

# Mon échographe ne sert pas qu'à faire de l'ALR

Dr Riu Poulenc

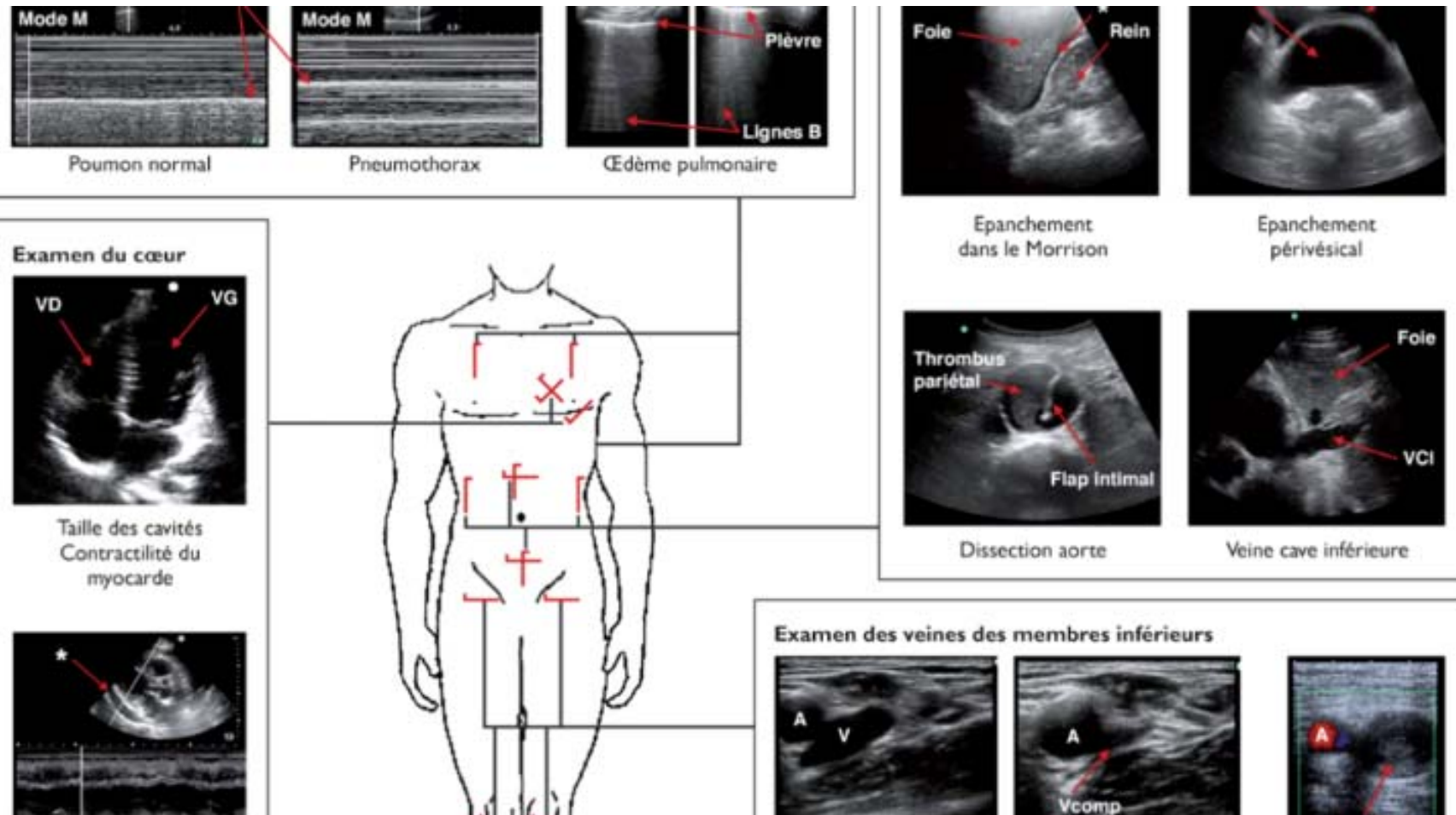
Rencontres d'anesthésie Sanofi

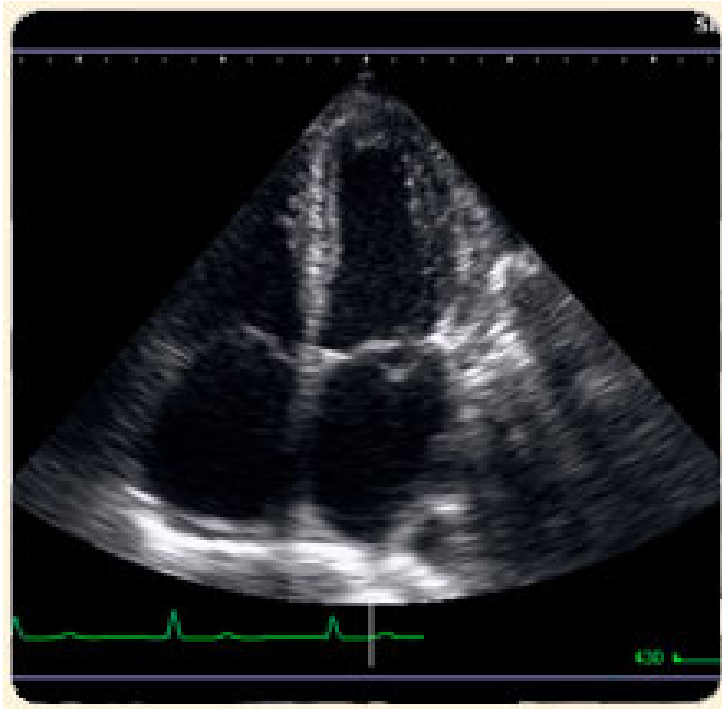
Juin 2016

# Place de l'écho dans le périop

- Orientation diagnostique
  - Diagnostique d'un état de choc
  - Diagnostique d'une détresse respiratoire aigue
- Guide la thérapeutique

