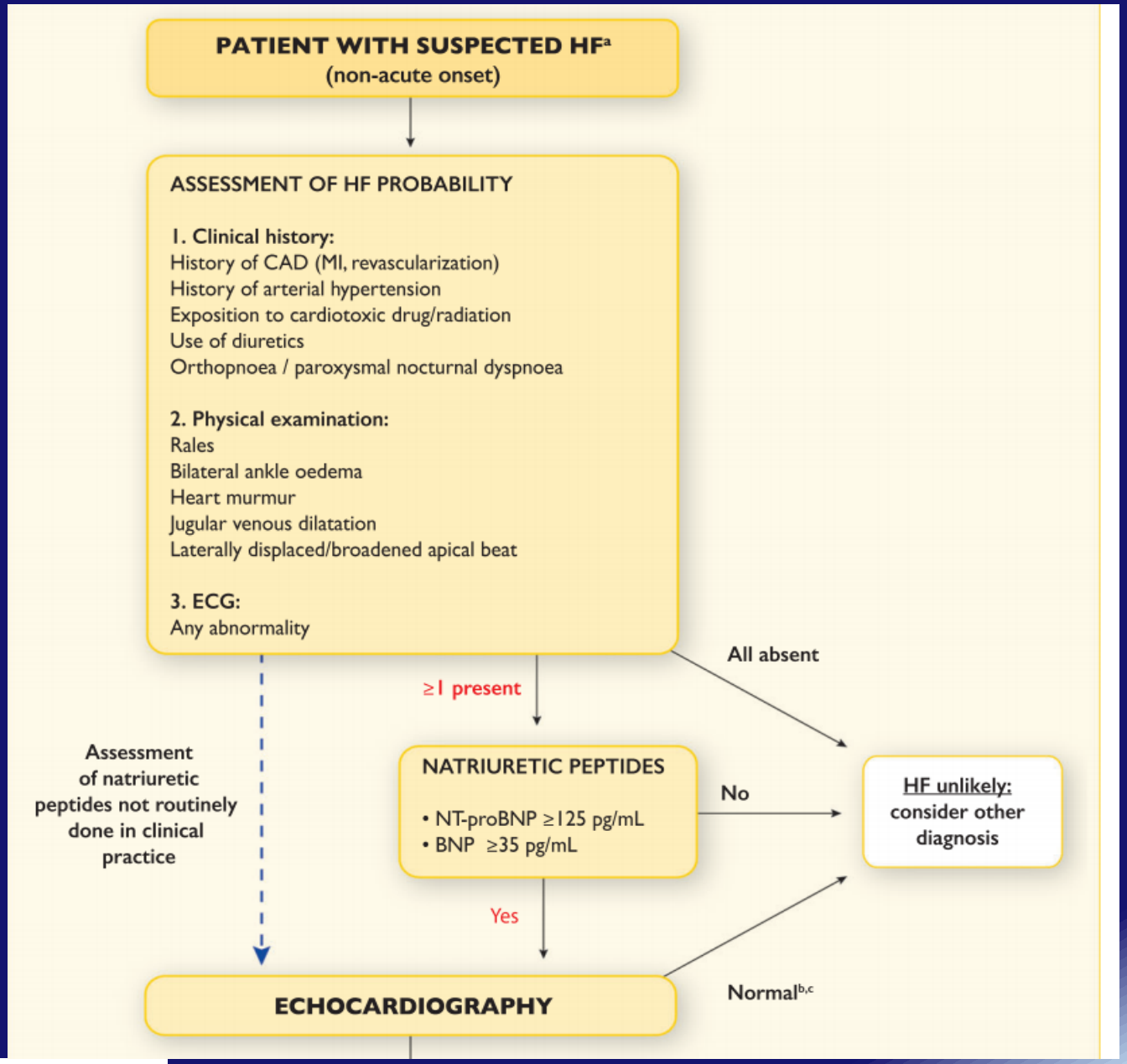
Interstitial syndrome positive exam:
– Two or more positive regions bilaterally.
– If 28 rib space technique :
for each rib space: number of individual B-lines(max ten)
if confluent, percentage occupied by coalescent B-lines / 10

Echographie pleuro- pulmonaire en cardiologie ambulatoire

Quid Guidelines ?

