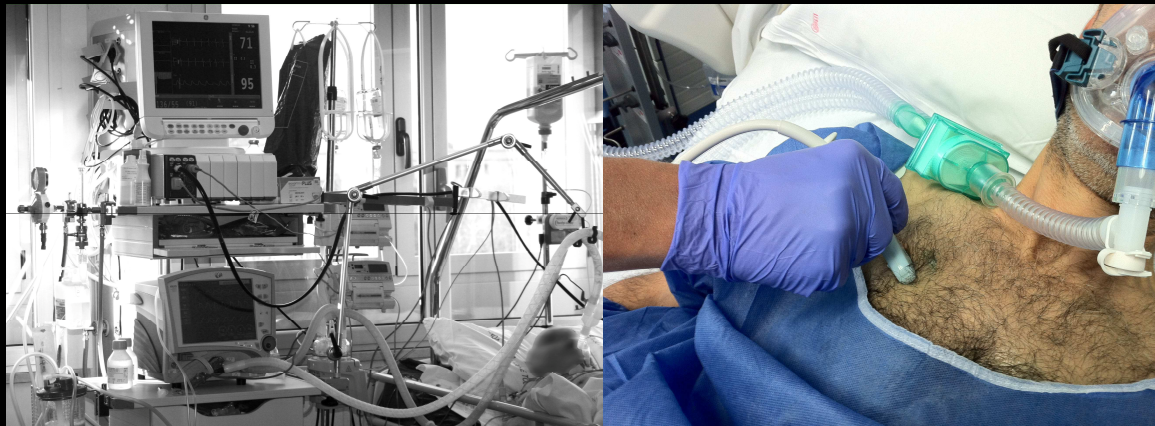
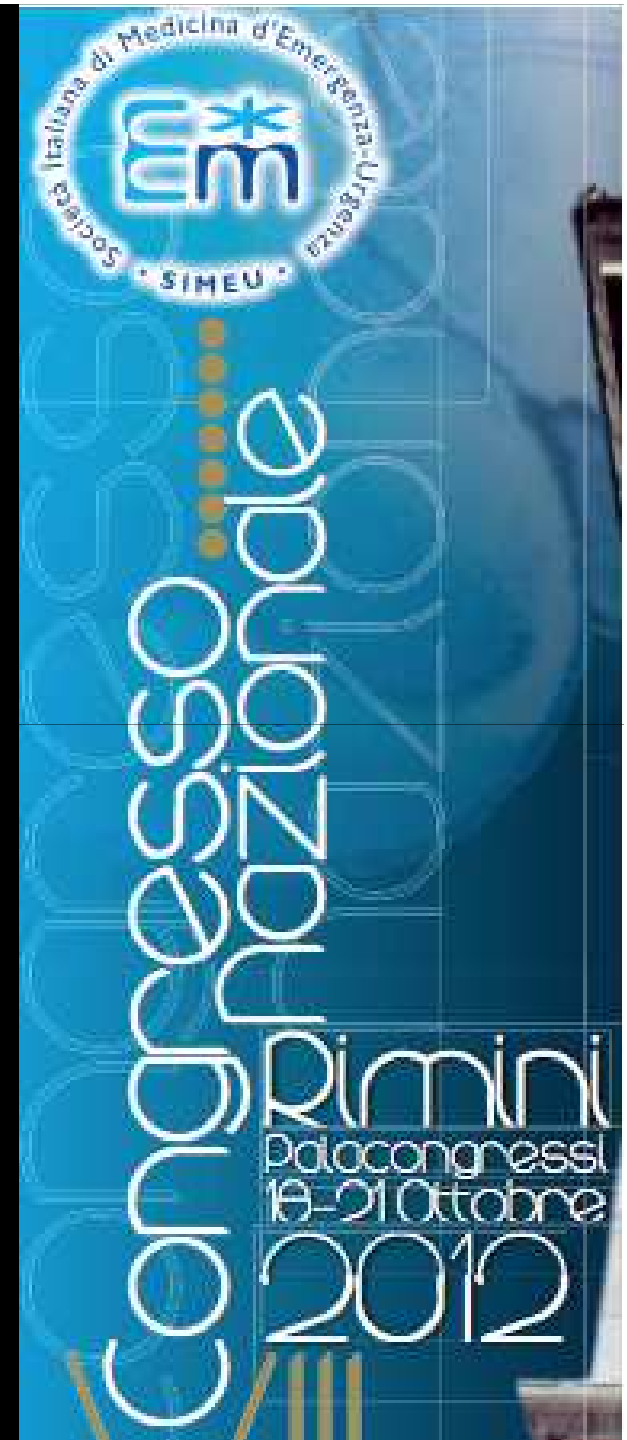


Monitoring eco nelle patologie polmonari



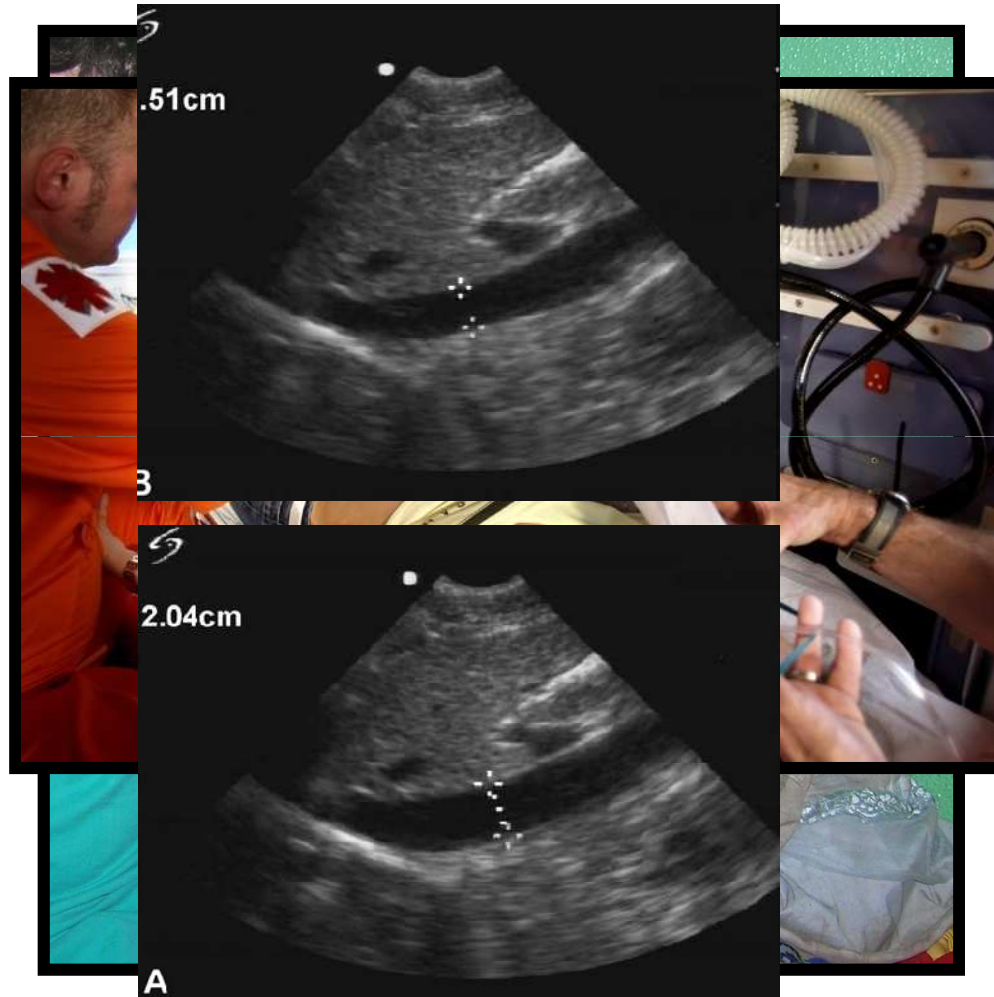
Fabrizio Elia
Terapia SubIntensiva
Ospedale San Giovanni Bosco
Torino



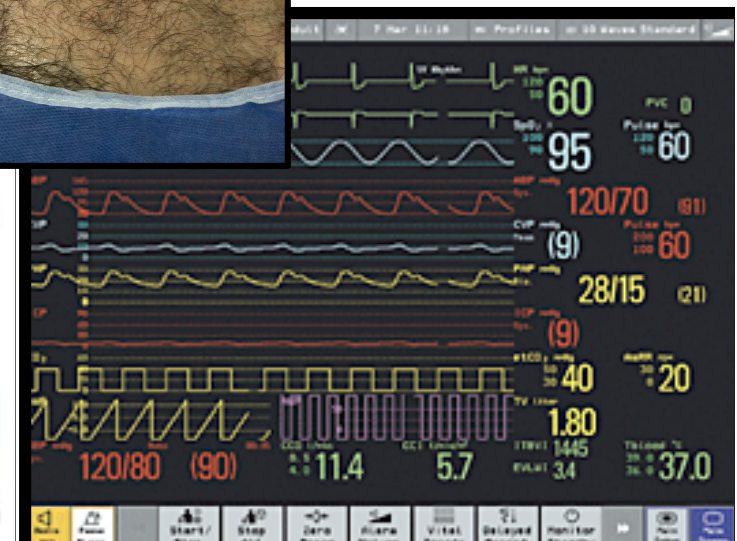
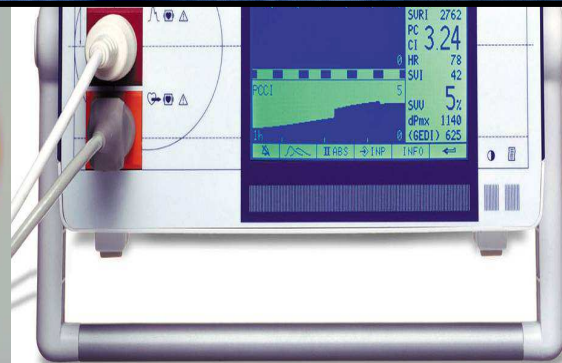
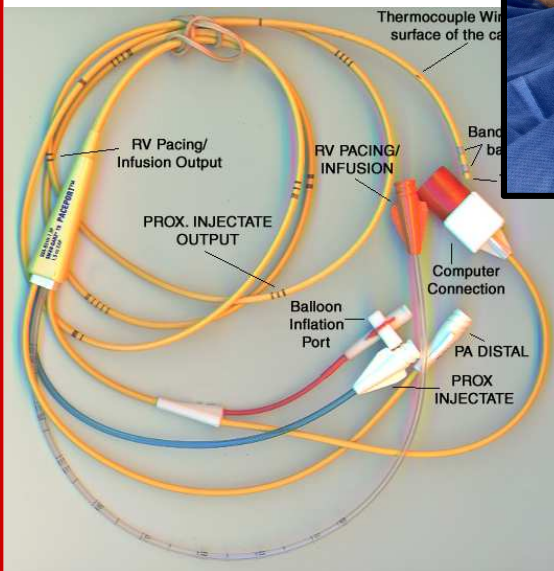
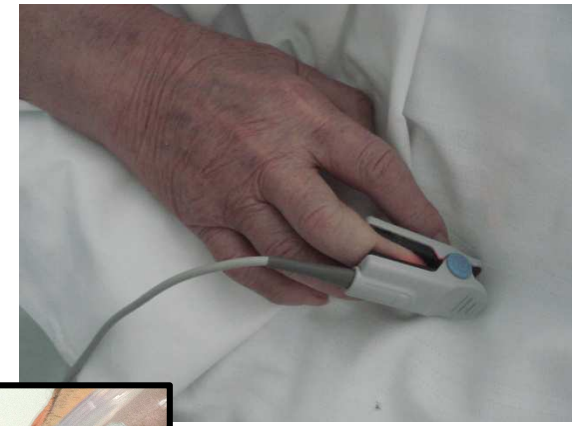


Lung Ultrasound: From Diagnostic Instrument To Respiratory Monitoring Tool ?