# Ce que l'on peut voir rapidement





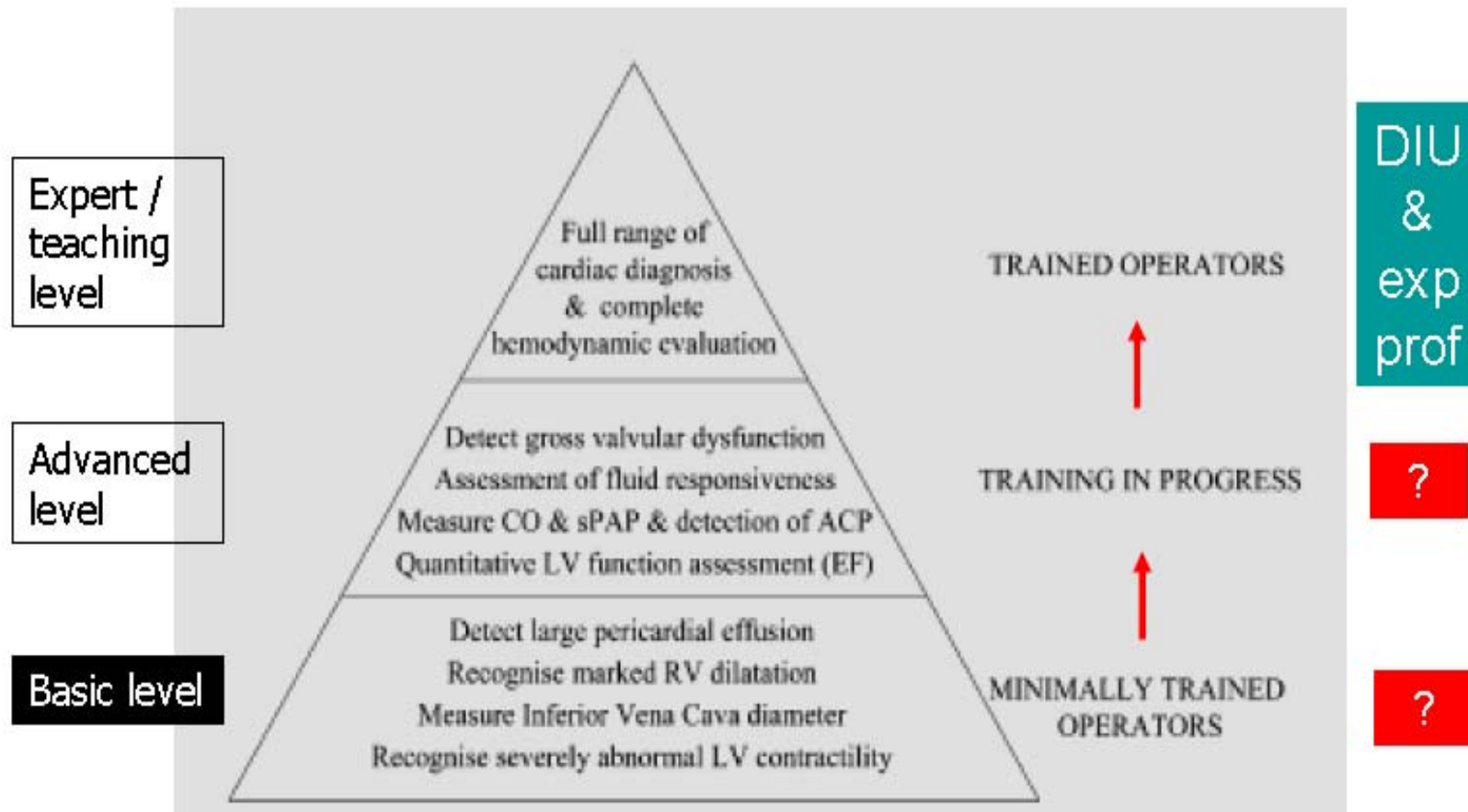
## L' ECHOGRAPHIE CARDIAQUE





Bernard P. Cholley  
Antoine Vieillard-Baron  
Alexandre Mebazaa

## Echocardiography in the ICU: time for widespread use!

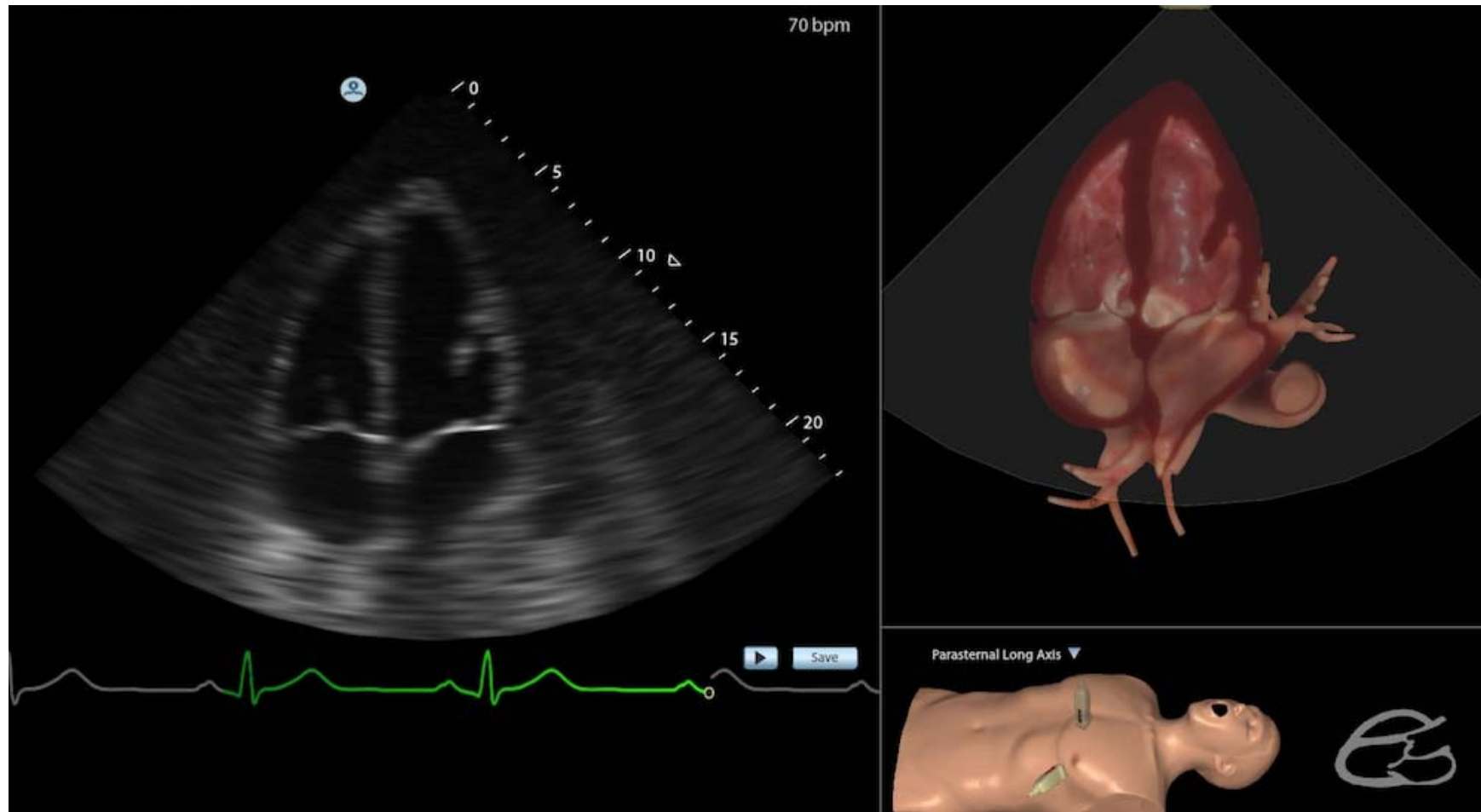


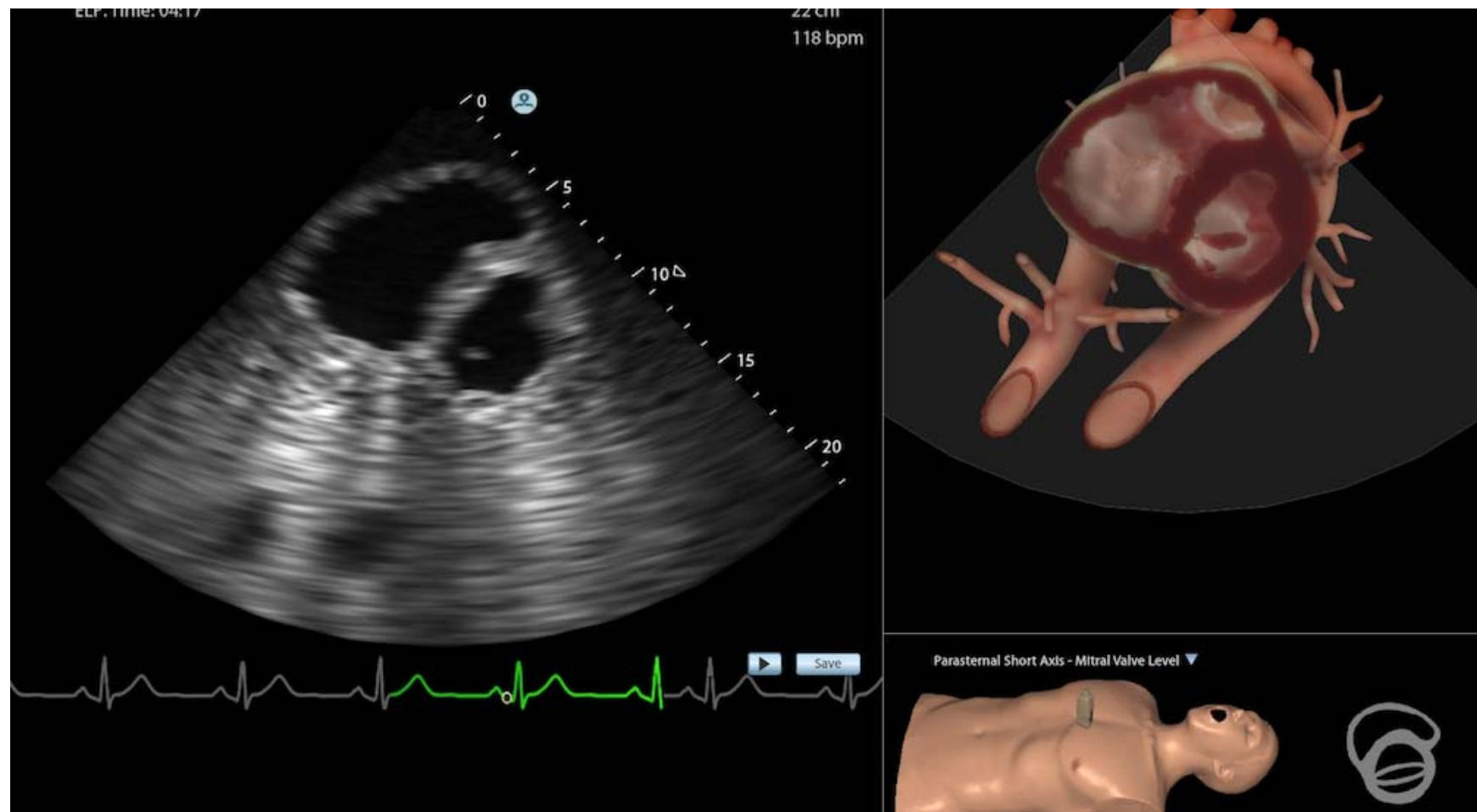


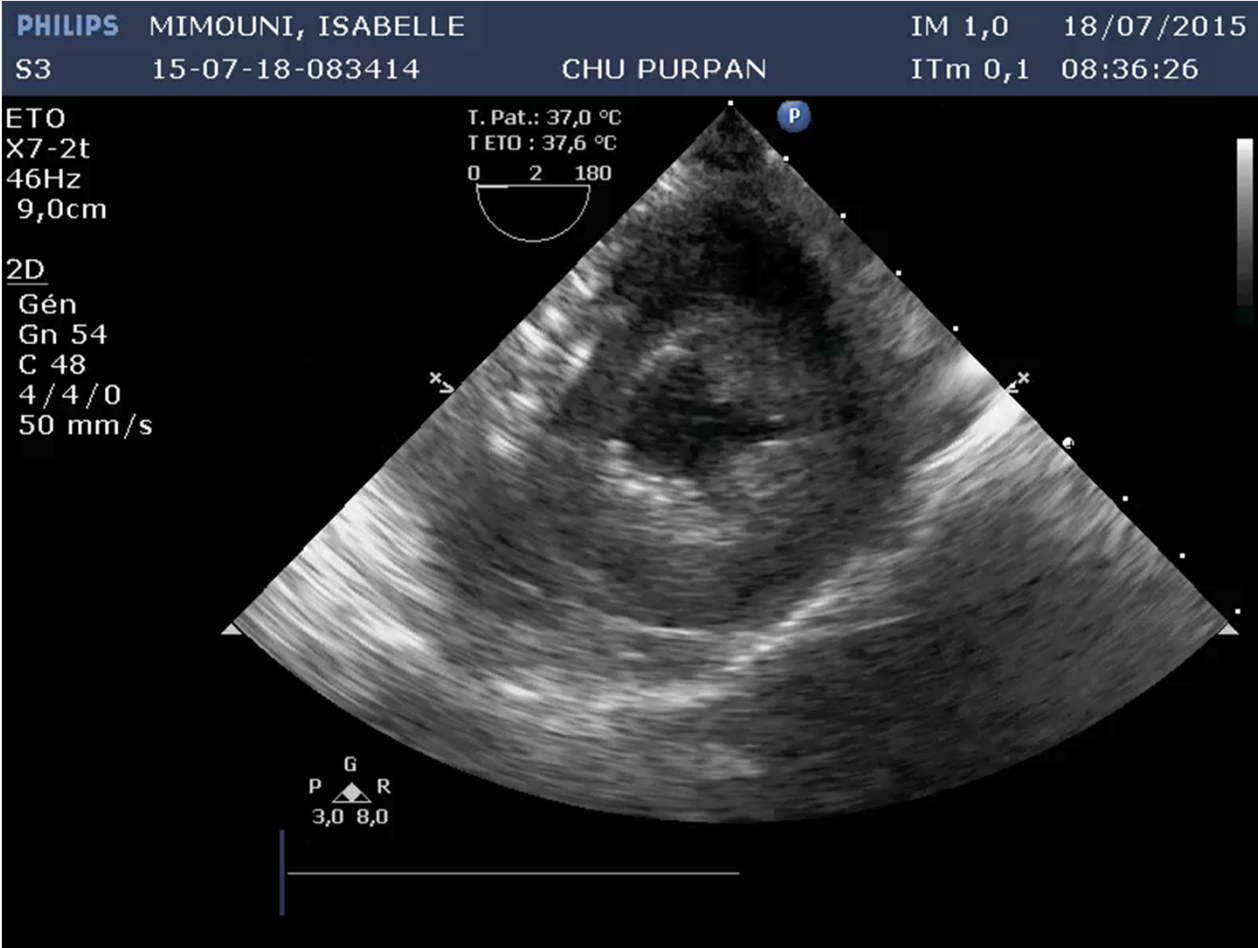
# Que suis je capable de détecter avec un niveau basique

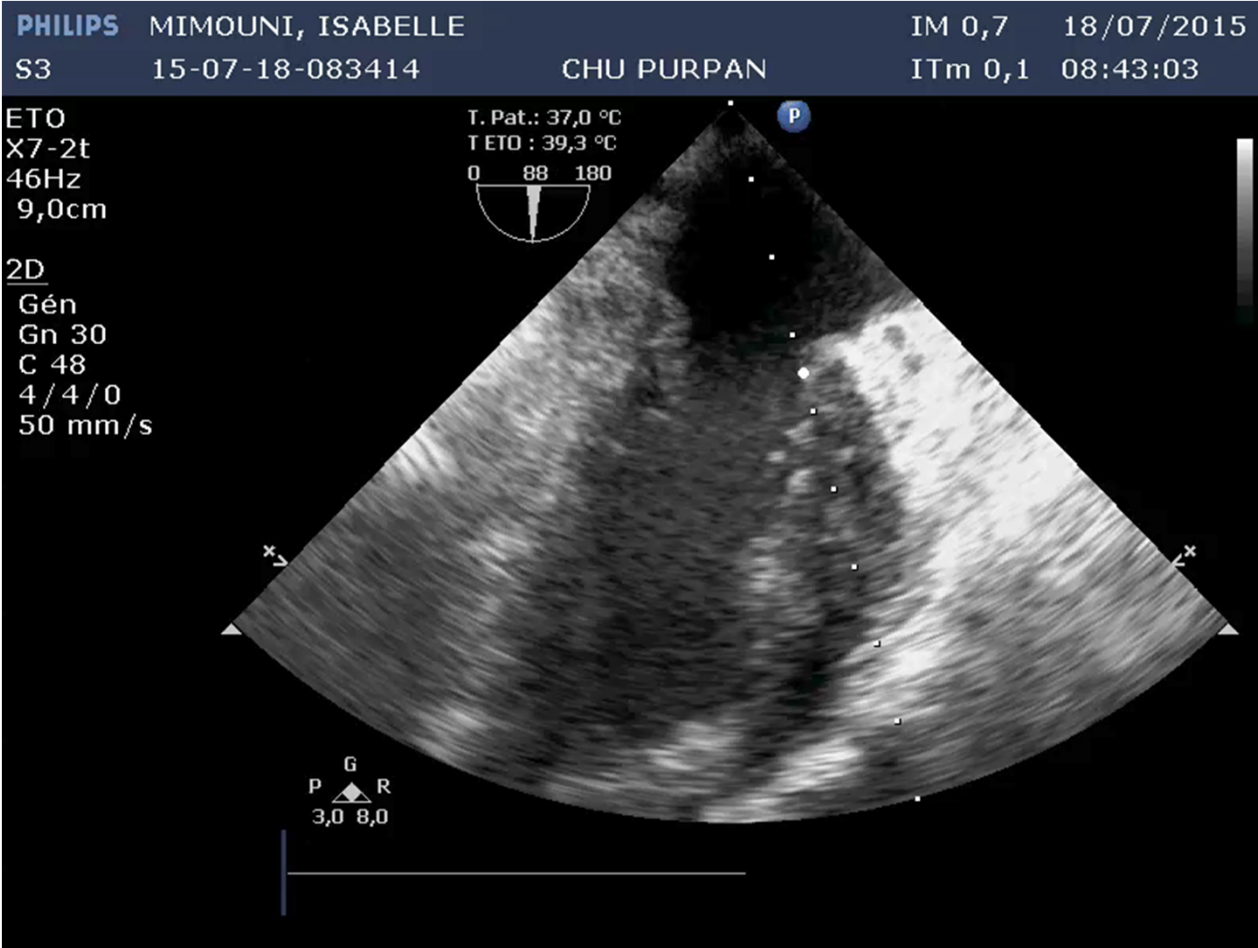
| Tableau clinique                 | À rechercher à l'écho                                                                                                                                                  |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| hypovolémie                      | <ul style="list-style-type: none"><li>-cavités ventriculaires petites</li><li>-Ventricules hyperkinétiques</li><li>-VCI non dilatée variations respiratoires</li></ul> |
| Dysfonction ventriculaire gauche | <ul style="list-style-type: none"><li>-fonction systolique cardiaque globale</li><li>-cinétique segmentaire</li><li>-dilatation ventriculaire gauche</li></ul>         |
| Dysfonction ventriculaire droite | <ul style="list-style-type: none"><li>-Cœur pulmonaire aigu</li><li>-VCI dilatée</li></ul>                                                                             |
| tamponnade                       | <ul style="list-style-type: none"><li>-épanchement péricardique</li><li>-collapsus VD/OD</li><li>- VCI dilaté, pas de variations respi</li></ul>                       |