Une seule ligne sur 70 pages

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



European Heart Journal, Volume 37, Issue 27, 14 July 2016, Pages 2129–2200,

Recommendations for cardiac imaging in patients with suspected or established heart failure:
écho pleuro pumonaire évoqué dans “autres tests”
1 seule ligne

			120
Chest radiography (X-ray) is recommended in patients with HF to detect/exclude alternative pulmonary or other diseases, which may contribute to dyspnoea. It may also identify pulmonary congestion/oedema and is more useful in patients with suspected HF in the acute setting.	I	C	
Right heart catheterization with a pulmonary artery catheter:			
- is recommended in patients with severe HF being evaluated for heart transplantation or mechanical circulatory support;	I	C	
- should be considered in patients with probable pulmonary hypertension assessed by echocardiography in order to confirm pulmonary hypertension and its reversibility before the correction of valve/structural heart disease;	IIa	C	
- may be considered in order to adjust therapy in patients with HF who remain severely symptomatic despite initial standard therapies and whose haemodynamic status is unclear.	IIb	C	
EMB should be considered in patients with rapidly progressive HF despite standard therapy when there is a probability of a specific diagnosis which can be confirmed only in myocardial samples and specific therapy is available and effective.	IIa	C	93
Thoracic ultrasound may be considered for the confirmation of pulmonary congestion and pleural effusion in patients with AHF.	IIb	C	121
Ultrasound measurement of inferior vena cava diameter may be considered for the assessment of volaemia status in patients with HF.	IIb	C	

Pas de Guidelines … mais depuis 3 ans des « Review » dans Journaux cardio. :

JACC: CARDIOVASCULAR IMAGING
VOL. 11, NO. 11, 2018

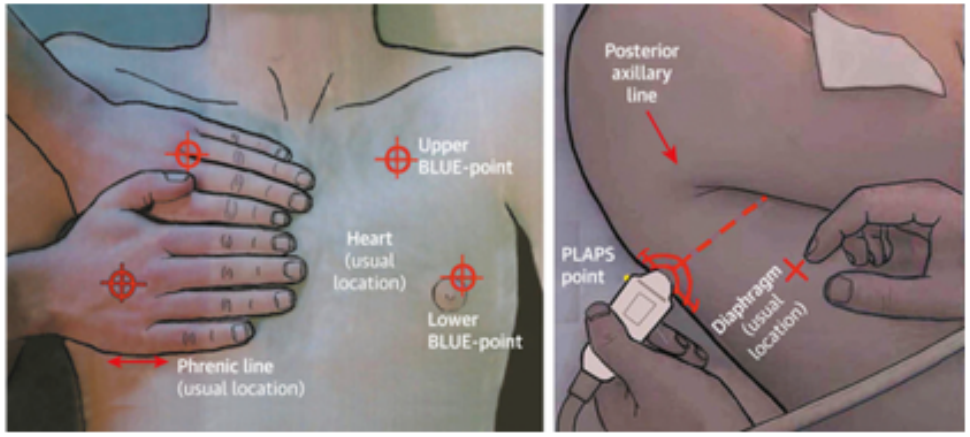
PUBLISHED BY ELSEVIER

Lung Ultrasound for the Cardiologist

Eugenio Picano, MD, PhD,[a] Maria Chiara Scali, MD, PhD,[b] Quirino Ciampi, MD, PhD,[c] Daniel Lichtenstein, MD[d]

ABSTRACT

For a cardiologist, lung ultrasound is an add-on to transthoracic echocardiography, just as lung auscultation is part of a cardiac physical examination. A cardiac 3.5- to 5.0-MHz transducer is generally suitable because the small footprint makes it ideal for scanning intercostal spaces. The image quality is often adequate, and the lung acoustic window is always patent. The cumulative increase in imaging time is <1 min for the 2 main applications targeted on pleural water (pleural effusion) and lung water (pulmonary congestion as multiple B-lines). In these settings, lung ultrasound outperforms the diagnostic accuracy of the chest radiograph, with a low-cost, portable, real-time, radiation-free method. A "wet lung" detected by lung ultrasound predicts impending acute heart failure decompensation and may trigger lung decongestion therapy. The doctors of tomorrow may still listen with a stethoscope to their patient's lung, but they will certainly be seeing it with ultrasound. (J Am Coll Cardiol Img 2018;11:1692-705) © 2018 by the American College of Cardiology Foundation.