Ecografia e monitoraggio: quali vantaggi ?



- Point of care (ovunque ci sia un paziente e sia disponibile un ecografo)
- Ripetibile
- Tecnologia “povera”, priva di rischi (esposizione a radiazioni, complicanze di procedure invasive)

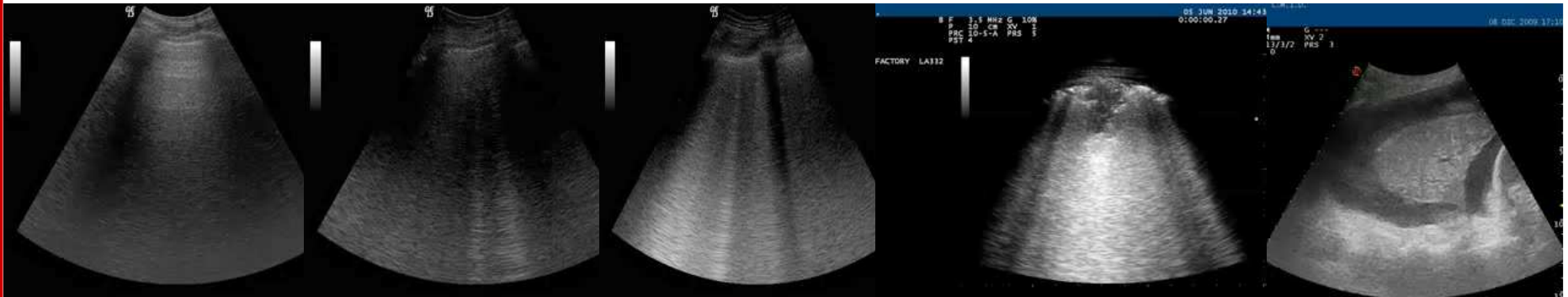




FUNCTIONAL HEMODYNAMIC (AND RESPIRATORY) MONITORING: THE CONCEPT

“It is less based on numbers and invasive tools, and more on qualitative and functional assessment, and on prediction of treatment effect ”

“Echodynamics”

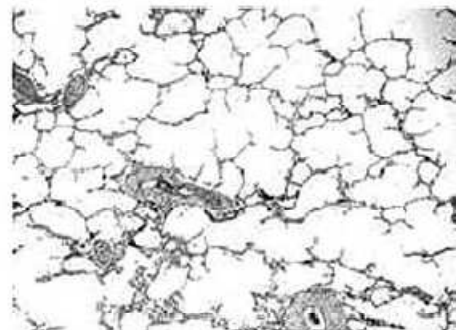
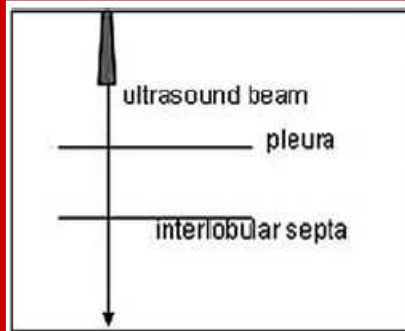


Valutazione dello stato di areazione polmonare

- ✓ Del polmone patologico che deve tornare ad essere areato
- ✓ Del polmone normale che rischia di perdere parte del contenuto aereo



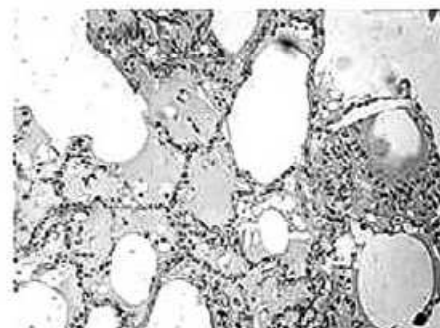
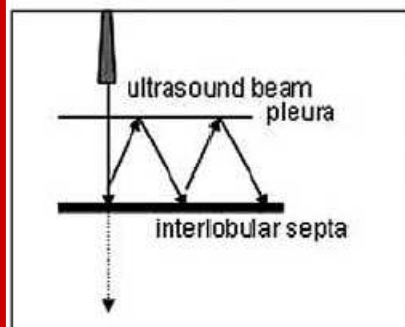
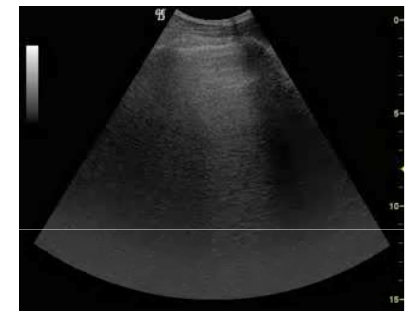
Acqua polmonare extravascolare - monitoring



normal lung



"ring-down" artifacts

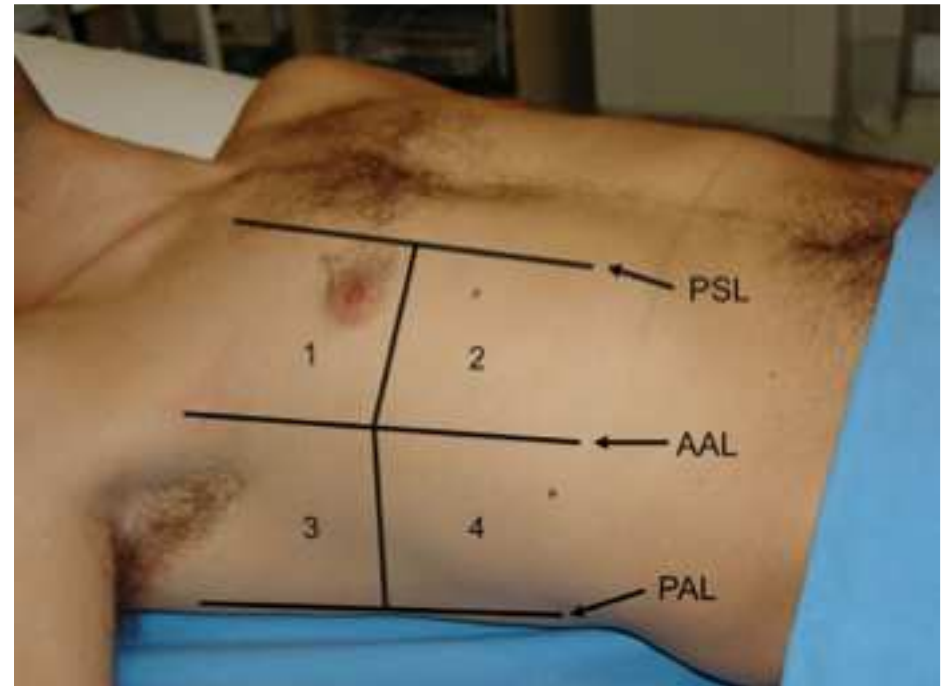
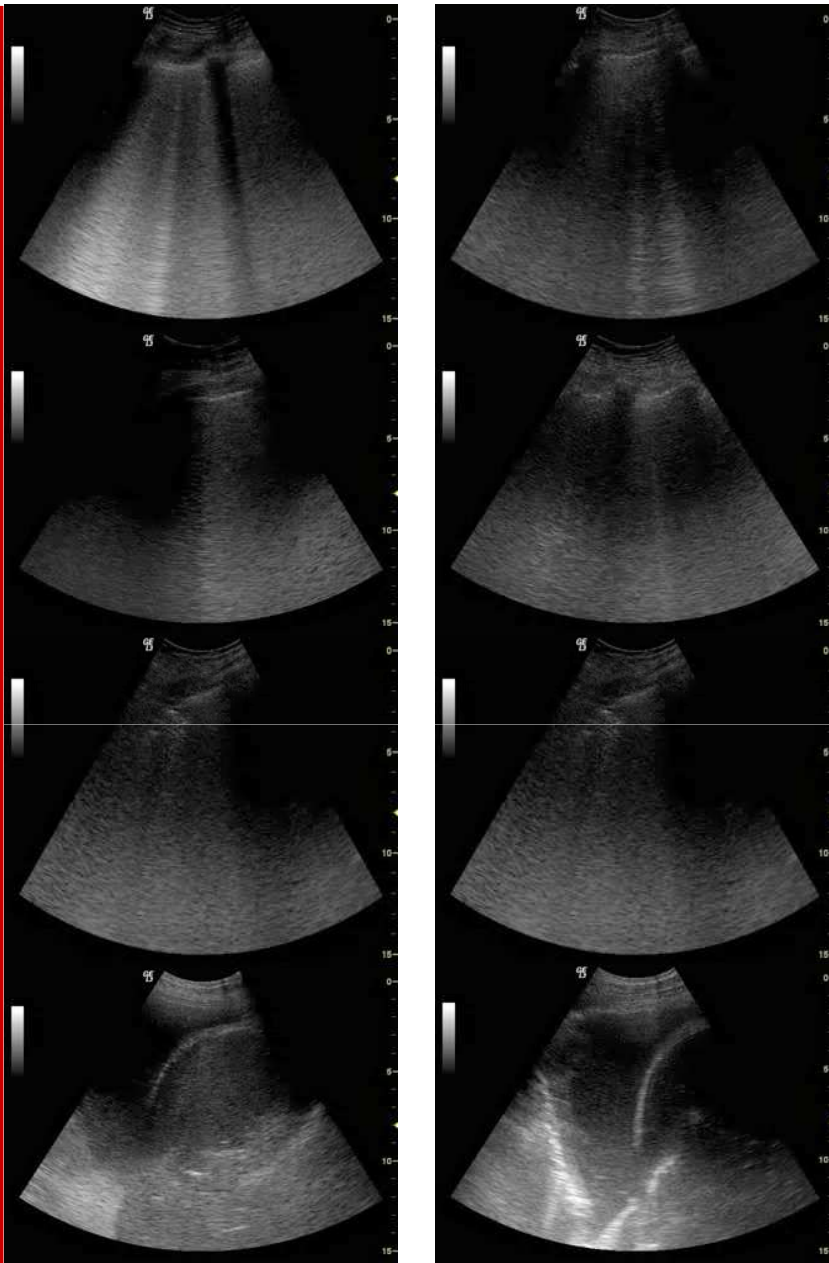


pulmonary edema



"comet-tail" artifact





- Sindrome interstiziale diffusa (B pattern):
 - Almeno 3 linee B per scansione
 - In almeno 2 scansioni per emitorace

