



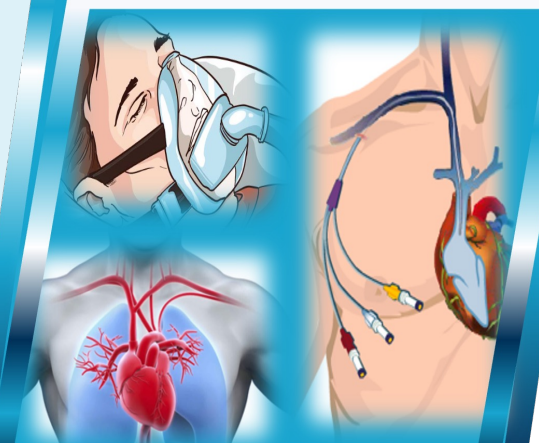
2° Edizione

**Area Critica in
Medicina Interna**

**13 Aprile 2024
Savona**

L'ecografia nel paziente dispnoico in Area Critica

Nathan Artom



EDITORIAL

The “ultrasonic stethoscope”: is it of clinical value?

A Salustri, P Trambaiolo

Heart 2003;**89**:704–706

The availability of miniaturised ultrasound instruments, such as the “ultrasonic stethoscope”, herald a new era in the detection of important cardiovascular pathology at the point-of-care

Fig. 1 Point-of-care ultrasound (POCUS) machines. Modern POCUS systems can be attached to a cart for easy of movement and portability (A), carried in laptop-sized housing (B), attached to a tablet (C), or even a cell phone (D)



BMJ

British
Cardiovascular
Society



PERSPECTIVE | VOL. 370 NO. 12, MAR 20, 2014

Point-of-Care Ultrasound in Medical Education — Stop Listening and Look

S.D. Solomon and F. Saldana | N Engl J Med 2014; 370:1083-1085



The NEW ENGLAND
JOURNAL of MEDICINE

Should point-of-care ultrasonography replace stethoscopes in acute respiratory failure?

BMJ 2019 ; 366 doi: <https://doi.org/10.1136/bmj.l5225> (Published 30 August 2019)

Cite this as: *BMJ* 2019;366:l5225

thebmj

This Issue

Views **24,804** | Citations **86** | Altmetric **826**

JAMA[®]

The Journal of the American Medical Association

Special Communication

April 2018

Time to Add a Fifth Pillar to Bedside Physical Examination

Inspection, Palpation, Percussion, Auscultation, and Insonation

Jagat Narula, MD, PhD¹; Y. Chandrashekar, MD²; Eugene Braunwald, MD³

» [Author Affiliations](#)

JAMA Cardiol. 2018;3(4):346-350. doi:10.1001/jamacardio.2018.0001

Emerging Technology Review

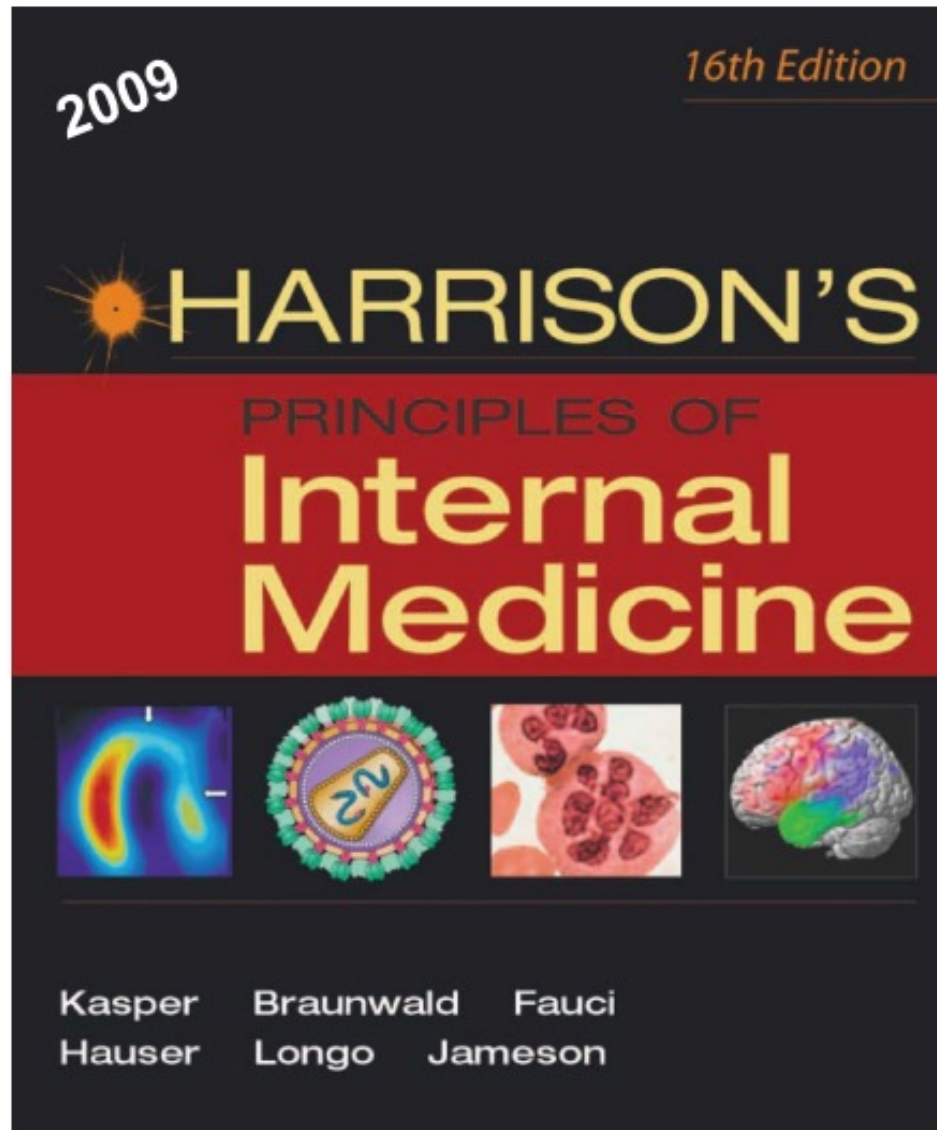
Handheld Point-of-Care Ultrasound Probes: The New Generation of POCUS

Yanick Baribeau BS, Aidan Sharkey MD, Omar Chaudhary MD, Santiago Krumm MD, Huma Fatima MD, Feroze Mahmood MD, FASE, Robina Matyal MD  



COST	\$200/month per probe + \$75/month warranty	>\$10,000	Starts at \$2,995	Starts at \$6,900	\$1,999 + \$420/year for cloud user license
OPERATING SYSTEM	Android	Android with proprietary tablet	Proprietary system based on Android/Linux	iOS and Android	iOS
PROBES	Separate linear, curvilinear, and phased array probes	Separate linear, curvilinear, and phased array probes	Dual probe (curvilinear and linear)	Separate linear, curvilinear, microconvex, and endocavitary probes; phased array clip-on not available in the United States yet	Three-in-one single probe that covers linear, curvilinear, and phased array
PROBE TECHNOLOGY	Crystals (piezoelectric)	Crystals (piezoelectric)	Crystals (piezoelectric)	Crystals (piezoelectric)	CMUT-on CMOS

DIAGNOSTICA ECOGRAFICA NELLA PATOLOGIA RESPIRATORIA



235 DIAGNOSTIC PROCEDURES IN RESPIRATORY DISEASE Steven E. Weinberger, Jeffrey M. Drazen

FIGURE 235-2
Fibrosis. There is especially prominent thickening at the base of the most marked.

clear in what lung tissue.

Recent advances in computer processing of the data acquired by helical scanning have allowed images to be presented in novel ways. For example, images may be displayed in views and planes other than the traditional cross-sectional view, and sophisticated three-dimensional reconstructions produce images (called *virtual bronchoscopy*) that mimic those seen by direct visualization through a bronchoscope.

MAGNETIC RESONANCE IMAGING The role of magnetic resonance (MR) imaging in the evaluation of respiratory system disease is less well defined than that of CT. Because MR generally provides a less detailed view of the pulmonary parenchyma as well as poorer spatial resolution, its usefulness in the evaluation of parenchymal lung disease is limited.

...is helpful in the detection of pleural effusion and is often used as a guide for thoracentesis

ULTRASOUND : Because ultrasound energy is rapidly dissipated in the air, ultrasound imaging is not useful for the evaluation of the pulmonary parenchyma.....

densities are vascular in origin and in defining aortic lesions such as aneurysms or dissection. In addition, gadolinium can be used as an intravascular contrast agent for MR angiography.

SCINTIGRAPHIC IMAGING Radioactive isotopes, administered by either intravenous or inhaled routes, allow the lungs to be imaged with a gamma camera. The most common use of such imaging is ventilation-perfusion lung scanning performed for evaluation of pulmonary embolism. When injected intravenously, albumin macroaggregates labeled with technetium 99m become lodged in pulmonary capillaries; therefore, the distribution of the trapped radioisotope follows the distribution of blood flow. When inhaled, radiolabeled xenon gas can be used to demonstrate the distribution of ventilation. For example, pulmonary thromboembolism usually produces one or more regions of ventilation-perfusion mismatch—that is, regions in which there is a

of a suspected of pulmonary artery. However, with advances in CT scanning, CT pulmonary angiography is increasingly being replaced by CT pulmonary angiography. The latter allows rapid acquisition of images with a less invasive procedure, since the radiocontrast material is injected intravenously rather than into a pulmonary artery.

ULTRASOUND Because ultrasound energy is rapidly dissipated in air, ultrasound imaging is not useful for evaluation of the pulmonary parenchyma. However, it is helpful in the detection and localization of pleural effusion and is often used as a guide to placement of a needle to aspirate pleural fluid (i.e., for thoracentesis).

spontaneous such as hyaline, is commoner because of its expected appearance in important sputum rather than other inflammatory cells. Consideration of a lower respiratory tract origin of the sample, whereas the presence of squamous epithelial cells in a "sputum" sample indicates contamination by secretions from the upper airways.

Besides processing for routine bacterial pathogens by Gram's staining and culture, sputum can be processed for a variety of other pathogens, including staining and culture for mycobacteria or fungi, culture for viruses, and staining for *Pneumocystis carinii*. In the specific case of sputum obtained for evaluation of *P. carinii* pneumonia in a patient infected with HIV, for example, sputum should be collected by induction, rather than spontaneous expectoration, and an immunofluorescent stain should be used to detect the organisms. Cytologic staining of sputum for malignant cells, using the traditional Papanicolaou method, allows noninvasive evaluation for suspected lung cancer. Traditional stains and cultures are now also being supplemented in some

Approccio al paziente con dispnea



POLMONARE ??

CARDIACA ??

CORTISONE ?

DIURETICO ?