# hypovolémie







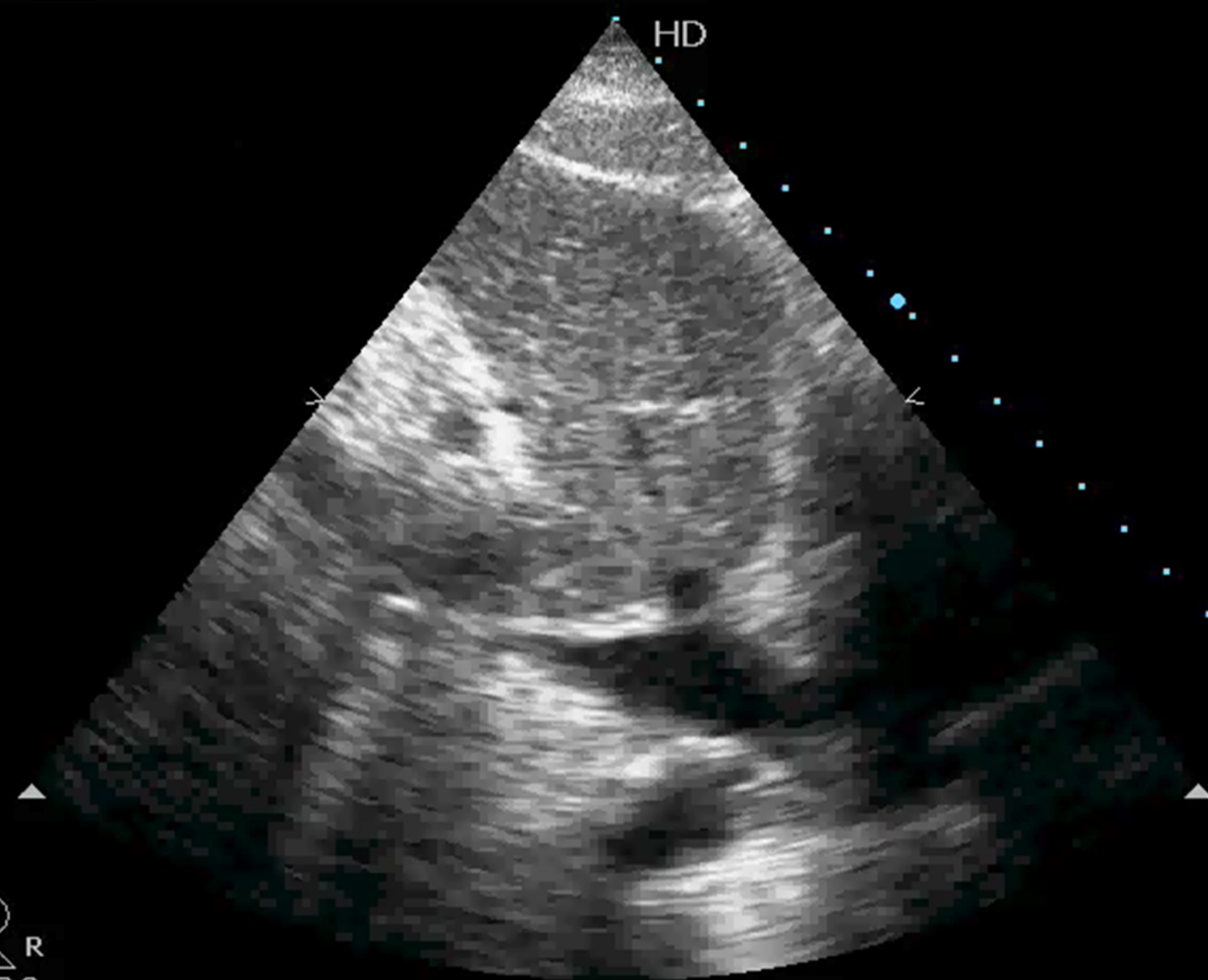




S,  
09-06-08-145940

C.H.U. DE PURPAN REANIMATION

08/06/2009 PHILIPS  
15:07:12



REA  
S4-2  
IM 1,6  
ITM 1,1  
H 3 Gn 55  
232dB/C3  
K / 2 / 1

30Hz 16cm

P  $\begin{matrix} \text{T} \\ \triangle \\ \text{R} \end{matrix}$  R  
1,9 3,8

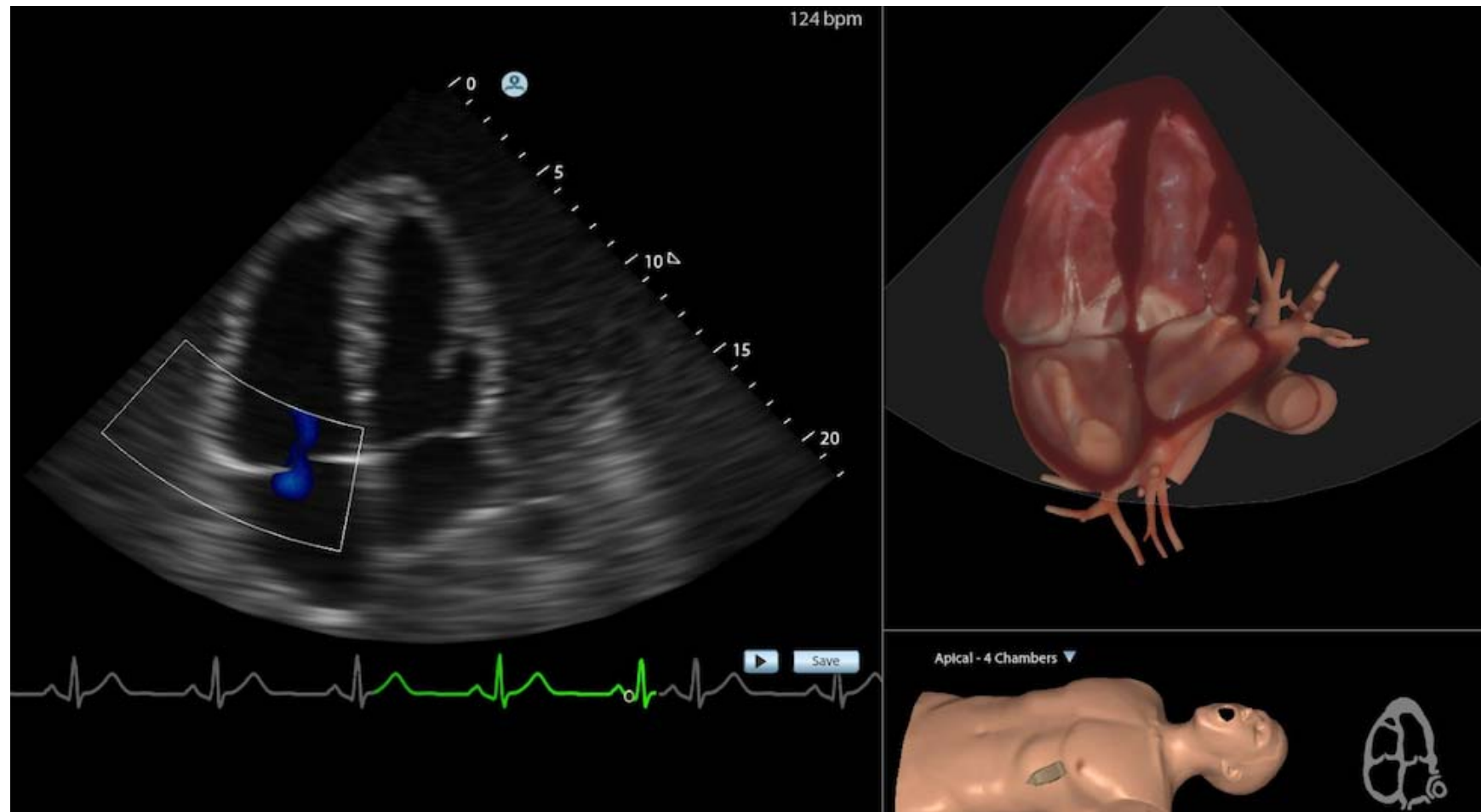
117  
bpm



# Dysfonction VD

- Embolie
  - Gazeuse
  - Graisseuse
  - pulmonaire
- SDRA
  - TRALI

CPA=dilatation VD + septum paradoxal

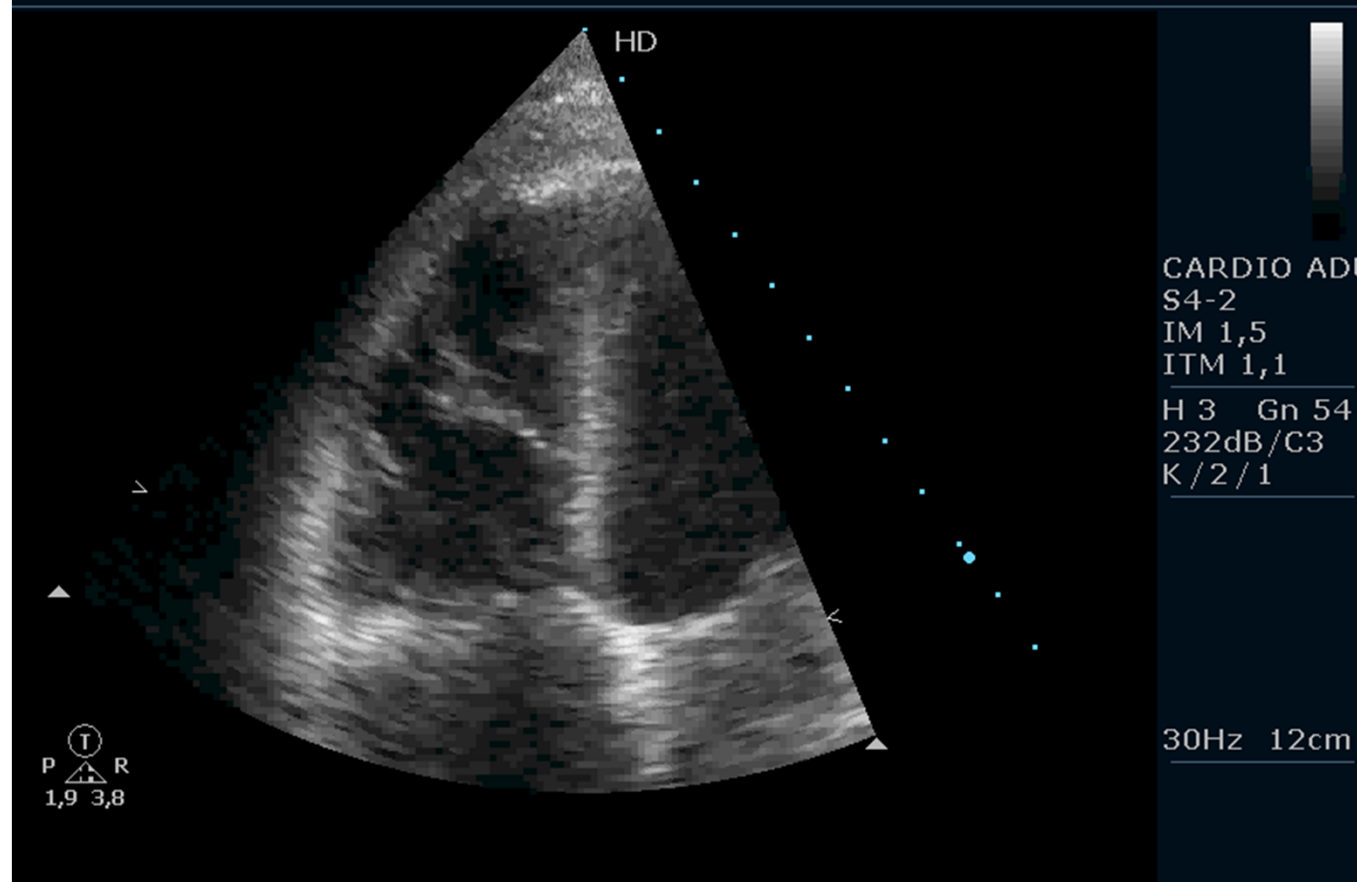


pouget,  
08-02-29-170259

C.H.U. DE PURPAN REANIMATION

29/02/2008  
17:14:07

PHILIPS

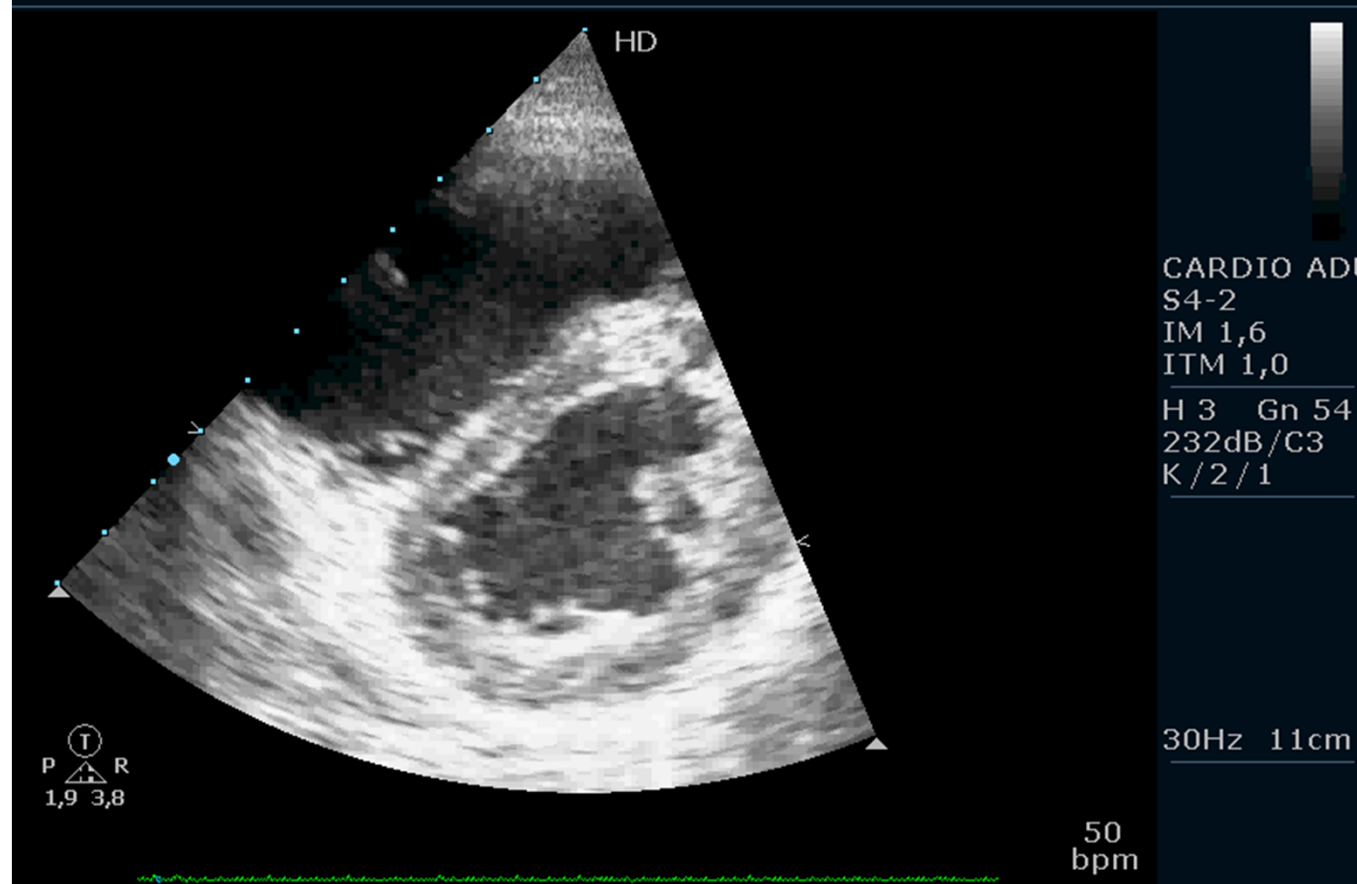


pouget, post NO  
08-02-29-172726

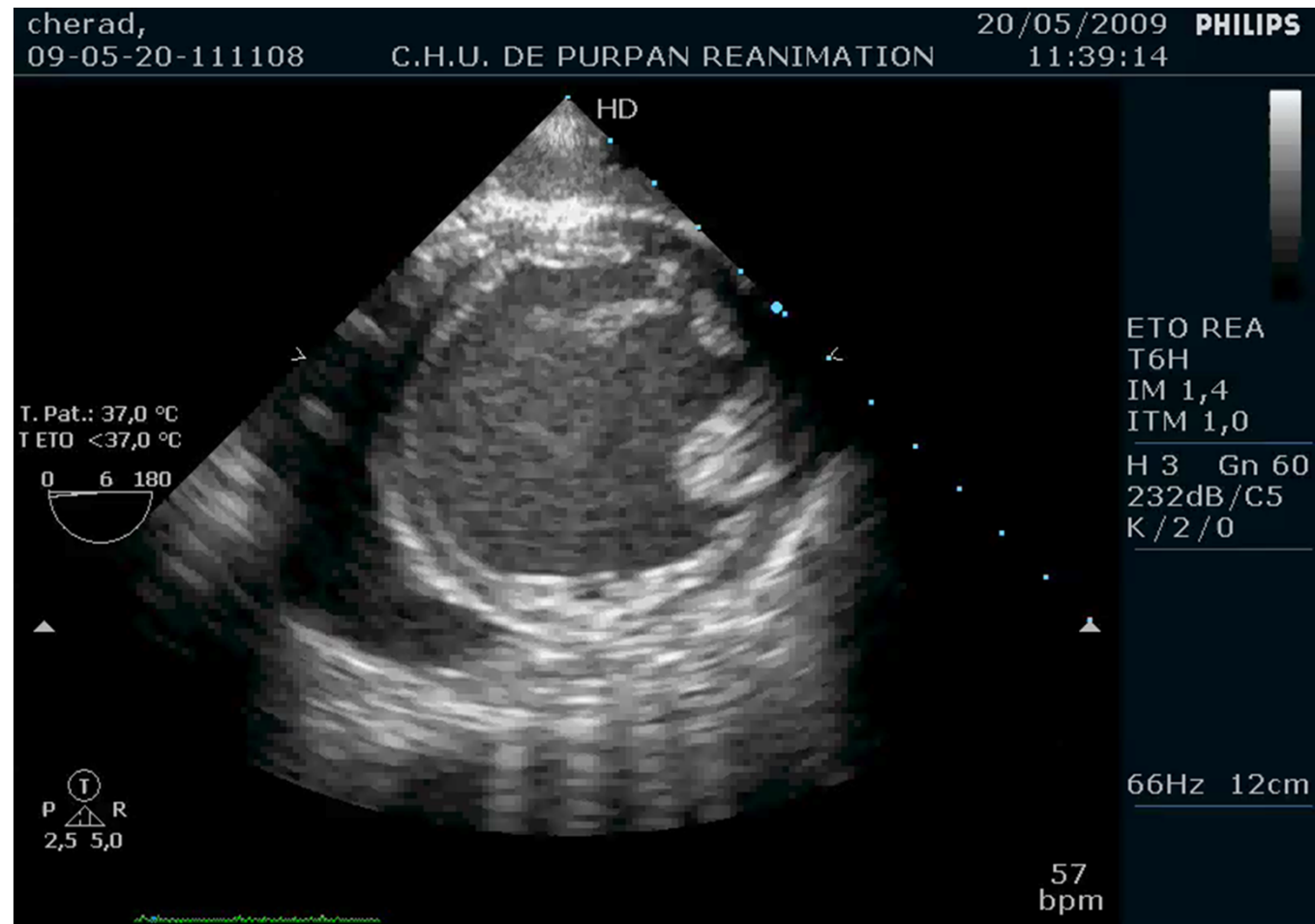
C.H.U. DE PURPAN REANIMATION

29/02/2008  
17:30:06

PHILIPS



# DYSFONCTION VG



**PHILIPS** XXXX, DU ECHO  
15-11-12-072225

CHU PURPAN

IM 1,2 12/11/2015  
ITm 0,4 07:26:39

## Echo adulte

S5-1

28Hz

19,0cm

2D

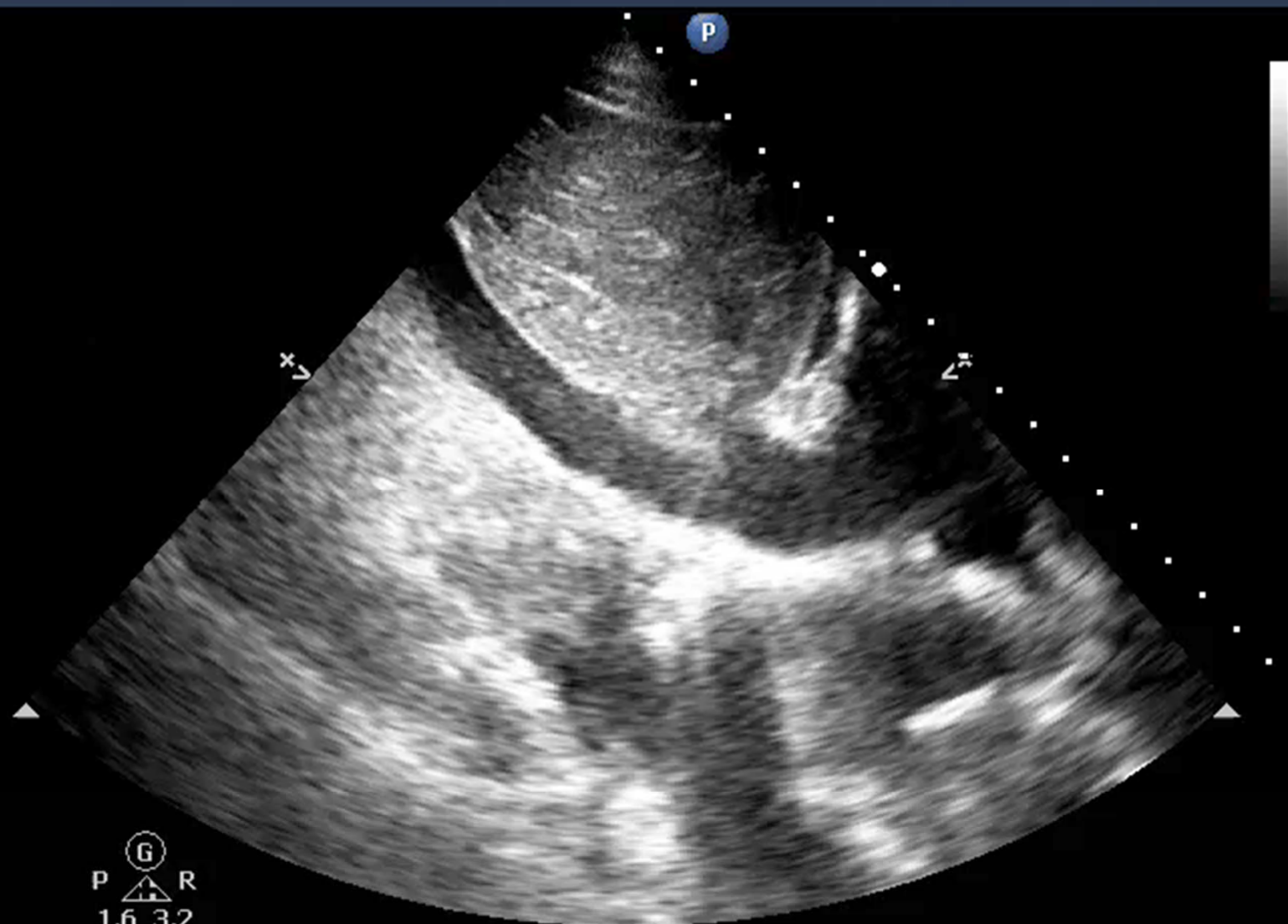
HGén

Gn 50

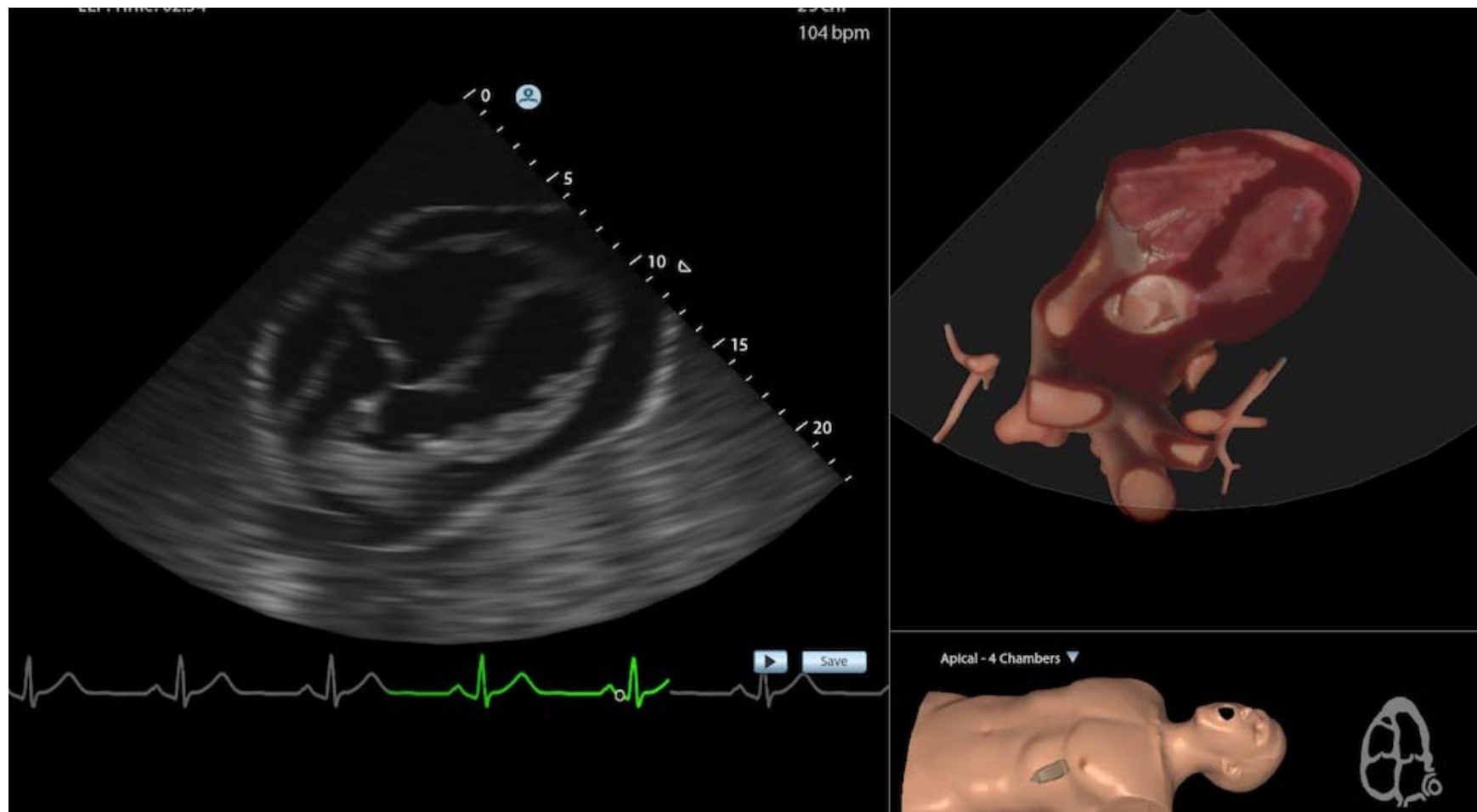
C 50

3 / 2 / 0

75 mm/s



# tamponnade

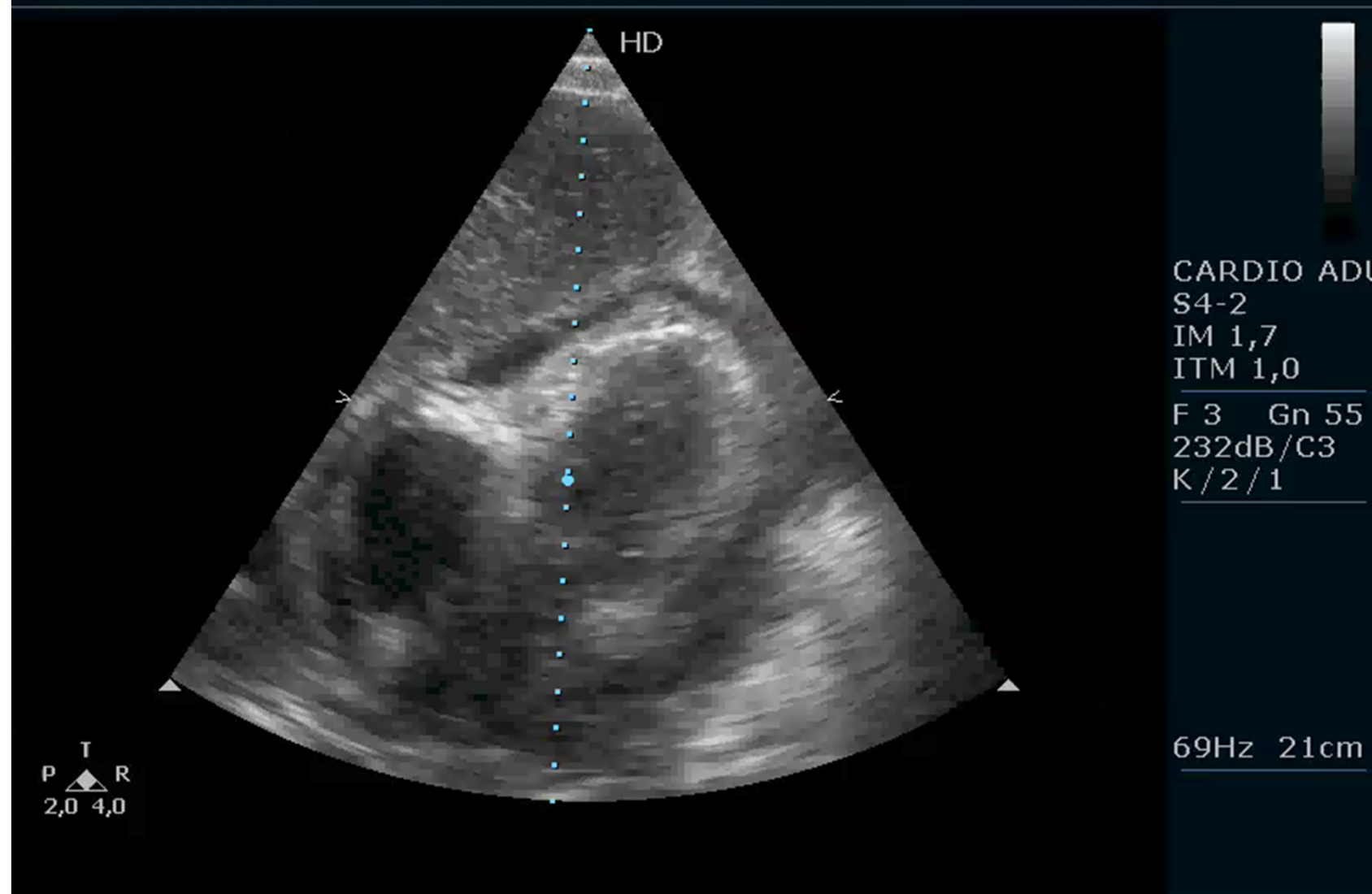


verdeau, patrice  
08-02-14-093445

C.H.U. DE PURPAN REANIMATION

14/02/2008  
09:37:32

PHILIPS

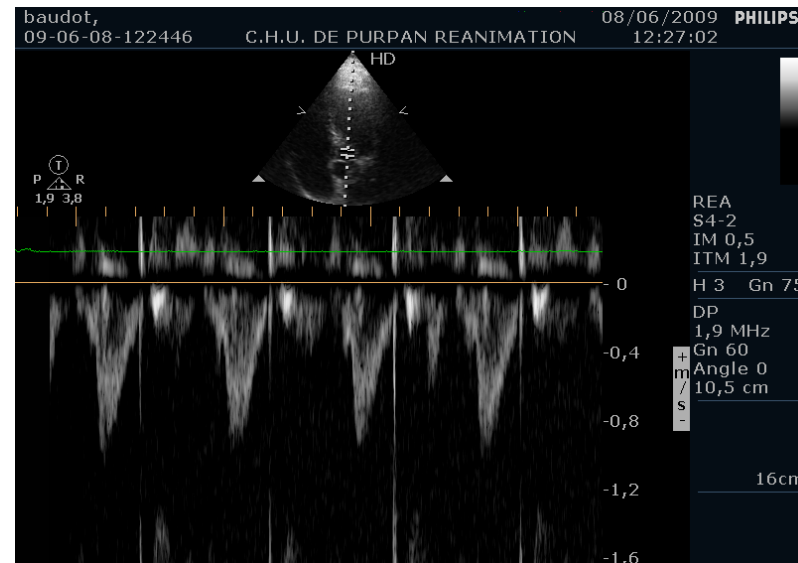
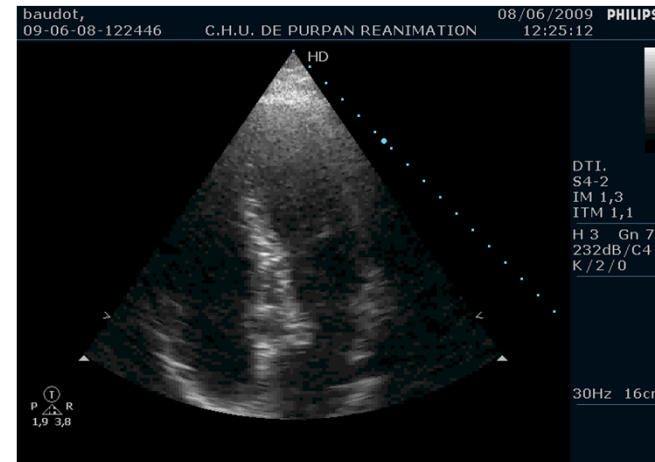




Mon patient est il précharge  
dépendant?

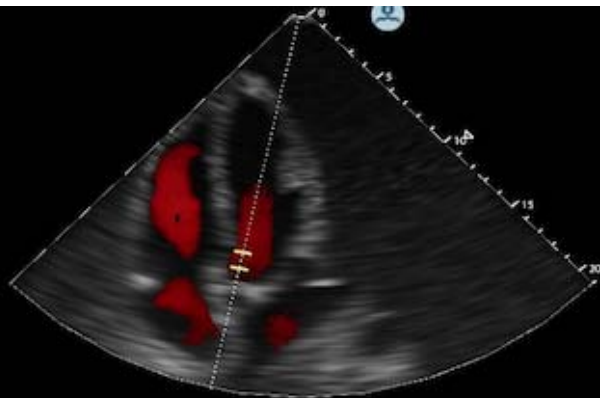
# ITV aortique

- Permet d'évaluer le VES
- $VES = ITV \times Sao$
- $Sao = cte$
- $ITV \propto VES$
- Variation d'ITV de 15% après épreuve de lever de jambe

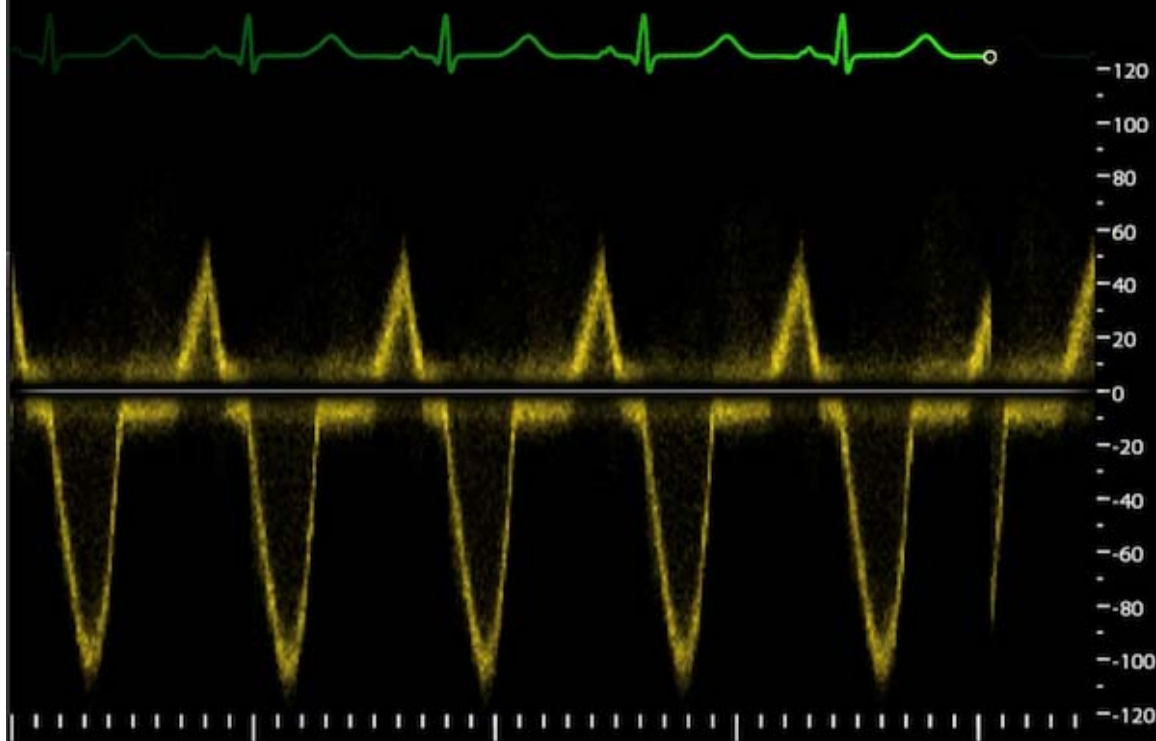


ELP. Time: 01:53

21 cm  
68 bpm



▶ Save



Parasternal Long Axis ▼

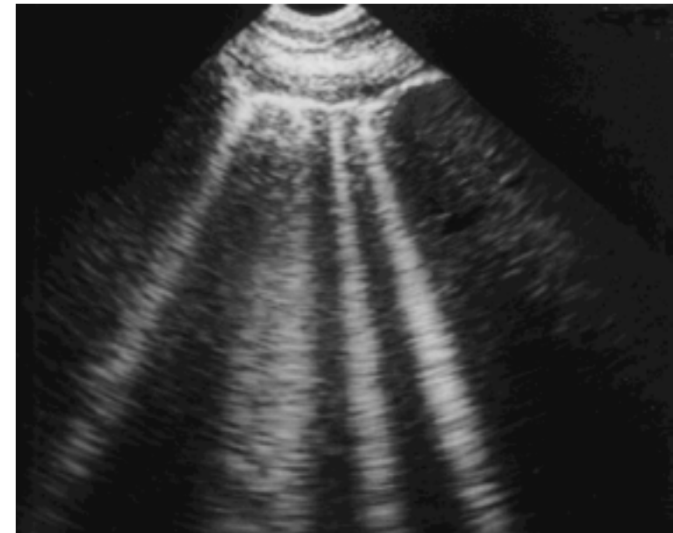
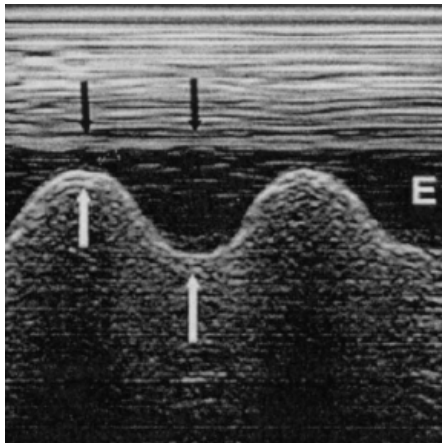


# Diagnostic d'une DRA en périop

Au lit du malade