The Comet-tail Artifact

An Ultrasound Sign of Alveolar-Interstitial Syndrome

SENSIBILITA' 93%

SPECIFICITA' 93%

DANIEL LICHTENSTEIN, GILBERT MÉZIÈRE, PHILIPPE BIDERMAN, AGNÈS GEPNER, and OLIVIER BARRÉ

Service de Réanimation Médicale and Service de Radiologie, Hôpital Ambroise-Paré, Boulogne (Paris), and Service de Réanimation Polyvalente, Centre Hospitalier Général, Saint-Cloud (Paris), France

Original Contribution

SENSIBILITA' 85%

SPECIFICITA' 97%

Bedside lung ultrasound in the assessment of alveolar-interstitial syndrome

Giovanni Volpicelli^{a,*}, Alessandro Mussa^a, Giorgio Garofalo^b, Lu
Giovanna Casoli^a, Fabio Perotto^b, Cesare Fava^b, Mauro Frascisco^a

Intensive Care Med (1998) 24: 1331–1334
© Springer-Verlag 1998

BRIEF REPORT

D. Lichtenstein
G. Mezière

A lung ultrasound sign allowing bedside distinction between pulmonary edema and COPD: the comet-tail artifact

Intern Emerg Med
DOI 10.1007/s11739-011-0709-1

EM - ORIGINAL

Diagnostic accuracy and reproducibility of pleural and lung ultrasound in discriminating cardiogenic causes of acute dyspnea in the Emergency Department

Gian Alfonso Cibinel · Giovanna Casoli · Fabrizio Elia ·
Monica Padoan · Emanuele Pivetta · Enrico Lupia ·
Alberto Goffi

Usefulness of Ultrasound Lung Comets as a Nonradiologic Sign of Extravascular Lung Water

Zoltan Jambrik, MD, Simonetta Monti, MD, Vincenzo Coppola, MD, Eustachio Agricola, MD, Gaetano Mottola, MD, Massimo Miniati, MD, and Eugenio Picano, MD, PhD

Clinical and echocardiographic determinants of ultrasound lung comets[☆]

Francesca Frassi^{a,c}, Luna Gargani^{a,c}, Suzana Gligorova^{b,c,d}, Quirino Ciampi^{a,c,e}, Gaetano Mottola^{b,c}, Eugenio Picano^{a,*,c}



European Journal of Heart Failure 10 (2008) 70–77

The
European Journal
of
Heart Failure

www.elsevier.com/locate/ejheart

Ultrasound lung comets for the differential diagnosis of acute cardiogenic dyspnoea: A comparison with natriuretic peptides[☆]

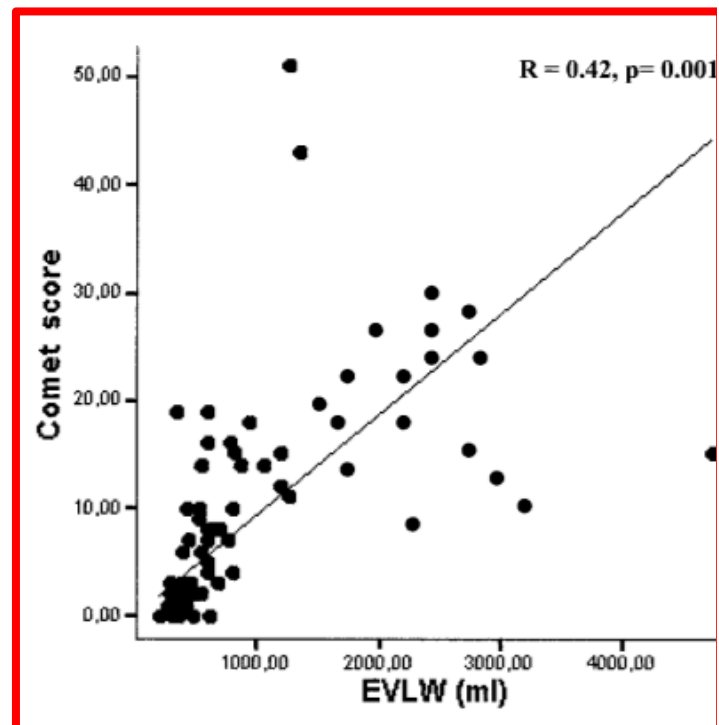
L. Gargani^{a,*}, F. Frassi^a, G. Soldati^b, P. Tesorio^c, M. Gheorghiade^d, E. Picano^a

“Ultrasound Comet-Tail Images”: A Marker Of Pulmonary Edema*

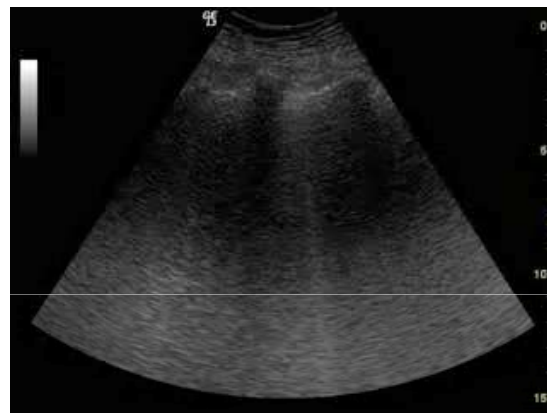
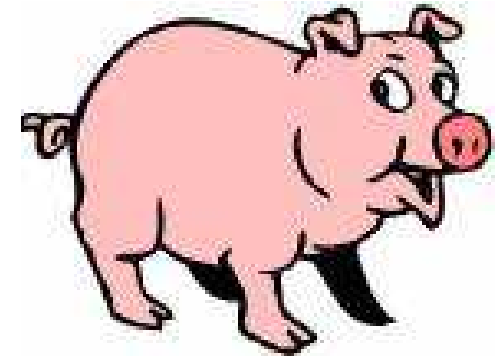
A Comparative Study With Wedge Pressure And Extravascular Lung Water

Eustachio Agricola, MD; Tiziana Bove, MD; Michele Oppizzi, MD; Giovanni Marino, MD; Alberto Zangrillo, MD; Alberto Margonato, MD; and Eugenio Picano, MD

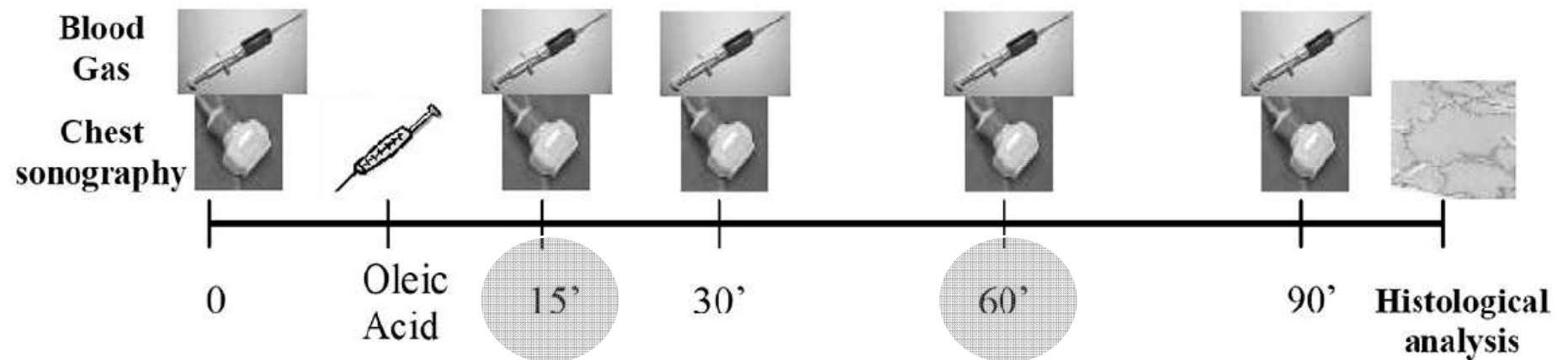
La quantità di linee B indica il grado di sovraccarico idrico



Le linee B sono un segno
precoce di impegno
interstiziale



**ACUTE
LUNG
INJURY**





Original Contribution

Bedside ultrasound of the lung for the monitoring of acute decompensated heart failure[☆]

Giovanni Volpicelli MD^{a,*}, Valeria Caramello MD^a, Luciano Cardinale MD^b,
Alessandro Mussa MD^a, Fabrizio Bar MD^a, Mauro F. Frascisco MD^a

^aDepartment of Emergency Medicine, San Luigi Gonzaga Hospital, 10043 Orbassano, Torino, Italy

^bInstitute of Radiology, San Luigi Gonzaga Hospital, 10043 Orbassano, Torino, Italy

Received 10 August 2007; revised 19 September 2007; accepted 20 September 2007

Abstract

Purposes: Multiple artifacts B lines (B+) at transthoracic lung ultrasound have been proposed as a sonographic sign of pulmonary congestion. Our aim is to assess B+ clearance after medical treatment in acute decompensated heart failure (ADHF) and to compare the usefulness of sonography with other traditional tools in monitoring resolution of pulmonary congestion.