Ecografia del Polmone

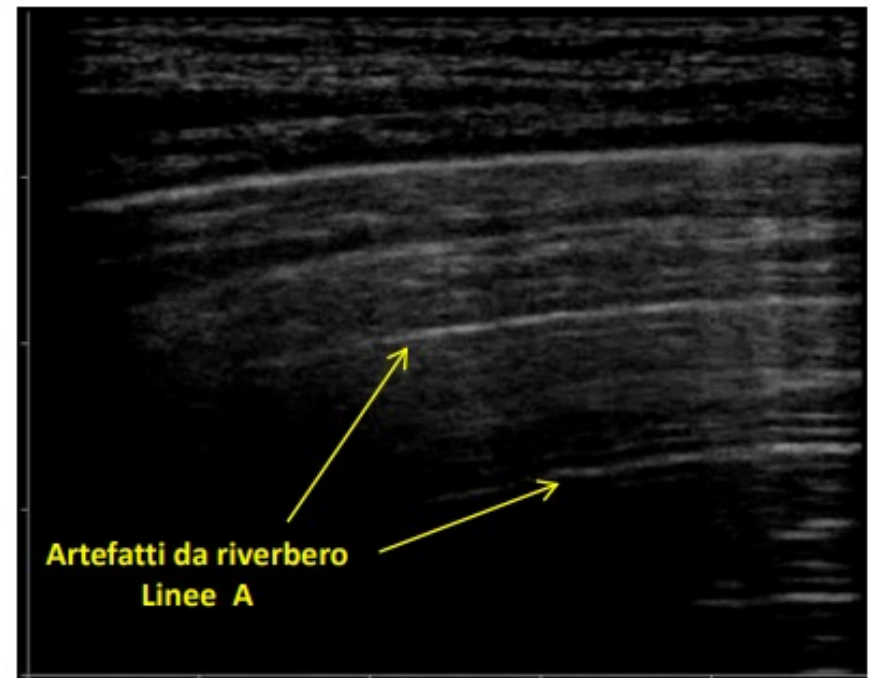
Quanto piu' elevata e' la differenza di impedenza acustica tra due mezzi **tanto piu' elevata sara' la quota riflessa degli ultrasuoni**

Nel polmone **normalmente aereato** - per l' elevata differenza di impedenza acustica **ARIA / PLEURA** - si verifica la riflessione del fascio ultrasonoro ad ogni interfaccia **tessuto - aria** determinando il **c.d. (Mirror effect).....**

	Densità ($\text{kg}\cdot\text{m}^{-3}$)	Impedenza ($\text{kg}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)	Velocità ($\text{m}\cdot\text{s}^{-1}$)
Aria	1,2	0,0004	330
Grasso	920	1,35	1460
Fegato	1060	1,64	1540-80
Milza	1060	1,66	1555-80
Sangue	1060	1,62	1560
Rene	1040	1,62	1560
Muscolo	1070	1,65-1,74	1545-1630
Osso	1380-1810	3,75-7,38	2700-4100

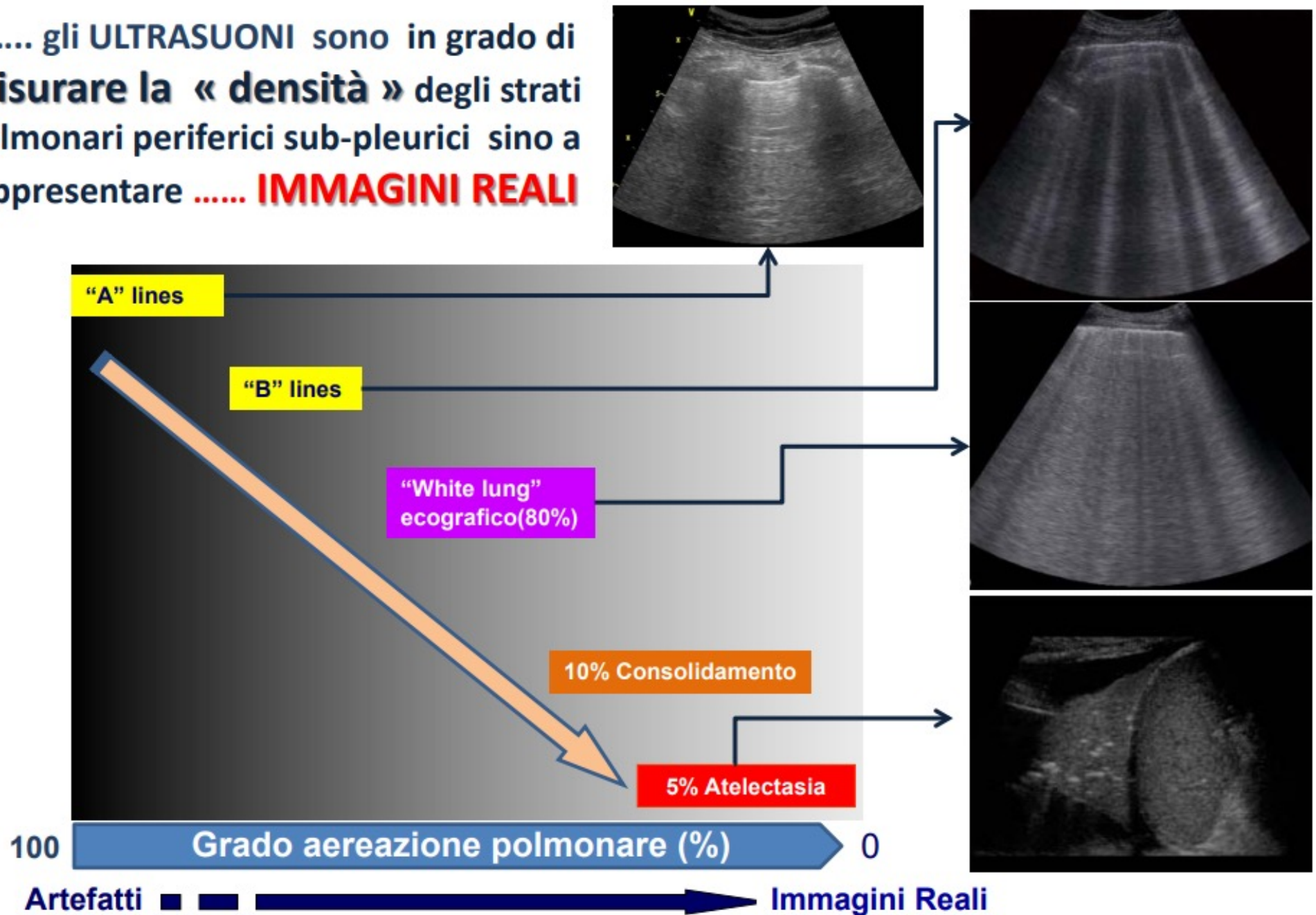


Linea
pleurica

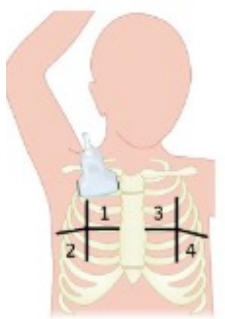
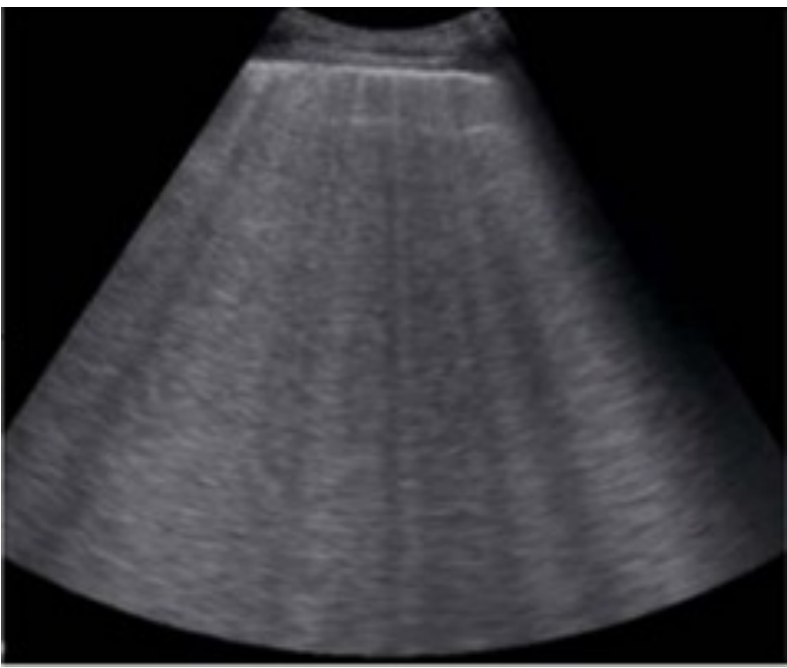
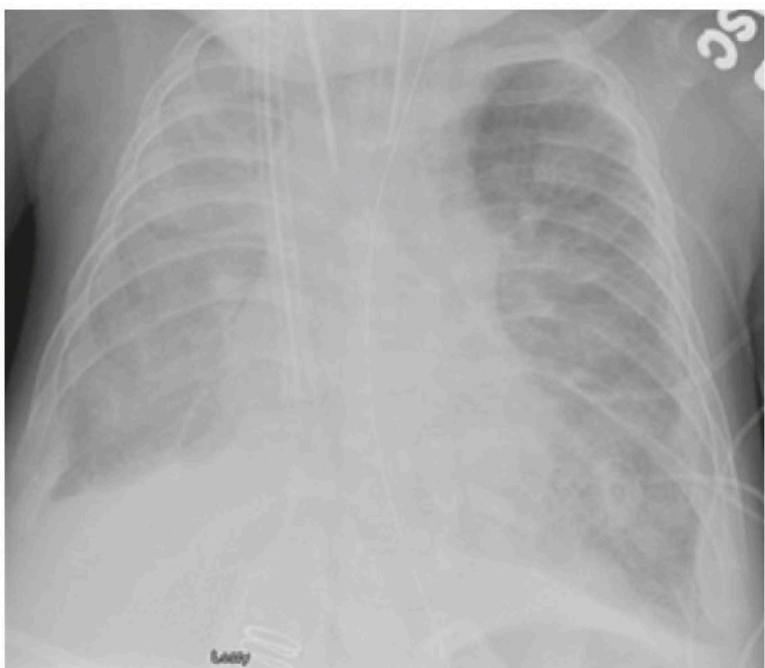


LUS: GRADO DI AEREAZIONE E IMMAGINI US

..... gli ULTRASUONI sono in grado di misurare la « densità » degli strati polmonari periferici sub-pleurici sino a rappresentare **IMMAGINI REALI**



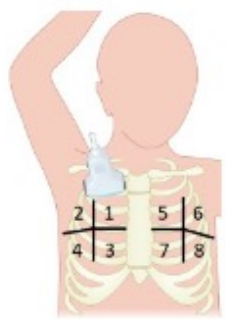
Edema polmonare acuto: white lung



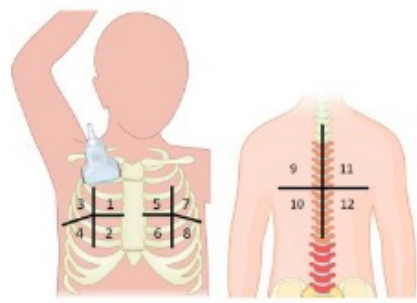
4-zone method
anterior and lateral chest



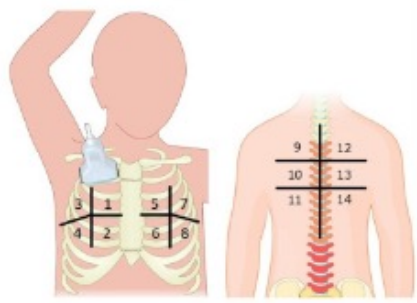
6-zone method
anterior and lateral chest



8-zone method
anterior and lateral chest



12-zone method
anterior, lateral and posterior chest

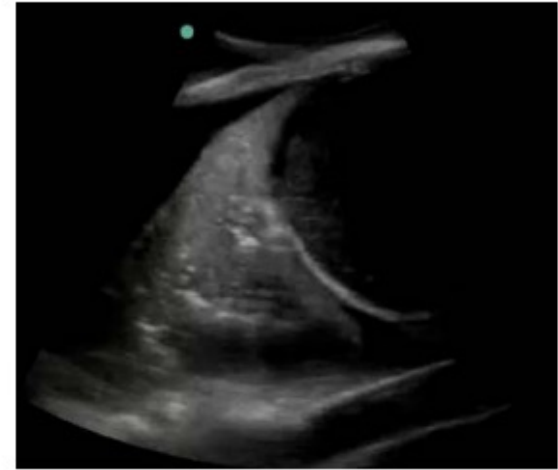


14-zone method
anterior, lateral and posterior chest

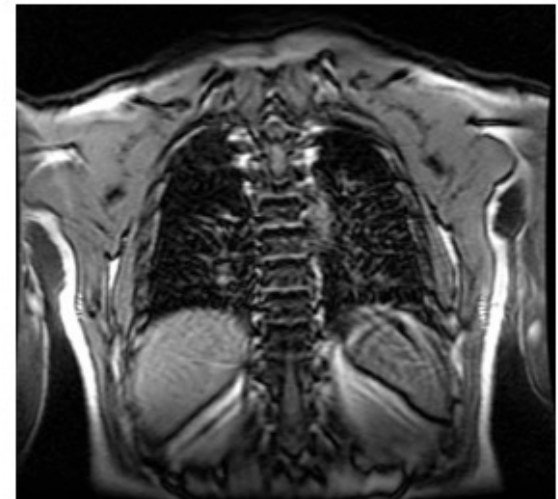
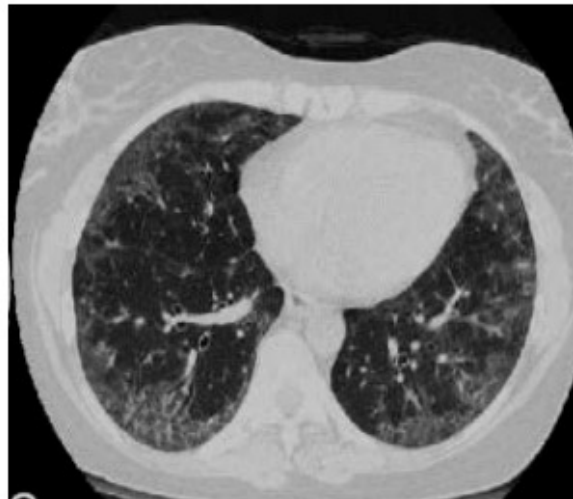
Quale ruolo per l'ecografia toracica nell'imaging della diagnostica polmonare ?