## L' ECHOGRAPHIE PULMONAIRE



# US dans le poumon

- Semblait peu accessible, faible pénétration US ds l'air
- Outil diagnostic: pneumopathie, atélectasie, syndrome interstitiel, pneumothorax, épanchement pleural
- Faible sensibilité RT
- Risque TDM

Nektaria Xirouchaki  
Eleftherios Magkanas  
Katerina Vaporidi

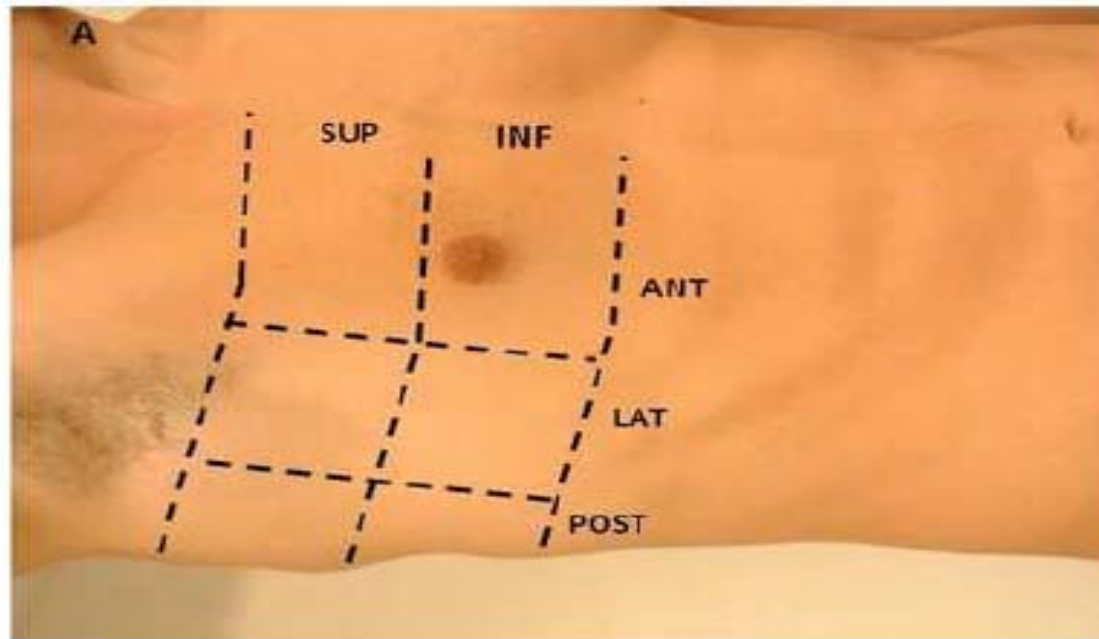
## Lung ultrasound in critically ill patients: comparison with bedside chest radiography

|     | consolidation                                | Sd interstitiel                             | pneumothorax                                | Épanchement pleural                            |
|-----|----------------------------------------------|---------------------------------------------|---------------------------------------------|------------------------------------------------|
| RT  | Se : 38 %<br>Sp : 89 %<br>$\Delta c$ : 49 %  | Se : 46 %<br>Sp : 80 %<br>$\Delta c$ : 58 % | Se : 0 %<br>Sp : 99 %<br>$\Delta c$ : 89 %  | Se : 65 %<br>Sp : 81 %<br>$\Delta c$ : 69 %    |
| EPP | Se : 100 %<br>Sp : 78 %<br>$\Delta c$ : 95 % | Se : 94 %<br>Sp : 93 %<br>$\Delta c$ : 94 % | Se : 75 %<br>Sp : 93 %<br>$\Delta c$ : 92 % | Se : 100 %<br>Sp : 100 %<br>$\Delta c$ : 100 % |

# Lieu mélange air eau

- Désordre riche en eau (pleurésie, pneumonie) dans les zones post
- Désordres riches en air (pneumo, syndrome interstitiel ) en antérieur ou latéral





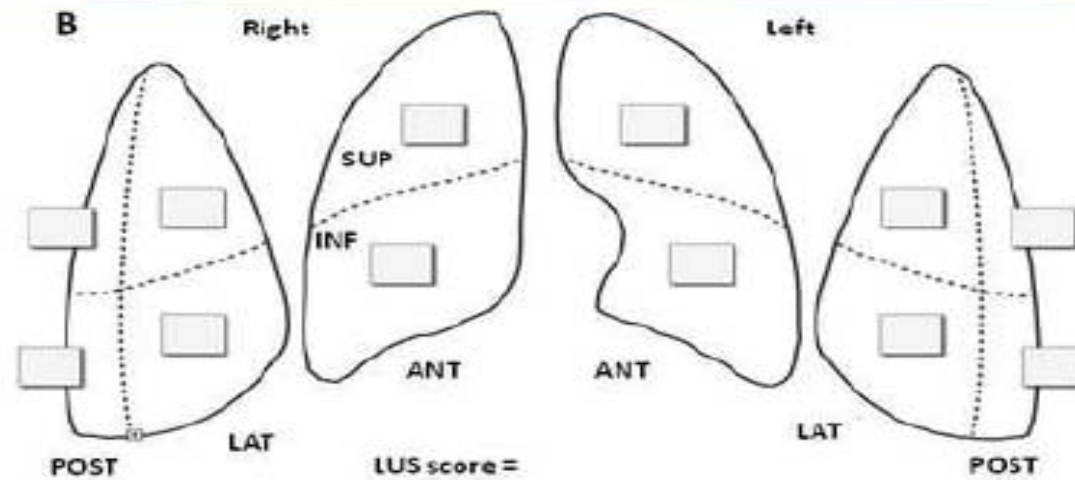
**LUS**

0=normal

1=syndrome  
interstitiel

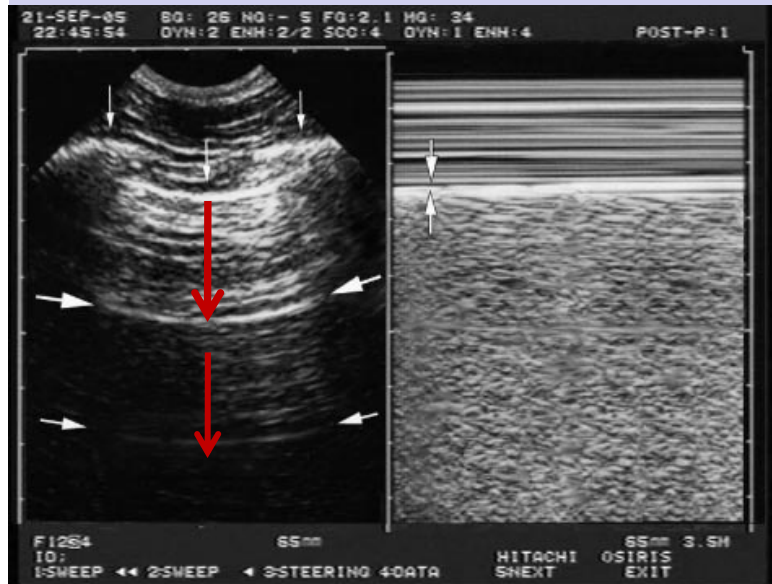
2=Syndrome alvéolo  
interstitiel

3=condensation

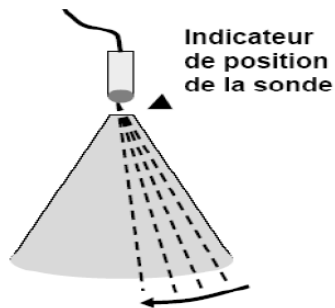


Bouhemad B, rouby JJ, Arbelot C, AJRCCM  
2011

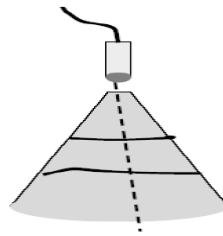
# Echo pleurale normale



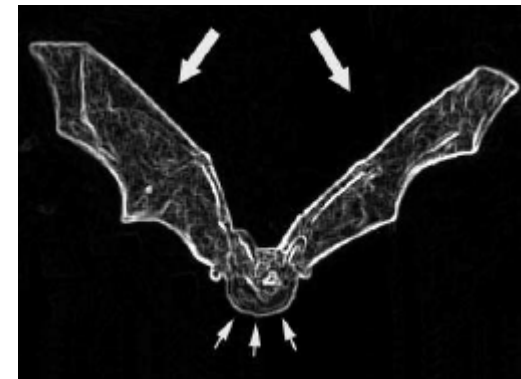
- Localisation ligne pleurale, hyperéchogène
- Signe de la chauve souris
- Ligne A: Artefact basic poumon normalement aéré