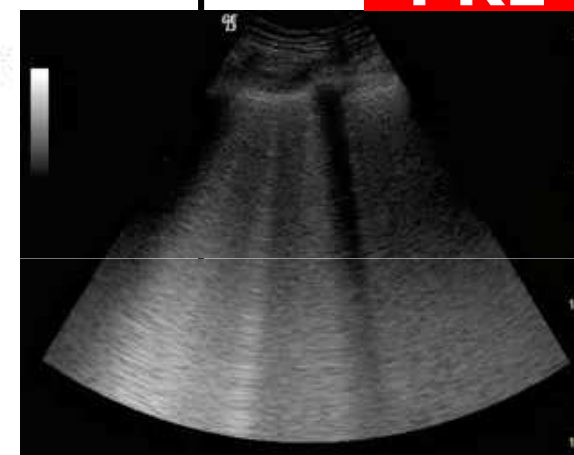
Methods: Eighty-one patients with a diagnosis of ADHF were submitted to lung ultrasound and chest radiography at admission, and 70 of them underwent the same procedures as control group after 4.2 ± 1.7 days of medical treatment. The ultrasound examination was performed with 11 scans on as many anterolateral thoracic areas (6 on the right side and 5 on the left side). Then, we calculated a sonographic score counting the B+ scans and compared it with radiologic score for extravascular lung water, clinical, and plasma brain natriuretic peptide improvement.

Main Results: All patients showed B+ pattern at admission and significant clearing after treatment, with median number of 8 positive scans (range, 3–9 scans) vs 0 (range, 0–7 scans) ($P < .05$). Our sonographic score showed positive linear correlation with radiologic score ($r = 0.62$; $P < .05$), clinical score ($r = 0.87$; $P < .01$), and brain natriuretic peptide levels ($r = 0.44$; $P < .05$). Δ Sonographic score correlated with Δ clinical ($r = 0.55$; $P < .05$) and radiologic ($r = 0.28$; $P < .05$) scores.

Conclusions: B line pattern mostly clears after adequate medical treatment of ADHF and represents an easy-to-use alternative bedside diagnostic tool for clinically monitoring pulmonary congestion in patients with ADHF.

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PRE



POST



AREA TORACICA	FASE 1	FASE 2
ANT SUP DX	51 (73%)	3 (4.3%)
ANT MED DX	54 (77%)	2 (2.9%)
ANT BAS DX	65 (93%)	4 (5.7%)
LAT SUP DX	64 (91%)	5 (7.1%)
LAT MED DX	67 (96%)	10 (14%)
LAT BAS DX	68 (97%)	21 (30%)
ANT SUP SIX	52 (74%)	6 (8.6%)
ANT MED SIX	58 (83%)	6 (8.6%)
LAT SUP SIX	63 (90%)	6 (8.6%)
LAT MED SIX	70 (100%)	11 (16%)
LAT BAS SIX	70 (100%)	20 (29%)

Main Results: All patients showed B+ pattern at admission and significant clearing after treatment, with median number of 8 positive scans (range, 3-9 scans) vs 0 (range, 0-7 scans) ($P < .05$). Our sonographic score showed positive linear correlation with radiologic score ($r = 0.62$; $P < .05$), clinical score ($r = 0.87$; $P < .01$), and brain natriuretic peptide levels ($r = 0.44$; $P < .05$). Δ Sonographic score correlated with Δ clinical ($r = 0.55$; $P < .05$) and radiologic ($r = 0.28$; $P < .05$) scores.

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



Ultrasound Assessment for Extravascular Lung Water in Patients Undergoing Hemodialysis* Time Course for Resolution

*Vicki E. Noble, MD, RDMS; Alice F. Murray, MBChB; Roberta Capp, MD;
Mary H. Sylvia-Reardon, RN; David J. R. Steele, MD; and
Andrew Liteplo, MD, RDMS*

Intern Emerg Med
DOI 10.1007/s11739-011-0625-4

IM - ORIGINAL

Lung ultrasonography for the assessment of rapid extravascular water variation: evidence from hemodialysis patients

Matteo Trezzi · Daniela Torzillo · Elisa Ceriani · Giorgio Costantino ·
Sabrina Caruso · Parham Tabae Damavandi · Augusto Genderini ·
Marco Cleardi · Nicola Montano · Chiara Cogliati

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

B-D4-S1 (strong: level A)

- In patients with cardiogenic pulmonary edema, semi-quantification of disease severity may be obtained by evaluating the number of B-lines as this is directly proportional to the severity of congestion.

B-D4-S2 (strong: level A)

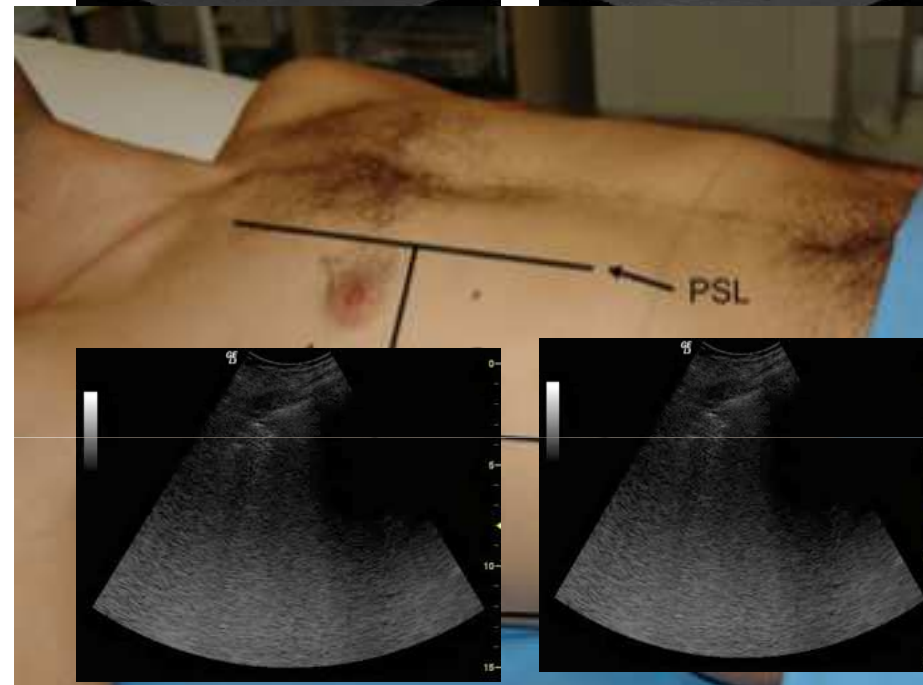
- In patients with cardiogenic pulmonary edema, B-lines should be evaluated because it allows monitoring of response to therapy.

P-D3-S1 (strong: level A)

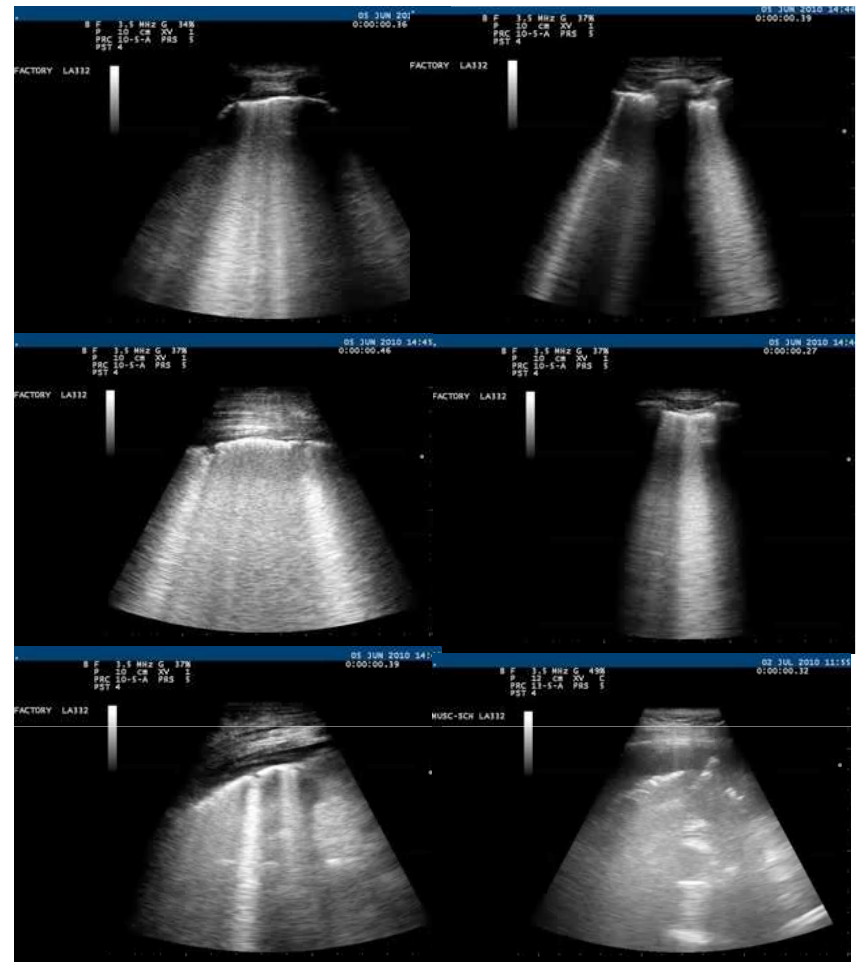
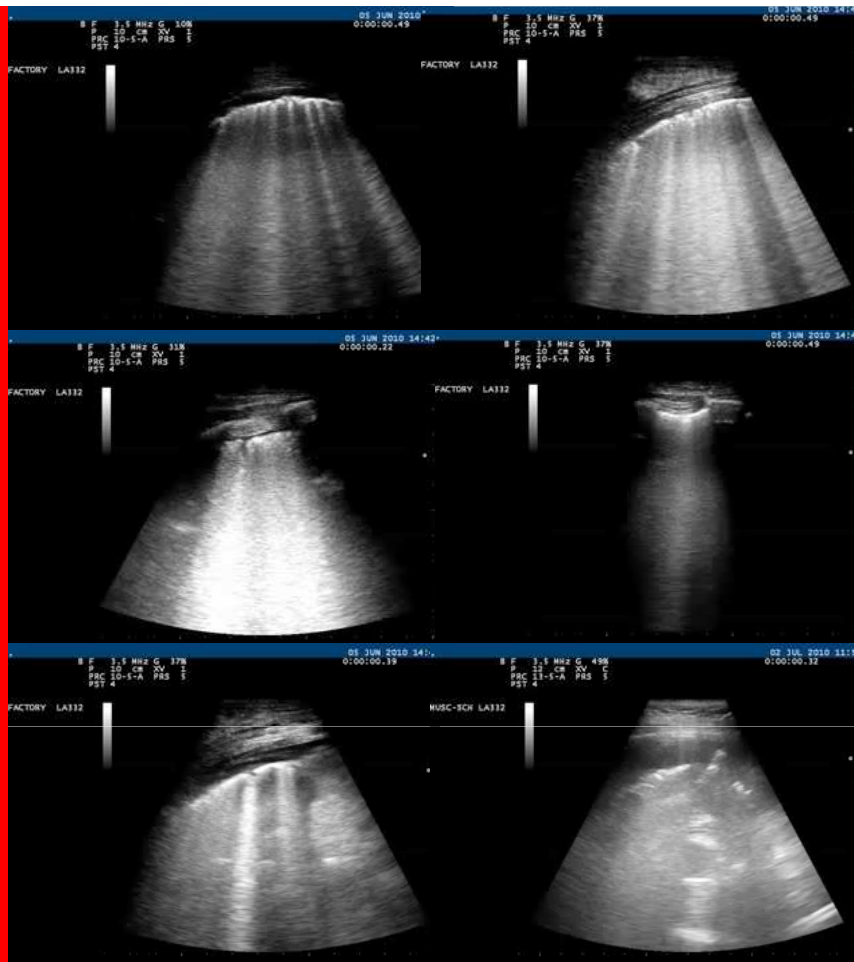
- In patients with increased extravascular lung water, assessment of lung reaeration can be assessed by demonstrating a change (decrease) in the number of B-lines.