Blue Protocol 6 zones

ou encore plus simple 4 zones (jaunes) : dyspnée aigue

VS 48 zones d interrogation : suivi semi quantitaif

congestion veineuse pumonaire insuf. Cardiaque chronique

Eugenio Picano et al. *J Am Coll Cardiol*

PA = Posterior-axillary

MA = Mid-axillary

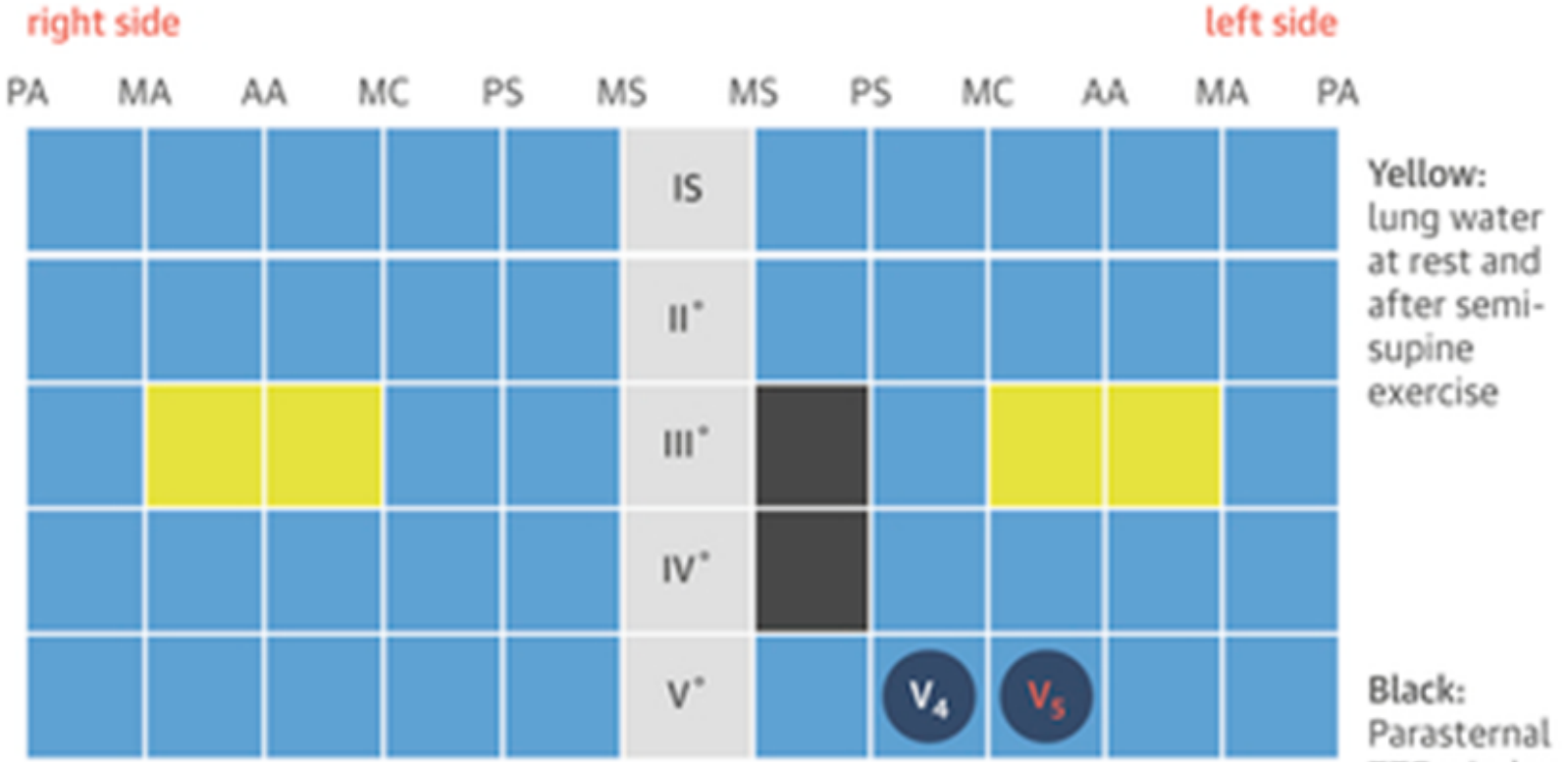
AA = Anterior-axillary

MC = Mid-clavicular

PS = Para-sternal

MS = Margino-sternal

Lung Ultrasound and TTE Windows (Supine Patient)