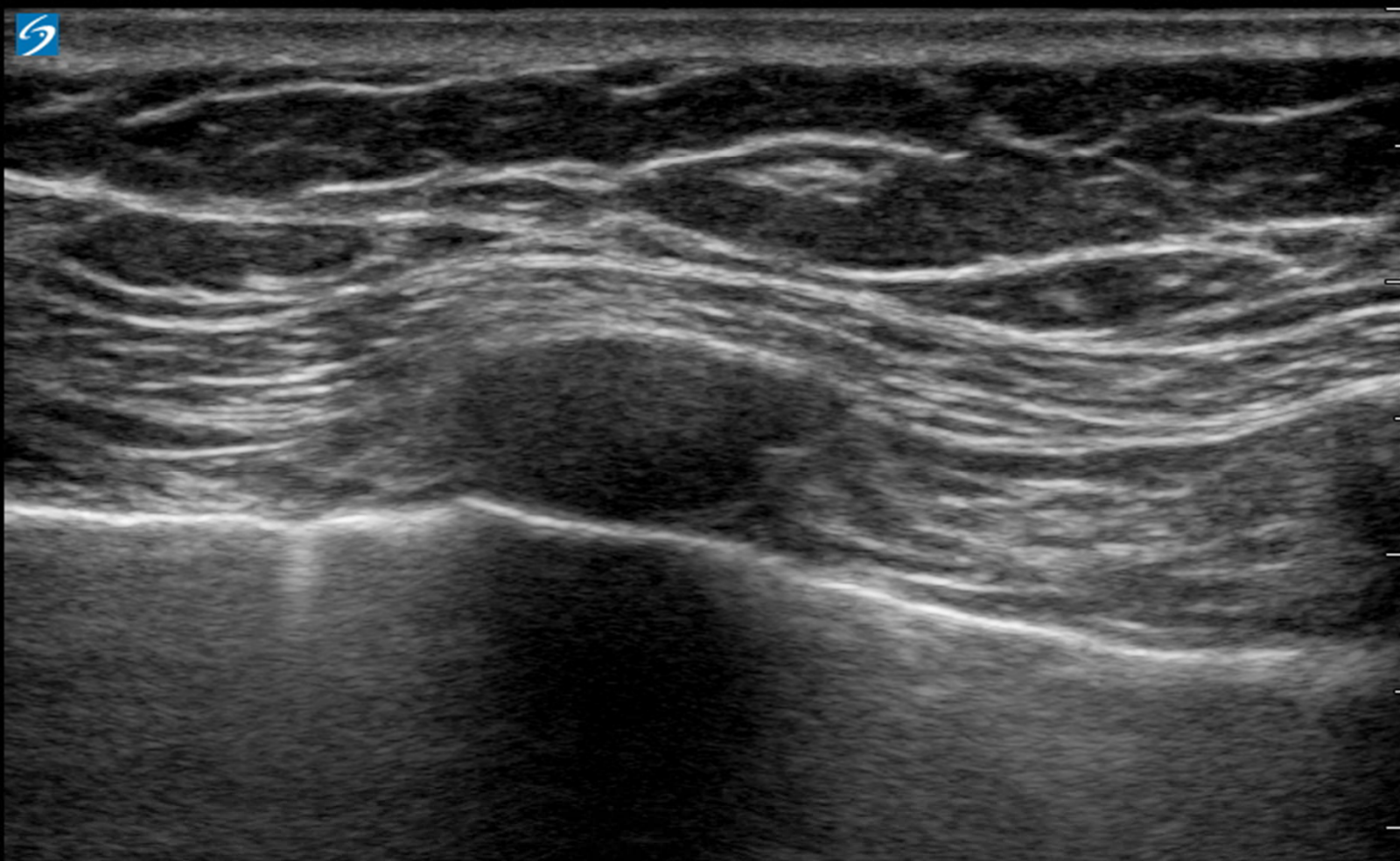
2 D



TM



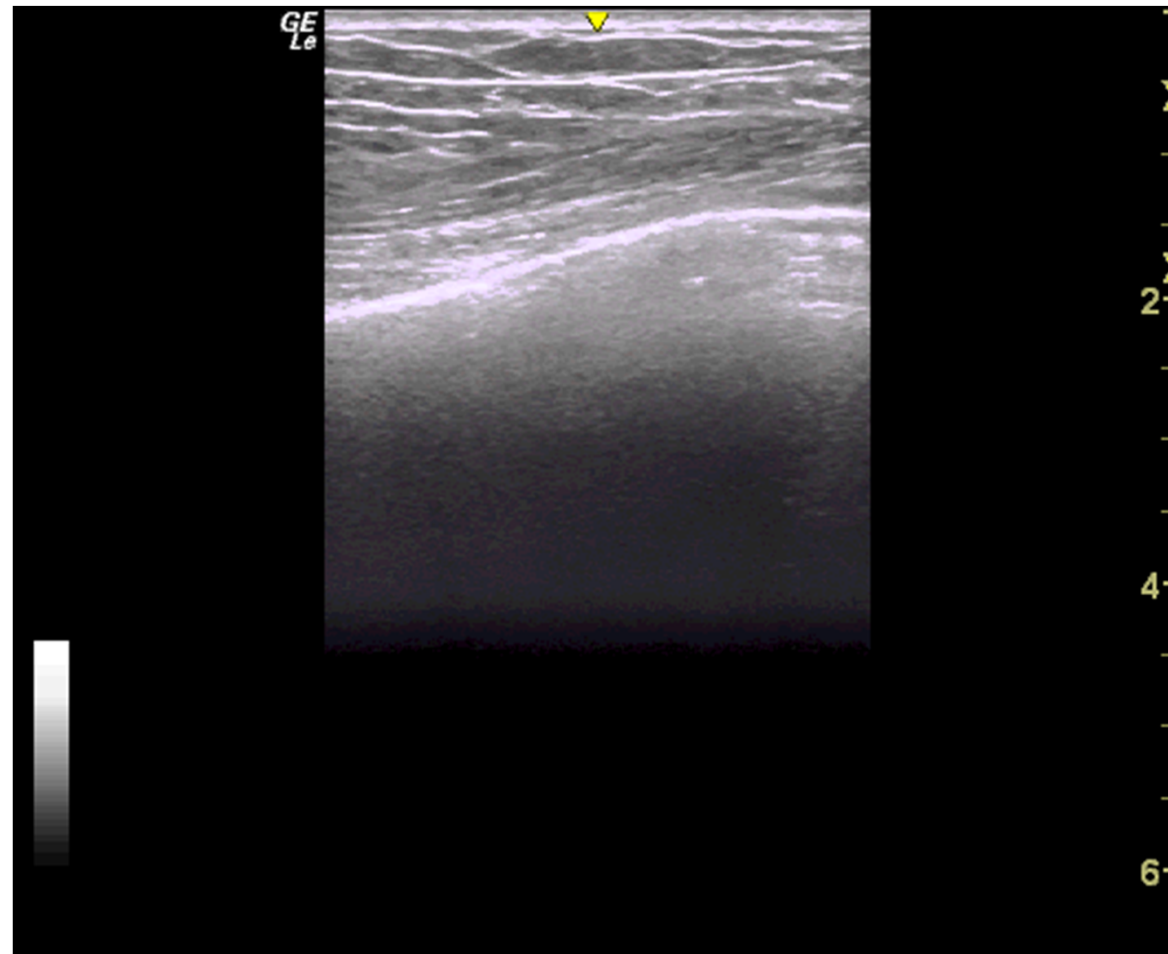
14 Jan 2014 / 17:57



**SonoSite**  
HFL50xp/15-6 Neuro.  
IM: 0.6 ITM: 0.2

3.1 cm

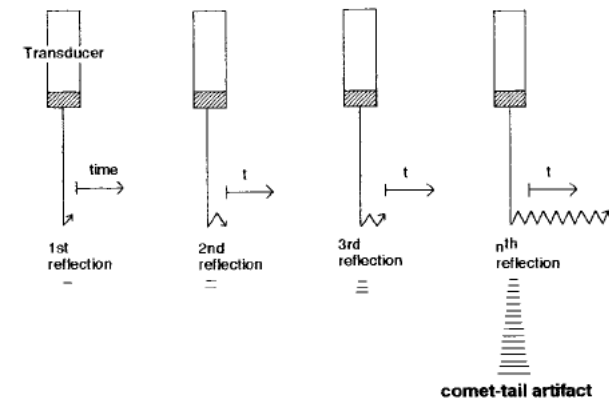
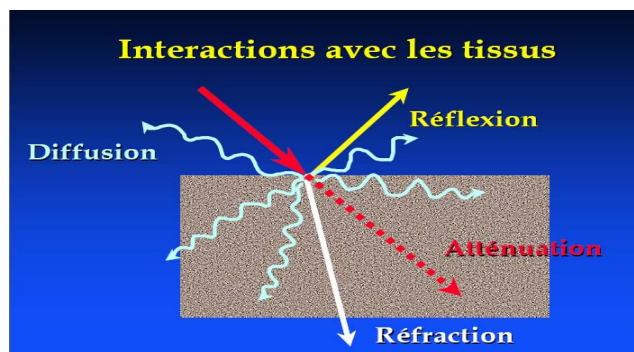
2D: G: 50  
PD: 0  
MB



# Syndrome interstitiel



- Artéfact en queue de comète ( ligne B )
- Naissent de la ligne pleurale
- En rayon laser
- Hyperéchogènes
- Descendant sans épuisements
- Effacent les lignes A
- mobiles





14 Jan 2014 / 12:59



**SonoSite**

P21xp/5-1 Cardiaque  
IM: 1.3 ITM: 0.6

13.0 cm

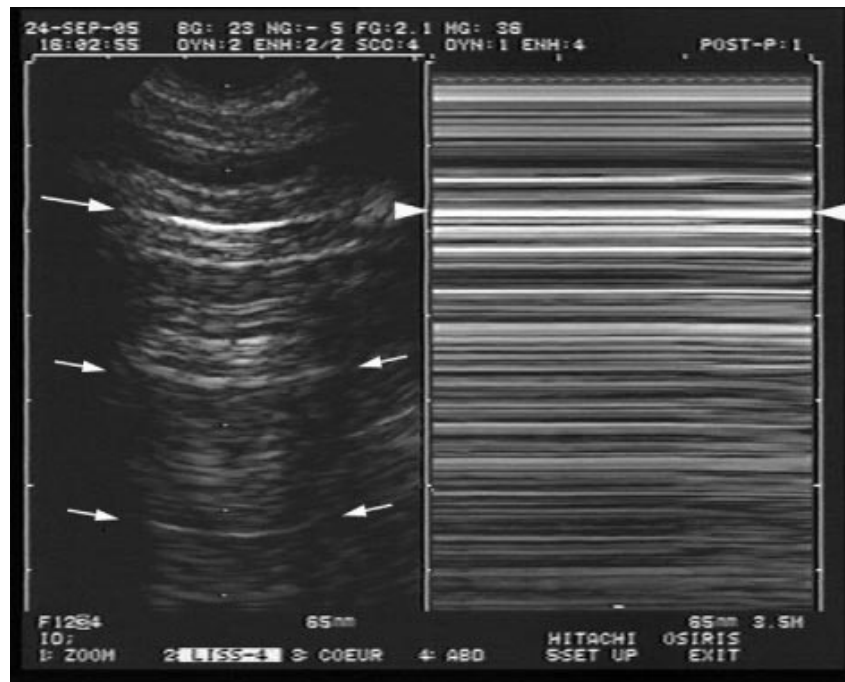
2D: G: 65  
PD: 0

THI

# Pneumothorax

Se: 94%, Sp: 95%

**Abolition du glissement pleural  
VPP 100%**

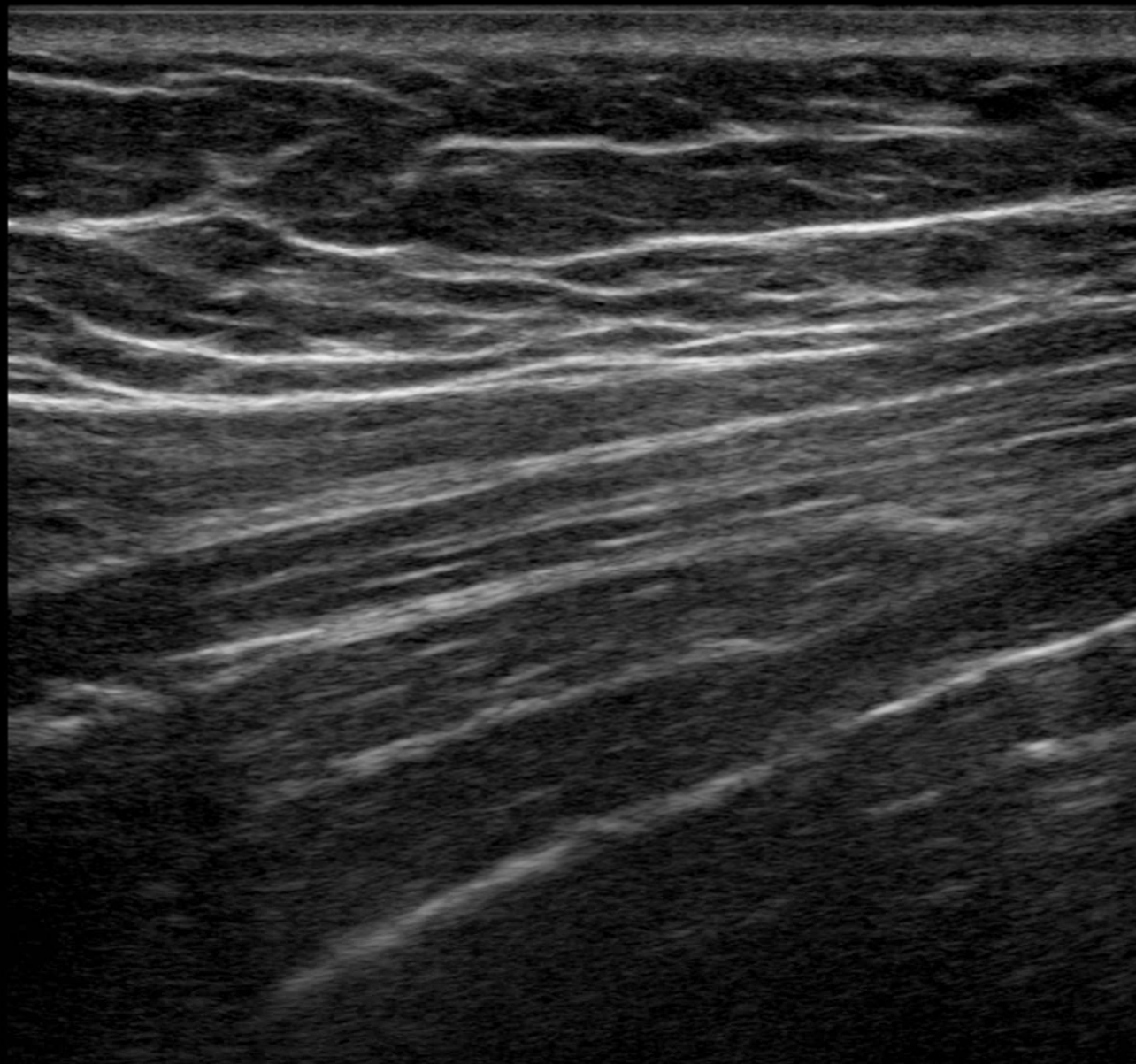


**Point poumon  
Spécifique à 100%**



Lichtenstein D, Mezière G, Lascols N, Biderman P, Courret JP, Gepner A, et al.  
Ultrasound diagnosis of occult pneumothorax.  
Critical Care Med 2005;33:1231–8.

