

# Ecografia polmonare nella valutazione del dolore pleurico in DEA

Giovanni Volpicelli

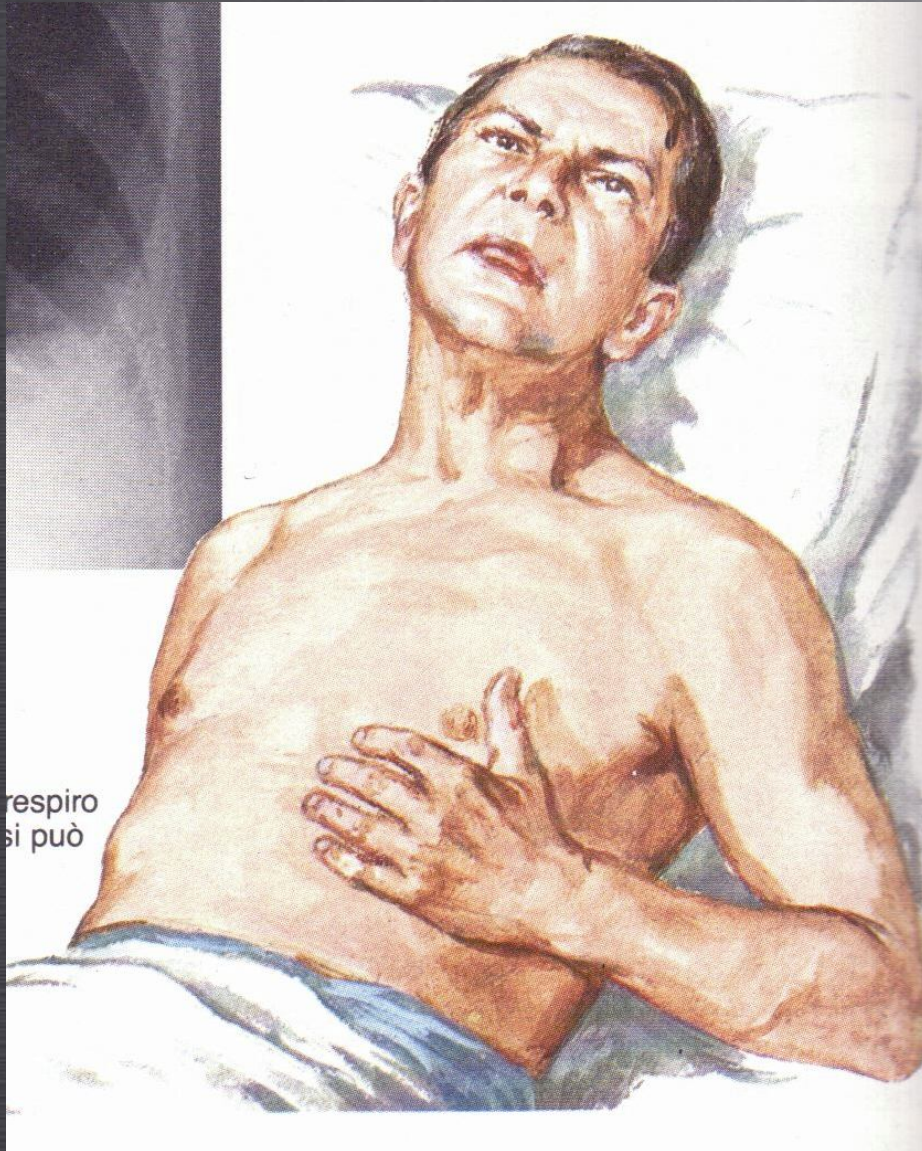
Medicina d'Urgenza

Direttore Prof. M. F. Frascisco

Ospedale Universitario San Luigi Gonzaga  
Torino



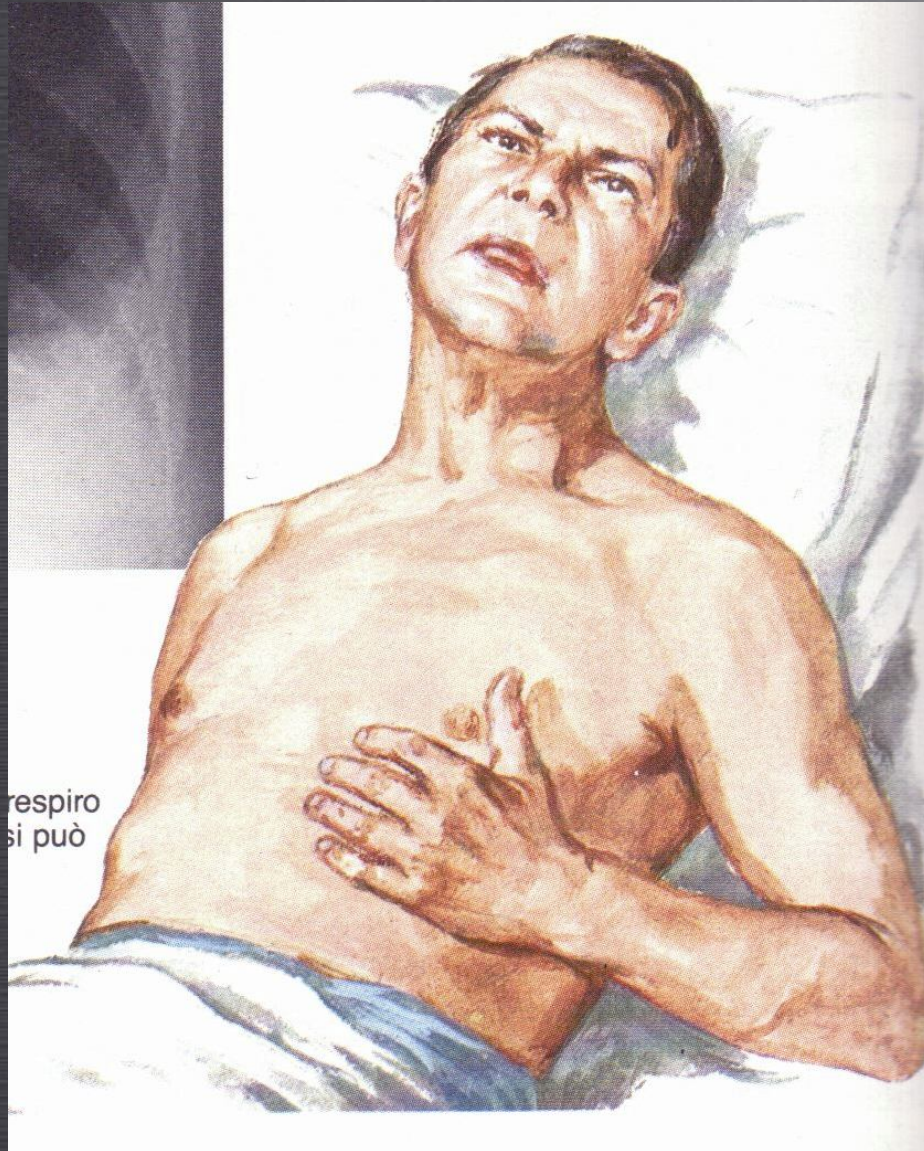
# Dolore Pleurico



1. insorgenza acuta
2. ben localizzato
3. aumenta con gli atti respiratori



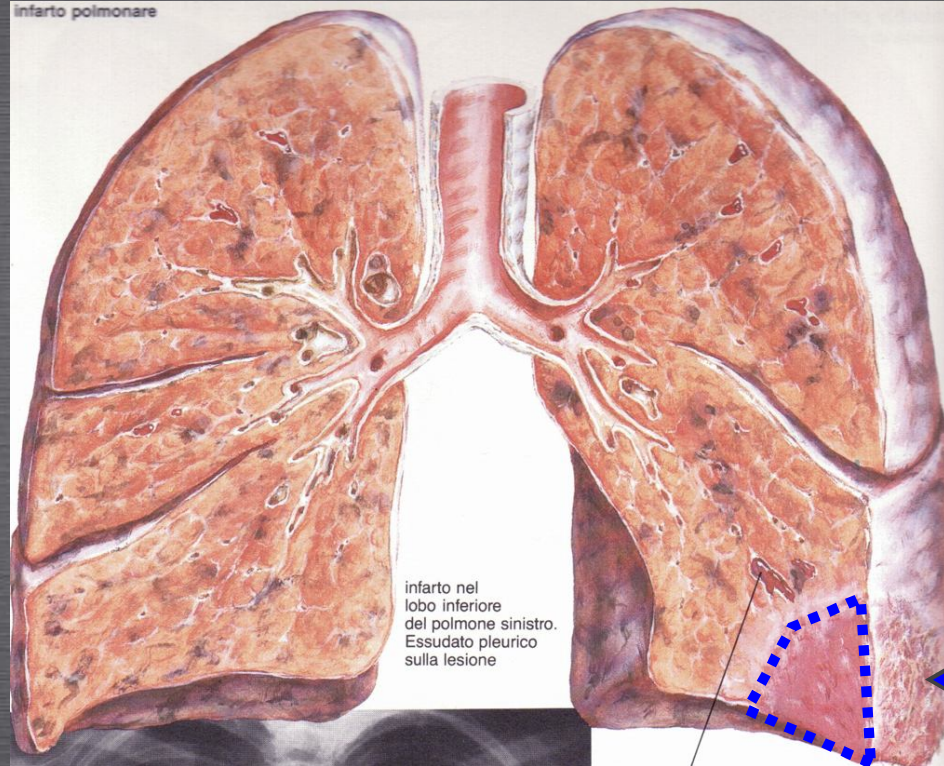
# Dolore Pleurico



Diagnosi differenziale in DEA

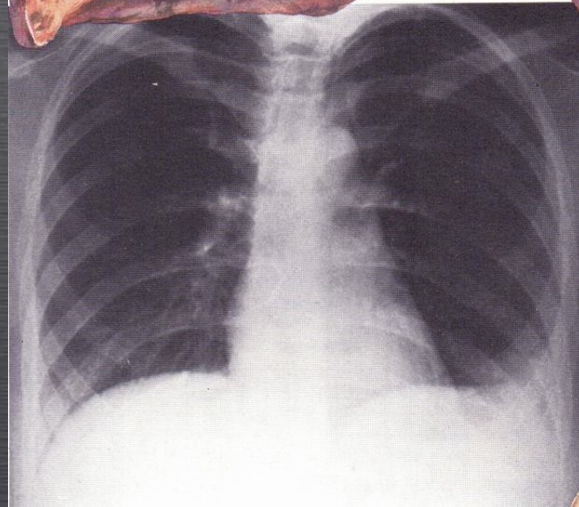
1. dolore di parete  
(60-70%)
2. patologia pleuro-polmonare  
(30-40%)





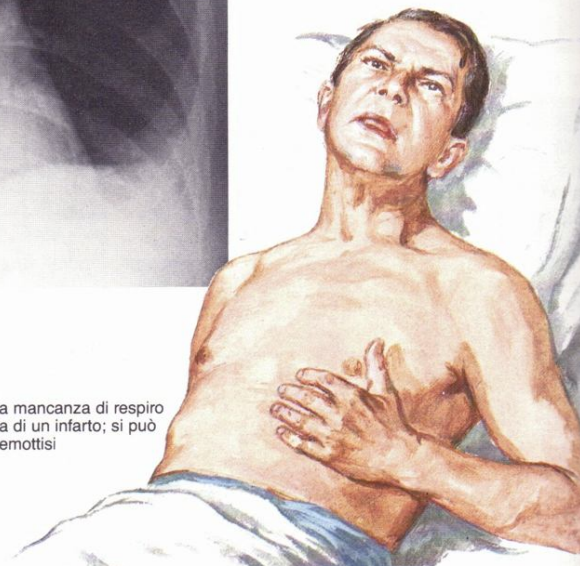
infarto nel  
lobo inferiore  
del polmone sinistro.  
Essudato pleurico  
sulla lesione

vaso ostruito che ne è la causa.  
Pochi emboli piccoli,  
sparsi, senza infarto, sono  
presenti in entrambi i polmoni