IS = Inter-costal space

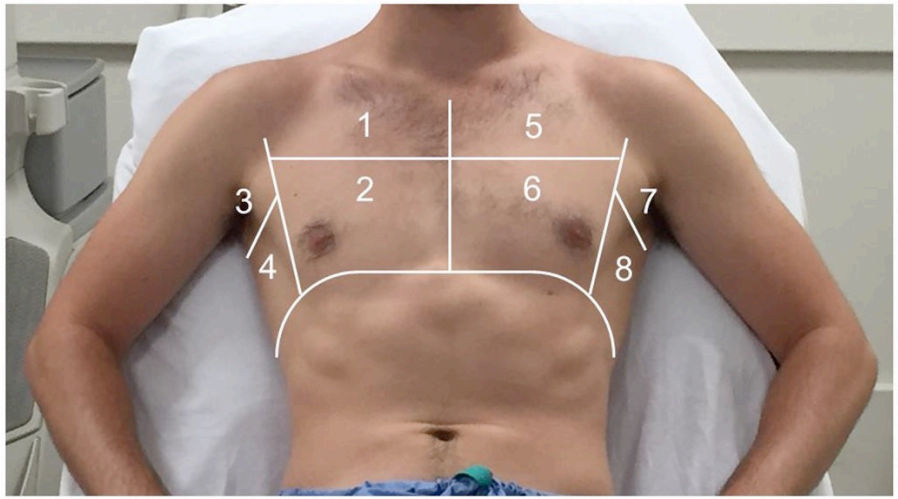
Published in final edited form as:
Eur J Heart Fail. 2019 July ; 21(7): 844–851. doi:10.1002/ejhf.1

standardized approach to reporting the quantification of pulmonary congestion:
number of positive zone (> 2 B lines/zone)
Or B-lines number in one intercostal space

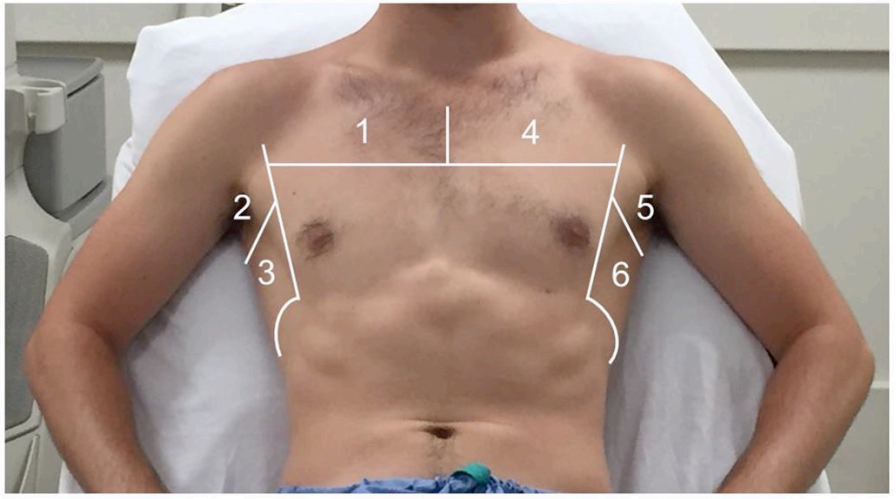
Expert consensus document: Reporting checklist for quantification of pulmonary congestion by lung ultrasound in heart failure

Elke Platz[1], Pardeep S. Jhund[2], Nicolas Girerd[3], Emanuele Pivetta[4], John J.V. McMurray[2], W. Frank Peacock[5], Josep Masip[6], Francisco Javier Martin-Sanchez[7], Òscar Miro[8], Susanna Price[9], Louise Cullen[10], Alan S. Maisel[11], Christiaan Vrints[12], Martin R. Cowie[9], Salvatore DiSomma[13], Hector Bueno[14], Alexandre Mebazaa[15], Danielle M. Gualandro[16],