EPA



24 ore dopo



24 ore dopo

ARDS



quanti liquidi ?

By targeting resuscitation to Scvo₂, rather than simply to the conventional hemodynamic indexes, the EGDT subjects were administered more fluid in the first 6 h (4,981 mL vs 3,499 mL; p 0.001)

- 55 anni, RCU
- Diarrea profusa, shock settico a partenza addominale

- 80 anni, cardiopatia ischemica, fa perm.
- Shock settico a partenza polmonare

7 litri in 6 ore

3 litri in 6 ore



A-Lines and B-Lines

Lung Ultrasound as a Bedside Tool for Predicting Pulmonary Artery Occlusion Pressure in the Critically Ill

Daniel A. Lichtenstein, MD, FCCP; Gilbert A. Mezière, MD;
Jean-François Lagoueyte, MD; Philippe Biderman, MD; Ivan Goldstein, MD;
and Agnès Gepner, MD

Background: The risk of pulmonary edema is the main limiting factor in fluid therapy in the critically ill. Interstitial edema is a subclinical step that precedes alveolar edema. This study assesses a bedside tool for detecting interstitial edema, lung ultrasound. The A-line is a horizontal artifact indicating a normal lung surface. The B-line is a kind of comet-tail artifact indicating subpleural interstitial edema. The relationship between anterior interstitial edema detected by lung ultrasound and the pulmonary artery occlusion pressure (PAOP) value was investigated.

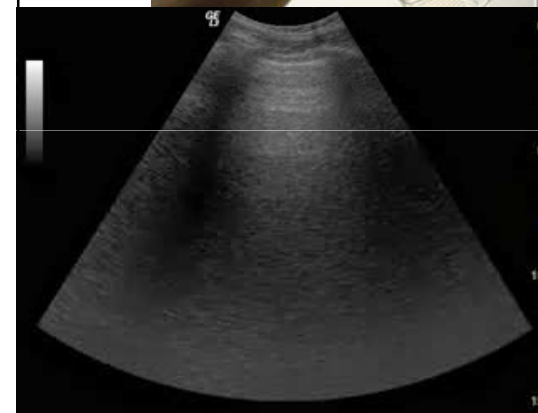
Method: We performed a prospective study in medicosurgical ICUs of university-affiliated teaching hospitals. We enrolled 102 consecutive mechanically ventilated patients who all underwent pulmonary artery catheterization. We defined A-predominance as a majority of anterior A-lines and B-predominance as a majority of anterior B-lines. These patterns were correlated with PAOP.

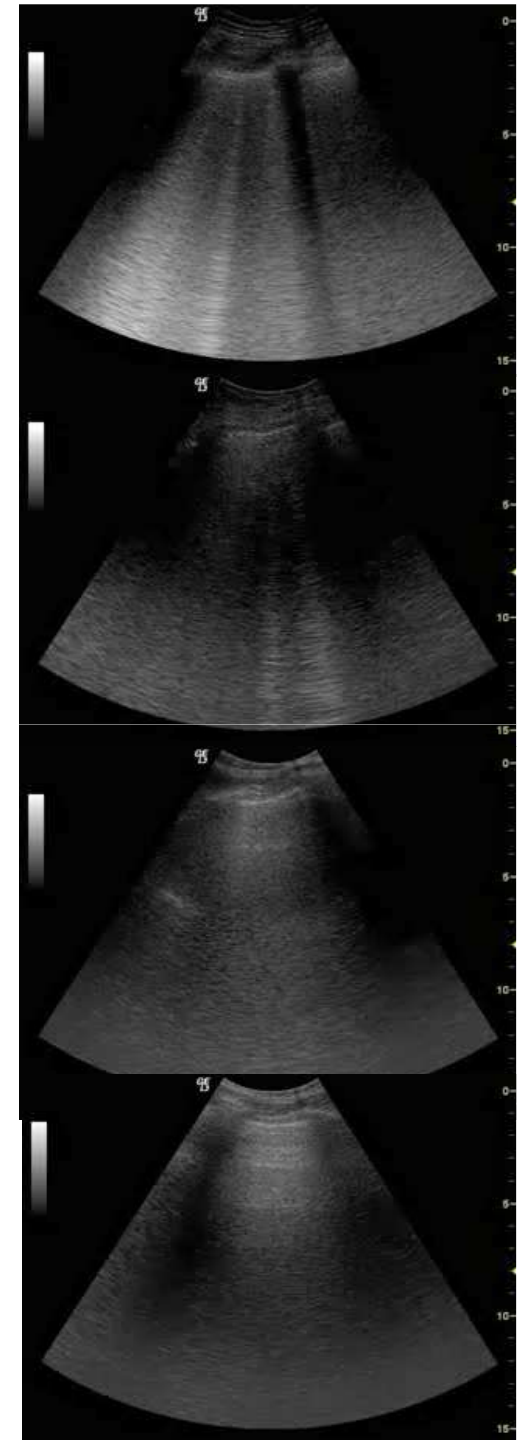
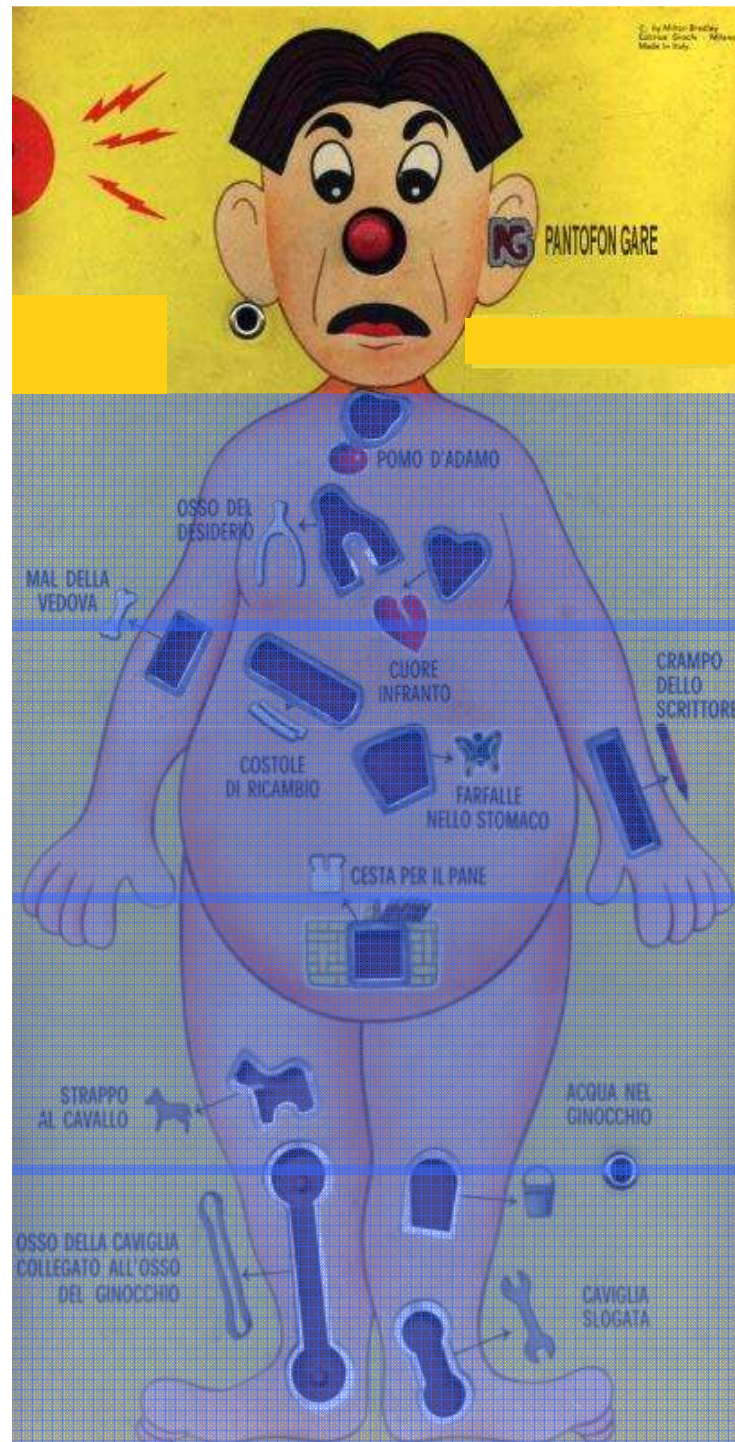
Results: For diagnosing PAOP ≤ 13 mm Hg, A-predominance had 90% specificity, 67% sensitivity, 91% positive predictive value, and 65% negative predictive value. For diagnosing PAOP ≤ 18 mm Hg, A-predominance had 93% specificity, 50% sensitivity, 97% positive predictive value, and 24% negative predictive value, respectively.

Conclusions: A-predominance indicates dry interlobular septa. Specific to predicting a low PAOP value, A-predominance suggests that fluid may be given without initial concern for the development of hydrostatic pulmonary edema. B-predominance indicates interstitial syndrome, which is usually related to interstitial edema. B-predominance is observed in a wide range of PAOP values, precluding conclusions about the need for fluid therapy. This bedside potential will be appreciated by those intensivists who envision fluid therapy based on low PAOP values and who consider that using the concept of a safety factor provided by lung ultrasound is logical.