AGENDA

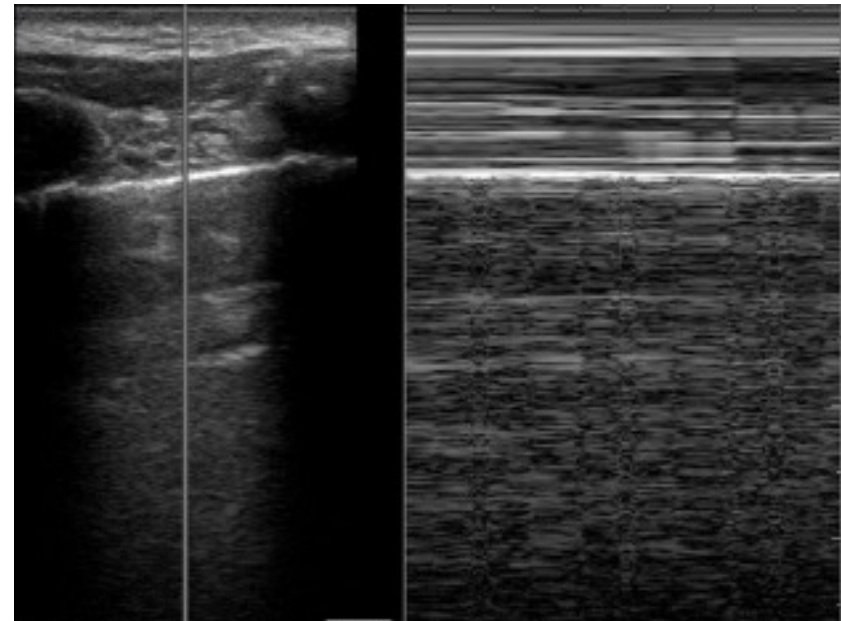
- ✓ *In quali patologie è indicata come esame di riferimento ?*
- ✓ *In quali casi può integrare la diagnosi clinica /radiologica ?*
- ✓ *In quali condizioni può vicariare la diagnosi radiologica ?*
- ✓ *Quali i limiti della metodica nella patologia polmonare ?*



Ma soprattuttocome ha cambiato l'approccio del clinico alla patologia pleuro- polmonare ???



GRADO DI CONGESTIONE POLMONARE



Approccio al paziente con dispnea eco-assistito

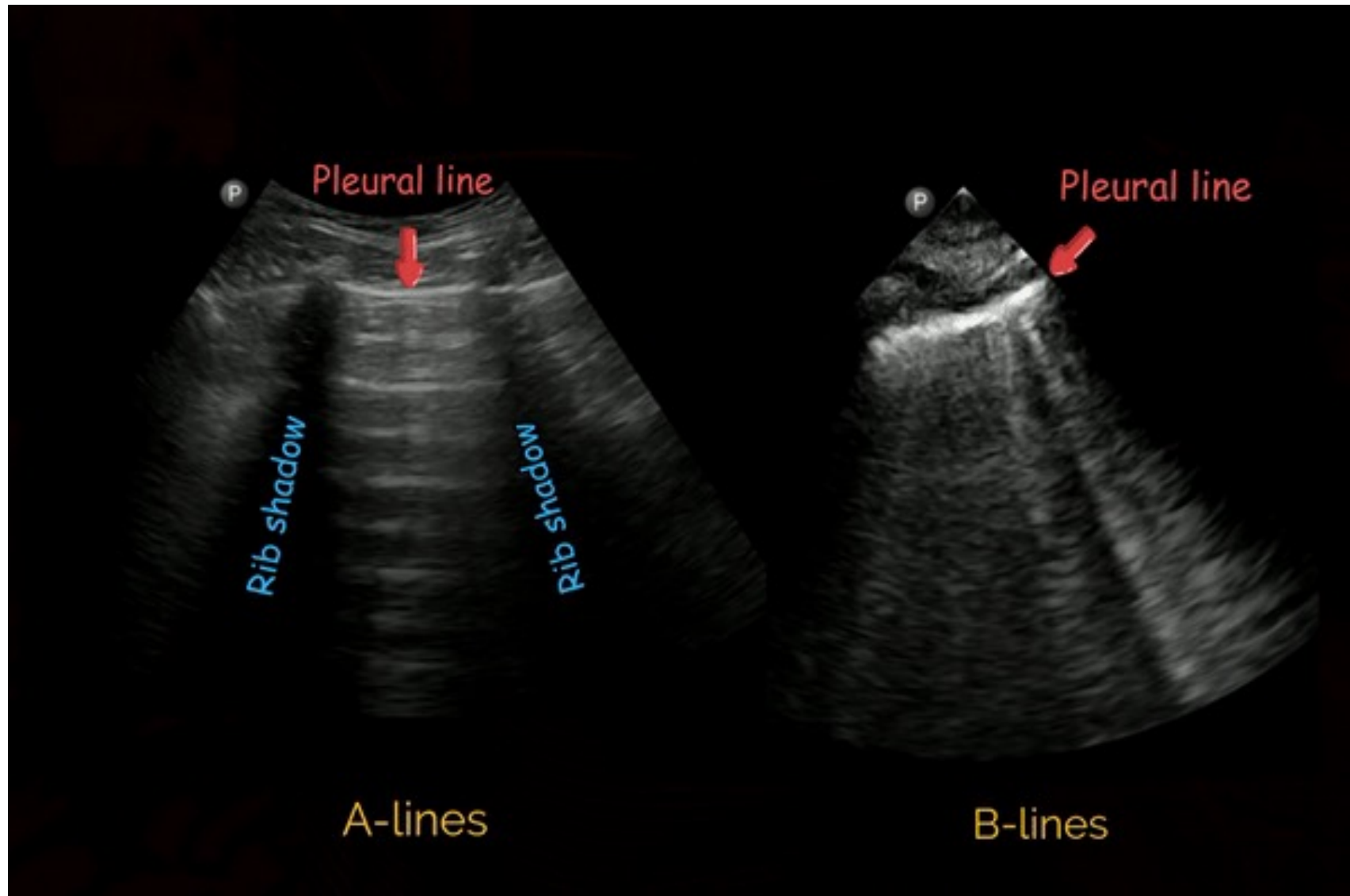


UMIDO

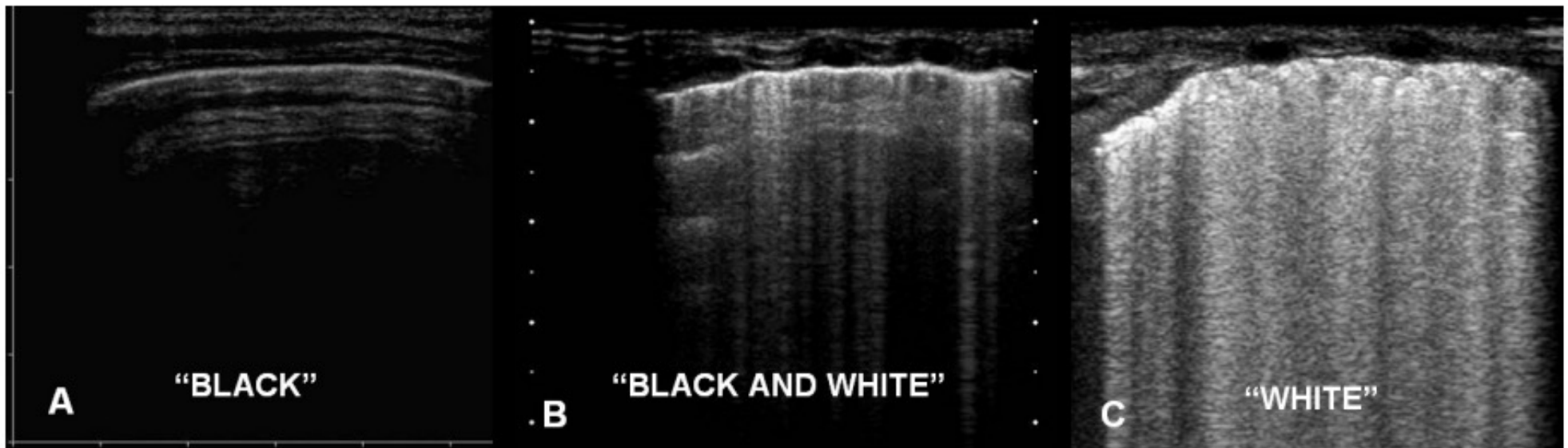


SECCO

DRY LUNG VS WET LUNG



SEMEIOTICA ULTRASONOGRAFICA DELLA SINDROME ALVEOLO-INTERSTIZIALE



Frassi F, Tesorio P, Gargani L, Agrusta M, Mottola G, Picano E: Le comete ultrasoniche polmonari: un nuovo segno ecografico di acqua extravascolare polmonare. G Ital Cardiol 2007; 8 (suppl 1-4).