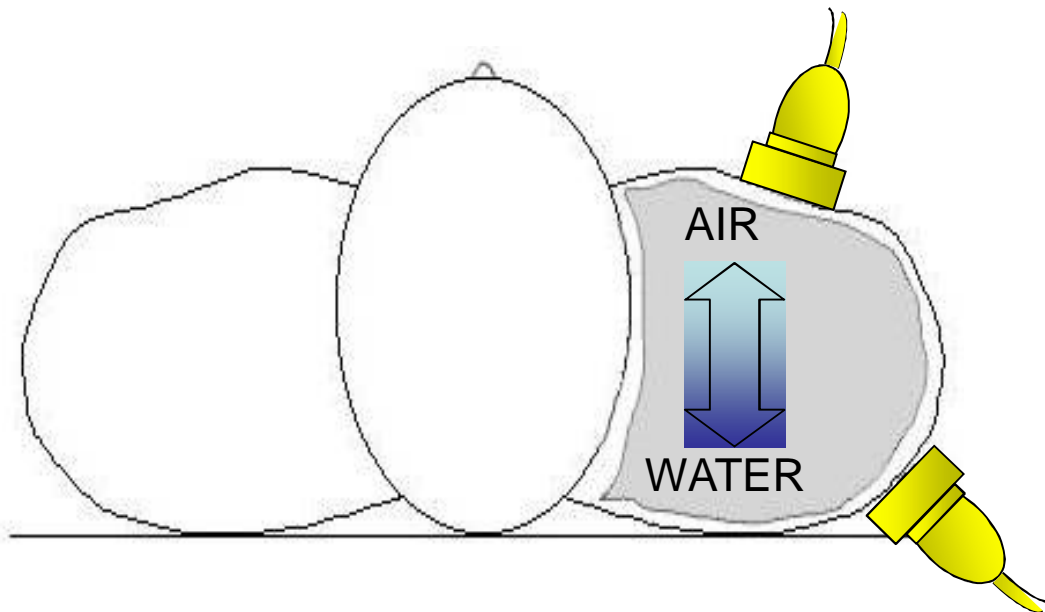
radiografia che mostra un'opacità a forma  
di cuneo nella regione costo-frenica sinistra

il dolore pleurico e la mancanza di respiro  
indicano che si tratta di un infarto; si può  
verificare anche un'emottisi





# A surface imaging technique





# Case 1

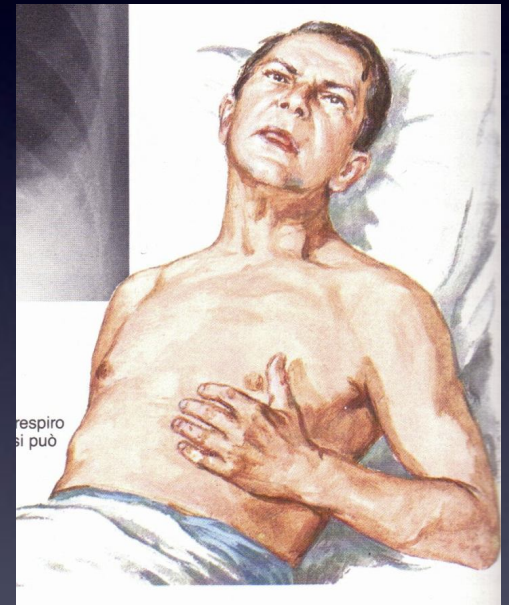
Healthy woman 31-years-old, she had been taking contraceptive for 2 ys.

Pleuritic pain at medium axillary line on the right and cough for some days.

D-dimer 425 ng/ml (v.n. <270 ng/ml)

CRP 45.1 mg/L (n.v. <10 mg/L)

WBC 14500 uL (n.v. <11500 uL)

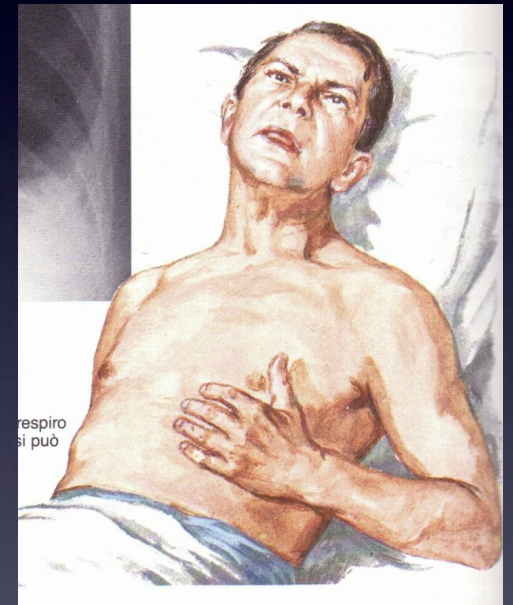




# Case 1

Healthy woman 31-years-old, she had been taking contraceptive for 2 ys.

Pleuritic pain at medium axillary line on the right and cough for some days.





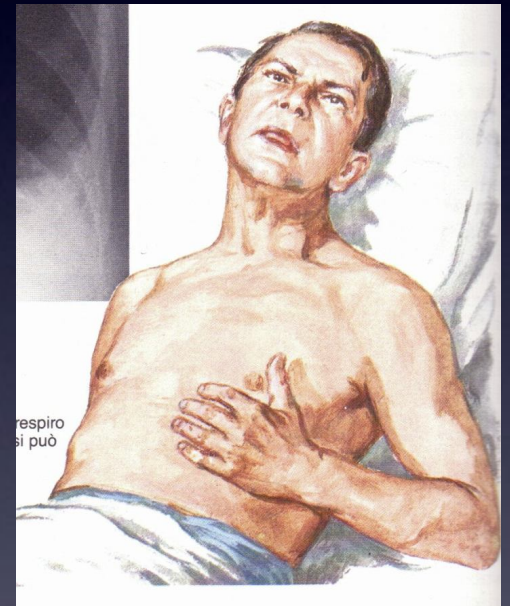
## Case 2

Healthy young woman, 22-years-old, she takes estroprogestinic.  
Acute pleuritic pain at the medium-posterior axillary line right sided  
and cough for one day. Discharged from another Institution the day  
before with the diagnosis of chest wall pain.

D-dimer 410 ng/ml (n.v. <270 ng/ml)

CRP 58.1 mg/L (n.v. <10 mg/L)

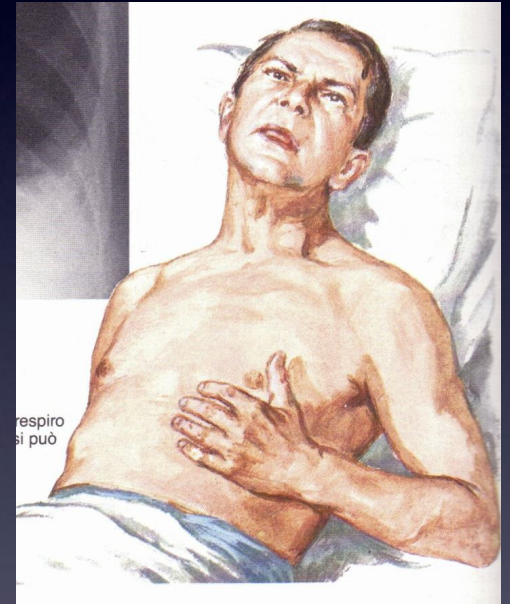
WBC 13500 uL (n.v. <11500 uL)





## Case 2

Healthy young woman, 22-years-old, she takes estroprogestinic.  
Acute pleuritic pain at the medium-posterior axillary line right sided  
and cough for one day. Discharged from another Institution the day  
before with the diagnosis of chest wall pain.





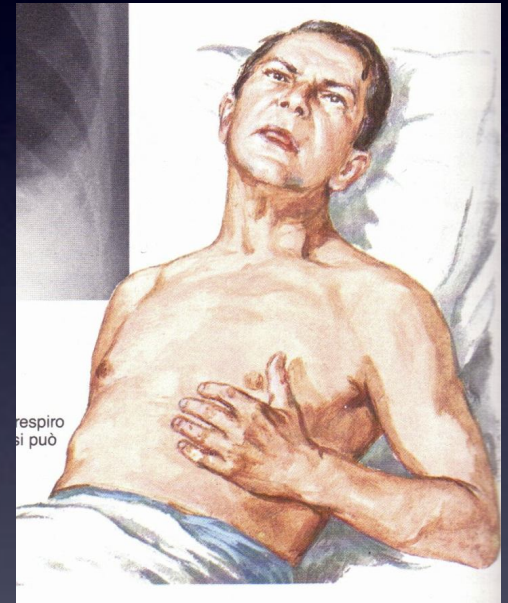
## Case 3

Healthy woman, 38-years-old, she takes estroprogestinic.  
Acute onset of anterior left chest pleuritic pain, beside the sternum,  
without cough and fever, for 1 day.

D-dimer 820 ng/ml (n.v. <270 ng/ml)