14 Jan 2014 / 12:38



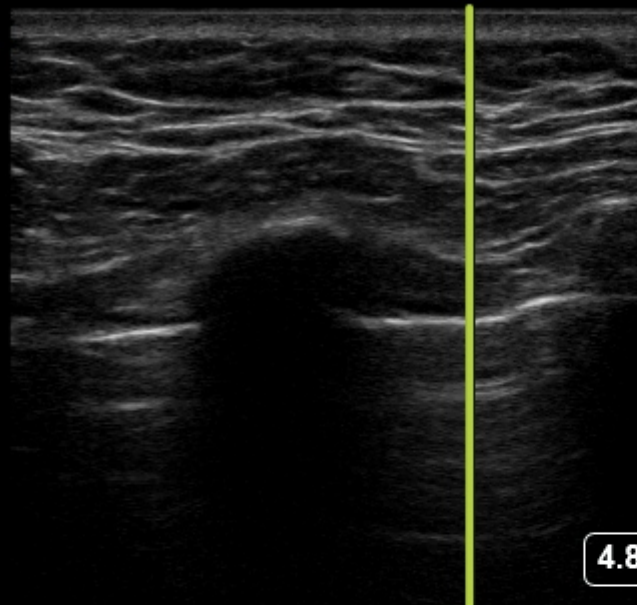
4.8 cm

**SonoSite**  
HFL50xp/15-6 Neuro.  
IM: 0.7 ITM: 0.2

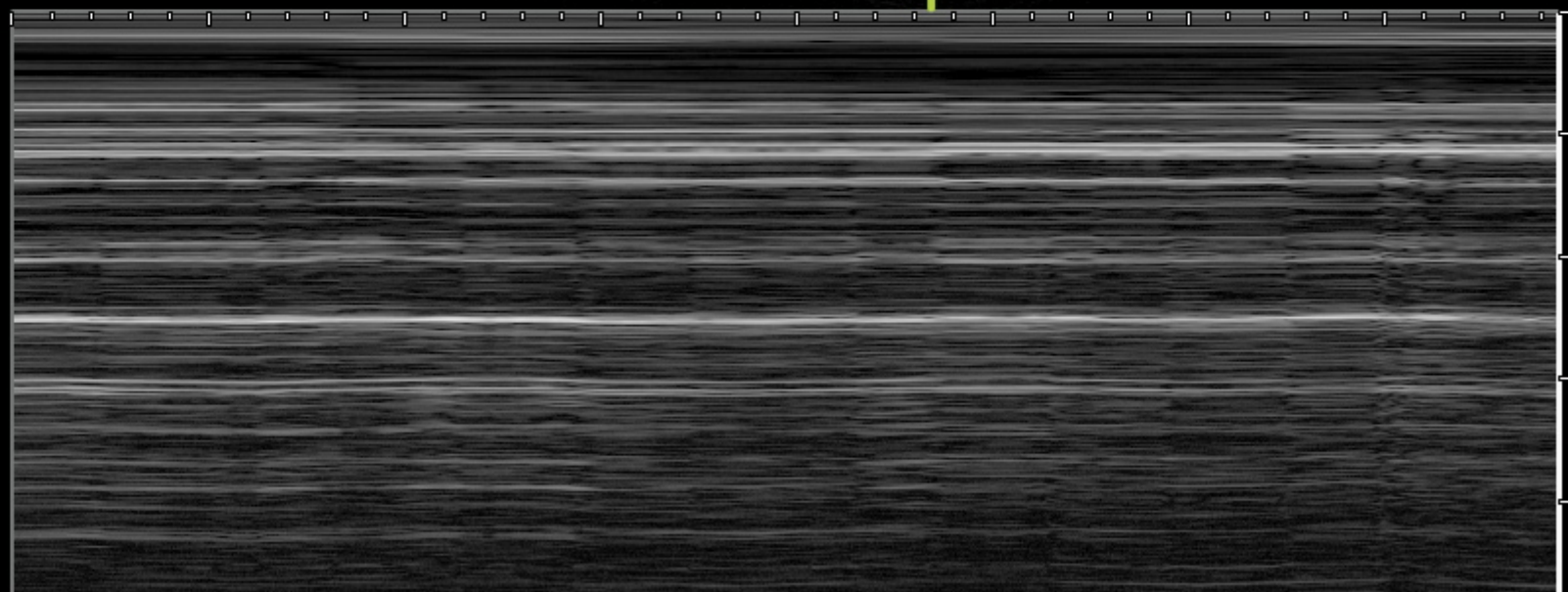
**2D:** G: 50  
PD: 0  
MB



14 Jan 2014 / 12:39



4.8 cm

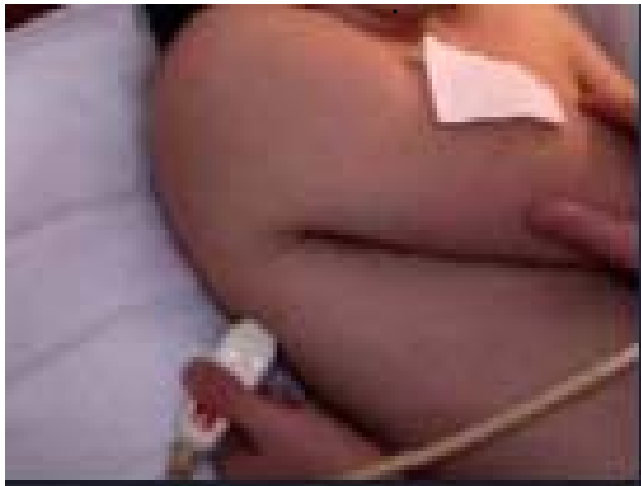


**SonoSite**  
HFL50xp/15-6 Neuro.  
IM: 0.9 ITM: 0.2

**M:** G: 50 **2D:** G: 50  
PD: 0

# Épanchement pleural

Se:94%, Sp:97%



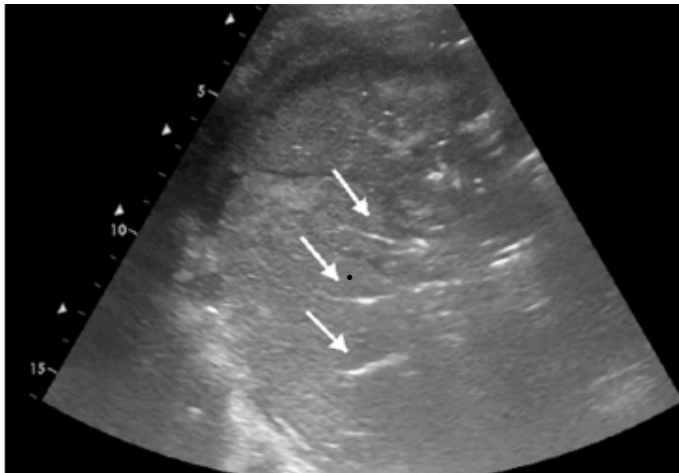
Lichtenstein D, Mezière

• Feasibility and safety of ultrasound-aided thoracentesis in mechanically ventilated patients.

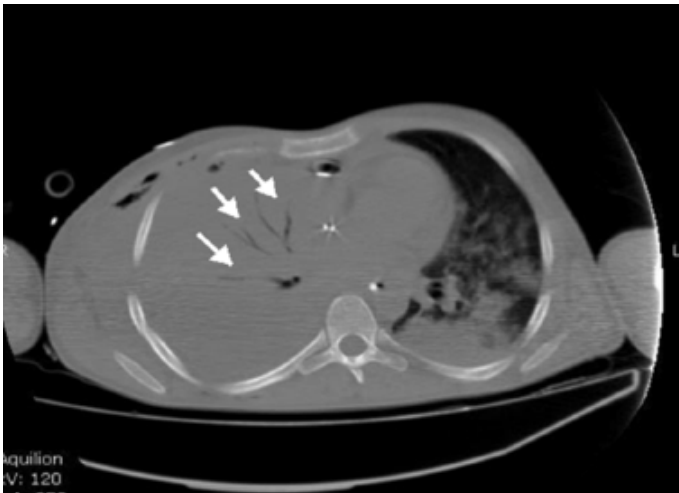
Intensive Care Med 1999;25:955–8.

# Consolidation alvéolaire

Se:90%, Sp:98%



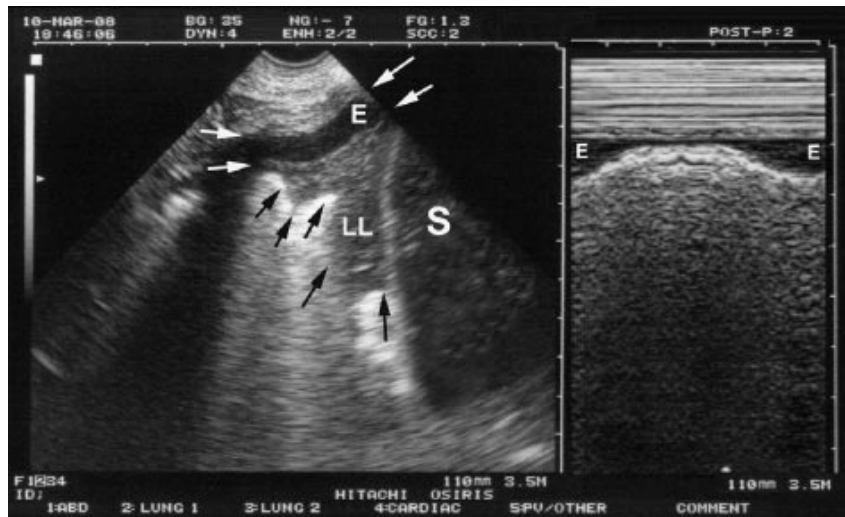
- signe du poumon tissulaire: tissu solide avec échogénicité tissulaire (hépatisation)
- + spécifique que la RT
- Lignes hyperéchogène bronchogramme aérique



*Lichtenstein D, .  
Ultrasound diagnosis of alveolar consolidation  
in the critically ill.  
Intensive Care Med 2004;30:276—81.*

# PLAPS

postero lateral alveolar and pleural syndrome



Zone 3, condensation pulmonaire et épanchement pleural  
Flèches noires = bronchogramme aérique

14 Jan 2014 / 13:00



**SonoSite**

P21xp/5-1 Cardiaque  
IM: 1.3 ITM: 0.6

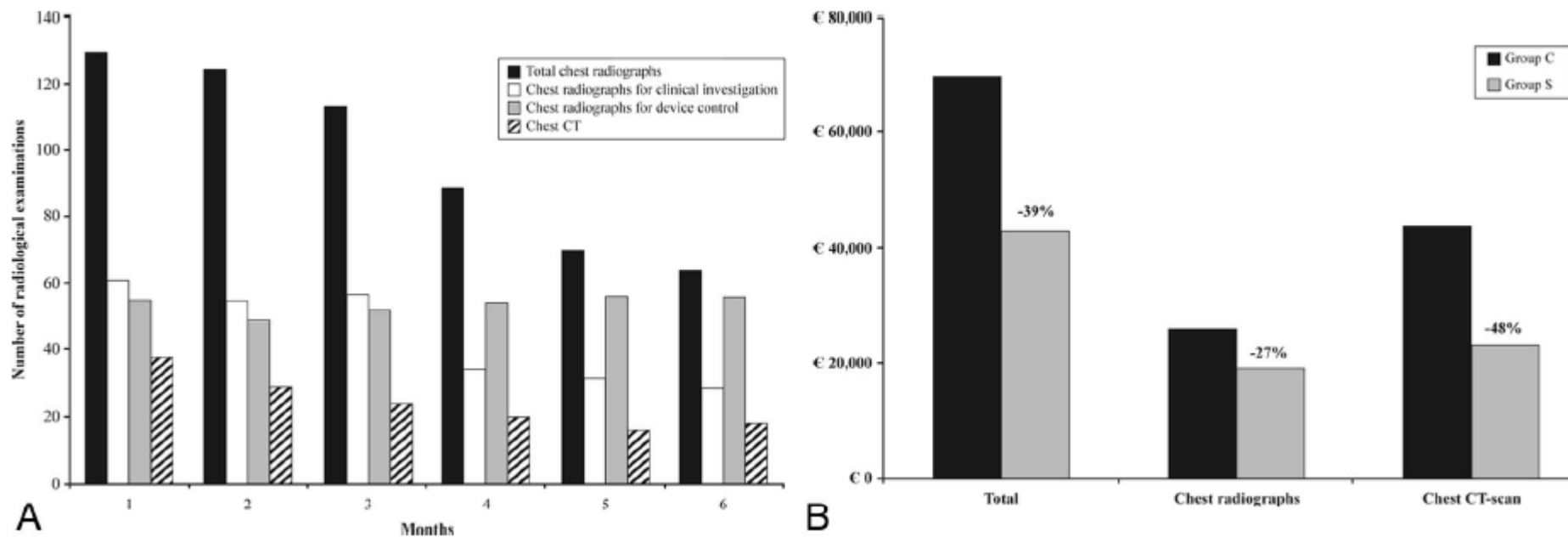
13.0 cm

2D: G: 65  
PD: 0

THI



# Étude médico économique

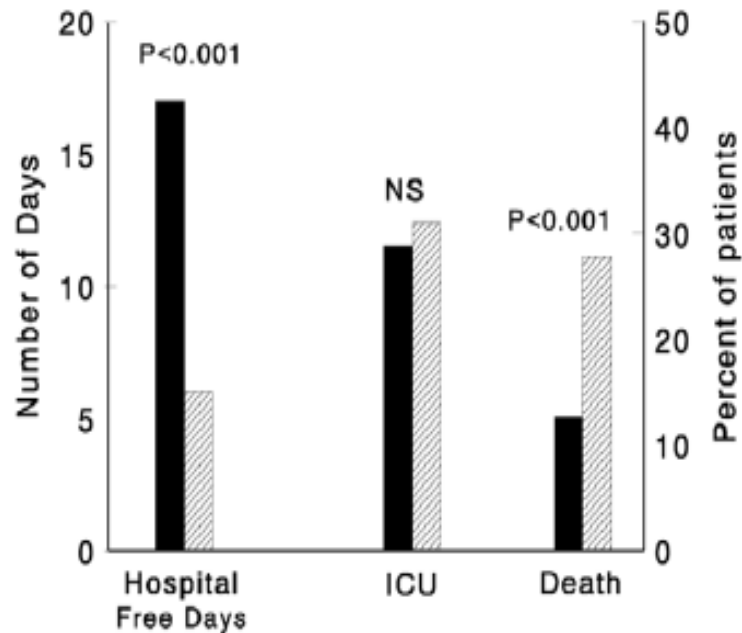


6mois, 376 patients

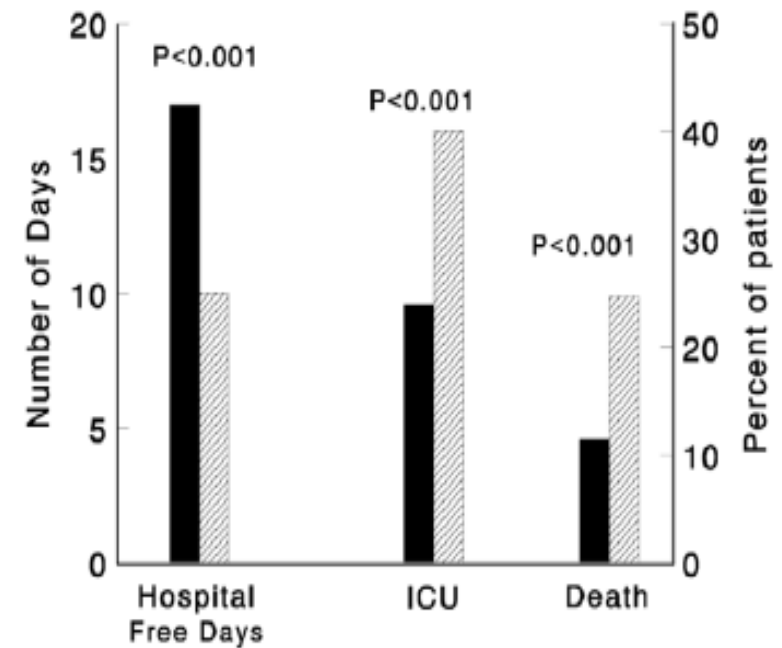
**Conclusion:** Routine use of LUS in the ICU setting can be associated with a reduction of the number of chest radiographs and CT scans performed.  
(Balik M, Anesth Analg 2010;111:687-92)



(a) Emergency Diagnosis



(b) Emergency Treatment



Effects of an appropriate medical care in the emergency department on prognosis. Effects of an appropriate (full bars) or inappropriate (hatched bars) diagnosis in the emergency department (a) or initial emergency treatment (b) on the number of hospital-free days within 1 month after admission (expressed as median), percentage of patients admitted to intensive care unit (ICU), or mortality. NS, not significant.

**DRA : >20% d'erreur diagnostique aux urgences**

*Acute respiratory failure in the elderly : etiology, emergency diagnosis and prognosis.  
Crit Care 2006; 10(3):R82 ; Ray P.*

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

Daniel A. Lichtenstein and Gilbert A. Mezière

*Chest* 2008; 134;117-125; Prepublished online April 10, 2008;  
DOI 10.1378/chest.07-2800

- Étude observationnelle
- Patients consécutifs hospitalisés pour DRA, 1 centre, 304 patients, 4 ans
- Comparaison entre écho pulm initial et diagnostique final retenu (CR de sortie)
- 3 items:
  - Artefacts (ligne A, ligne B)
  - Glissement pleural
  - Condensation pulm +/- épanchement pleural

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

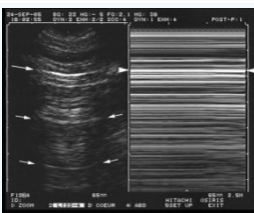
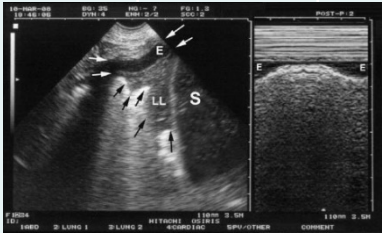
Daniel A. Lichtenstein and Gilbert A. Mezière

*Chest* 2008; 134;117-125; Prepublished online April 10, 2008;  
DOI 10.1378/chest.07-2800

- Objectif principal: pertinence de l'écho pulmonaire pour le diagnostique DRA
- BLUE PROTOCOL: Bedside Lung US in Emergency

**Table 1—Final Diagnoses and Methods of Diagnosis**

| Diagnoses                                                                        | Methods                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| For all patients                                                                 | History, clinical examination, radiography read by radiologists, CT when available (n = 38), favorable clinical progression under treatment, and:                                                                                                                                                                                                                              |
| Cardiogenic pulmonary edema (referred to as <i>pulmonary edema</i> ) [n = 64]    | Evaluation of cardiac function using echocardiography, functional tests, and American Heart Association recommendations                                                                                                                                                                                                                                                        |
| Pneumonia (n = 83)                                                               | Infectious profile, radiologic asymmetry, microorganism isolated (blood, invasive tests), recovery with antibiotics. Included were infectious, aspiration, community, or hospital-acquired pneumonia. Pneumonia complicating chronic respiratory disease was classified as pneumonia. Beginning ARDS (n = 7) and massive atelectasis (n = 1) were included in this group       |
| Decompensated chronic respiratory disease (referred to as <i>COPD</i> ) [n = 49] | Condition defined as exacerbation of chronic respiratory disease without pneumonia, pneumothorax, pulmonary edema, pleurisy, or pulmonary embolism. COPD was confirmed by functional tests. Patients with simple bronchial superinfection were classified in this case. COPD patients with pneumonia, pneumothorax, etc, were first considered as pneumonia, pneumothorax, etc |
| Acute asthma (n = 34)                                                            | History, responds to bronchodilator treatment                                                                                                                                                                                                                                                                                                                                  |
| Pulmonary embolism (n = 21)                                                      | Helical CT                                                                                                                                                                                                                                                                                                                                                                     |
| Pneumothorax (n = 9)                                                             | Radiography (CT if necessary)                                                                                                                                                                                                                                                                                                                                                  |
| Excluded patients                                                                |                                                                                                                                                                                                                                                                                                                                                                                |
| Rare (< 2%) causes (n = 9)                                                       | Chronic diffuse interstitial disease (n = 4), massive pleural effusion (n = 3), fat embolism (n = 1), tracheal stenosis (n = 1). Note: no dyspnea due to pericardial effusion in this consecutive series                                                                                                                                                                       |
| No final diagnosis (n = 16)                                                      | Unknown diagnosis at the end of hospitalization, progression preventing conclusions                                                                                                                                                                                                                                                                                            |
| Several final diagnoses (n = 16)                                                 | Pulmonary edema plus pneumonia (n = 10), pulmonary edema plus COPD (n = 3), others (n = 3)                                                                                                                                                                                                                                                                                     |

| pathologies              | artefact                                                                                    | glisseme<br>nt        | PLAPS | Se                                                                                    | Sp   |
|--------------------------|---------------------------------------------------------------------------------------------|-----------------------|-------|---------------------------------------------------------------------------------------|------|
| OEDEME<br>N=64           | B+/B+<br> | 100%                  | 56%   | 97%                                                                                   | 95%  |
| BPCO<br>N=49             | A<br>B (3 cas)                                                                              | 77%                   | O     | 89%                                                                                   | 97%  |
| ASTME<br>N=34            | A<br>     | 100%                  | 1     | 89%                                                                                   | 97%  |
| PNO<br>N=9               | A<br>    | 0%                    | 55%   | 81%                                                                                   | 100% |
| PNEUMOPATHI<br>E<br>N=83 | B/B (7%)<br>B/B (11%)<br>B/A (14%)<br>Condensation (21%)<br>A (40%)<br>Normal 3%            | Oui<br>Non<br><br>oui | 90%   |  |      |