LUS NELLA DIAGNOSTICA DELLA DISPNEA

DISPNEA



Linee B +
Wet lung

Dispnea Cardiogena

Ecocardio

*Valutazione funzione
sistolica/diastolica,
valvulopatie, altre..*

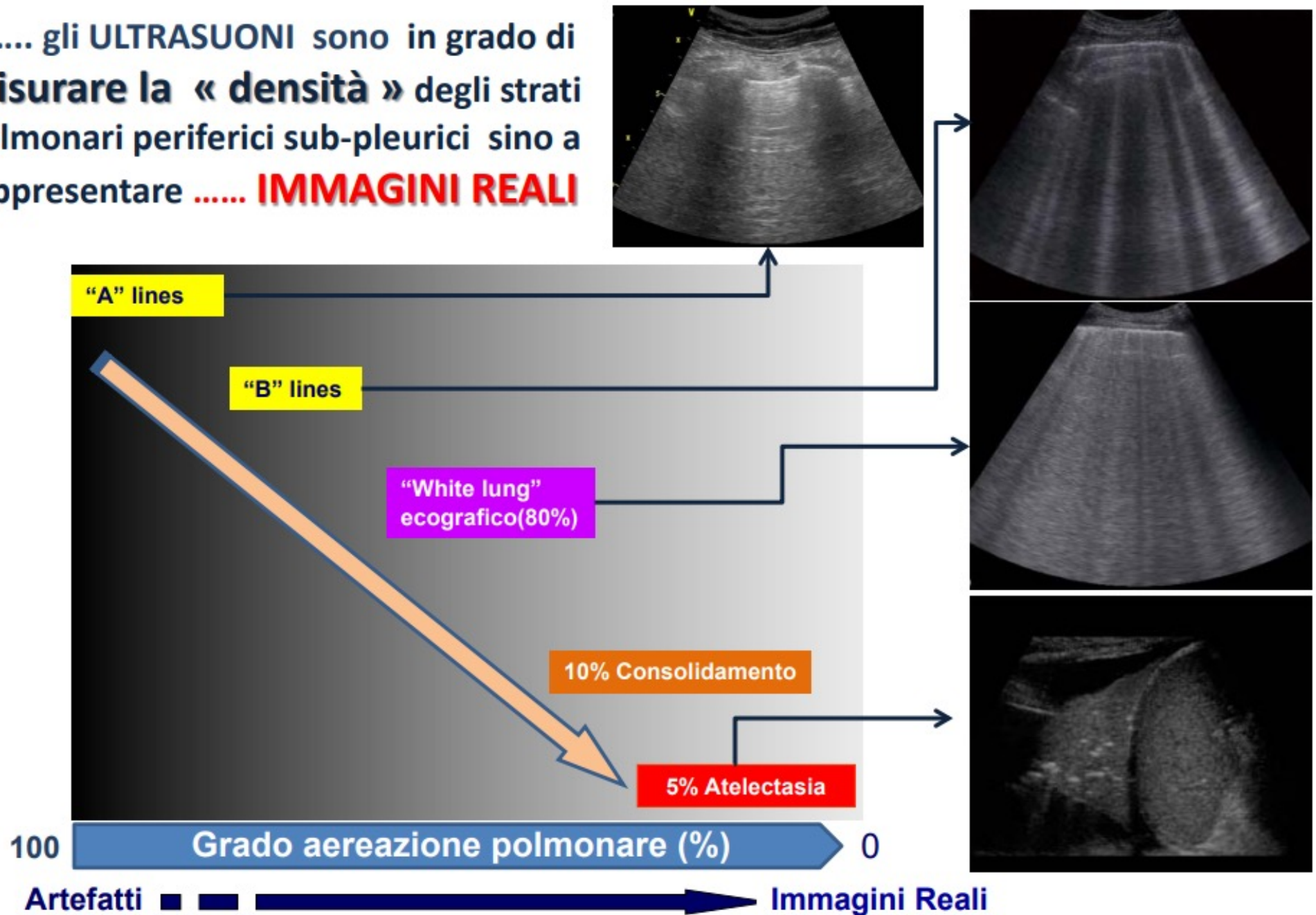
Linee B -
Dry lung

Dispnea Pneumogena

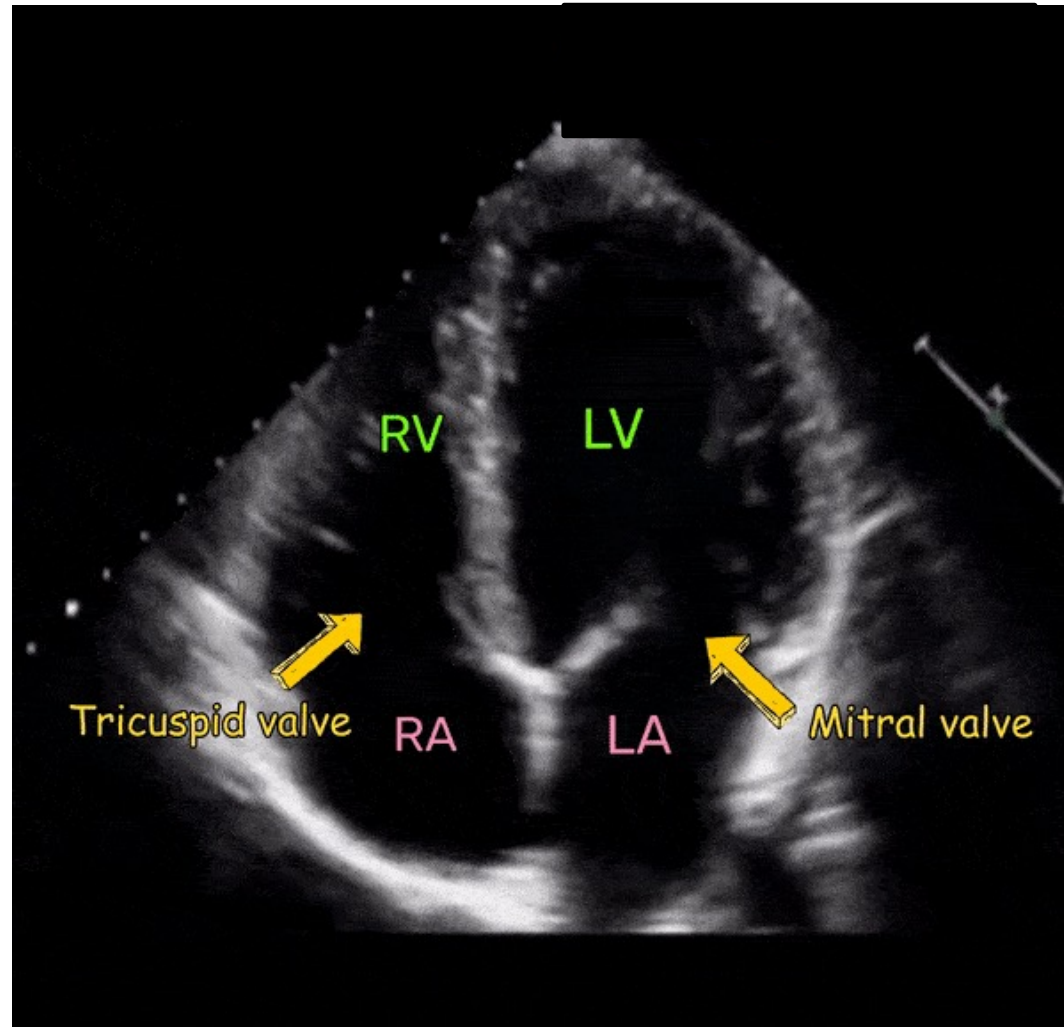
- COPD
- Pnx
- Embolia P.
- Asma

LUS: GRADO DI AEREAZIONE E IMMAGINI US

..... gli ULTRASUONI sono in grado di misurare la « densità » degli strati polmonari periferici sub-pleurici sino a rappresentare **IMMAGINI REALI**



ECOCARDIOSCOPIA



SPECIAL ARTICLE

International Evidence-Based Recommendations for Focused Cardiac Ultrasound

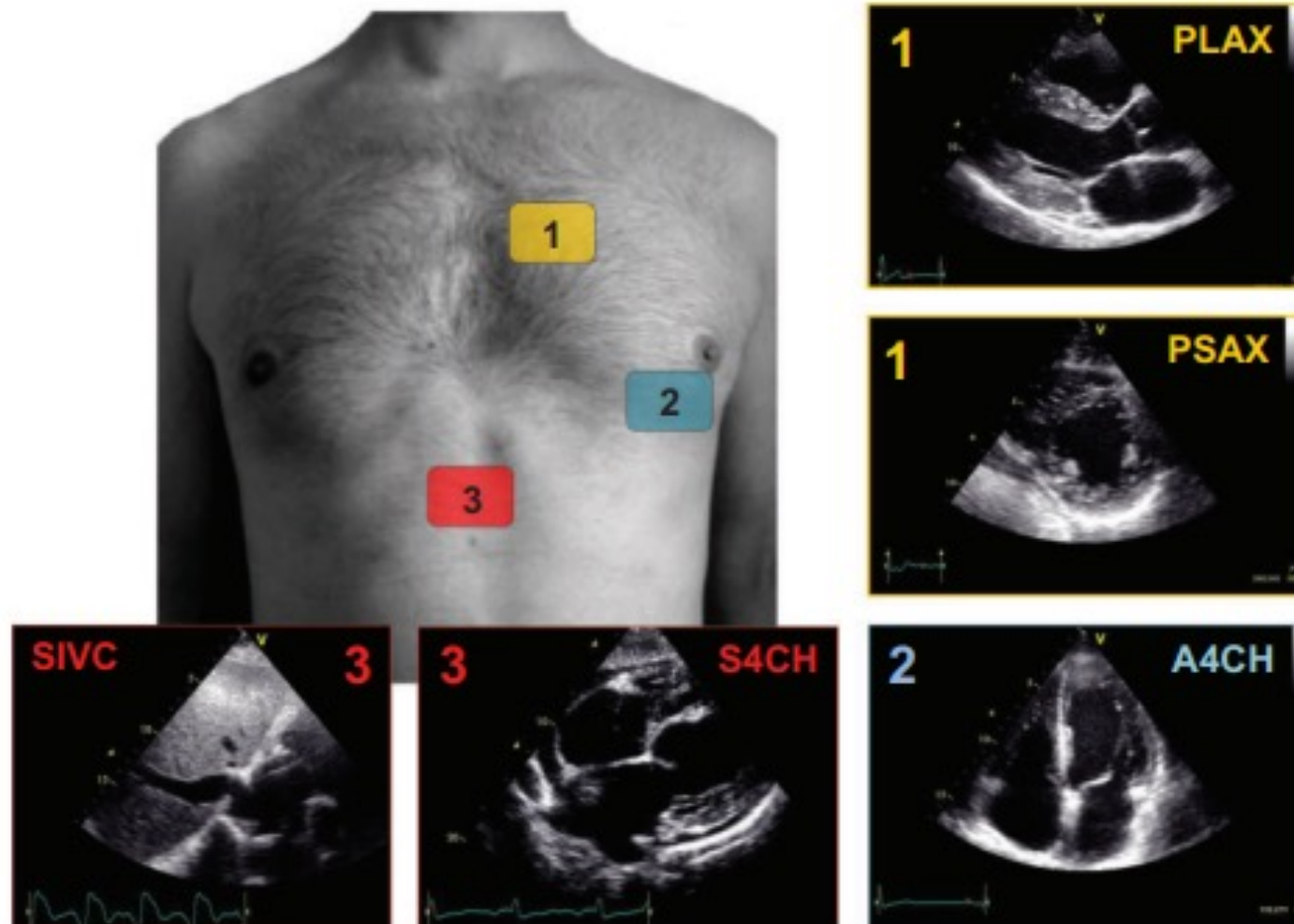
Guidelines for the Appropriate Use of Bedside General and Cardiac Ultrasonography in the Evaluation of Critically Ill Patients—Part II: Cardiac Ultrasonography

«.. è diventata **parte integrante** della medicina interna nel corso degli ultimi due decenni ed è un'abilità importante che **influenza positivamente l' outcome dei pazienti**»

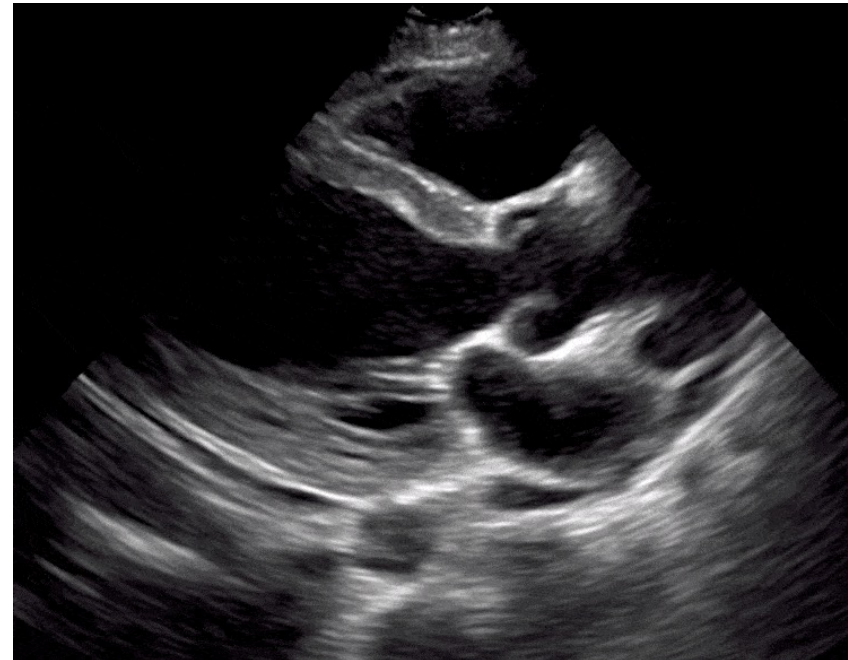
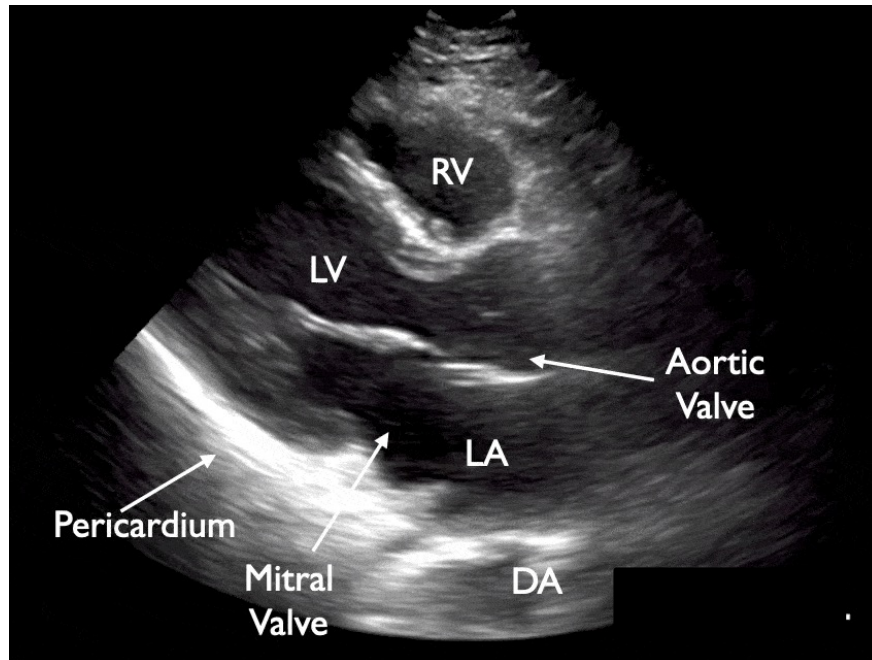
Critical Care (2016) 20:227