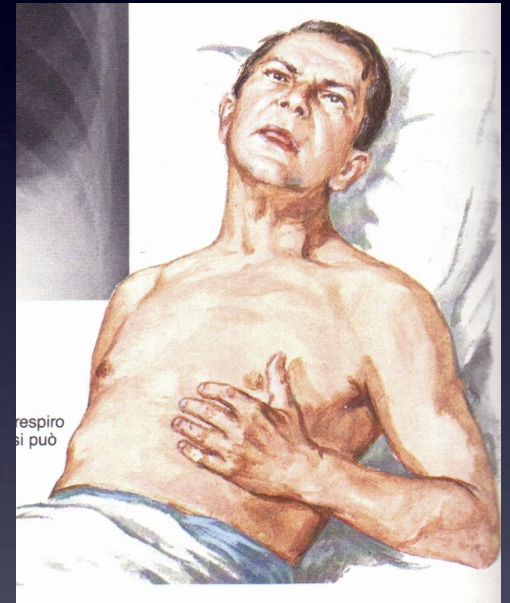
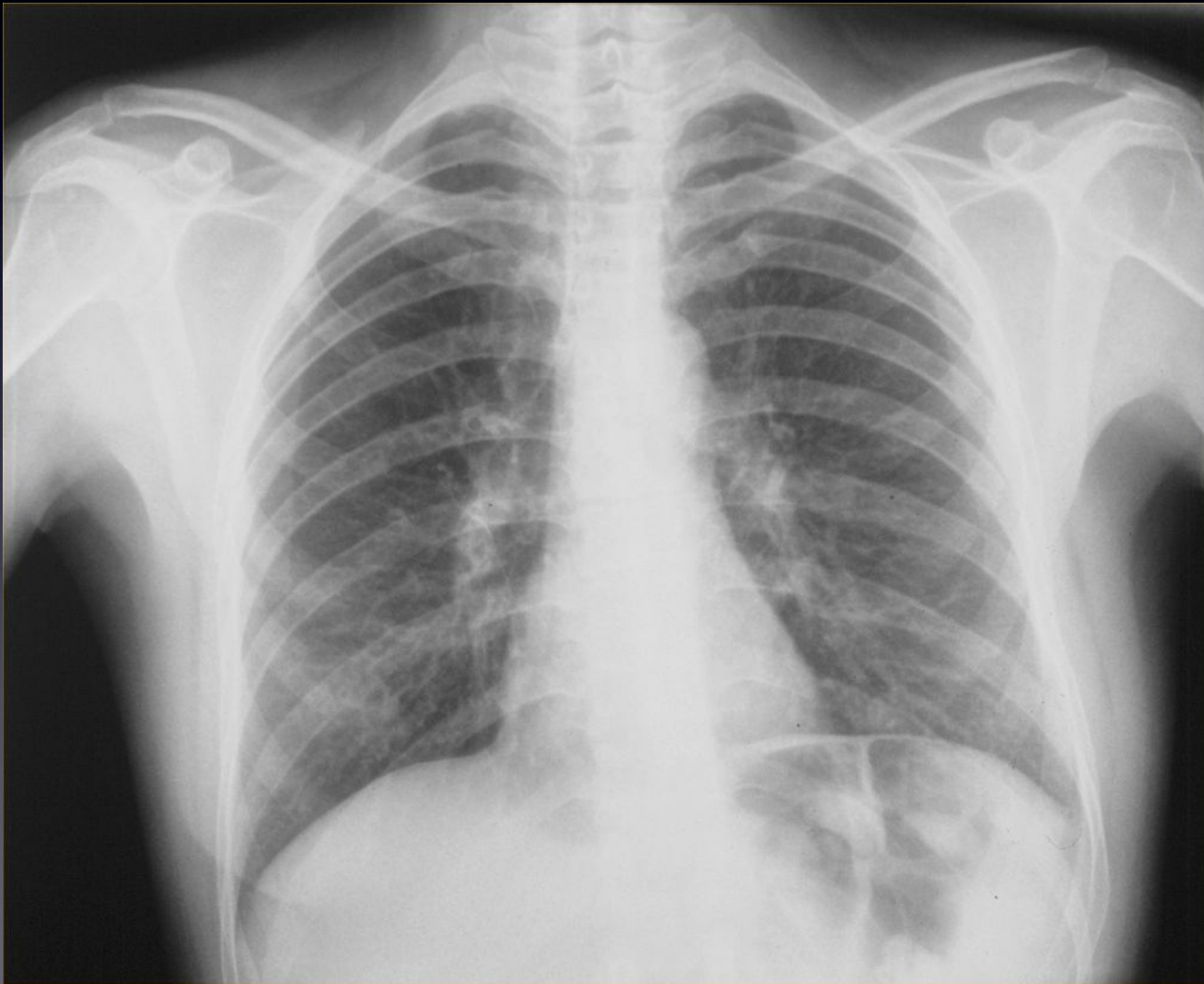
CRP 51.5 mg/L (n.v. <10 mg/L)

WBC 9500 uL (n.v. <11500 uL)



## Case 3

Healthy woman, 38-years-old, she takes estroprogestinic.  
Acute onset of anterior left chest pleuritic pain, beside the sternum,  
without cough and fever, for 1 day.

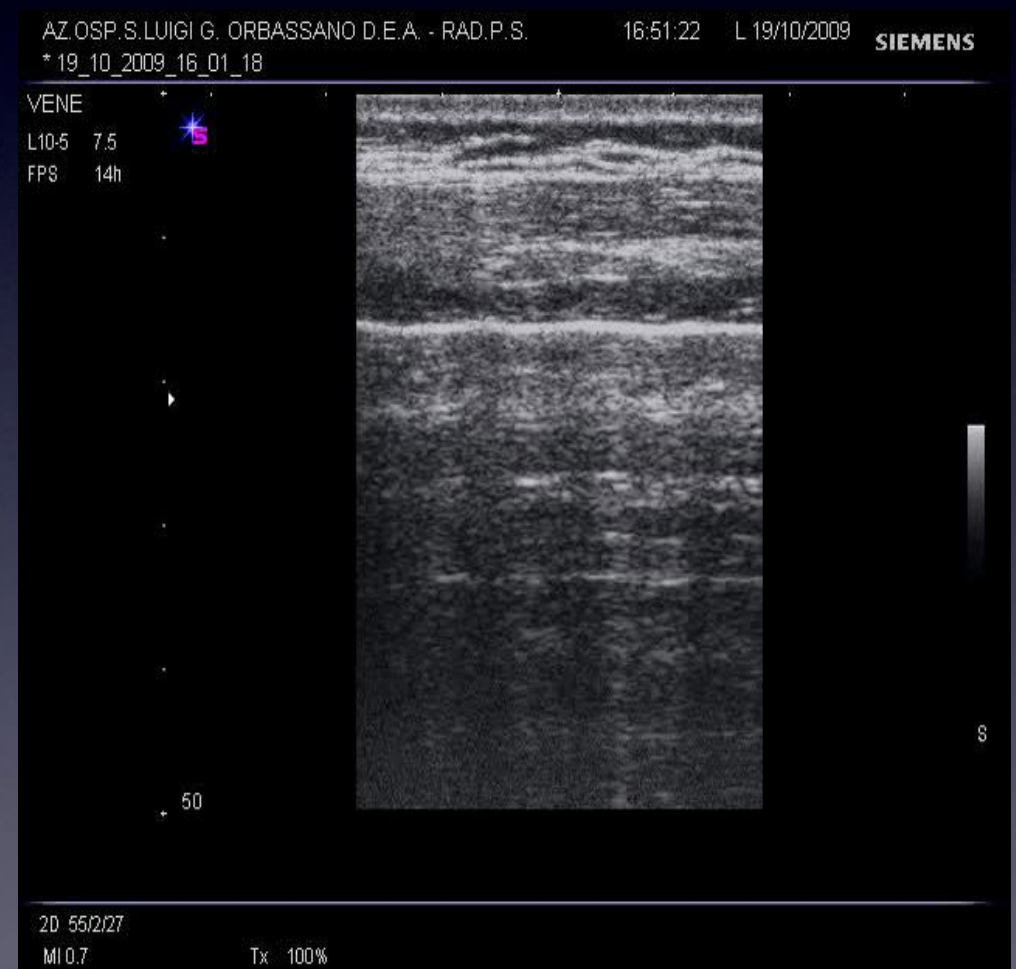




# Case 1

Healthy woman 31-years-old, she had been taking contraceptive for 2 ys.

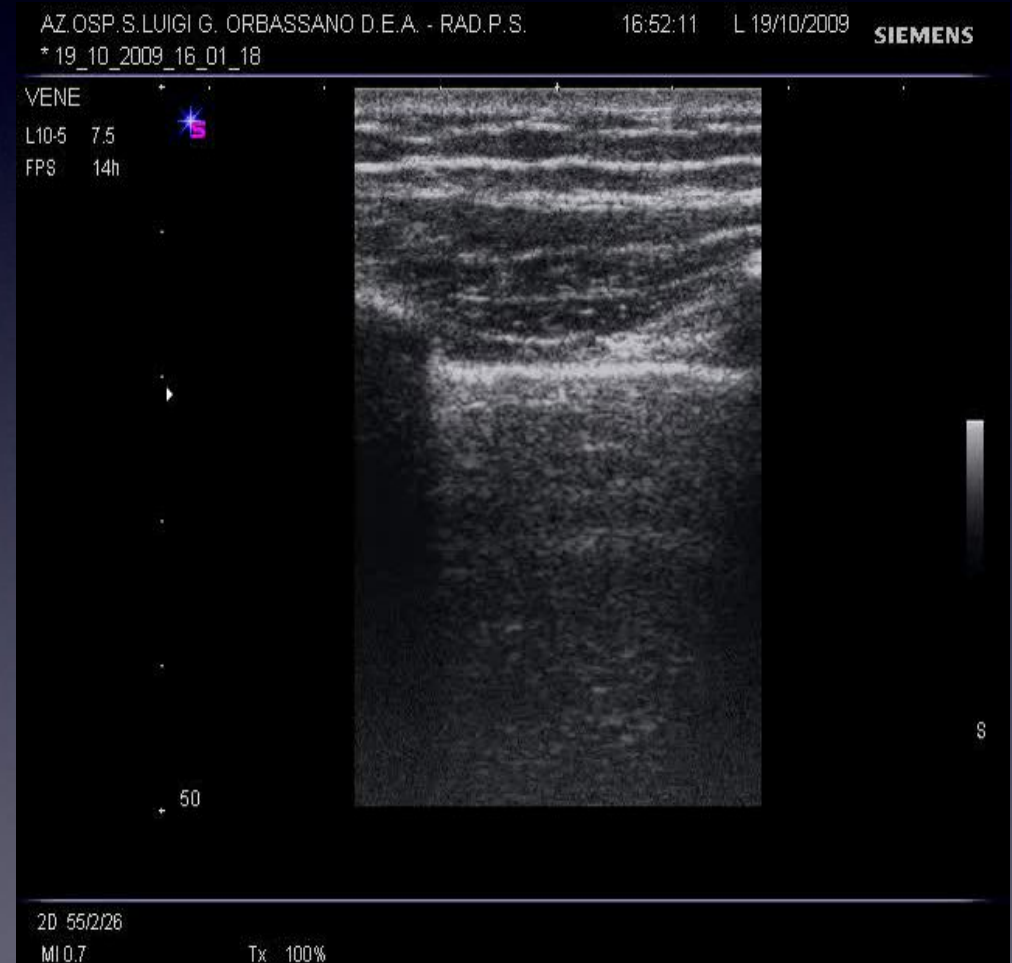
Pleuritic pain at medium axillary line on the right and cough for some days.



# Case 1

Healthy woman 31-years-old, she had been taking contraceptive for 2 ys.

Pleuritic pain at medium axillary line on the right and cough for some days.





# Case 1

Healthy woman 31-years-old, she had been taking contraceptive for 2 ys.