A) 8 zone method



B) 6 zone method



Integration de l echo pumonaire aux critères ETT classiques

CONSENSUS STATEMENT

NATURE REVIEWS | CARDIOLOGY VOLUME 14 | JULY 2017 | 427

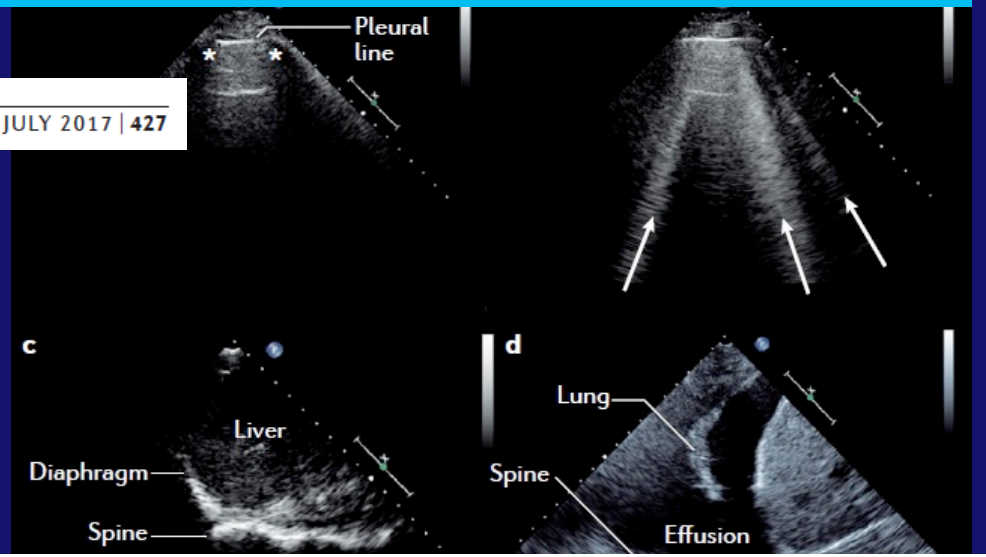
OPEN

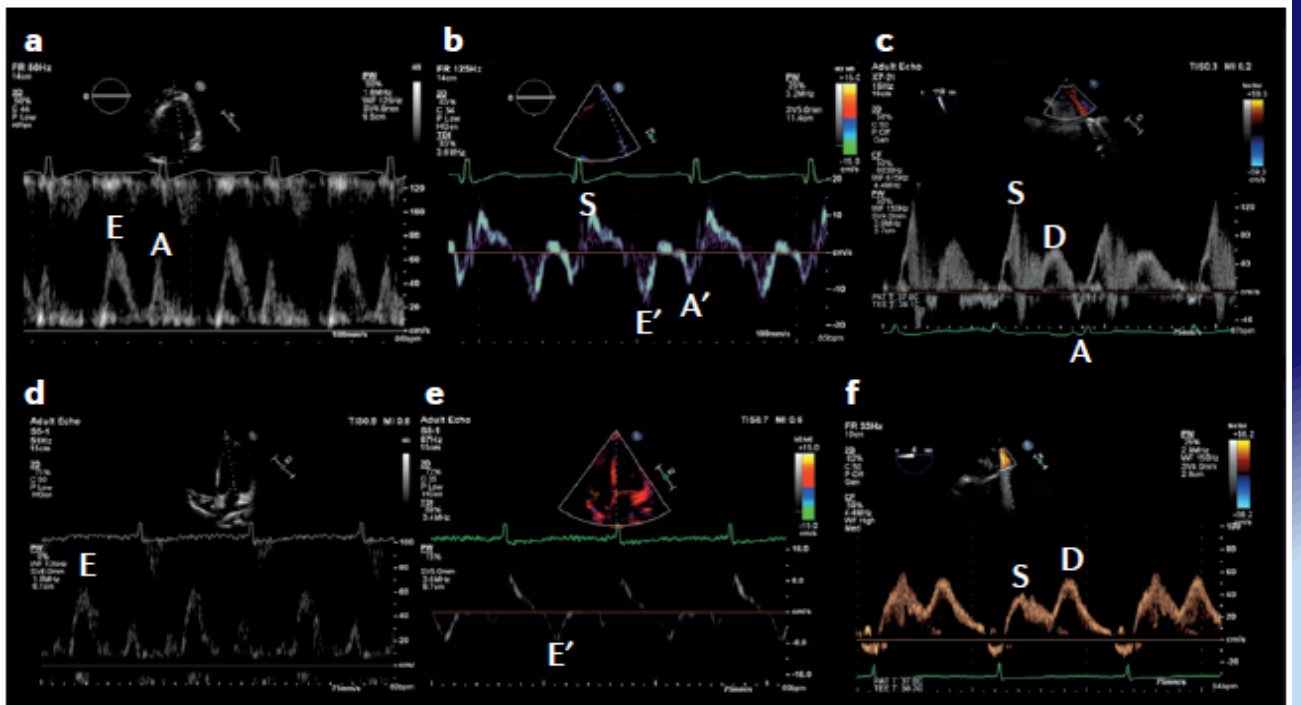
EXPERT CONSENSUS DOCUMENT

Echocardiography and lung ultrasonography for the assessment and management of acute heart failure