J Am Soc Echocardiogr 2014;27:683.e1-e33

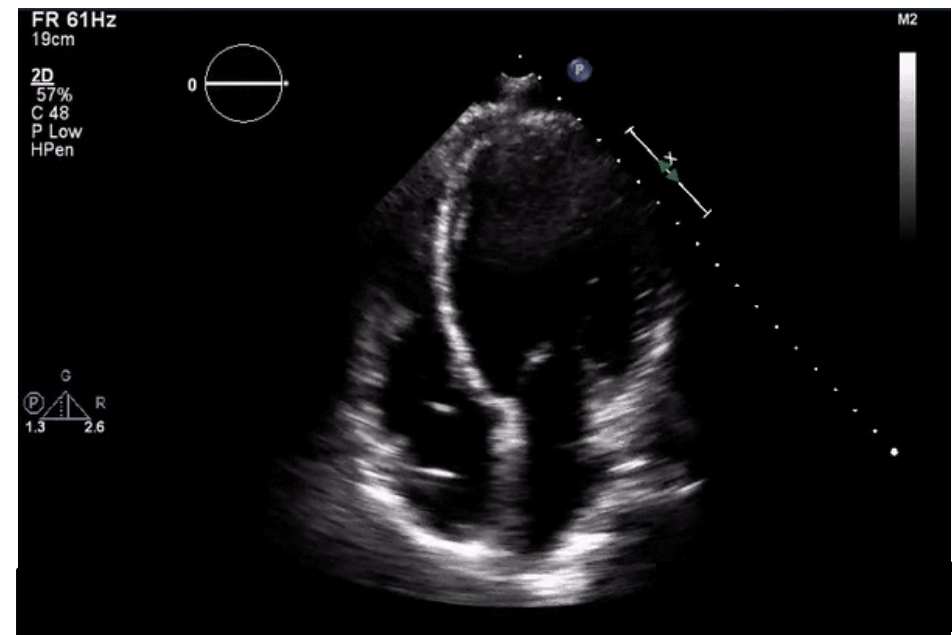
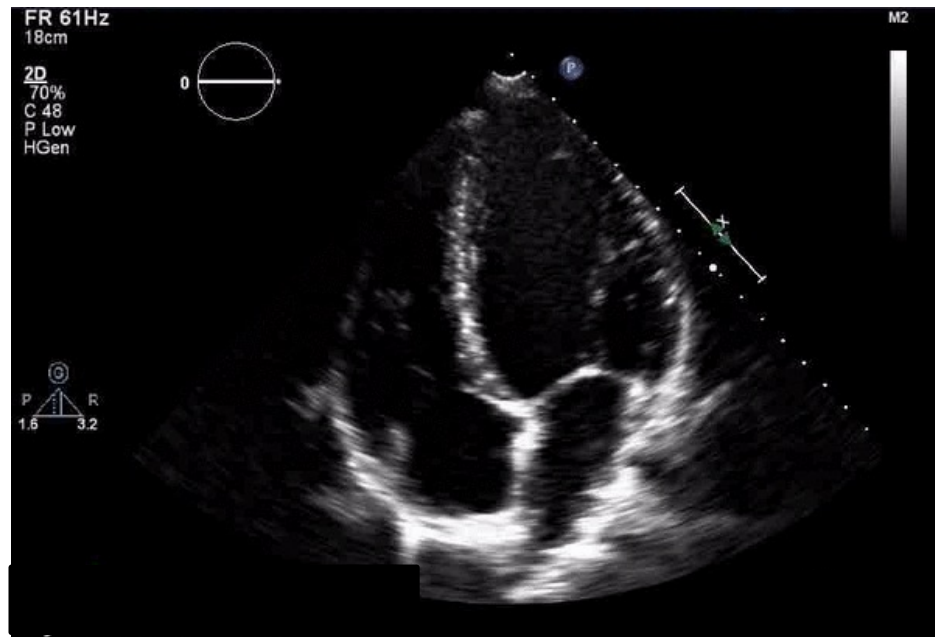
Focus cardiac ultrasound: the European Association of Cardiovascular Imaging viewpoint



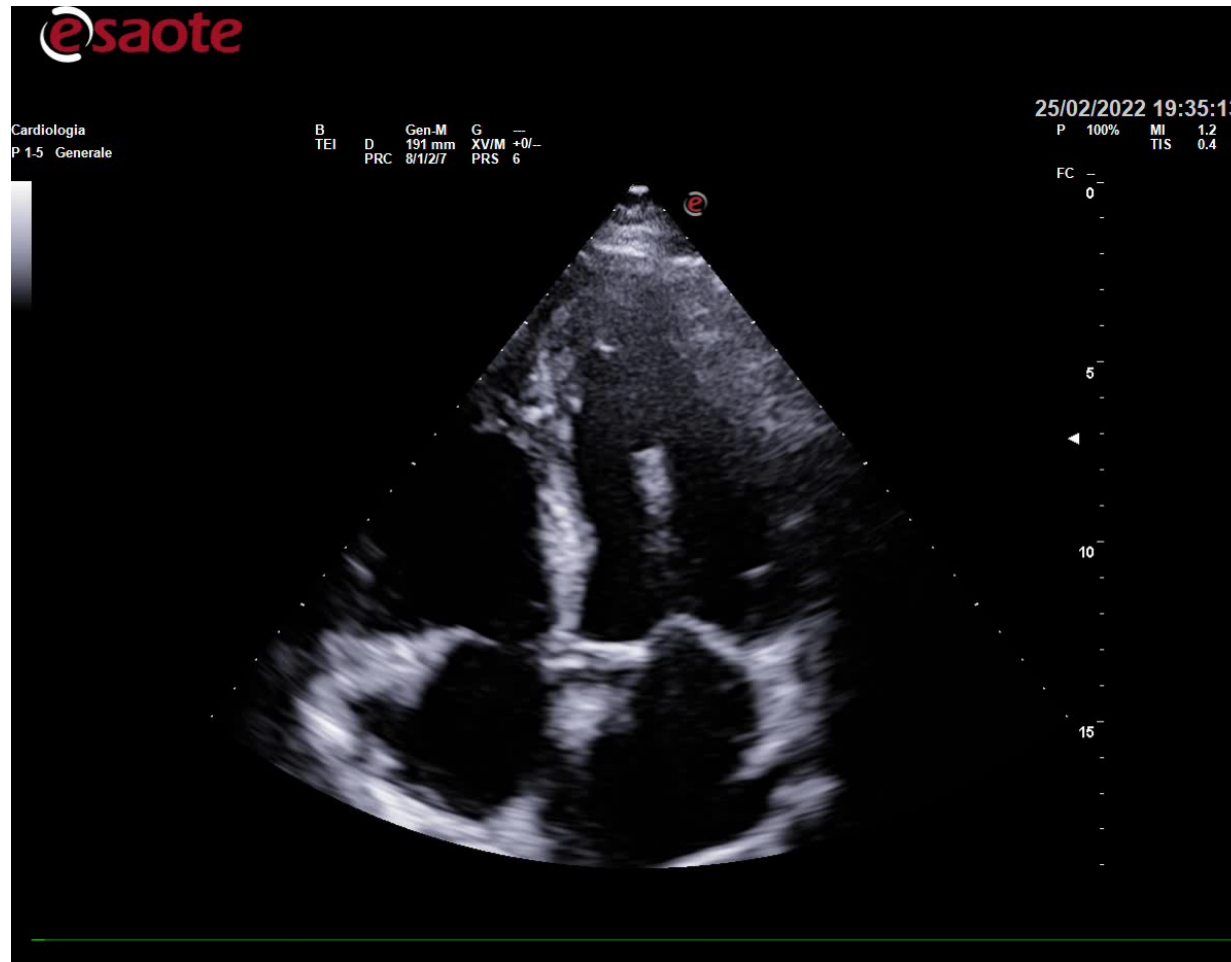
Focus cardiac ultrasound: the European Association of Cardiovascular Imaging viewpoint



Focus cardiac ultrasound: the European Association of Cardiovascular Imaging viewpoint



Shock cardiogeno

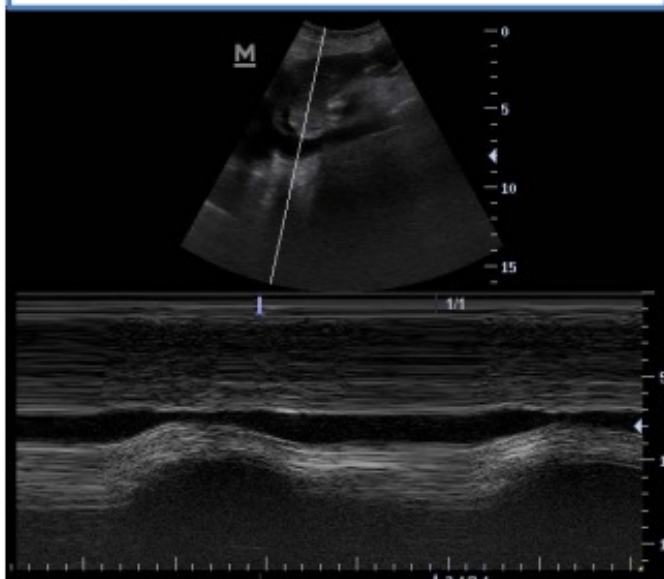


Ecografia della Vena Cava Inferiore

Lloyd,TR. Accuracy of Central Venous Pressure Measurement From the Abdominal Inferior Vena Cava. Pediatrics 1992; 89: 506-508

IVC DIAMETER	RESPIRATORY CHANGES	Estimated RAP mmHg
<1.5 small	Collapse	0-5
1.5-2.5 nl	Decrease > 50%	5-10
>2.5 nl	Decrease < 50%	10-15
>2.5 dilated	Decrease < 50%	15-20
Dilated and dilated hepatic veins	No change	>20