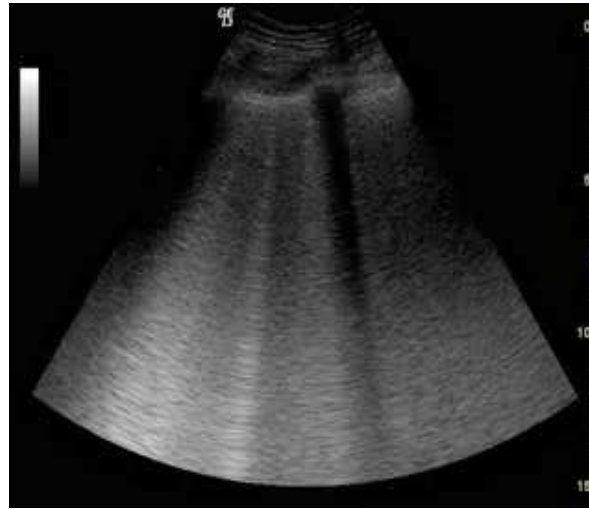
(CHEST 2009; 136:1014-1020)

Abbreviations: FN = false-negative; FP = false-positive; NPV = negative predictive value; PAC = pulmonary artery catheter; PAOP = pulmonary artery occlusion pressure; PEEP = positive end-expiratory pressure; PPV = positive predictive value; TN = true-negative; TP = true-positive.





- 40 anni
- HIV +
- Shock settico, batteriemia da MRSA



Liquidi
Noradrenalina



Dobutamina
5 μ g/kg/min



ARDS



CONTUSIONE

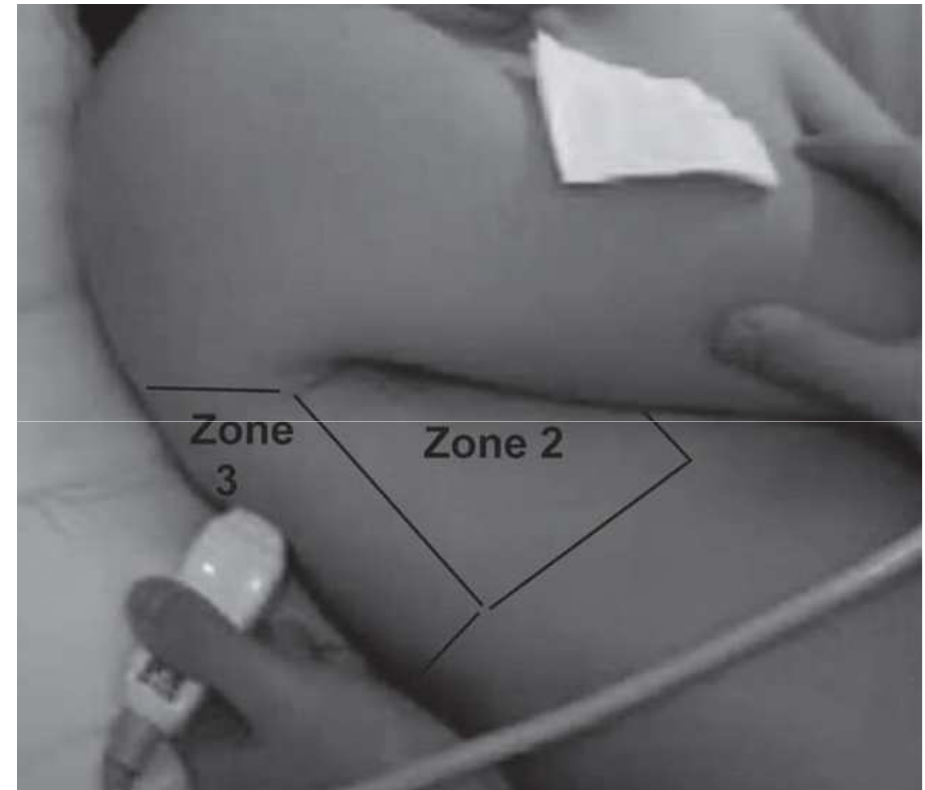
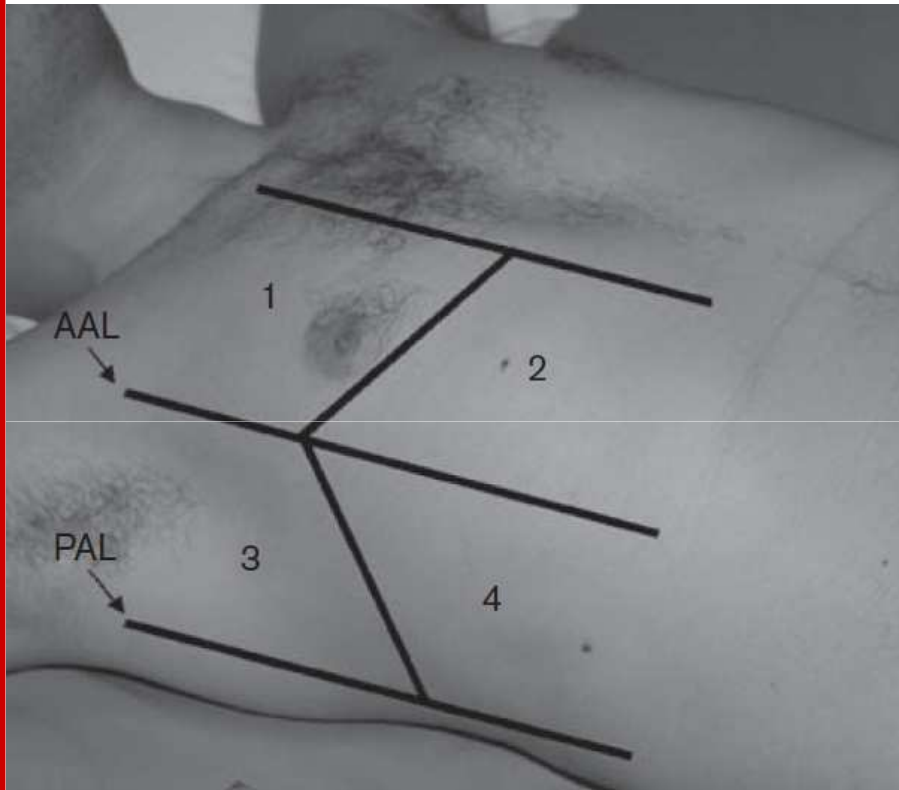


POLMONITE

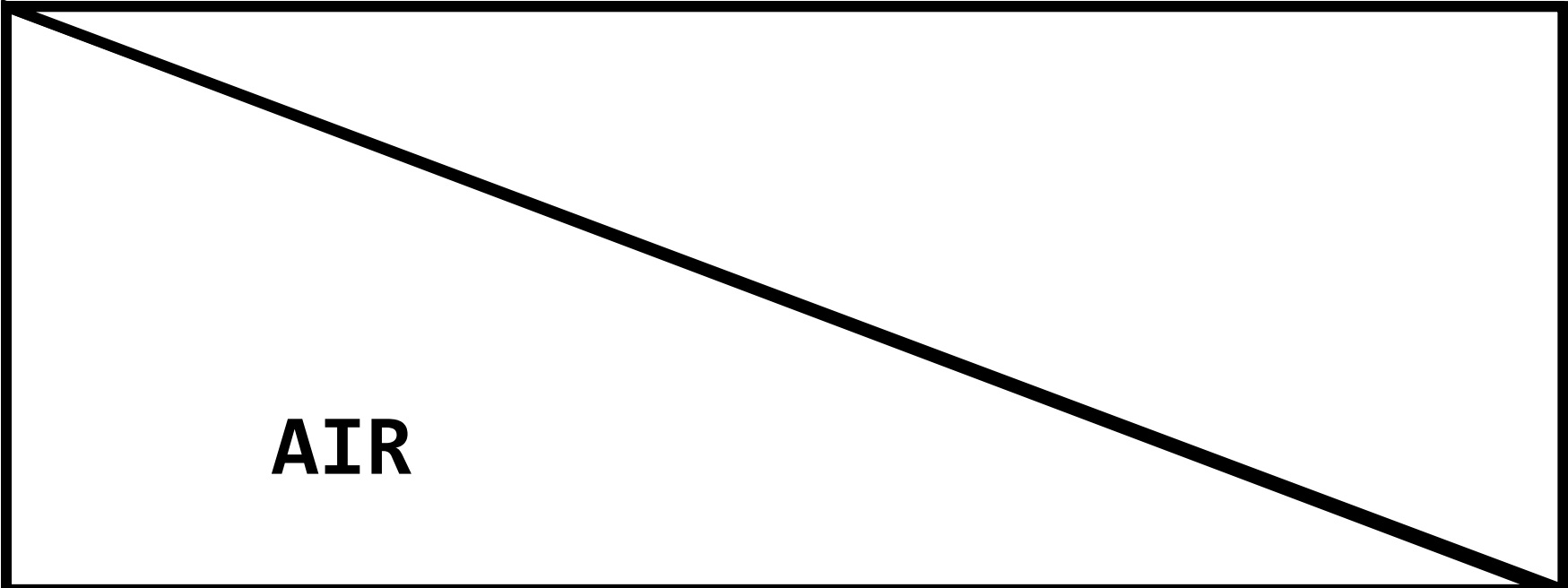


ATELECTASIA





- La mia terapia antibiotica sta funzionando ?
- Sto fornendo valori di peep adeguati ?
- Ho risolto l'atelectasia tramite broncoscopia ?
- Ho risolto l'atelectasia tramite drenaggio del liquido pleurico ?
- Lo svezzamento dal ventilatore procede per il verso giusto?



A diagram consisting of a large rectangle with a diagonal line from the top-left corner to the bottom-right corner, forming a right-angled triangle. The word "AIR" is written in bold, black, sans-serif capital letters in the center of the triangle.