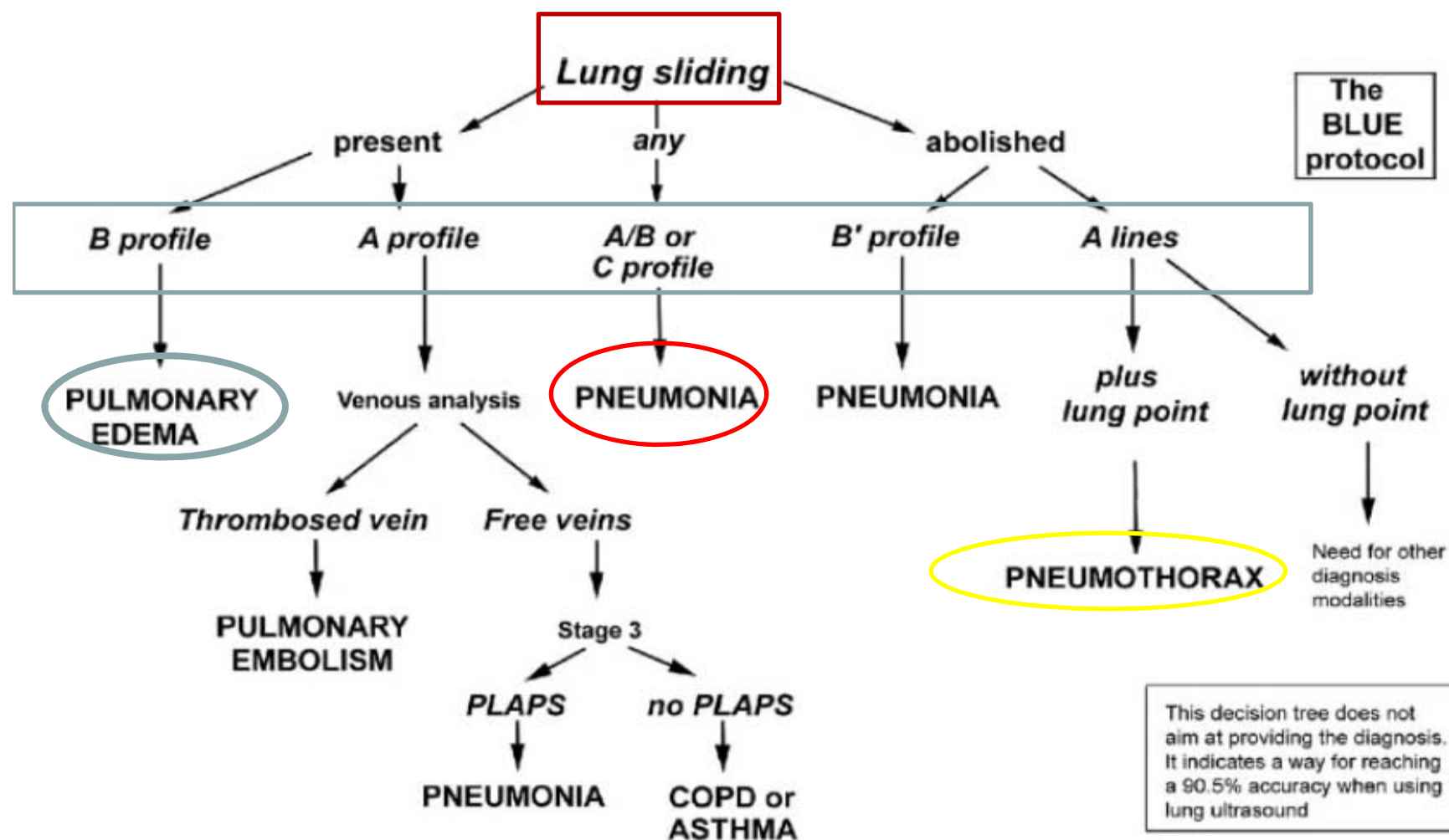
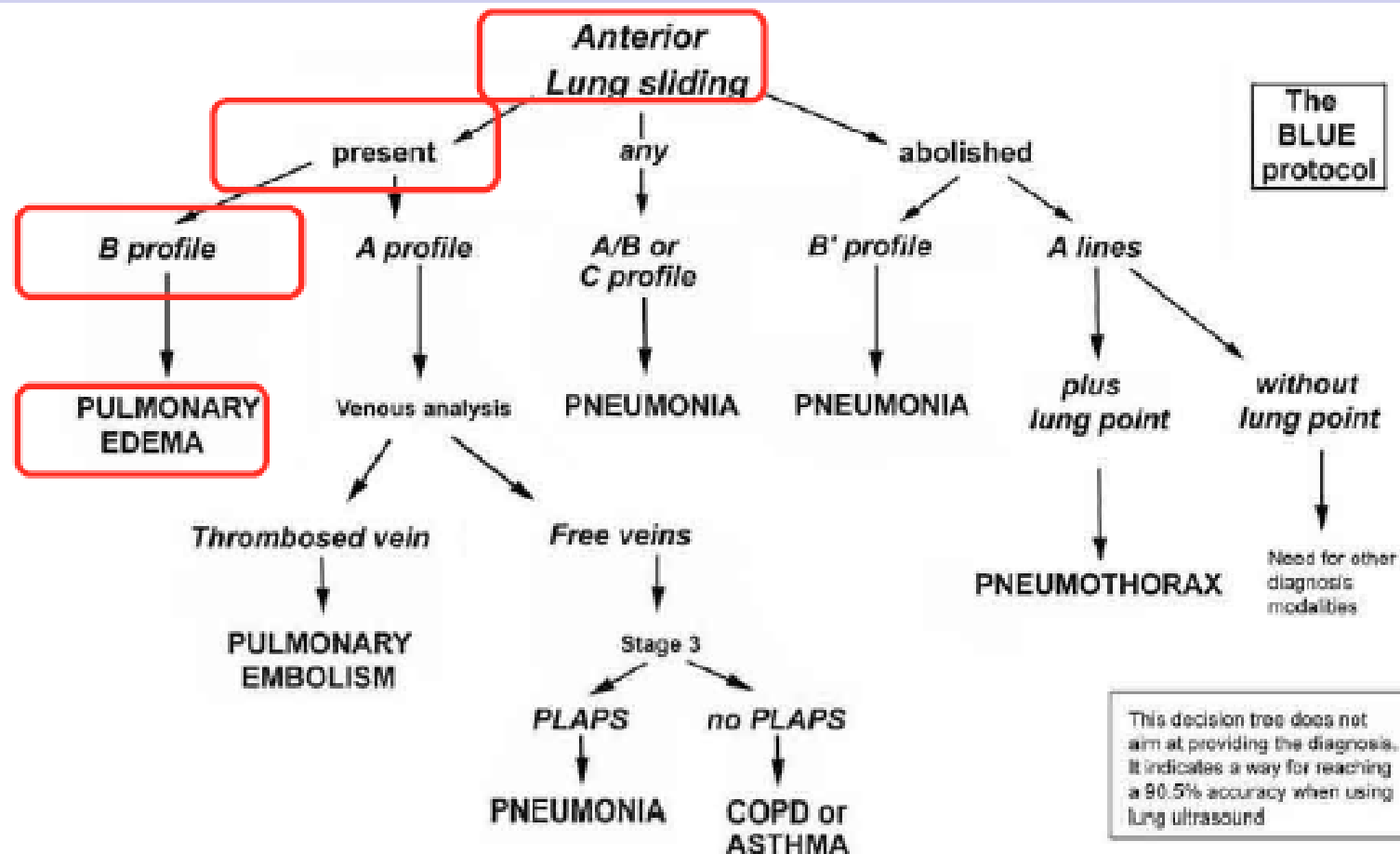


FIGURE 7. A decision tree utilizing lung ultrasonography to guide diagnosis of severe dyspnea.

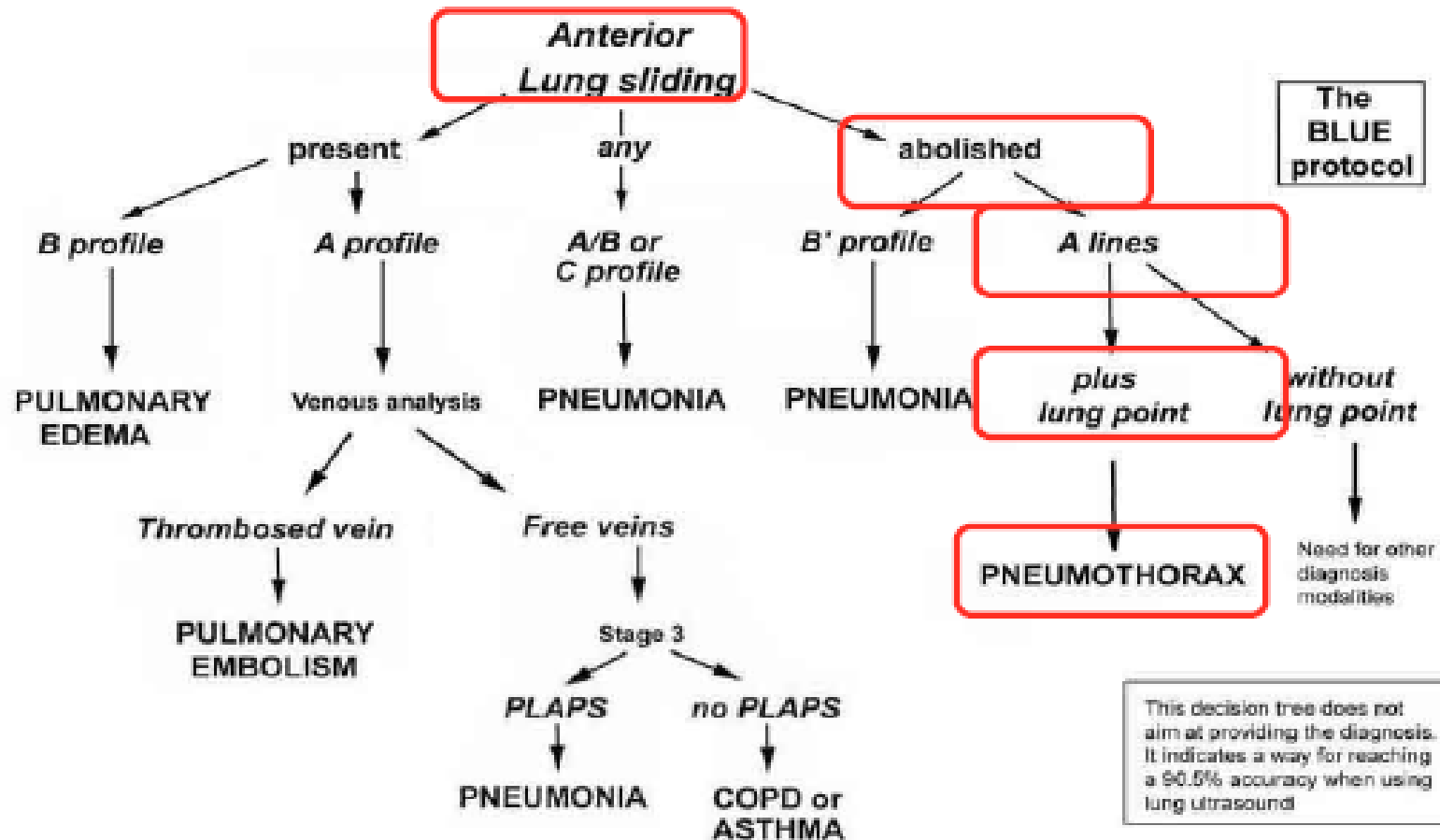
# Diagnostic d'un OAP



Sensibilité 97%    Spécificité 95%    VPN 99%    VPP 87%



# Diagnostic d'un pneumothorax



88% Spécificité 100% Valeur prédictive négative 100% VP

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Daniel A. Lichtenstein and Gilbert A. Mezière

*Chest* 2008; 134; 117-125; Prepublished online April 10, 2008;  
DOI 10.1378/chest.07-2800

- Implications cliniques
  - Gain de temps
  - ↓ nombre de TDM
  - $\frac{1}{4}$  diagnostic erroné dans les 2 h, avec thérapeutique inappropriée
- Limites
  - Opérateurs très confirmés

Conclusion : Diagnostic immédiat d'une DRA dans 90,5% des cas

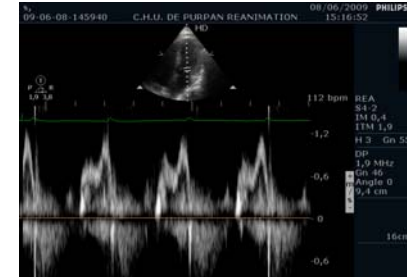
QUID des pressions de remplissage??

$E/A > 2$  est prédictif d'une  $PAP0 > 18 \text{ mmHg}$  avec une VPP de 100%.

Evaluation of left ventricular filling pressure by TTE in the intensive care unit.  
Boussuges.

Crit Care Med 2002 vol30 n° 2 (VM)

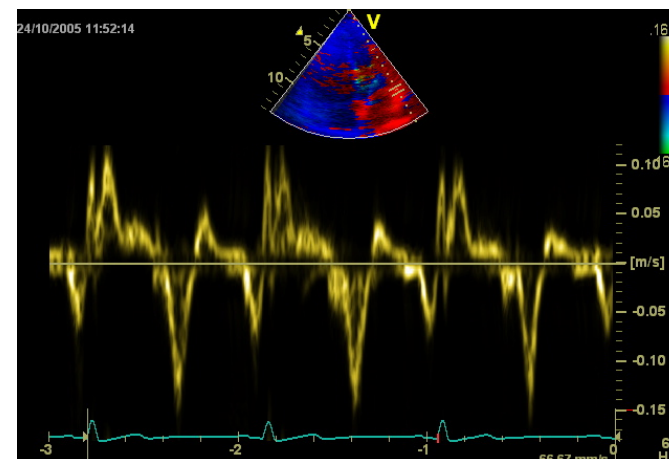
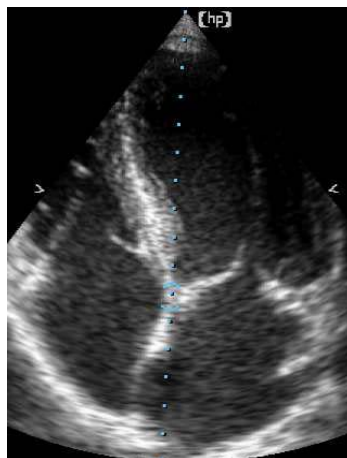
Giannuzzi et al. J Am Coll Cardiol 1994; 23:1630 (VS)



$E/E' > 15$  est prédictif d'une  $PAP0 > 15 \text{ mmHg}$  avec Se à 86%, Sp 88%.

Optimal noninvasive assessment of left ventricular filling pressures.

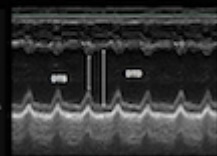
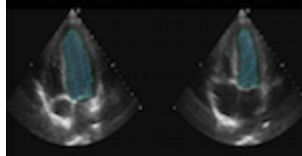
A comparison of tissue echocardiography and B-type natriuretic peptid in patients with pulmonary artery catheters. Dokainich. Circulation 2004. 109: 2432-9.