V. CAVA INFERIORE NORMALE



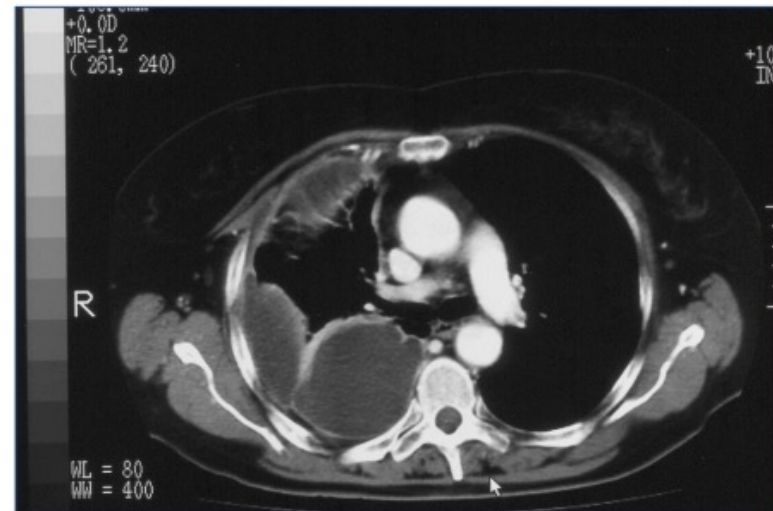
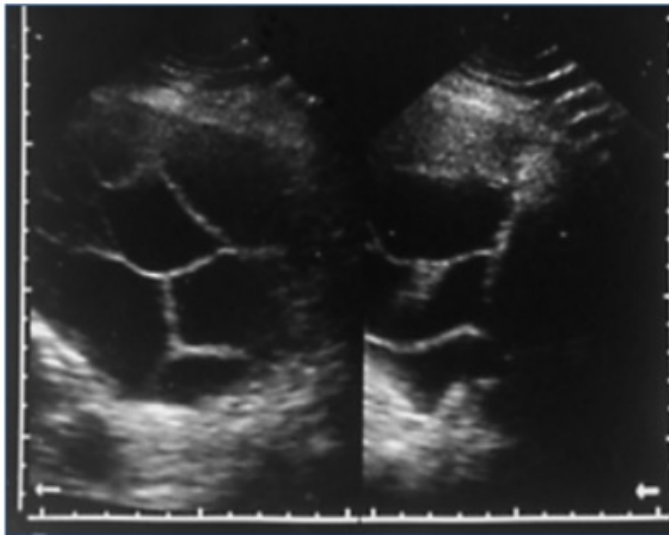
Scompenso Cardiaco Congestizio



VERSAMENTO PLEURICO

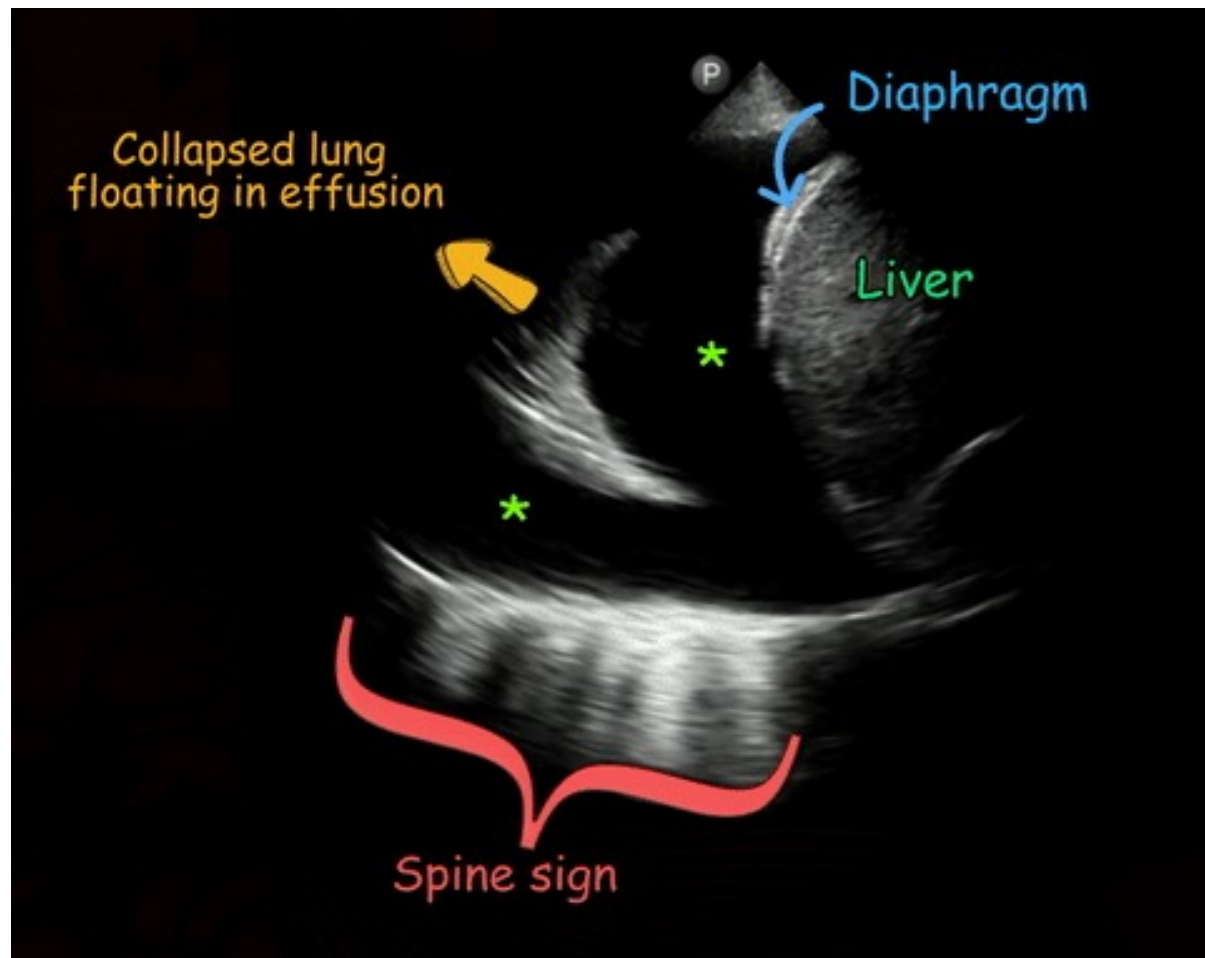
L' ecografia toracica nella diagnostica polmonare

Imaging versamento pleurico



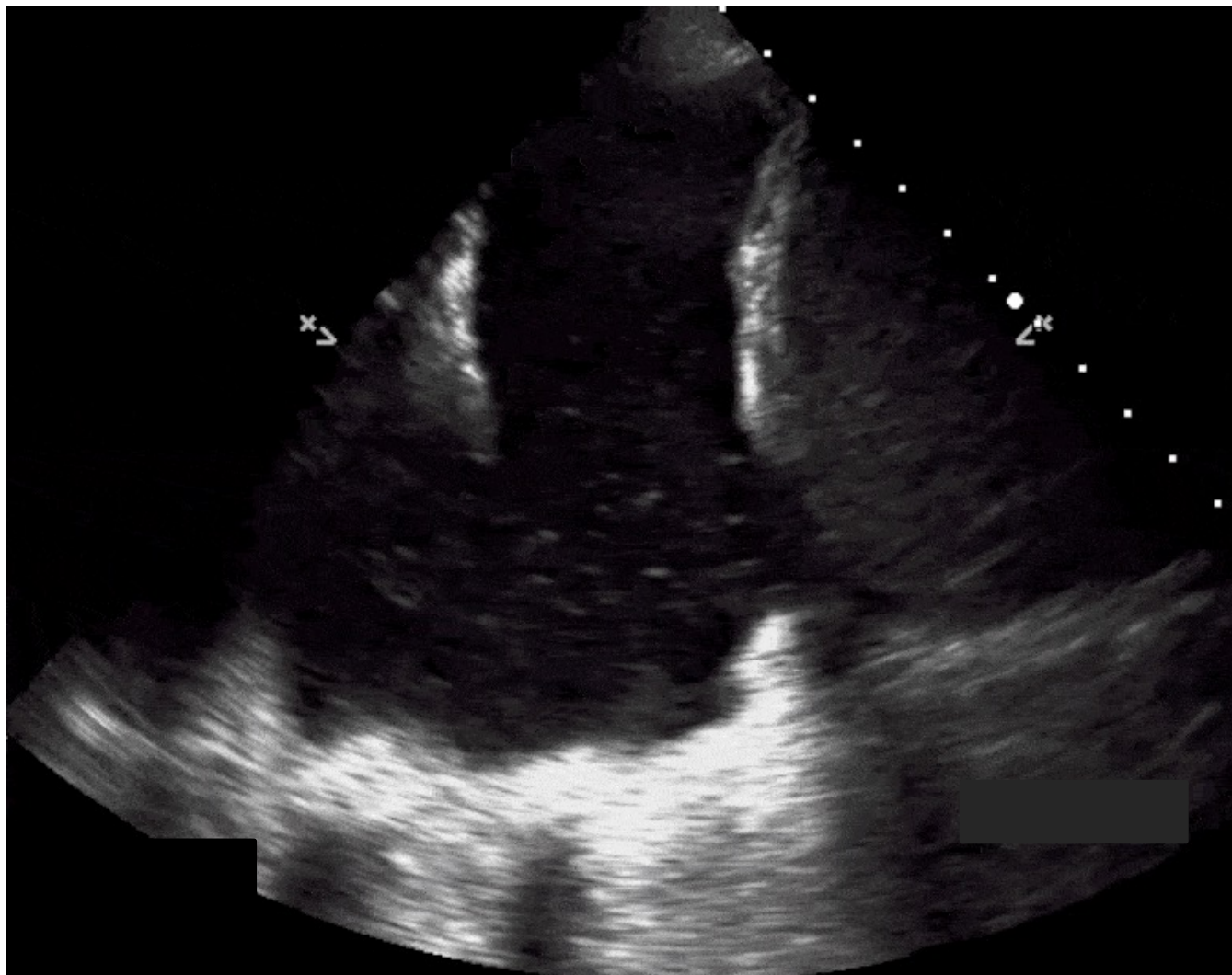
L' ecografia toracica nella diagnostica polmonare

Imaging versamento pleurico



L' ecografia toracica nella diagnostica polmonare

Imaging versamento pleurico

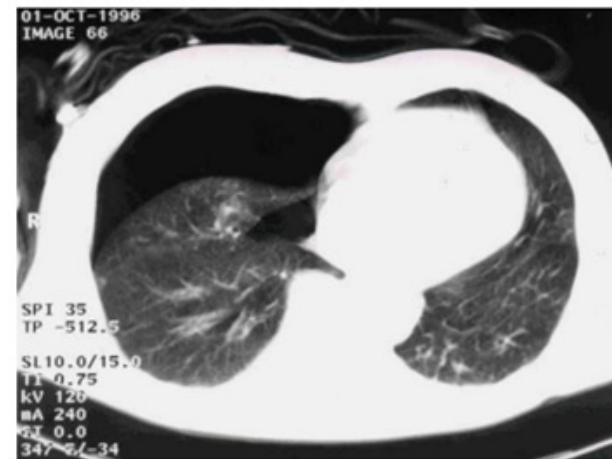
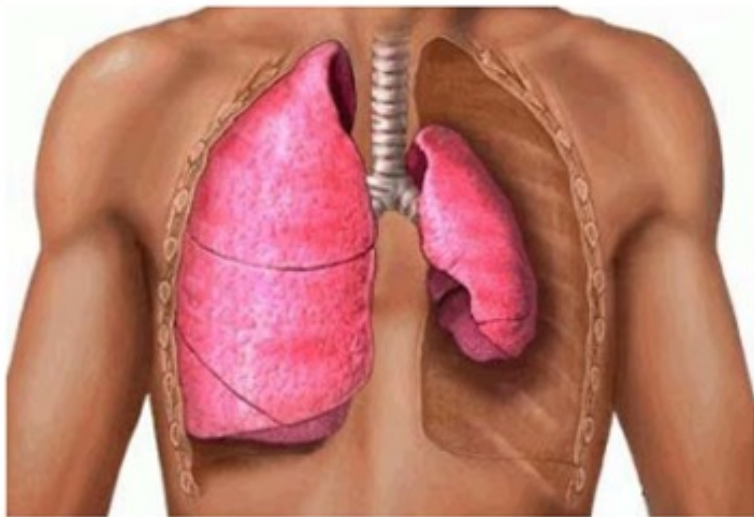