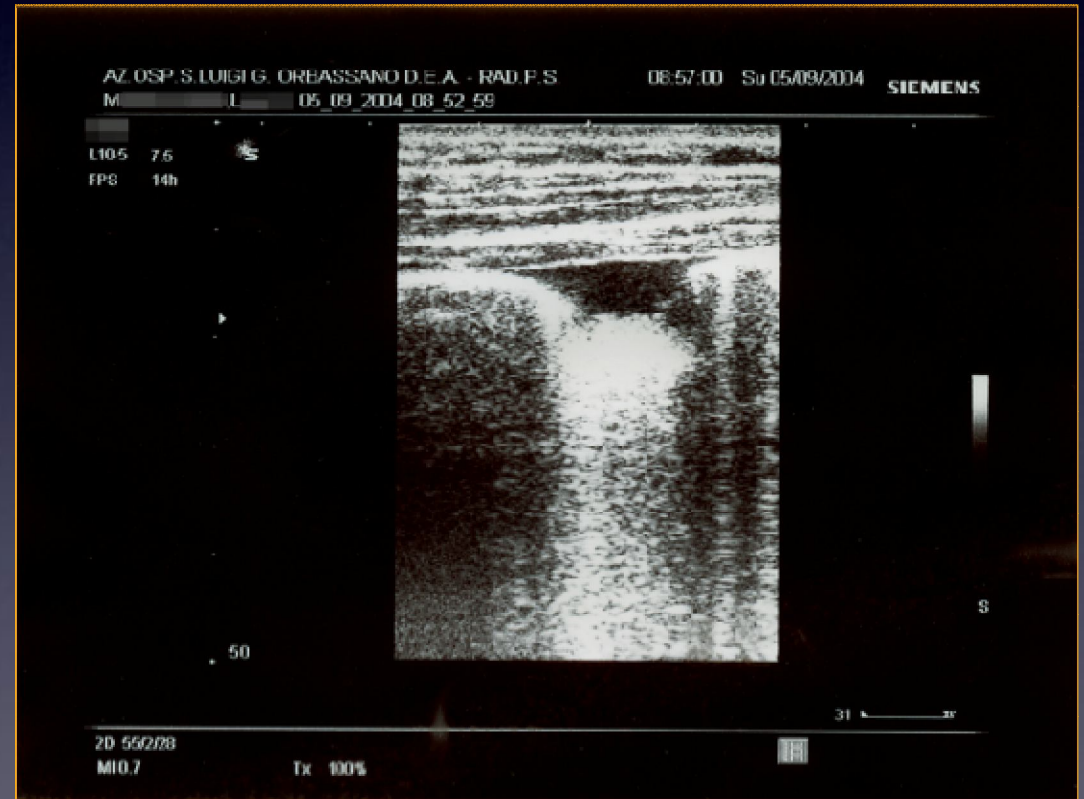
Pleuritic pain at medium axillary line on the right and cough for some days.



chest wall pain  
**DISCHARGED**

## Case 2

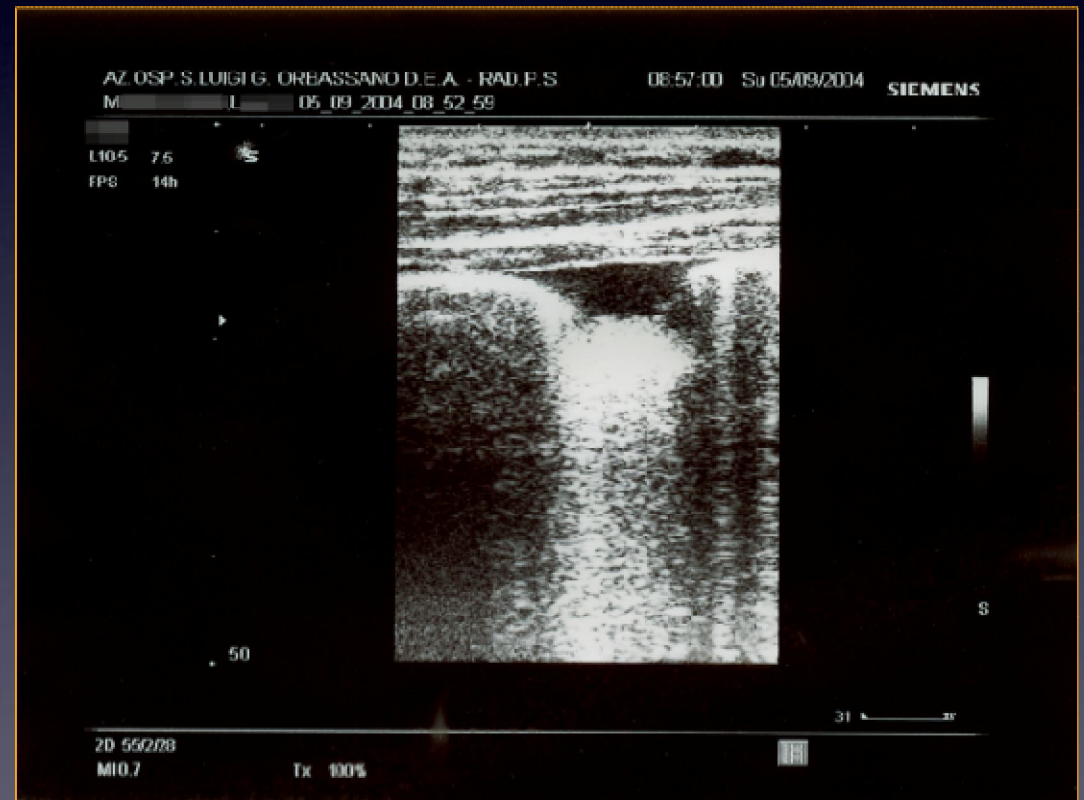
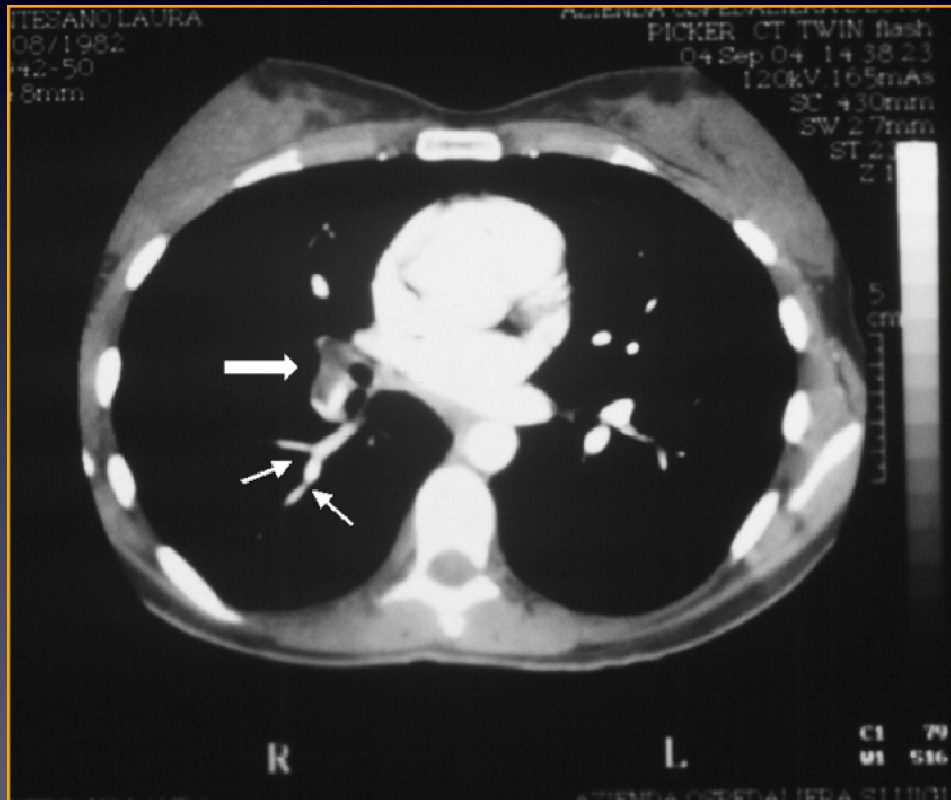
Healthy young woman, 22-years-old, she takes estroprogestinic.  
Acute pleuritic pain at the medium-posterior axillary line right sided and  
cough for one day. Discharged from another Institution the day before  
with the diagnosis of chest wall pain.





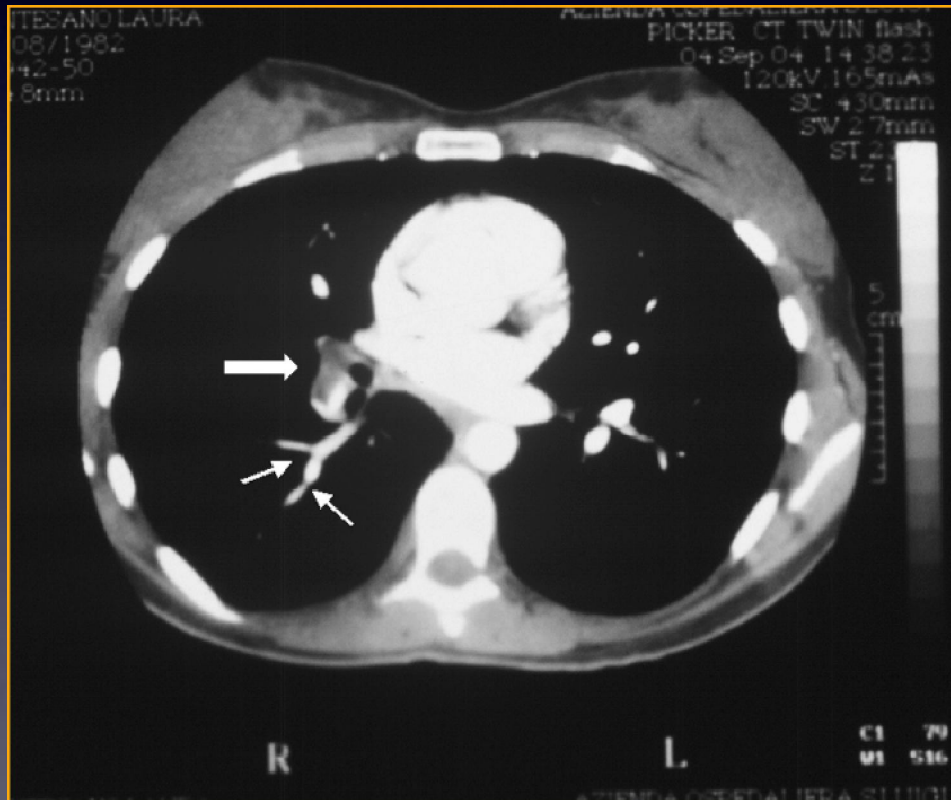
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Acute pleuritic pain at the medium-posterior axillary line right sided and cough for one day. Discharged from another Institution the day before with the diagnosis of chest wall pain.