Susanna Price[1], Elke Platz[2]*, Louise Cullen[3]*, Guido Tavazzi[4], Michael Christ[5], Martin R. Cowie[6], Alan S. Maisel[7], Josep Masip[8], Oscar Miro[9], John J. McMurray[10], W. Frank Peacock[11], F. Javier Martin-Sanchez[12], Salvatore Di Somma[13], Hector Bueno[14], Uwe Zeymer[15] and Christian Mueller[16], for the Acute Heart Failure Study Group of the European Society of Cardiology Acute Cardiovascular Care Association*

Abstract | Echocardiography is increasingly recommended for the diagnosis and assessment of patients with severe cardiac disease, including acute heart failure. Although previously considered to be within the realm of cardiologists, the development of ultrasonography technology has led to the adoption of echocardiography by acute care clinicians across a range of specialties. Data from echocardiography and lung ultrasonography can be used to improve diagnostic accuracy, guide and monitor the response to interventions, and communicate important prognostic information in patients with acute heart failure. However, without the appropriate skills and a good understanding of ultrasonography, its wider application to the most acutely unwell patients can have substantial pitfalls. This Consensus Statement, prepared by the Acute Heart Failure Study Group of the ESC Acute Cardiovascular Care Association, reviews the existing and potential roles of echocardiography and lung ultrasonography in the assessment and management of patients with acute heart failure, highlighting the differences from established practice where relevant.





Quid des études en cliniques ? Analyse congestion pulmonaire chez l hémodialysé

JACC: CARDIOVASCULAR IMAGING VOL. 3, NO. 6, 2010
© 2010 BY THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION ISSN 1936-878X/$36.00

1 Corrélation indépendante nombre lignes B pre dialyse / FEVG

Detection of Pulmonary Congestion by Chest Ultrasound in Dialysis Patients

Francesca Mallamaci, MD,*† Francesco A. Benedetto, MD,‡ Rocco Tripepi,†
Stefania Rastelli, MD,§ Pietro Castellino, MD Prof.,§ Giovanni Tripepi, Stat. Dr.,†
Eugenio Picano, MD Prof.,‖ Carmine Zoccali, MD Prof.*†
Reggio Calabria, Catania, and Pisa, Italy

Effective and Timely Evaluation of Pulmonary Congestion: Qualitative Comparison Between Lung Ultrasound and Thoracic Bioelectrical Impedance in Maintenance Hemodialysis Patients

Medicine: 94; 6 201

Carlo Donadio, MD, Laura Bozzoli, MD, Elisa Colombini, MD, Giovanna Pisanu, MD, Guido Ricchiuti, MD, Eugenio Picano, MD, PhD, and Luna Gargani, MD

1 Diminution des lignes B post dialyse est correlée à impédance thoracique et diminution eau pulmonaire extra vasculaire

2 Nombres de lignes résiduelles B post dialyse corrélés FEVG en analyse régression multiple

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

Claudia Torino, Luna Gargani, Rosa Sicari, Krzysztof Letachowicz, Robert Ekart, Danilo Fliser, Adrian Covic, Kostas Siamopoulos, Aristeidis Stavroulopoulos, Ziad A. Massy, Enrico Fiaccadori, Alberto Caiazza, Thomas E Itzchak Slotki, Alberto Martinez-Castelao, Marie-Jeanne Coudert-Krier, Patrick Rossignol, Faikah Gueler, Thierry Hannedouche, Vincenzo Panichi, Andrzej Wiecek, Giuseppe Pontoriero, Pantelis Sarafidis, Marian Ki Radovan Hojs, Sarah Seiler-Mussler, Fabio Lizzi, Dimitrie Siriopol, Olga Balafa, Linda Shavit, Rocco Tripepi, Francesca Mallamaci, Giovanni Tripepi, Eugenio Picano, Gérard Michel London, and Carmine Zoccali

Clin J Am Soc Neprol 11: 2005-2011, 2016

3 L examen clinique sous estime constamment la congestion pulmonaire / Echo pulmonaire: ROC area de 0,5 à 0,7

Quid des études en cliniques ?

Lignes B: facteur pronostic
insuffisance cardiaque chronique

European Journal of Heart Failure (2017) 19, 1154–1163
doi:10.1002/ejhf.839

RESEARCH ARTICLE

Dynamic changes and prognostic value of pulmonary congestion by lung ultrasound in acute and chronic heart failure: a systematic review

Elke Platz[1,2]*, Allison A. Merz[2], Pardeep S. Jhund[3], Ali Vazir[4,5], Ross Campbell[3], and John J. McMurray[3]

Systematic literature review:
Studies published English , > 24 adult pts:
Changes in pulmonary congestion (B-lines)
in Heart Failure (AHF or CHF)
Prognostic utility of B-lines in HF.