L' ecografia toracica nella diagnostica polmonare

Imaging versamento pleurico



PNEUMOTORACE



L' ecografia toracica nella diagnostica polmonare

*The Lung Point...
.....M-Mode*



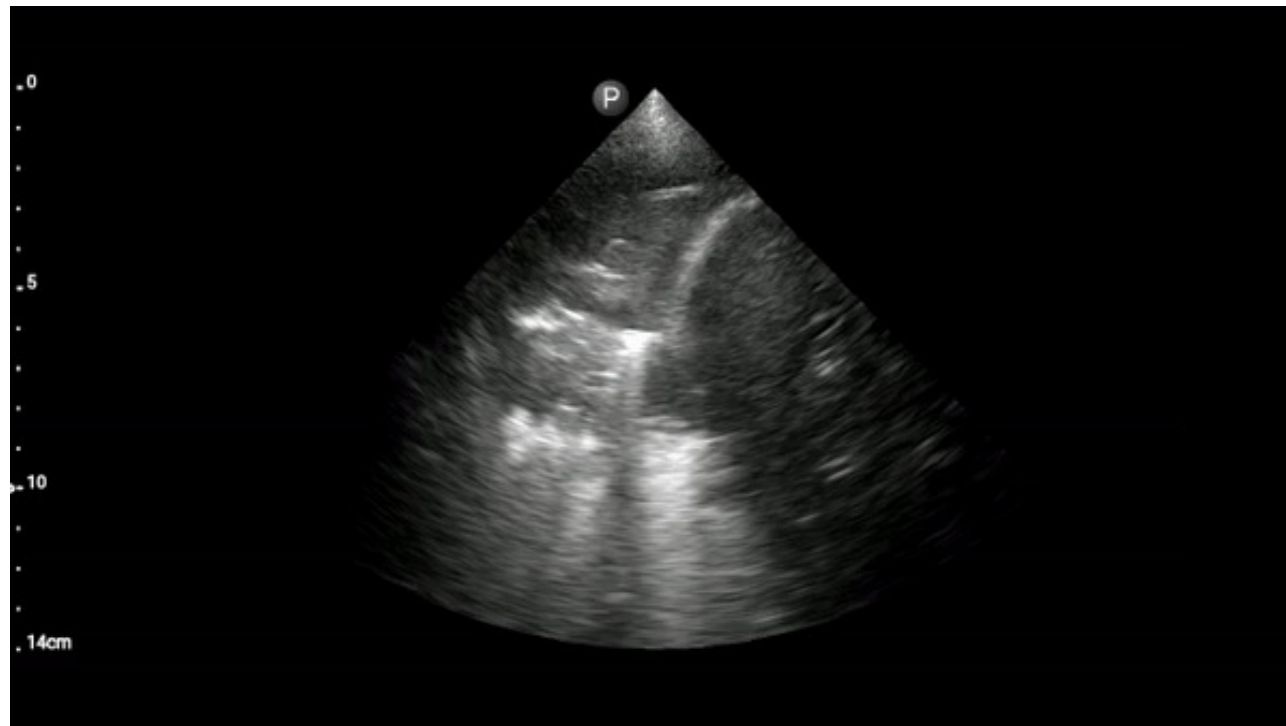
Lung sliding assente
(Stratosphere sign)

Lung sliding presente
(Seashore sign)

Lung Point



BRONCOPOLMONITE

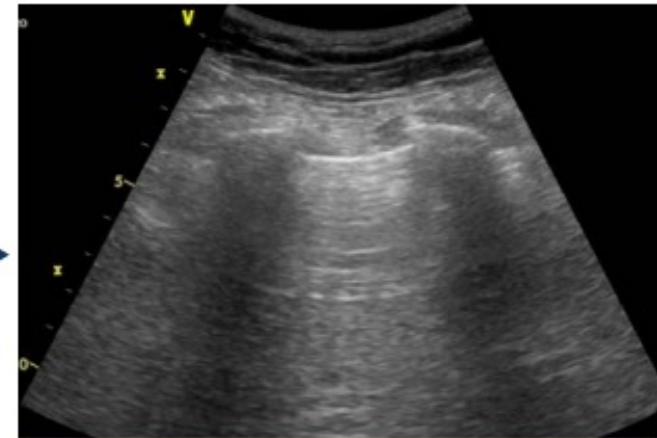


L'ecografia nella diagnosi di consolidamento polmonare- Premessa

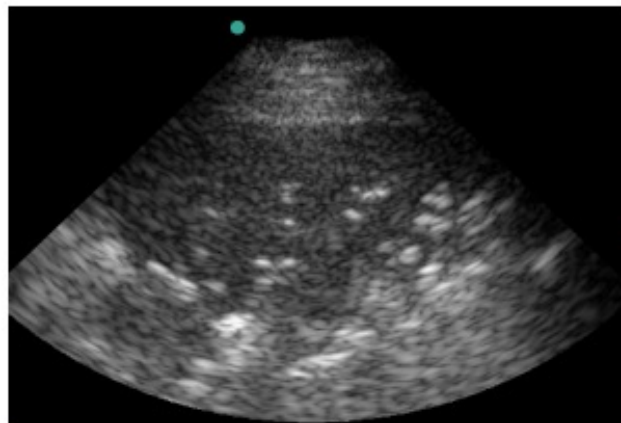


Senza coinvolgimento mantellare

NEG



LUS : Polmone normale



LUS : Consolidamento polmonare

POS



Con coinvolgimento mantellare

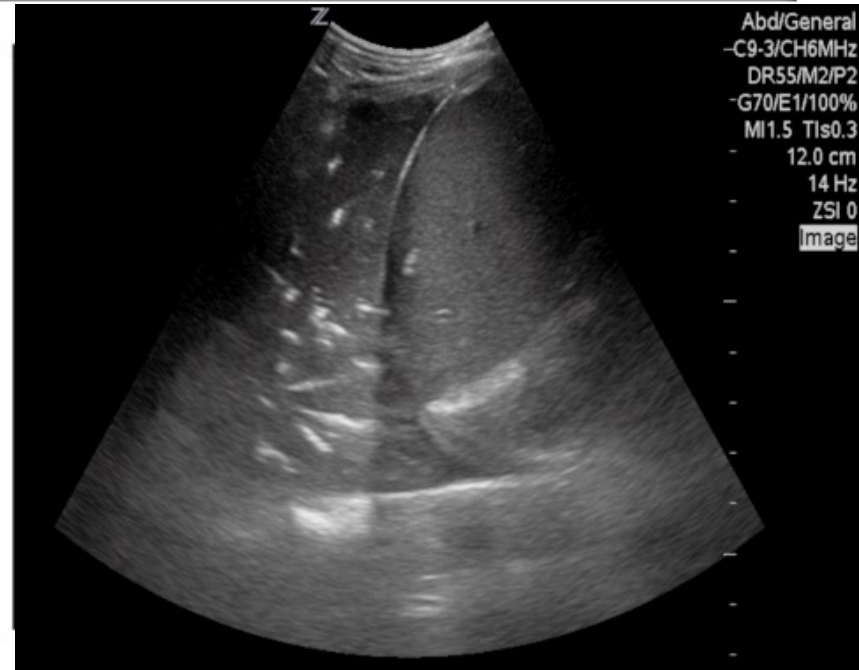
L'ecografia nella diagnosi di consolidamento polmonare- Premessa

La LUS risulta positiva nei consolidamenti polmonari che :

- ✓ *interessano il mantello pleurico e/o*
- ✓ *hanno una interfaccia liquida con la parete toracica*



LA SEMEIOTICA ECOGRAFICA NELLA DIAGNOSI DI POLMONITE



Liver-like tissue sign : ✓ *consolidazione polmonare definito come la presenza di addensamento sub-pleurico con pattern ecostrutturale di tipo tissutale simil parenchima epatico / splenico.*

✓ *Segno ecografico di elevata sensibilità (90% e specificità 98%) di consolidamento alveolare*

Dynamic air bronchogram : *Strutture ecogene ramificate all'interno dell'area di consolidazione alveolare con movimenti centrifughi con l'inspirazione.*

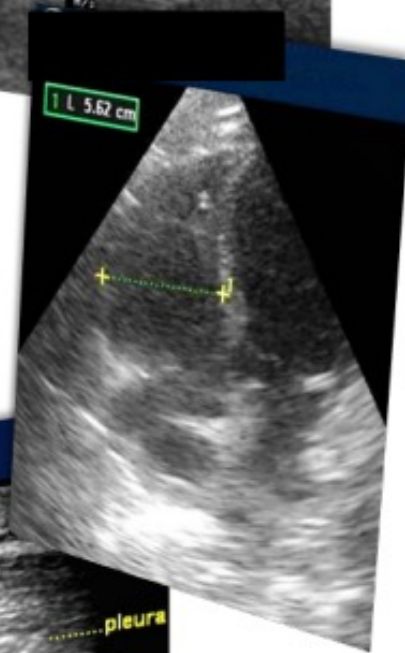
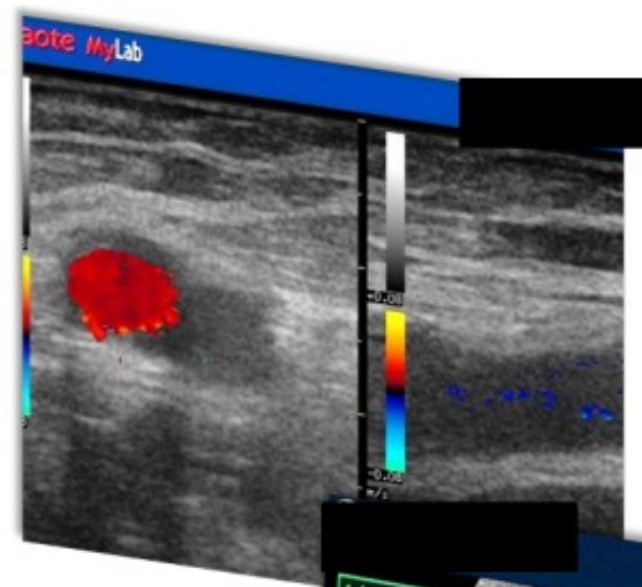
La presenza dei broncogrammi aerei dinamici ha un elevato valore predittivo positivo nella diagnosi di polmonite e ne permette la diagnosi ecografica differenziale con l'atelettasia ostruttiva che in non pochi casi mostra broncogrammi aerei statici

- Mathis G. et al 1992 Chest
- Gemacher O. et al 1996 Eur J Ultrasound
- Reissig A. et al 2007 Respiration

- Lichtenstein D.A. et al 2009 Chest
- Reissig A. et al 2012 Chest
- Cortellaro F. et al 2012 Emerg Med J

Approccio ecografico *bedside*

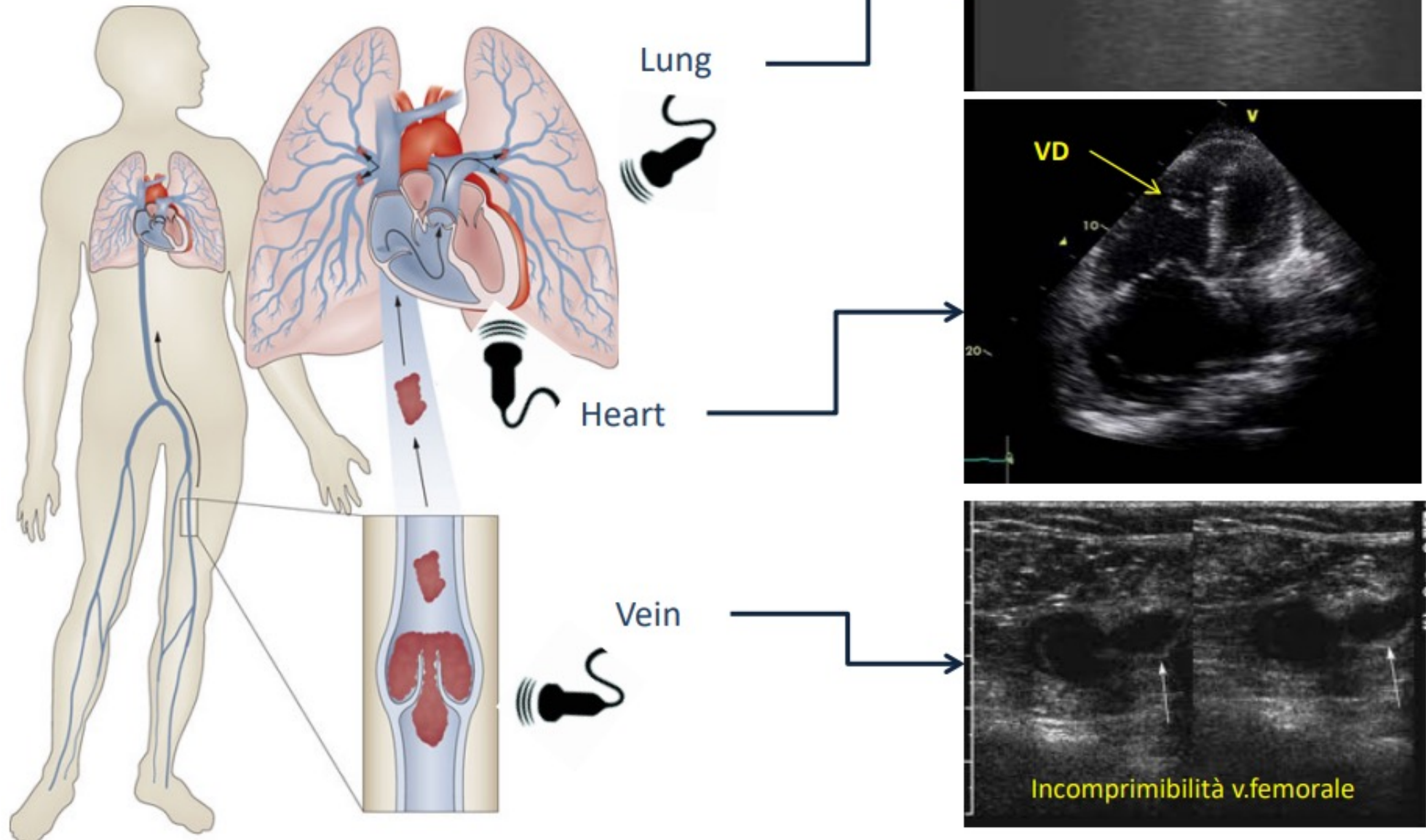
- Ecografia venosa
- Ecografia cardiaca
- Ecografia polmonare