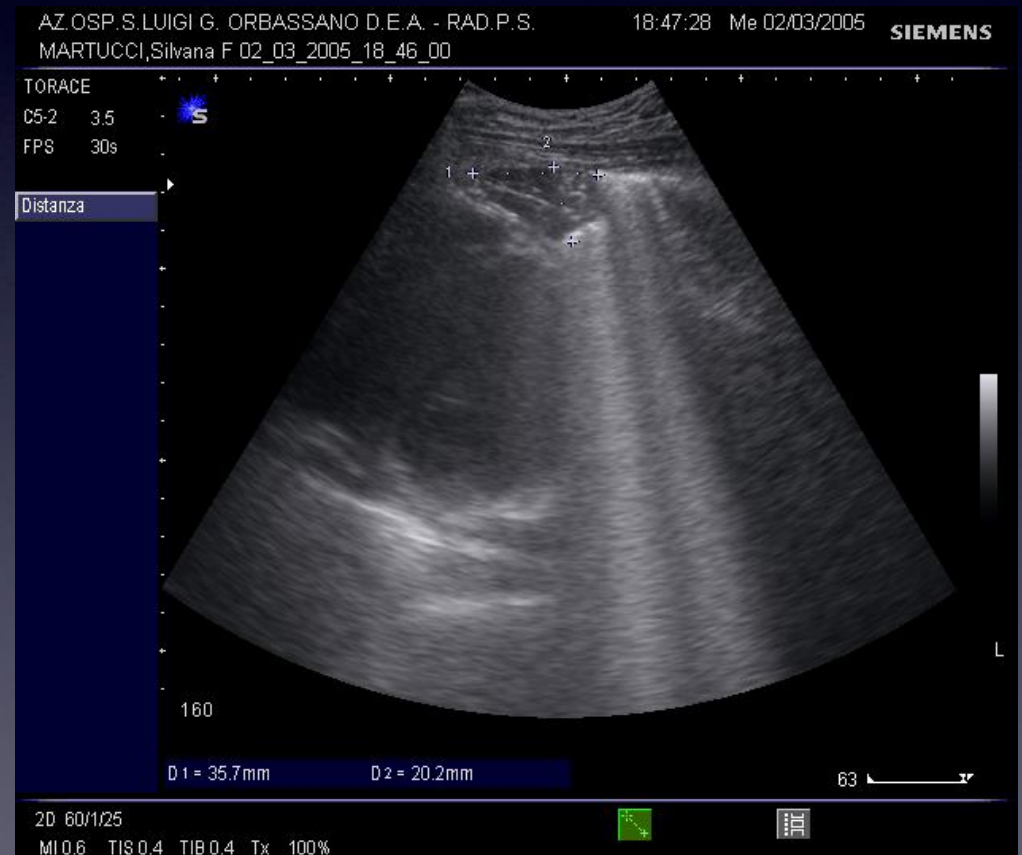
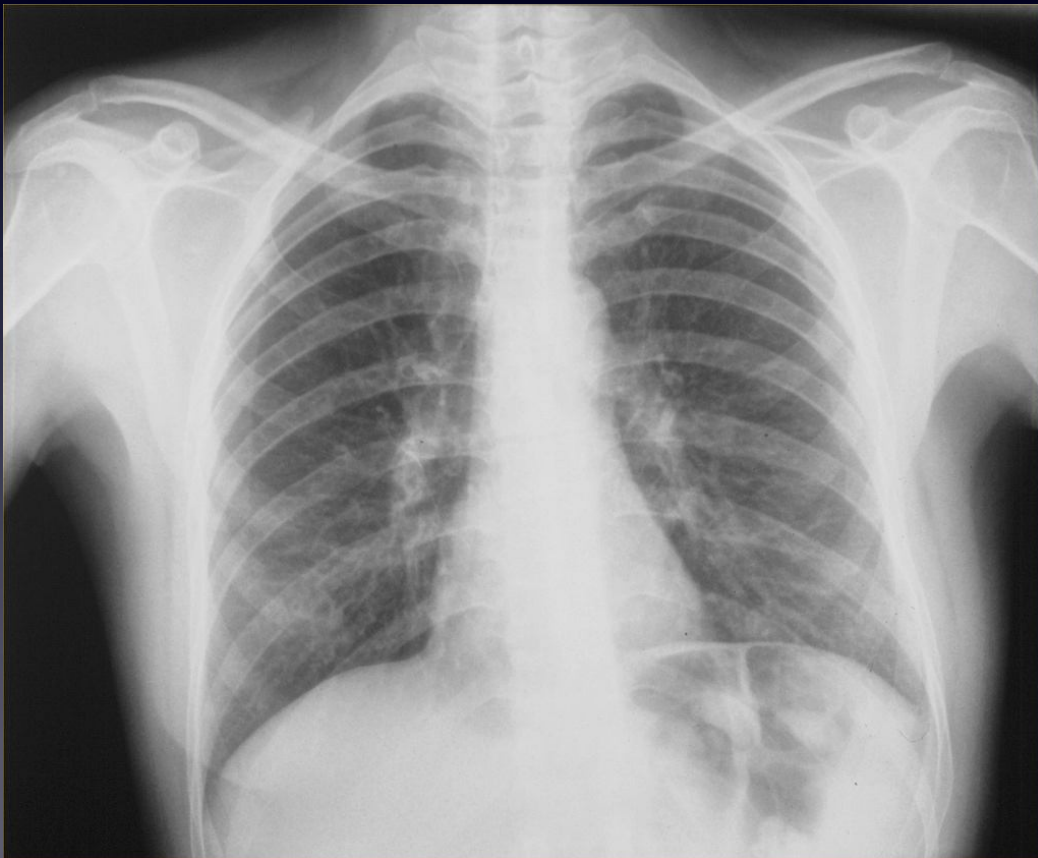


pulmonary embolism  
ADMITTED



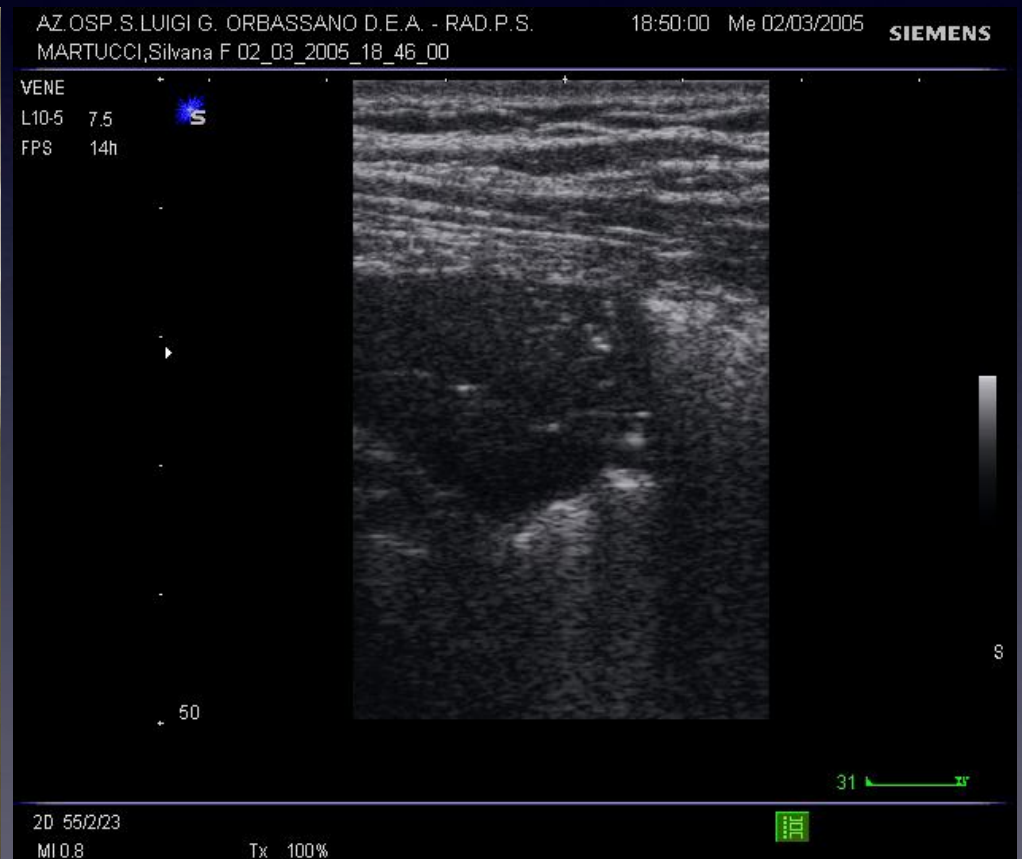
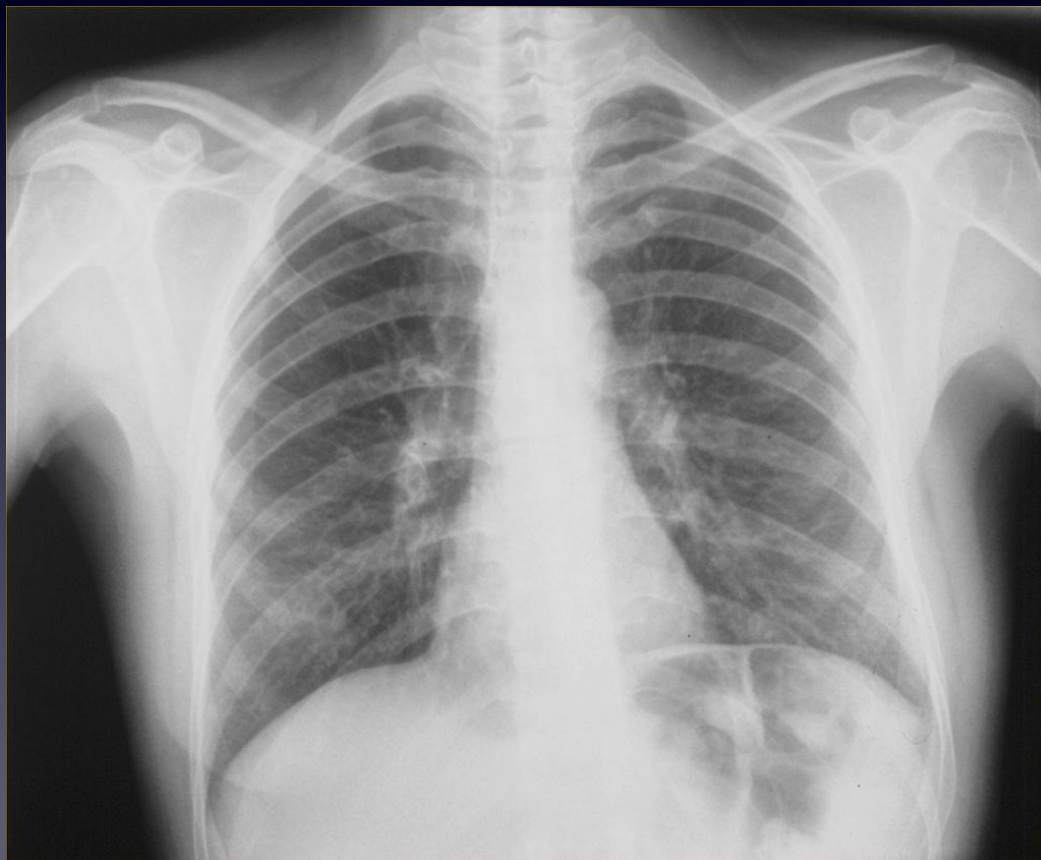
# Case 3

Healthy woman, 38 years-old, she takes estroprogestinic.  
Acute onset of anterior left chest pleuritic pain, beside the sternum,  
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## Case 3