AIR

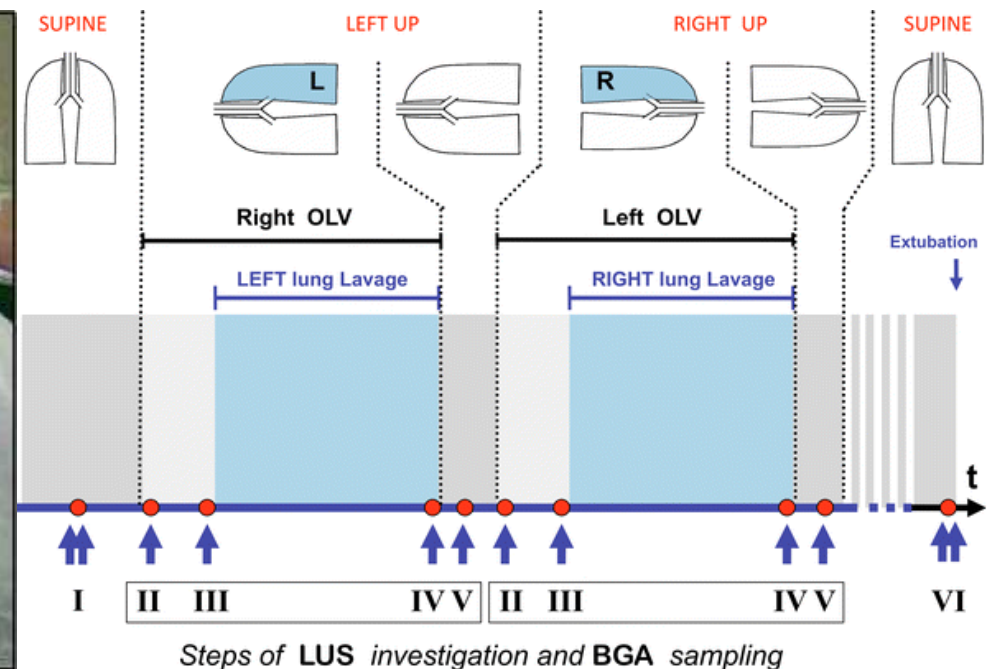
Monitoraggio in tempo reale?

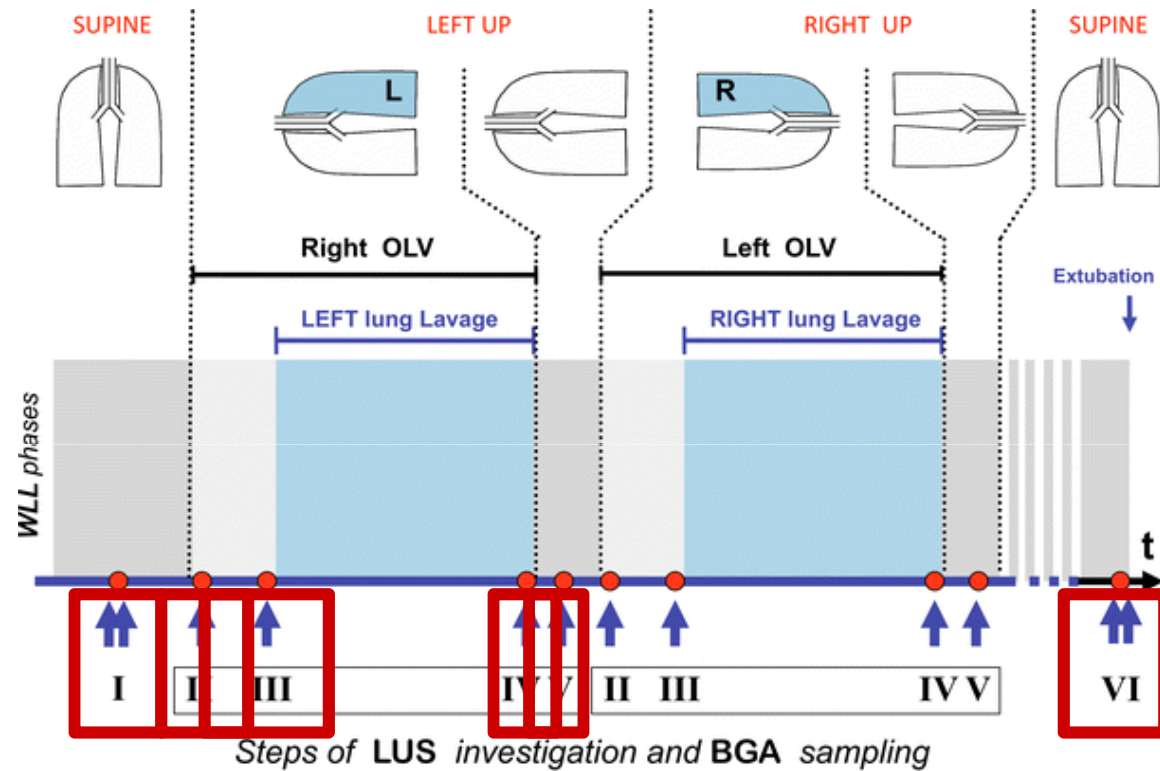
Intensive Care Med (2010) 36:999–1007
DOI 10.1007/s00134-010-1834-4

ORIGINAL

Gabriele Via
Daniel Lichtenstein
Francesco Mojoli
Giuseppe Rodi
Luca Neri
Enrico Storti
Catherine Klersy
Giorgio Iotti

Whole lung lavage: a unique model for ultrasound assessment of lung aeration changes

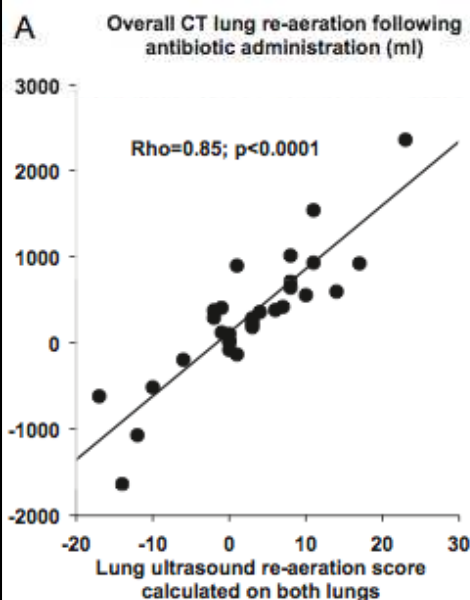




Confrontabile con altri strumenti di monitoraggio ?

Ultrasound assessment of antibiotic-induced pulmonary reaeration in ventilator-associated pneumonia*

Bélaïd Bouhemad, MD, PhD; Zhi-Hai Liu, MD
Fabio Ferarri, MD, PhD; Morgan Le-Guen, MD
Jean-Jacques Rouby, MD, PhD



Bedside Ultrasound Assessment of Positive End-Expiratory Pressure-Induced Lung Recruitment

Bélaïd Bouhemad¹, Héliène Brisson¹, Morgan Le-Guen¹, Charlotte Arbelot¹, Qin Lu¹, and Jean-Jacques Rouby¹

¹Multidisciplinary Intensive Care Unit Pierre Viars, Assistance Publique Hôpitaux de Paris, UPMC (Université Pierre et Marie Curie) Paris-6, Department of Anesthesiology and Critical Care Medicine, La Pitié-Salpêtrière Hospital, Paris, France

Rationale: In the critically ill patients, lung ultrasound (LUS) is increasingly being used at the bedside for assessing alveolar-interstitial syndrome, lung consolidation, pneumonia, pneumothorax, and pleural effusion. It could be an easily repeatable noninvasive tool for assessing lung recruitment.

Objectives: Our goal was to compare the pressure-volume (PV) curve method with LUS for assessing positive end-expiratory pressure (PEEP)-induced lung recruitment in patients with acute respiratory distress syndrome/acute lung injury (ARDS/ALI).

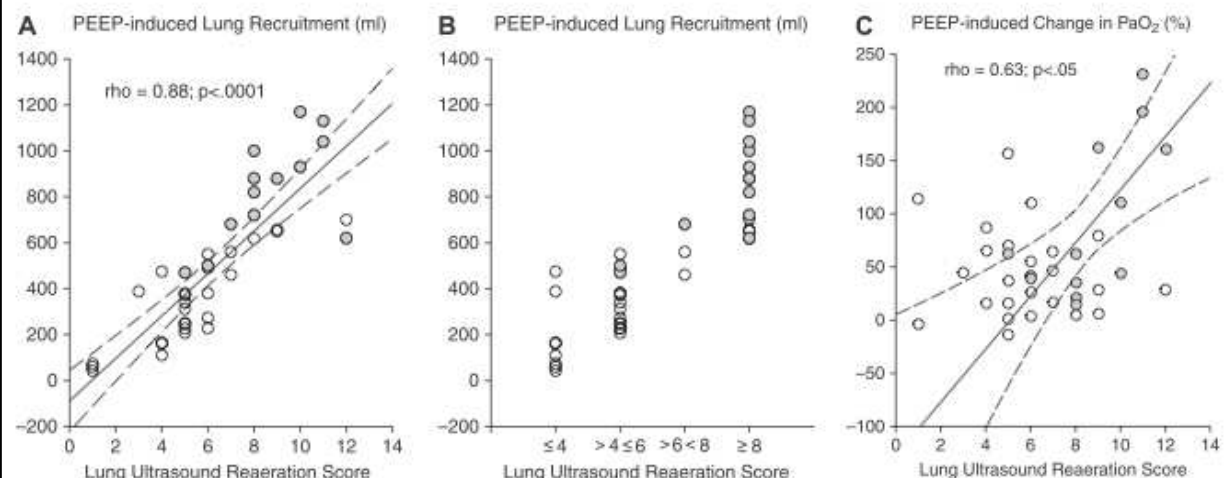
Methods: Thirty patients with ARDS and 10 patients with ALI were

AT A GLANCE COMMENTARY

Scientific Knowledge on the Subject

In critically ill patients, lung ultrasound is increasingly being used for assessing lung consolidation, pneumonia, pleural effusion, and pneumothorax.