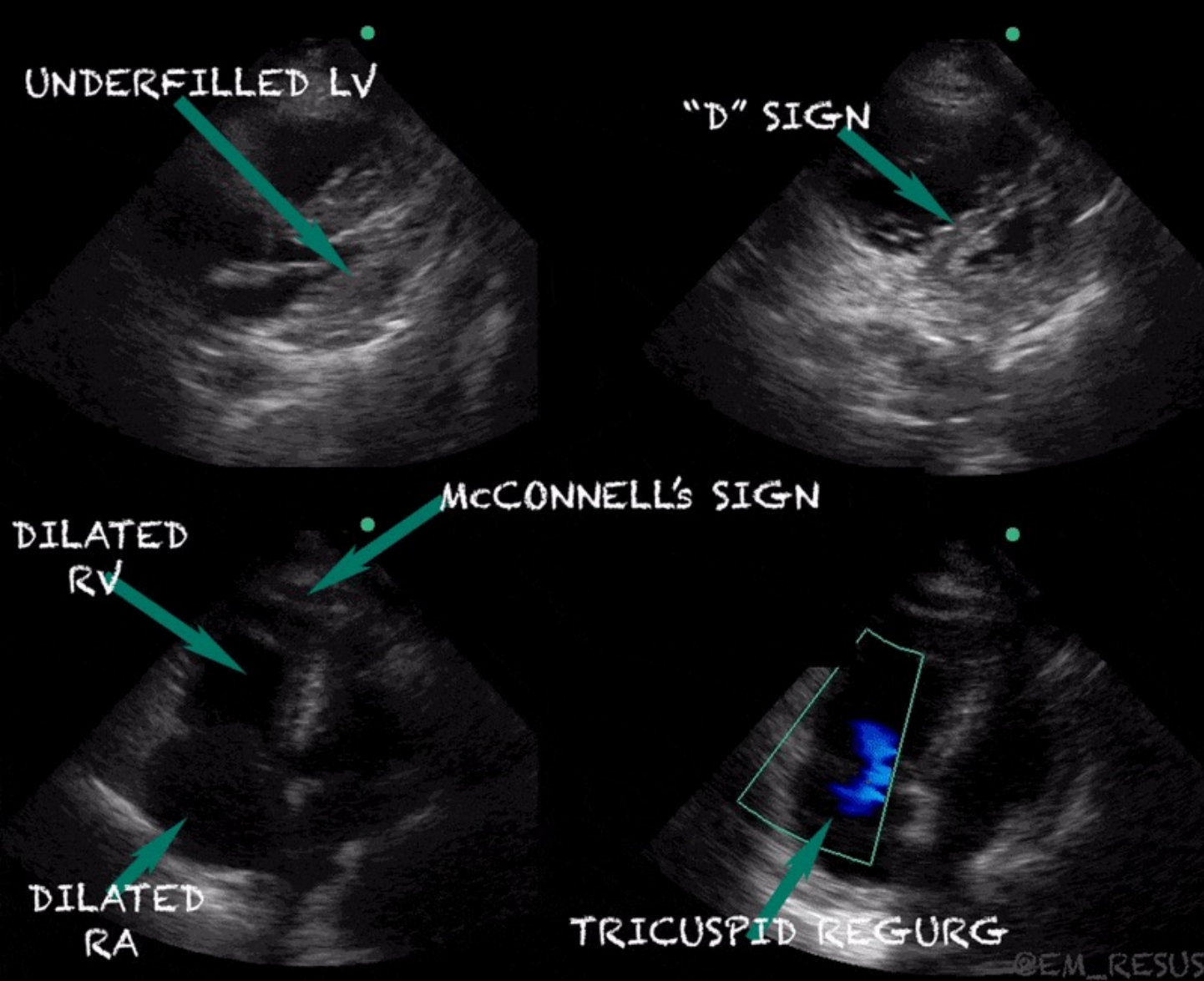
Accuracy of point-of-care multiorgan ultrasonography for the diagnosis of pulmonary embolism.

Nazerian P, Vanni S, Volpicelli G, Gigli C, Zanobetti M, Bartolucci M, Ciavattone A, Lamorte A, Veltri A, Fabbri A, Grifoni S.

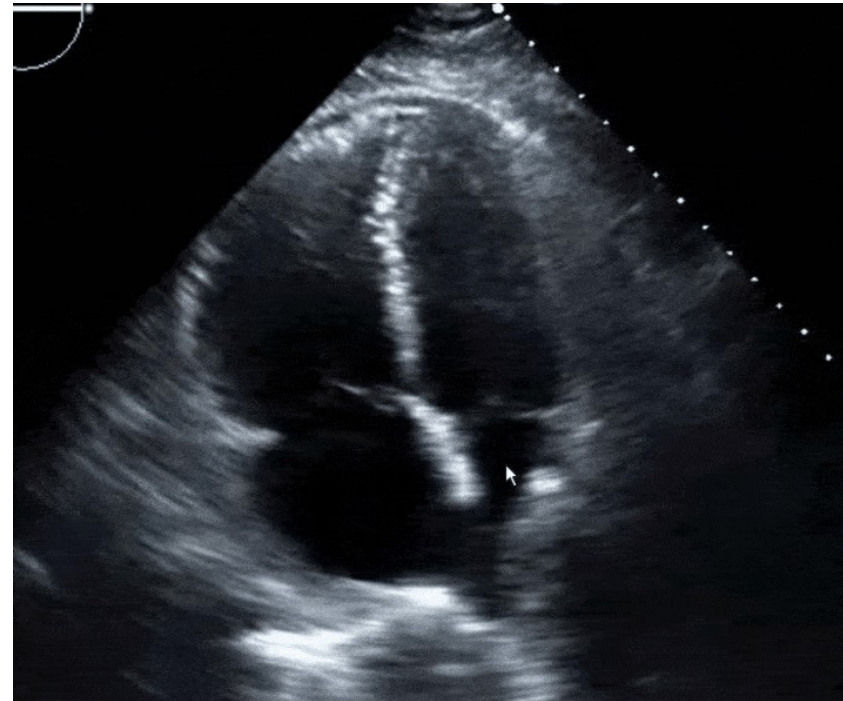
Chest 2014 May;145(5):950-7. doi: 10.1378/chest.13-1087.



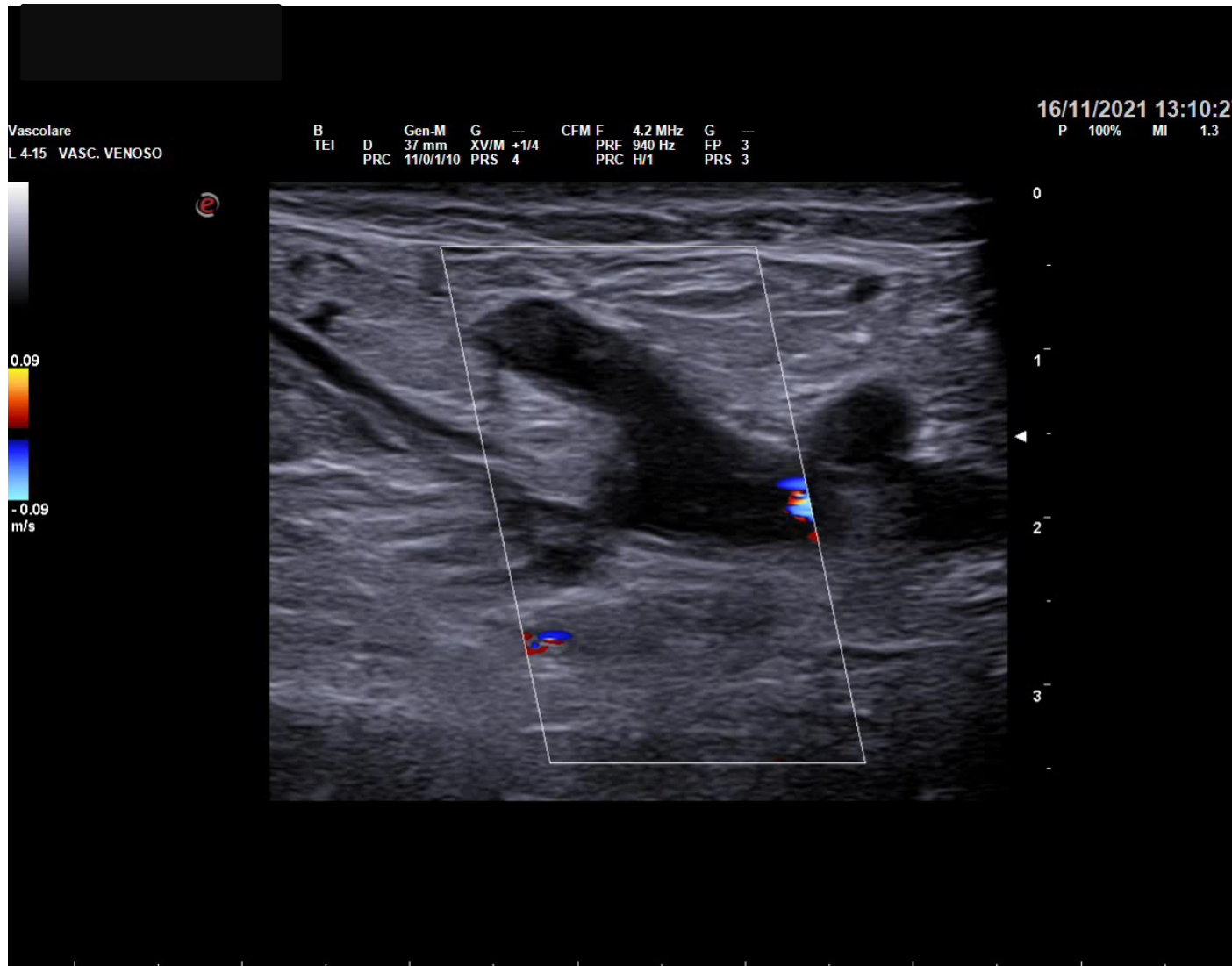
Ecografia multidistrettuale nella TEP



Ecografia multidistrettuale nella TEP



Ecografia multidistrettuale nella TEP



CONCLUSIONI

- **POCUS consente di effettuare diagnosi immediata al letto del malato dispnoico**
- **Diagnosi immediata vuol dire terapia immediata (patologie tempo dipendenti) con migliori outcomes per il paziente (e ridotti tempi di degenza)**
- **POCUS deve essere multidistrettuale (vena cava inferiore, cuore, polmone e pleura)**
- **POCUS riduce la richiesta degli esami radiologici (e quindi riduce i costi)**
- **POCUS patrimonio del clinico (quinto pilastro dell'esame obiettivo)**

Ultrasound

The New Stethoscope (Point-of-Care Ultrasound)



GRAZIE DELL'ATTENZIONE



This is the new stethoscope. This is the future.