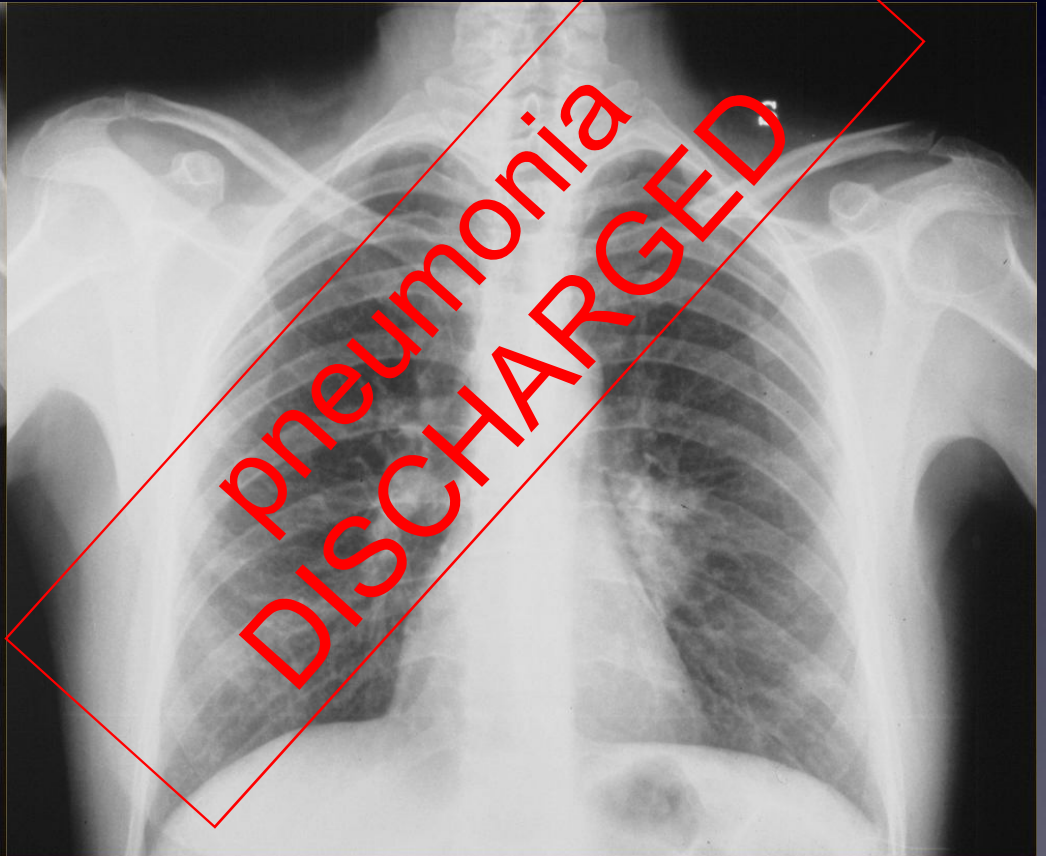
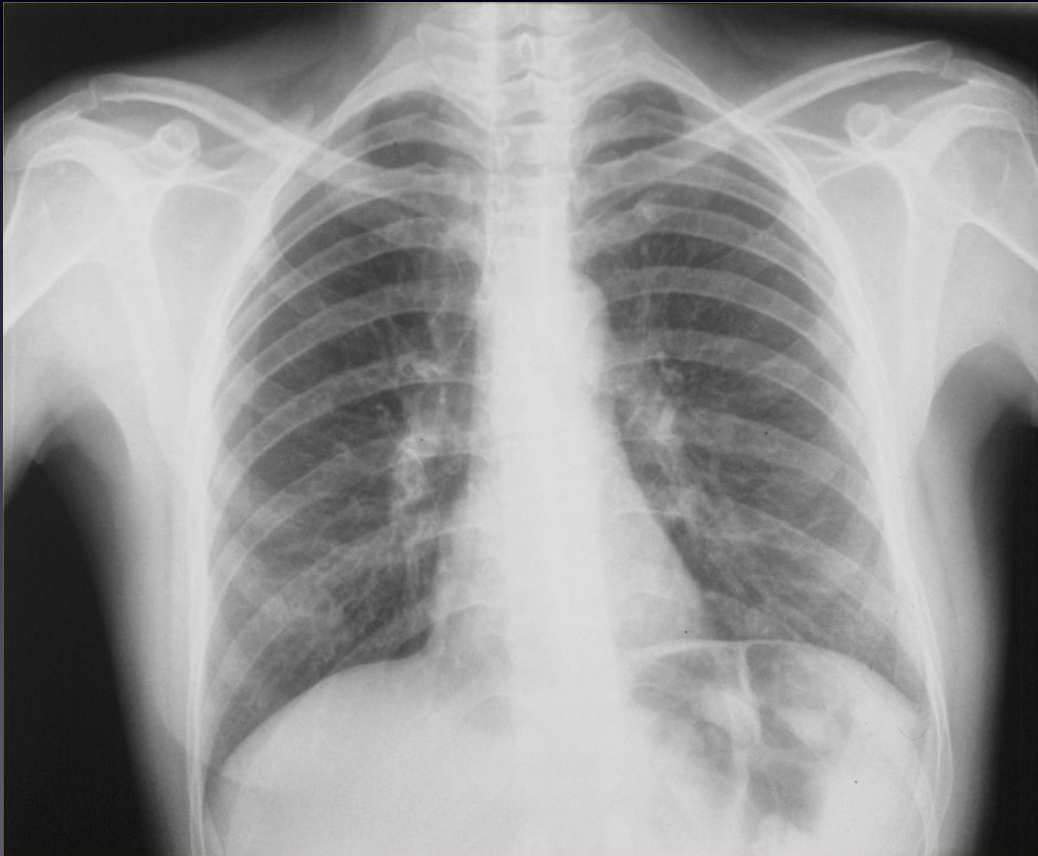
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## Case 3

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without cough and fevere, for 1 day.





## **Ultrasound in Emergency Medicine**

### **LUNG ULTRASOUND IN THE EVALUATION OF PATIENTS WITH PLEURITIC PAIN IN THE EMERGENCY DEPARTMENT**

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**□ Abstract**—The evaluation of pleuritic pain in the emergency setting is a diagnostic challenge. Most patients are discharged from the Emergency Department (ED) with a diagnosis of chest wall pain not otherwise specified. It is important to rule out possible sources of acute pleuritic pain, like pulmonary embolism, pneumonia, lung cancer, and pneumothorax. Clinical examination, plain film radiography of the chest, and other routine investigations may be inadequate to make the correct diagnosis. In this setting, another bedside test to aid diagnosis would be useful. ED bedside lung ultrasound is a novel technique for the diagnosis of lung diseases. We report on 5 patients who presented to our ED complaining of pleuritic pain, few other symptoms, and negative routine investigations, in whom bedside lung ultrasound aided in making the diagnosis. © 2008 Elsevier Inc.

**□ Keywords**—lung ultrasound; pleuritic pain; pleura; emergency ultrasound

otherwise healthy patient presenting with pleuritic pain but normal respiratory function, clinical examination, and routine investigations, the physician has to decide whether to exclude a lung disease by further image testing. This is not always an easy choice, especially in cases of overcrowded or poorly equipped institutions and night or weekend referral. In this setting, lung ultrasound could be a useful, sometimes decisive clinical adjunct. This non-invasive bedside approach is easily performed in a few minutes by the emergency physician with a minimum of training. Despite a large number of articles about the usefulness of lung sonography in the diagnosis of pulmonary embolism, alveolar consolidation, and pneumothorax, we did not find any reference about the sonographic approach to distinguish different sources of pleuritic pain (5–12). Moreover, we found no reports on the means for incorporating lung sonography into a diagnostic algorithm that combines pre-test probability,



● *Original Contribution*

## DIAGNOSIS OF RADIO-OCCULT PULMONARY CONDITIONS BY REAL-TIME CHEST ULTRASONOGRAPHY IN PATIENTS WITH PLEURITIC PAIN

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\*Department of Emergency Medicine, San Luigi Gonzaga Hospital; and <sup>†</sup>Institute of Radiology, San Luigi Gonzaga Hospital, Orbassano (Torino), Italy

(Received 18 December 2007; revised 10 February 2008; in final form 10 April 2008)

**Abstract**—The evaluation of pleuritic pain in the emergency department (ED) presents a considerable challenge for the attending physician. Chest radiography (CXR) is a basic test, but its sensitivity is low, and often more sophisticated imaging techniques are needed. Our aim is to assess the diagnostic value of bedside B-mode lung ultrasound (LUS) in the visualization of radio-occult pulmonary lesions. Forty-nine patients complaining of pleuritic pain with negative CXR were prospectively studied by LUS. Detection of at least one of the following

and irregularity of the line, with or without localized effusion. The final diagnoses were confirmed by spiral CT scanning ( $n = 12$ ) and follow-up ( $n = 37$ ). Final diagnoses were chest wall pain ( $n = 30$ ), pleuropneumonia ( $n = 14$ ), pulmonary embolism ( $n = 4$ ), lung metastasis ( $n = 1$ ). In 18 patients of the group with pulmonary conditions, LUS showed signs of pleurisy. They were PAC ( $n = 12$ ), AIS ( $n = 17$ ), pleural disruption ( $n = 17$ ). If any sign is considered, the sensitivity of LUS in the diagnosis of radio-occult lesions was 94.7%, specificity was 96.7%, positive and negative predictive values were 94.7% and 96.7%, respectively, and accuracy was 95.9%. In

96.7%, positive and negative predictive values were 94.7% and 96.7%, respectively, and accuracy was 95.9%. In patients with pleuritic pain of unknown cause, real-time LUS enables the diagnosis of radio-occult lung and pleural lesions. (E-mail: [giov.volpicelli@tin.it](mailto:giov.volpicelli@tin.it)) © 2008 World Federation for Ultrasound in Medicine & Biology.

**Key Words:** Chest ultrasound, Lung sonography, Lung ultrasound, Pleuritic pain, Chest pain.

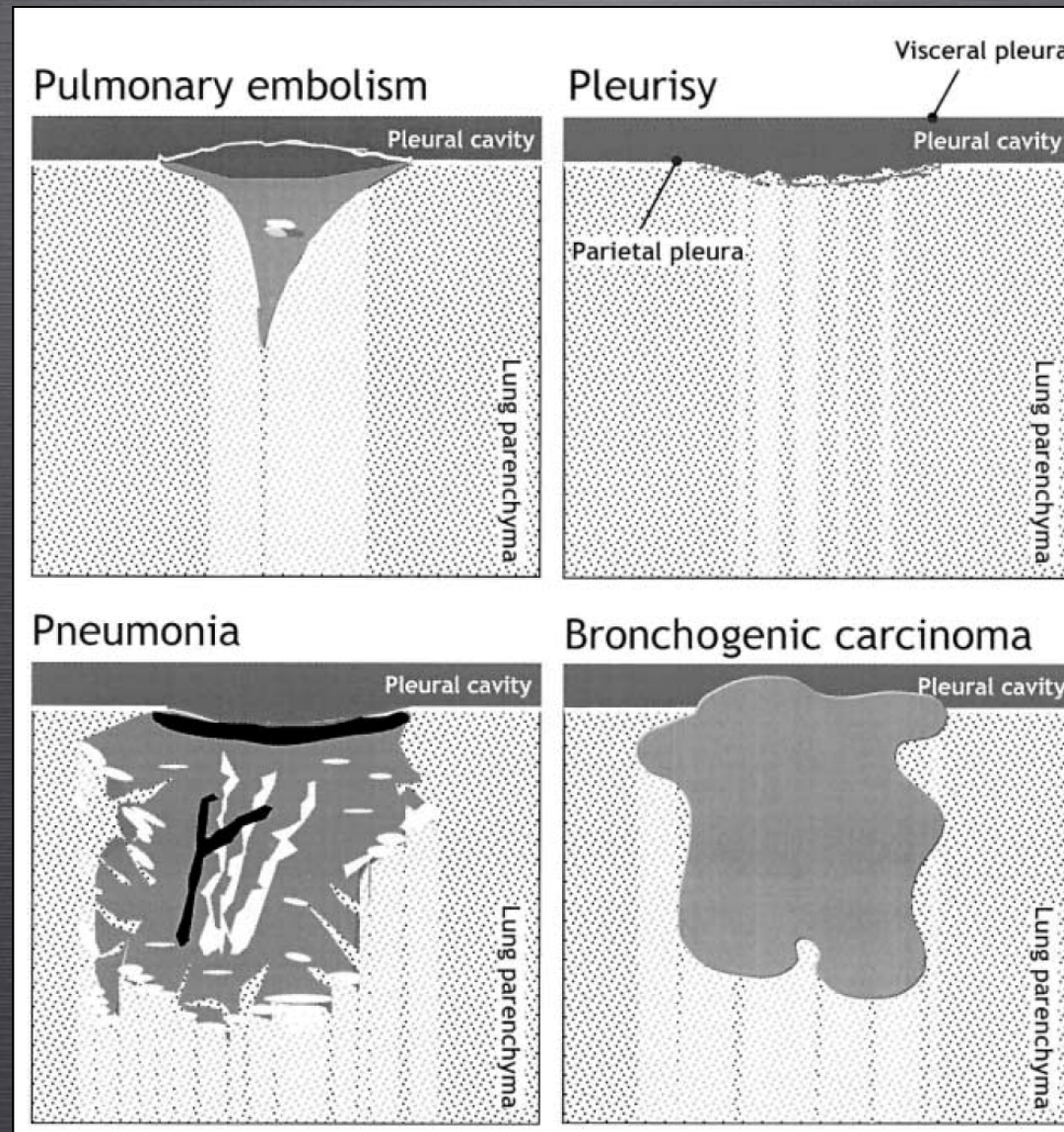
## **Material and methods:**

- Detection of at least one of the following sonographic signs in the painful thoracic area was considered diagnostic (differential diagnosis between parietal chest pain and pleural/pulmonary condition):

- ① The absence of pleural sliding
- ② The focal interstitial syndrome, defined as multiple B lines
- ③ The peripheral alveolar consolidation, defined as hypoechoic subpleural images
- ④ The pleural disruption with thickening and irregularity of the line, with or without localized effusion



Schematic representation of the sonomorphology of conditions to be considered in the differential diagnoses when pulmonary embolism is suspected.