Of 1327 studies, 13 met the inclusion criteria:
Six reported on dynamic changes in LUS : 438 pts
Seven on the prognostic value of B-lines in HF: 953 pts

In AHF, B-line number changed within as few as 3 h of treatment.
≥15 B-lines on 28-zone LUS at discharge: 5 x risk for HF readmission or death.

In CHF, ≥3 B-lines on 8 zone LUS 4 X risk for 6-month HF admission or death.

Quid des études en cliniques ?

ESC European Society of Cardiology

European Journal of Heart Failure (2019) **21**, 904–916
doi:10.1002/ejhf.1383

RESEARCH ARTICLE

Insuffisant cardiaque ambulatoire

Prevalence, pattern and clinical relevance of ultrasound indices of congestion in outpatients with heart failure

Pierpaolo Pellicori[1,2]*, Parin Shah[1], Joe Cuthbert[1], Alessia Urbinati[1], Jufen Zhang[1,3], Anna Kallvikbacka-Bennett[1], Andrew L. Clark[1], and John G.F. Cleland[2,4]

Nombre de lignes B:
non retrouvé comme variable indépendante
de décès/réhospitalistion par rapport Nt pro BP, VCI > 20 mm,
ratio Valsava V.J.I.

permet de reclasser le pronostic des patients à haut BNP (3 eme tercile)