# Échocardiographie Transthoracique au Déchocage

Jonathan Etcheverry - Stein Silve - Béatrice Riu Poulenc  
Jean Ruiz - Michel Olivier - Michèle Genestal - Olivier Fourcade

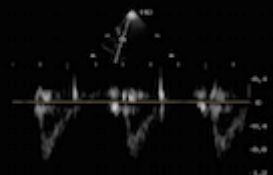
## Cœur Gauche



Fraction de raccourcissement - mode TM

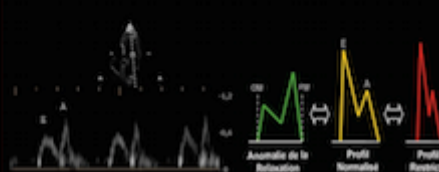
$$FR = (DTD - DTS) / DTD$$

### Fonction Systolique



Diamètre de la chambre de chasse aortique (TV sous aortique) (profil duplex pulvé anneau aortique)

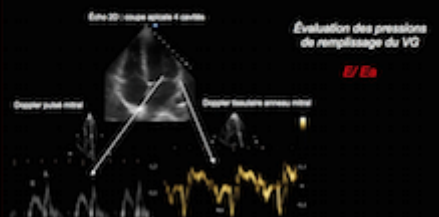
$$DC = Fc \times ITVsAo \times SAo$$



Doppler pulvé à l'anneau mitral

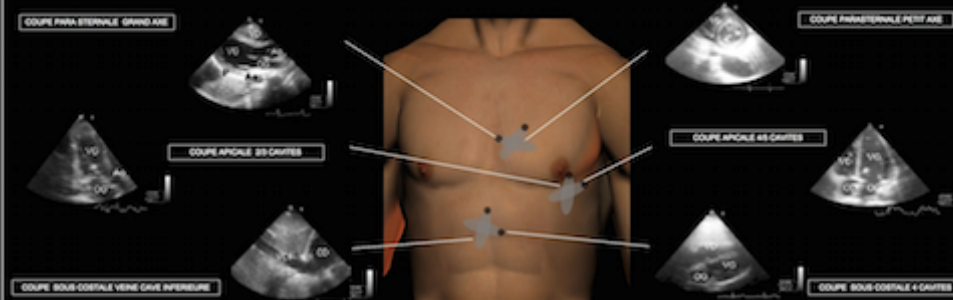
E : relaxation isovolumique du VG  
A : systole auriculaire

### Fonction Diastolique



Évaluation des pressions de remplissage du VG

$$E/Ea$$



## Cœur Droit

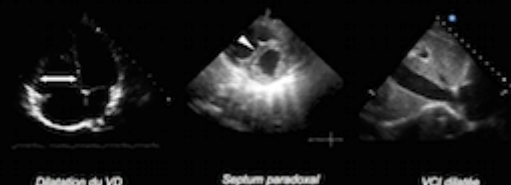
Estimation PAPS  
(pression artérielle pulmonaire syst)



$$PAPS = 4 V_{max}^2 + POD$$

Flux d'insuffisance tricuspidienne  
(Doppler continu)

Répercussion / CPA (cœur pulmonaire aigu)

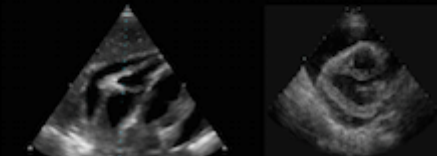


Dilatation du VD

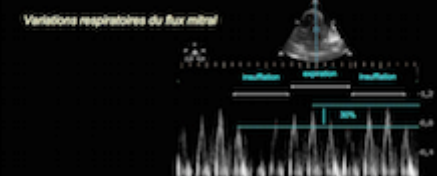
Septum paradoxal

VCI dilatée

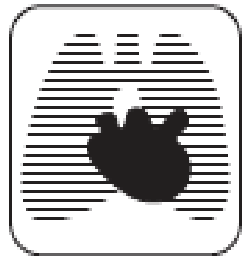
Diagnostiquer un épanchement péricardique



Répercussion / Tamponnade



Variations respiratoires du flux mitral



# CHEST

Original Research

CRITICAL CARE

## Usefulness of Cardiothoracic Chest Ultrasound in the Management of Acute Respiratory Failure in Critical Care Practice

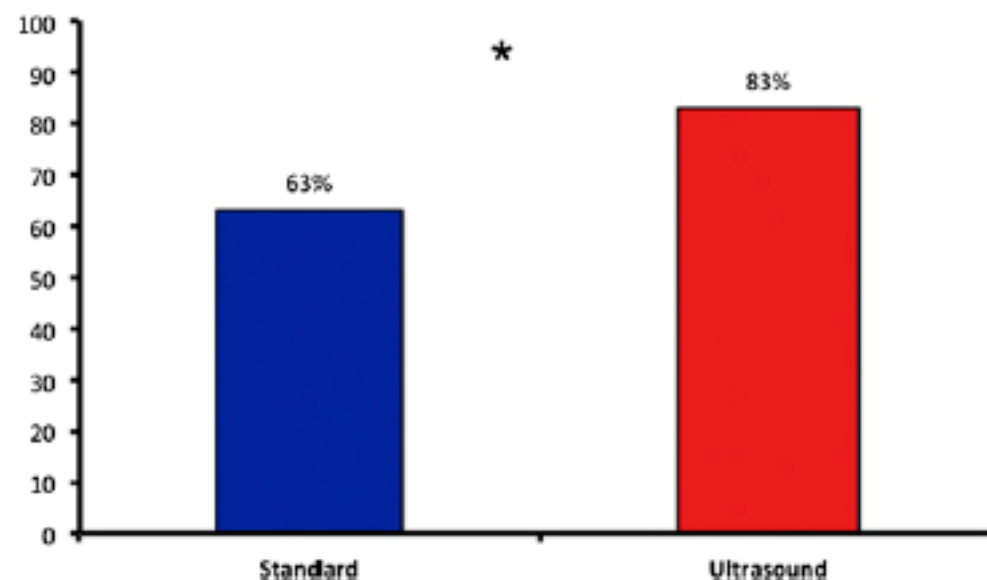
*Stein Silva, MD, PhD; Caroline Biendel, MD; Jean Ruiz, MD; Michel Olivier, MD;  
Benoit Bataille, MD; Thomas Geeraerts, MD, PhD; Arnaud Mari, MD;  
Beatrice Riu, MD; Olivier Fourcade, MD, PhD; and Michele Genestal, MD*

*Chest.* 2013;144(3):859-865. doi:10.1378/chest.13-0167



## Usefulness of Cardiothoracic Chest Ultrasound in the Management of Acute Respiratory Failure in Critical Care Practice

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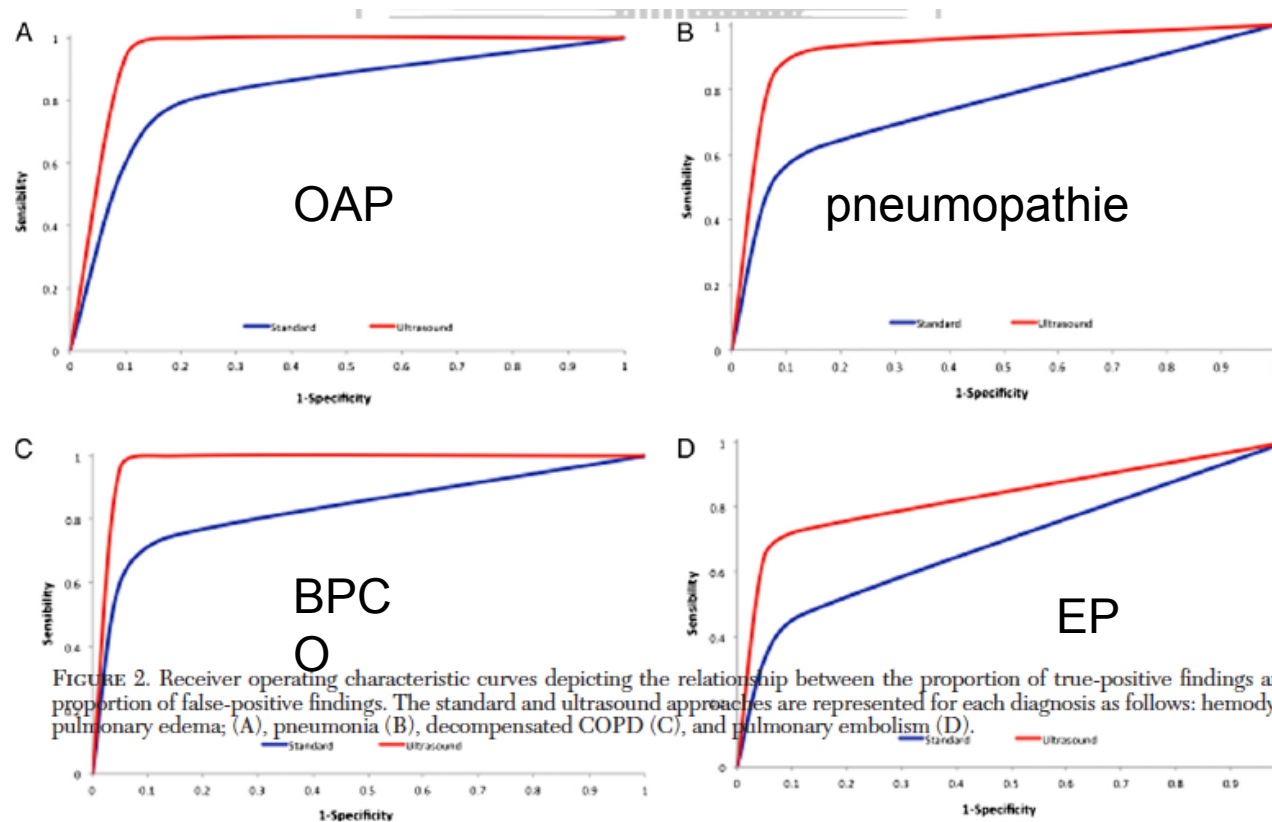
15] FIGURE 1. Comparative diagnostic accuracy. Each diagnostic ap-  
16] proach (standard and ultrasound) was compared against the final  
diagnosis determined by a panel of experts ( $P < .05$ ).





## Usefulness of Cardiothoracic Chest Ultrasound in the Management of Acute Respiratory Failure in Critical Care Practice

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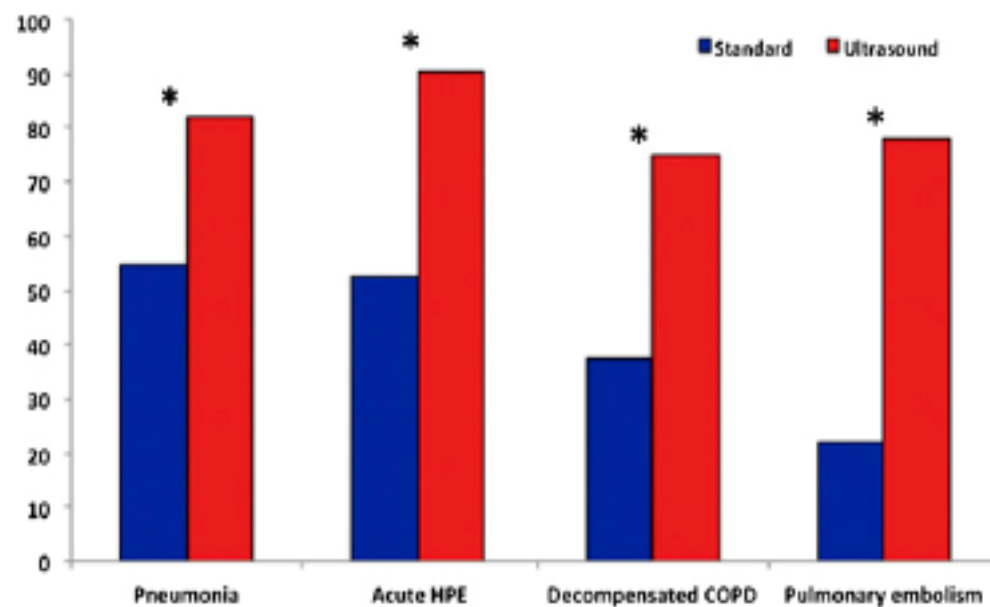


[A]



## Usefulness of Cardiothoracic Chest Ultrasound in the Management of Acute Respiratory Failure in Critical Care Practice

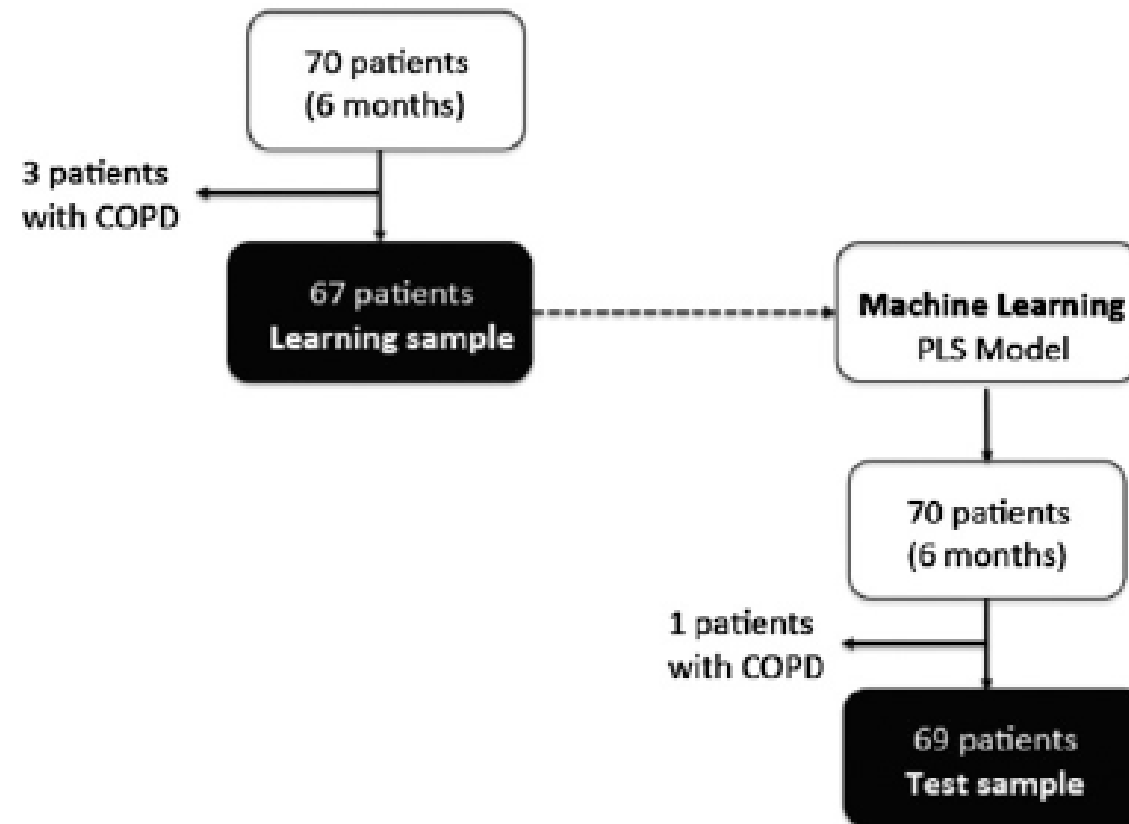
*Stein Silva, MD, PhD; Caroline Biendel, MD; Jean Ruiz, MD; Michel Olivier, MD; Benoit Bataille, MD; Thomas Geeraerts, MD, PhD; Arnaud Mari, MD; Beatrice Riu, MD; Olivier Fourcade, MD, PhD; and Michele Genestal, MD*



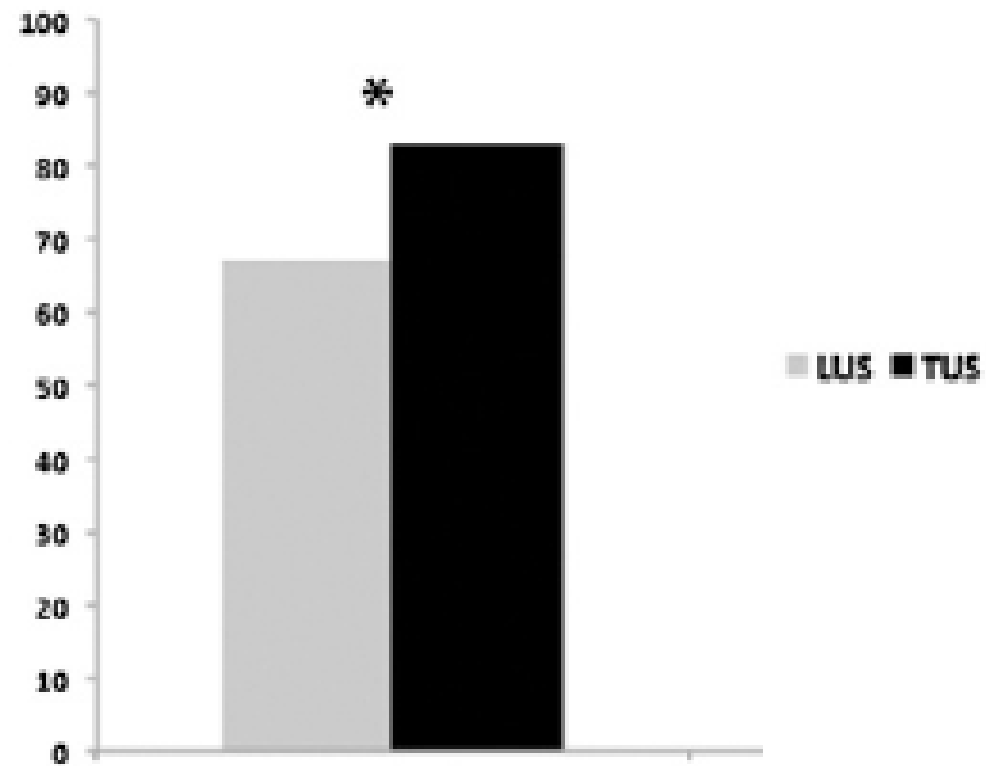
# Integrated Use of Bedside Lung Ultrasound and Echocardiography in Acute Respiratory Failure

## A Prospective Observational Study in ICU

*Benoit Bataille, MD; Beatrice Riu, MD; Fabrice Ferre, MD; Pierre Etienne Moussot, MD; Arnaud Mari, MD; Elodie Brunel, MD; Jean Ruiz, MD; Michel Mora, MD; Olivier Fourcade, MD, PhD; Michele Genestal, MD; and Stein Silva, MD, PhD*



| Demographic                        | Value    |
|------------------------------------|----------|
| No. patients                       | 136      |
| Age, y                             | 68 ± 15  |
| Sex                                |          |
| Female                             | 57 (42)  |
| Male                               | 79 (58)  |
| Weight, kg                         | 76 ± 18  |
| Height, cm                         | 167 ± 9  |
| Pao <sub>2</sub> /Fio <sub>2</sub> | 156 ± 82 |
| Tracheal intubation                | 19 (14)  |
| Use of catecholamine               | 13 (10)  |
| SAPS II                            | 34 ± 10  |
| Diagnosis                          |          |
| Cardiogenic edema                  | 34 (25)  |
| Pneumonia                          | 77 (57)  |
| Pulmonary embolism                 | 13 (10)  |
| Pneumothorax                       | 12 (9)   |



# Conclusion

- Diagnostic + précoce et prise en charge adaptée
- Amélioration disponibilité du matériel et formation adaptée
- Echo au lit déjà standardisée chez le polytraumatisé et en réanimation se développe au bloc et en SSPI
- But: diminuer la morbi-mortalité de nos patients admis dans la période Péri opératoire
- Avenir: stéthoscope du 21<sup>ème</sup> siècle