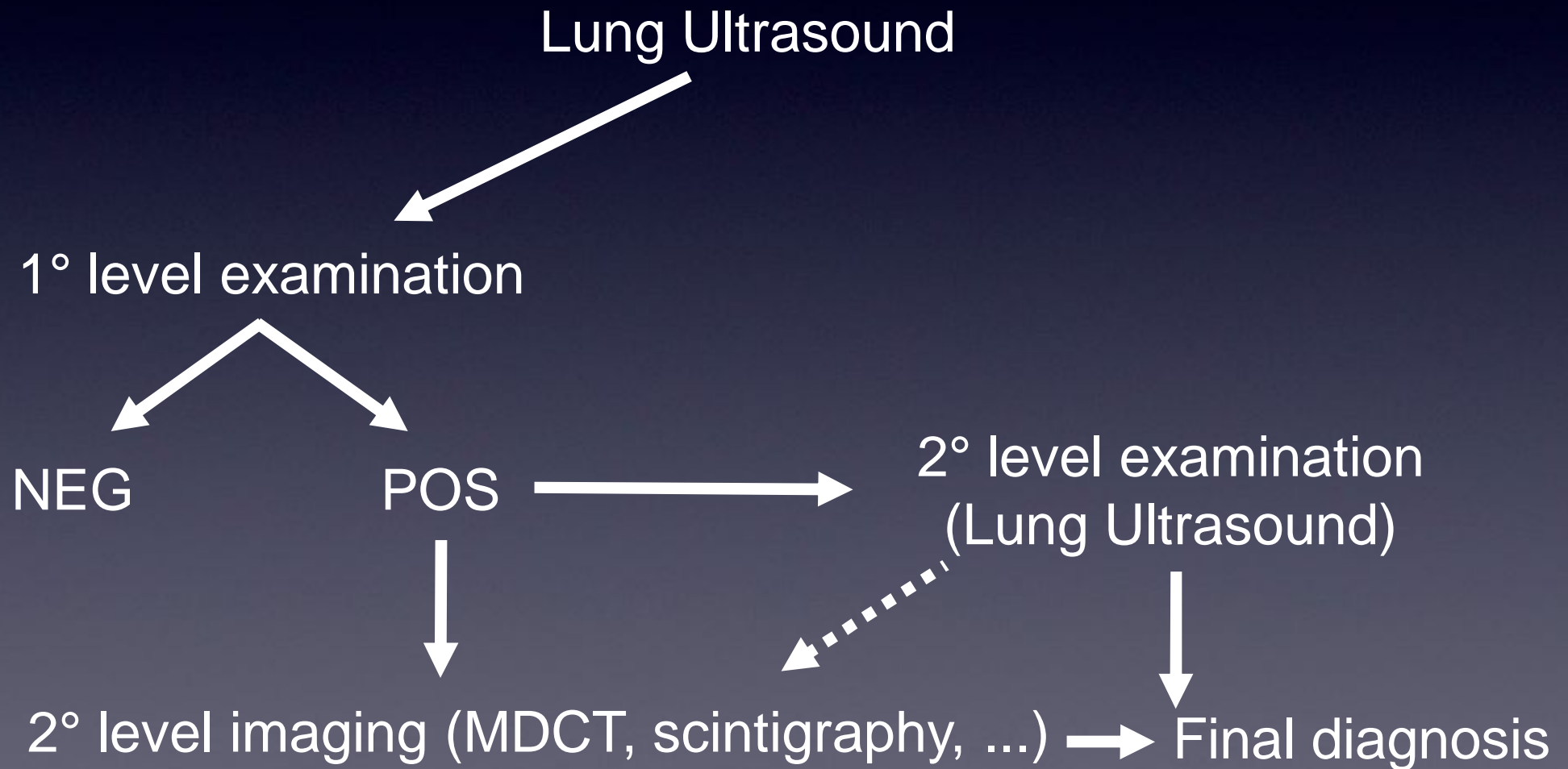


● *Original Contribution*

**DIAGNOSIS OF RADIO-OCCULT PULMONARY CONDITIONS BY REAL-TIME CHEST ULTRASONOGRAPHY IN PATIENTS WITH PLEURITIC PAIN**

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Original Contribution

## A comparison of different diagnostic tests in the bedside evaluation of pleuritic pain in the ED

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Alessandro Mussa MD<sup>a</sup>, Fabrizio Bar MD<sup>a</sup>, Mauro F. Frascisco MD<sup>a</sup>

<sup>a</sup>Department of Emergency Medicine, S. Luigi Gonzaga University Hospital, Orbassano (TO), Italy

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Received 13 October 2010; revised 24 November 2010; accepted 24 November 2010

### Abstract

**Purposes:** Bedside lung ultrasound (LUS) is useful in detecting radio-occult pleural-pulmonary lesions. The aim of our study is to compare the value of LUS with other conventional routine diagnostic tools in the emergency department (ED) evaluation of patients with pleuritic pain and silent chest radiography (CXR).

### Methods:

retrospecti  
and submi  
predict an  
follow-up

### Results:

In a pleural-p  
pneumothe  
84.68%-99  
pleural-pu  
characteris  
0.911) and  
considered

**Results:** In 57 cases, the final diagnosis was chest wall pain. The other 33 patients were diagnosed with a pleural-pulmonary condition (22 pneumonia, 2 pleuritis, 7 pulmonary embolism, 1 lung cancer, 1 pneumothorax). Lung ultrasound showed a sensitivity of 96.97% (95% confidence interval [CI], 84.68%-99.46%) and a specificity of 96.49% (95% CI, 88.08%-99.03%) in predicting radio-occult pleural-pulmonary lesions and significantly higher area under the curve (AUC) of receiver operating characteristic analysis (AUC, 0.967; 95% CI, 0.929-1.00) than D-dimer (AUC, 0.815; 95% CI, 0.720-0.911) and white blood cell count (AUC, 0.778; 95% CI, 0.678-0.858). None of the other routine tests considered or a combination between them better predicted the final diagnosis.

**Conclusions:** Chest radiography and blood tests may be inadequate in the diagnostic process of pleuritic pain. In case of silent CXR, LUS is critical for identifying patients with pleural-pulmonary radio-occult conditions at bedside and cannot be safely replaced by other conventional methods.

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## **Material and methods:**

- 90 patients admitted to our emergency department (ED) complaining of pleuritic pain as the main symptom
- negative 2 views chest radiography
- normal respiratory function and hemodynamic stability
- All patients underwent bedside lung ultrasound to analyze pleura and underpleural parenchymal morphology, particularly in the painful thoracic area
- Final diagnosis was confirmed by follow-up at 7 and 30 days or sCT scan



## **Material and methods:**

- Detection of at least one of the following sonographic signs in the painful thoracic area was considered diagnostic (differential diagnosis between parietal chest pain and pleural/pulmonary condition):

- ① The absence of pleural sliding
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AZ. OSP. S. LUIGI G. ORBASSANO D.E.A. - RAD. P.S.  
16\_54\_03