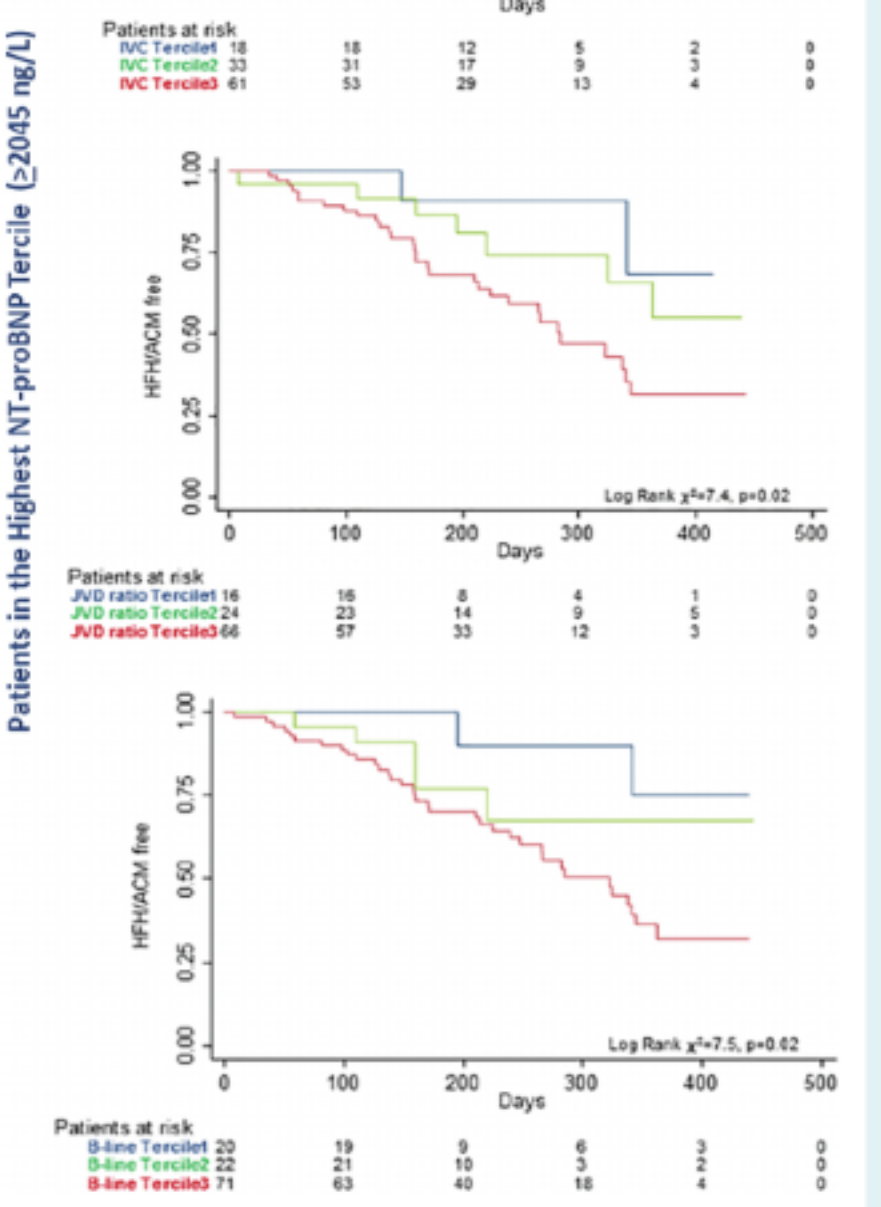


Figure 3 Multi-panel Kaplan–Meier for the primary outcome of all-cause death (ACM) and heart failure hospitalizations (HFH) showing additive value of measuring congestion by ultrasound in patients in the highest N-terminal pro-B-type natriuretic peptide (NT-proBNP) tercile (≥2045 ng/L). IVC, inferior vena cava; JVD,

Quid des études en cliniques ?

Insuffisant cardiaque ambu: Lignes B peuvent elles guider le ttt

ESC European Society of Cardiology

European Journal of Heart Failure (2019) **21**, 1605–16[illegible]3
doi:10.1002/ejhf.1604

RESEARCH ARTICLE

Lung ultrasound-guided treatment in ambulatory patients with heart failure: a randomized controlled clinical trial (LUS-HF study)

Mercedes Rivas-Lasarte, Jesús Álvarez-García, Juan Fernández-Martínez, Alba Maestro, Laura López-López, Eduard Solé-González, Maria J. Pirla, Nuria Mesado, Sonia Mirabet, Paula Fluvià, Vicens Brossa, Alessandro Sionis*, Eulàlia Roig†, and Juan Cinca†

Cardiology Department, Hospital de la Santa Creu i Sant Pau, IIb-SantPau, CIBERCV, Universitat Autónoma de Barcelona, Barcelona, Spain

Aims

Lung ultrasound (LUS) is a useful tool with which to assess subclinical pulmonary congestion and to stratify the prognosis of patients with heart failure (HF). The aim of this study was to evaluate whether an LUS-guided follow-up protocol improves the outcomes of patients with HF.

LUS – HF study

Single-blinded

123 HF pts randomized :

62 pts to standard follow-up (control group)

61 LUS-guided follow-up (LUS gp): diuretic therapy modified /number of B-lines : 8 zones

Primary composite endpoint: urgent visit + hospitalization for worsening HF + death

Systematic Visits at 14 30 90 and 180 days after discharge

69 ± 12 years

72% male

Mean LVEF 39 ± 14%

HR primary composite outcome LUS gp was 0.518 [95% CI 0.268–0.998; P = 0.049]

mainly decrease in urgent visits for worsening HF

Number of patients needed to treat to avoid an event was 5 (95% CI 3–62)

NT pro BNP reduction not achieved.

LUS gp received more loop diuretics [51 (91%) vs.42(75%) ;P = 0.02]

improvement in 6-min walk test [60 m vs. 37 m ; P = 0.023].

Quid des études en cliniques ?

Insuffisant cardiaque ambu:
Lignes B peuvent elles guider le ttt

Seconde étude clinique prospective positive

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Heart failure and cardiomyopathies
Original research

Lung ultrasound-guided therapy reduces acute decompensation events in chronic heart failure

Claudia Marini [1], Gabriele Fragasso [2], Leonardo Italia [1], Hamayak Sisakian [3], Vincenzo Tufaro [1], Giacomo Ingallina [1], Stefano Stella [1], Francesco Ancona [1], Ferdinando Loiacono [2], Pasquale Innelli [4], Marco Fabio Costantino [4], Laura Sahakyan [3], Sirvard Gabrielyan [3], Mariam Avetisyan [3], Alberto Margonato [2, 5], Eustachio Agricola [1, 5]

PDF

Diminution des hospit. à J 90 :
de 21,4 à 9,4 %
HR 0,44
CI 0,23 à 0,84 p 0,01
8 pts traités évite 1 hospit
Diminution NT Pro BNP
Amélioration qualité de vie

Quid des études en cliniques ?

EBM CHF abondante et solide + Guidelines pour:

B bloquant

IEC/sartan Entresto

Anti minéralo

Inhibiteur co transport Sodium/glucose type 2

L adaptation des diurétiques reste « artisanale »:

Dose la plus basse efficace (clinique + peptides natriurétiques)

Du fait de l impact délétère hypo TA , hypo Na, dégradation rénale

Etudes en cours pronostic chez l insuffisant cardiaque chronique

randomisée interventionnelle:

adaptation posologie furosémide

paramètres standards vs Standards + echo pleuro pulmonaire

Welcome in the wonderful world of Lung Ultrasound