What This Study Adds to the Field



N**B1****B2****C**

4 pattern ecografici (dal più areato
al meno areato) analizzati su 6
scansioni per emitorace

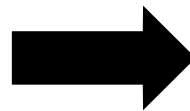
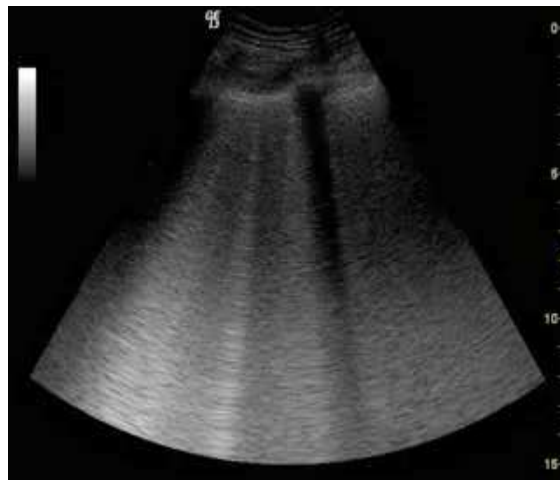
QUANTIFICATION - REAREATION

1 POINT	3 POINT	5 POINT
B1 → N	B2 → N	C → N
B2 → B1	C → B1	
C → B2		

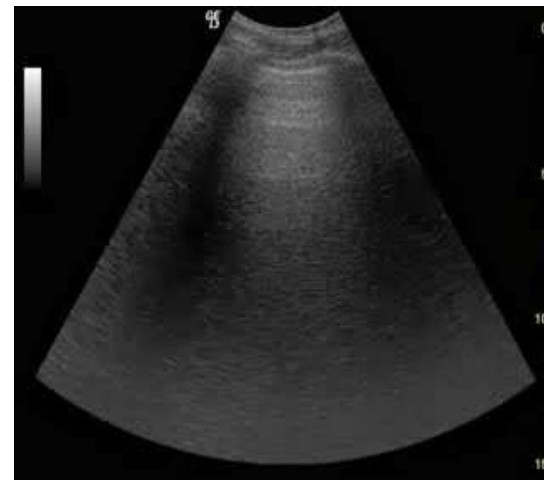
QUANTIFICATION - LOSS OF REAREATION

- 1 POINT	- 3 POINT	- 5 POINT
N → B1	N → B2	N → C
B1 → B2	B1 → C	
B2 → C		

B2



N



QUANTIFICATION - REAREATION

1 POINT	3 POINT	5 POINT
B1 → N	B2 → N	C → N
B2 → B1	C → B1	
C → B2		

QUANTIFICATION - LOSS OF REAREATION

- 1 POINT	- 3 POINT	- 5 POINT
N → B1	N → B2	N → C
B1 → B2	B1 → C	
B2 → C		

C



B2



GIORNO 1



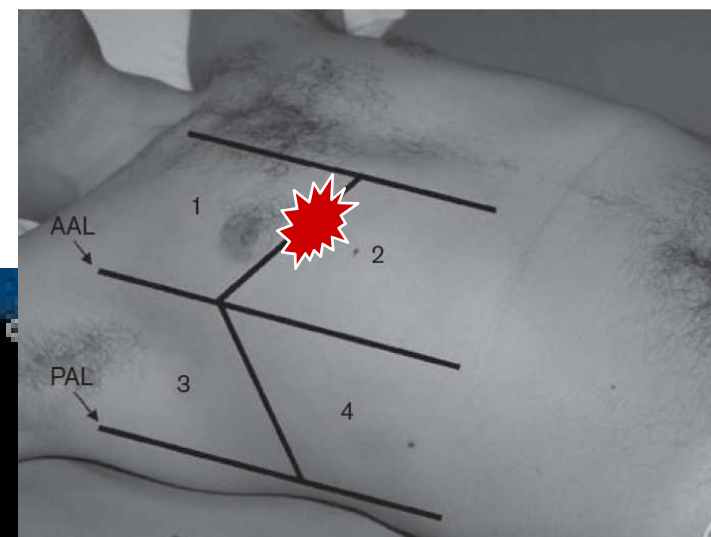
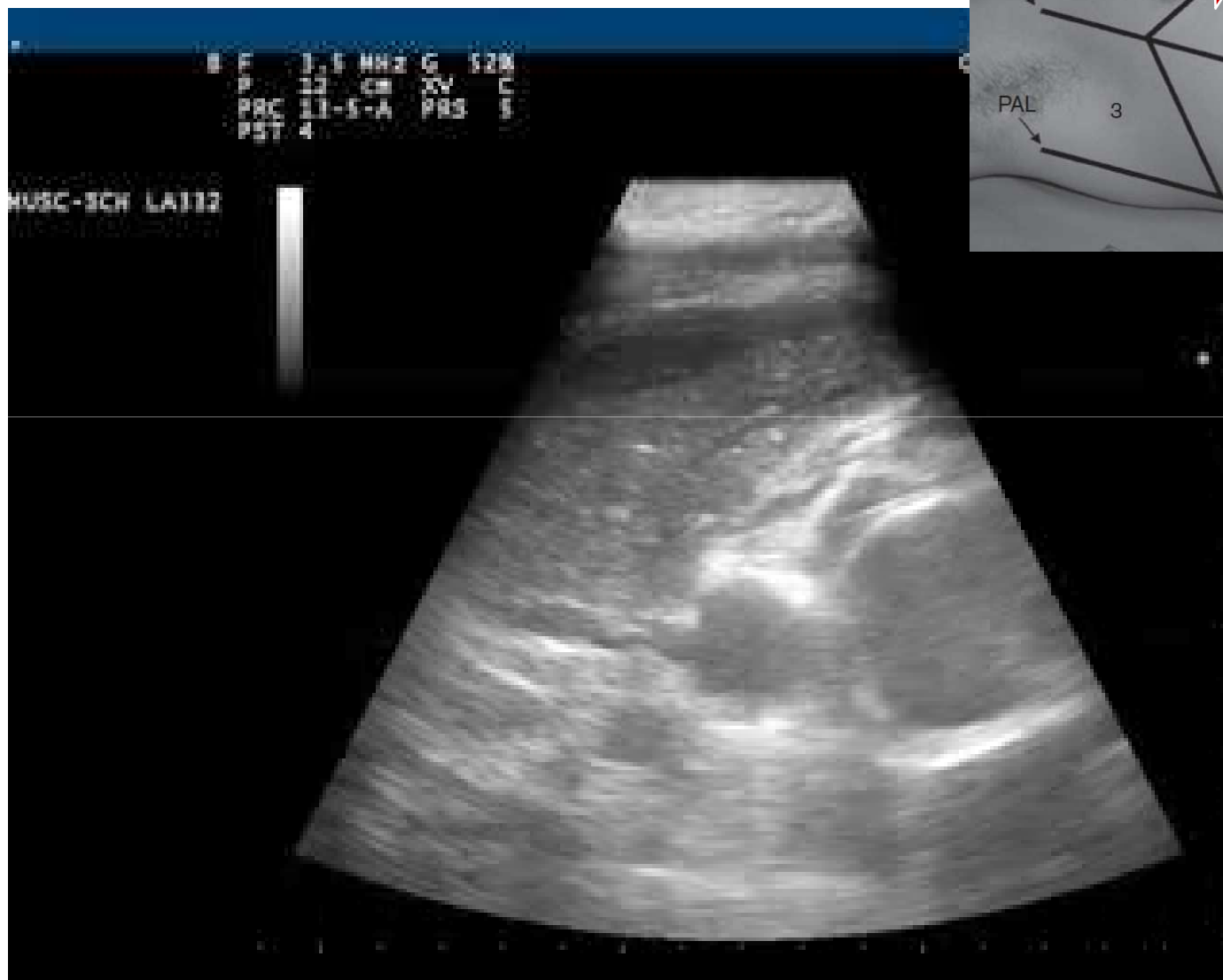
polmonite,
evoluzione dopo
cpap e terapia
antibiotica

GIORNO 3

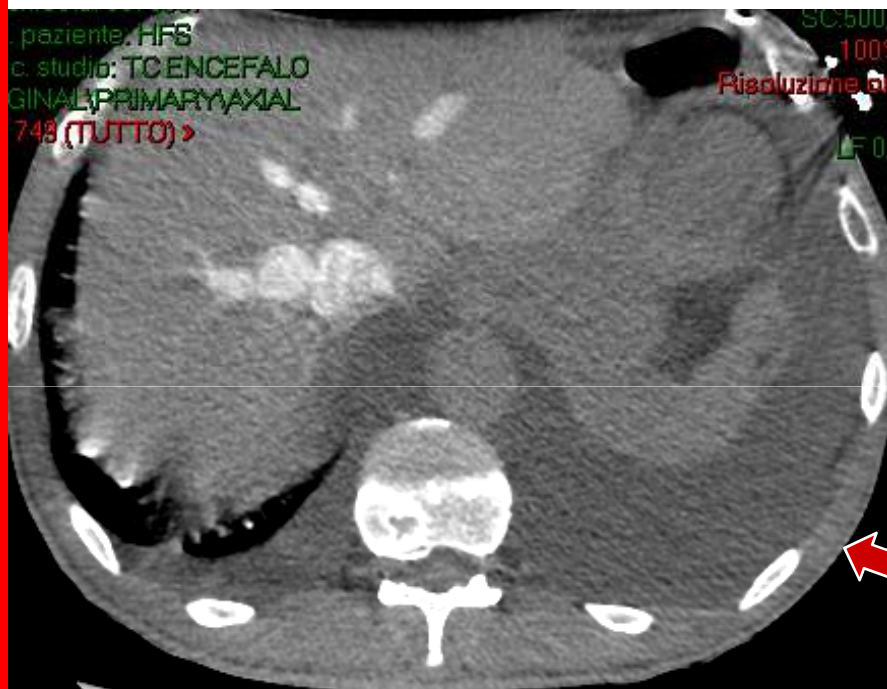


GIORNO 5











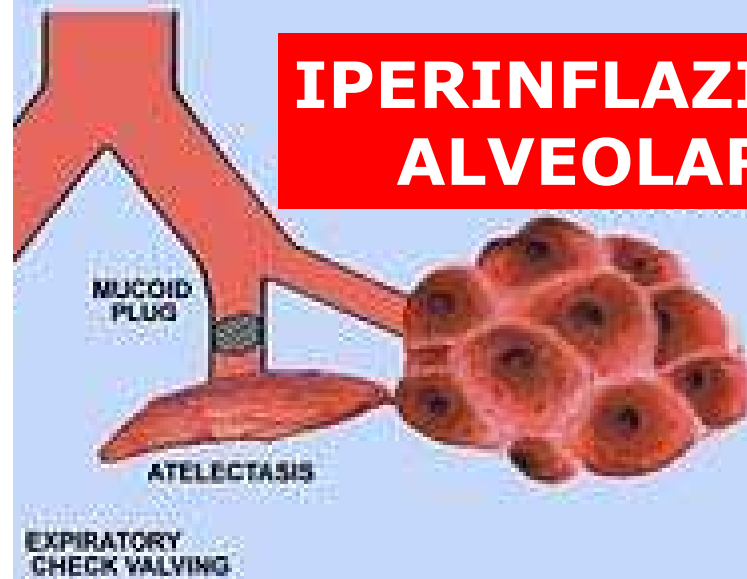
L'ecografia non ci indica solo **se** il polmone viene reclutato ma anche **come** viene reclutato (quali aree, con quale aspetto)



Monitoraggio ecografico, fino a dove possiamo arrivare?



IPERINFLAZIONE ALVEOLARE



VILI

IPPV with high volume and pressure induces pulmonary edema.



nl lung

after 5'

after 20'

Dreyfuss et al. Am Rev Resp Dis 1985; 132: 880-4