16:56:46 Me 10/03/2010

SIEMENS

ADDOME

C5-2 3.5

FPS 30s



2D 60/1/24

MI 0.6

Tx 100%

AZ. OSP. S. LUIGI G. ORBASSANO D.E.A. - RAD. P.S.  
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SIEMENS

ADDOME

C5-2 3.5

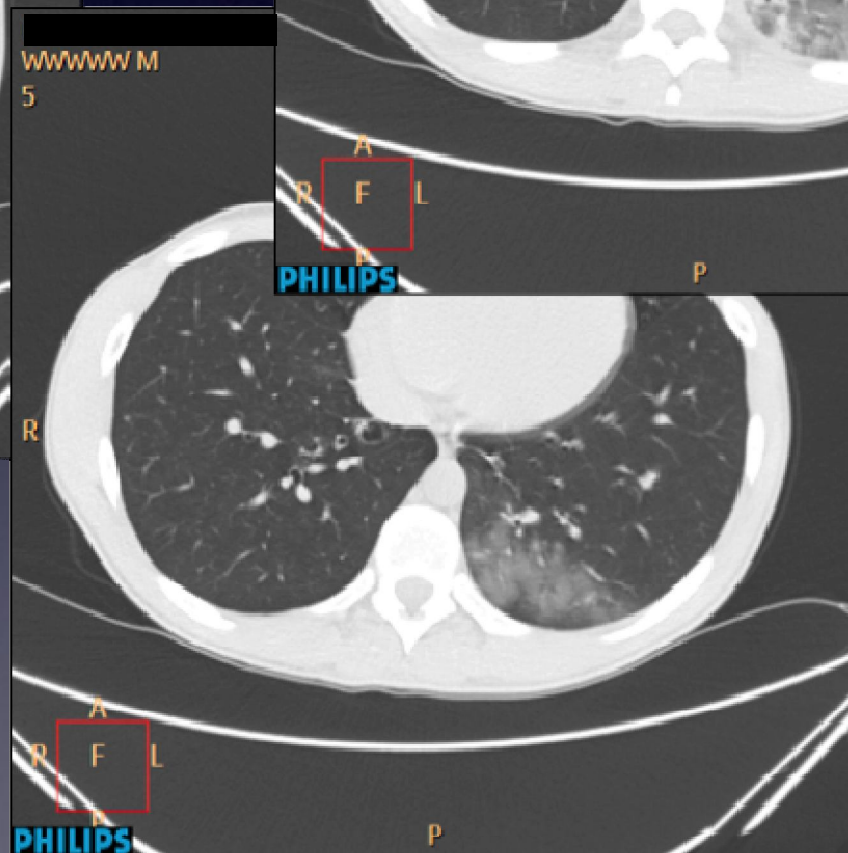
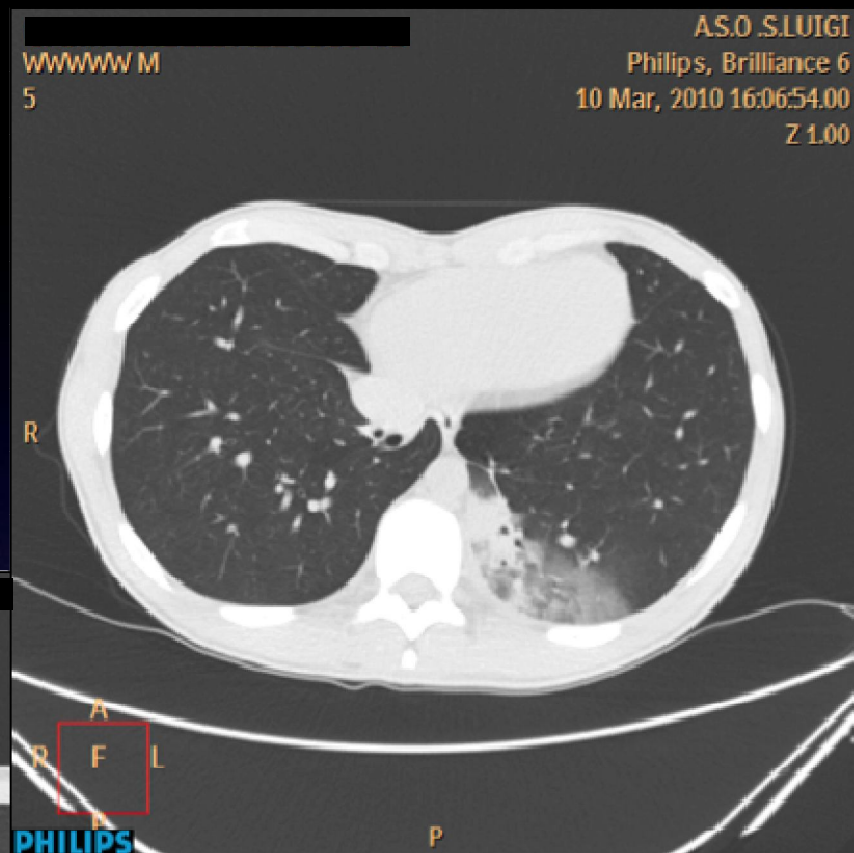
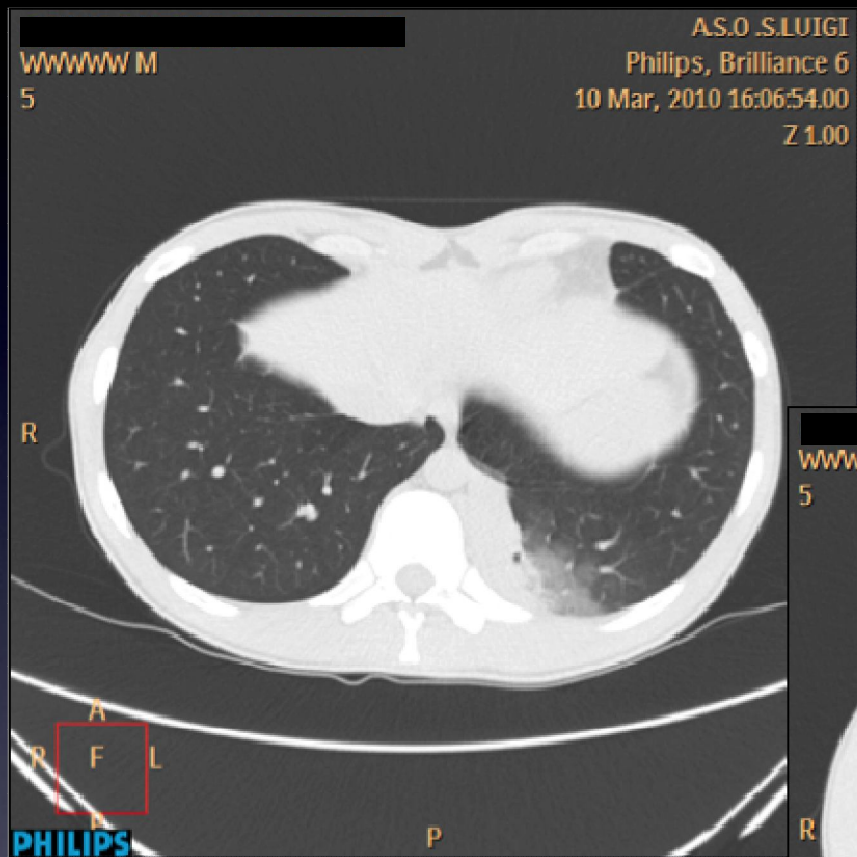
FPS 30s



2D 60/1/24

MI 0.6

Tx 100%



**Table 1** Comparison between diagnostic accuracy of LUS, routine blood tests, and symptoms in predicting any pleural and/or pulmonary radio-occult condition in 90 patients who presented to the ED complaining of pleuritic pain and no symptoms of respiratory distress

Diagnostic test	Sensitivity	Specificity	Positive PV	Negative PV
LUS	96.97 84.68-99.46	96.49 88.08-99.03	94.12 80.91-98.37	98.21 90.55-99.68
Blood tests				
d-dimer	75.76 58.98-87.17	84.21 72.64-91.46	75.53 56.88-85.14	85.71 74.26-92.58
CRP	90.91 76.43-96.86	80.7 68.66-88.87	73.17 58.07-84.31	93.88 83.48-97.9
WBC	51.52 35.22-67.5	96.49 88.08-99.03	89.47 68.61-97.06	77.46 66.48-85.63
Symptom-based tests				
Fever	42.42 27.24-59.19	87.72 76.8-93.9	66.67 45.37-82.81	72.46 60.95-81.61
Cough	36.36 22.19-53.38	64.91 54.94-76	37.5 22.93-54.75	63.79 50.93-74.95
Hemoptysis	3.03 0.54-15.32	96.49 88.08-99.03	33.33 6.15-79.23	63.22 52.73-72.59
Sequential tests				
Laboratory+ <sup>a</sup>	100 89.57-100	70.18 57.34-80.47	66 52.15-77.56	100 91.04-100
Symptom+ <sup>b</sup>	57.58 40.81-72.76	53.3 48.43-72.94	46.34 32.06-62.25	71.43 57.59-82.15

Data are expressed as percentage (95% CI). PV indicates predictive value.

<sup>a</sup> At least 1 positive blood test, among WBC, CRP, and D-dimer.

<sup>b</sup> At least 1 symptom in the history recording, among fever, cough, and hemoptysis.



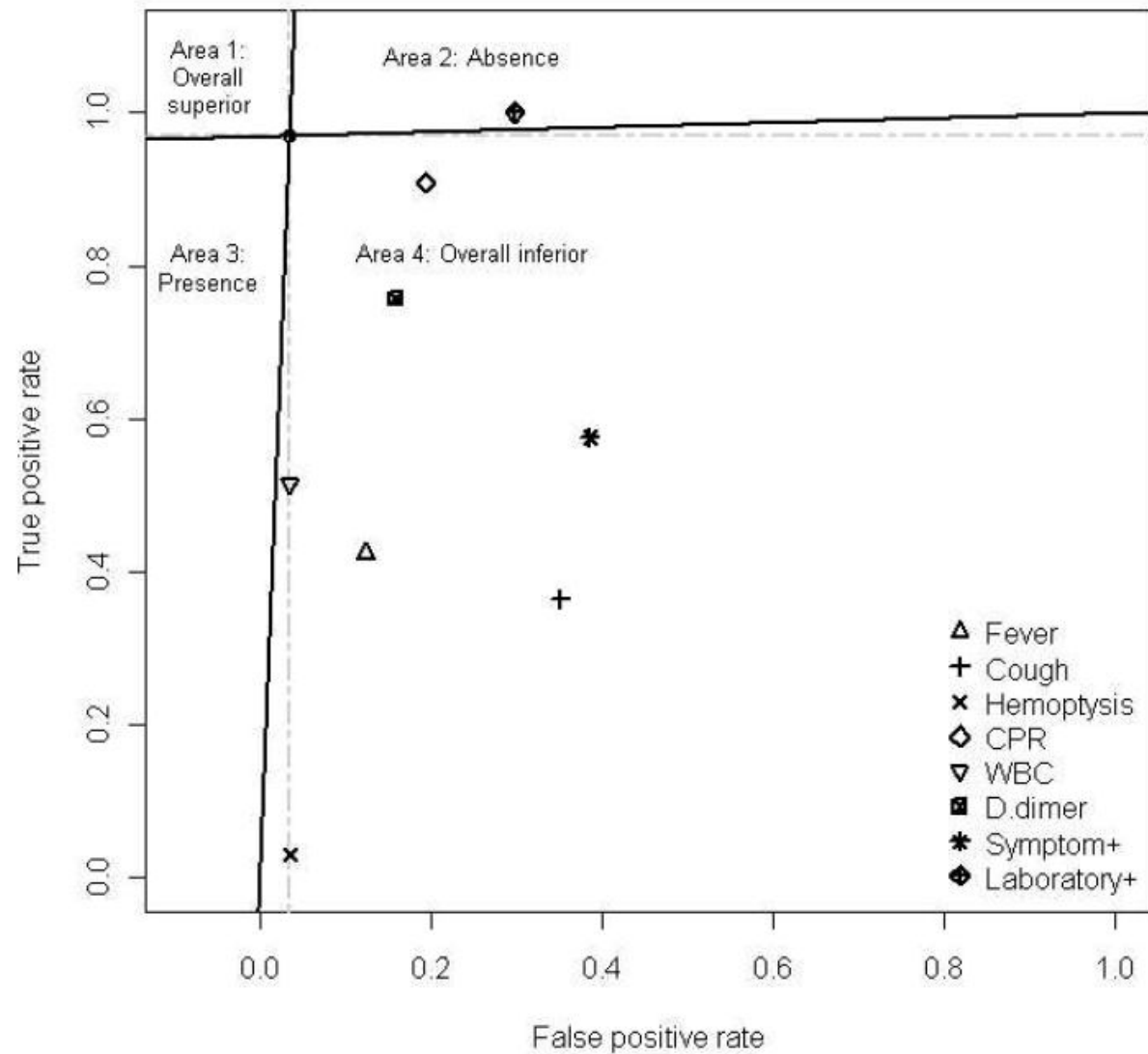
**Table 2** Areas under the ROC curves of routine blood tests and symptoms in predicting any radio-occult pleural and/or pulmonary condition in 90 patients who presented to the ED complaining of pleuritic pain and pairwise comparison with LUS ROC curve

Diagnostic test	AUC	Difference between areas (LUS)	<i>P</i>
LUS	0.967 0.929-1.00	—	—
Blood tests			
D-dimer	0.815 0.720-0.911	0.152	.001
CRP	0.926 0.869-0.983	0.041	.22
WBC	0.778 0.671-0.884	0.19	.001
Symptom-based tests			
Fever	0.651 0.555-0.747	0.317	<.001
Cough	0.506 0.402-0.611	0.461	<.001
Hemoptysis	0.498 0.459-0.536	0.469	<.001
Sequential tests			
Laboratory+ <sup>a</sup>	0.851 0.791-0.911	0.116	.001
Symptom+ <sup>b</sup>	0.595 0.488-0.702	0.372	<.001

Data are expressed as percentage (95% CI).

<sup>a</sup> At least 1 positive blood test, among WBC, CRP, and D-dimer.

<sup>b</sup> At least 1 symptom in the history recording, among fever, cough, and hemoptysis.



Negative and positive likelihood ratio are numerically equivalent to the slopes of the solid lines. The solid line passing through (0,0) is the likelihood ratio positive-line and the solid line passing through (1,1) is the likelihood ratio negative-line. The solid lines split the graph in four areas. Tests falling in area 1 are overall superior to LUS, those falling in area 2 are superior for confirming absence of disease, tests in area 3 are superior for confirming presence of disease, finally tests in area 4 are overall inferior. The dashed lines represent the sensitivity and specificity of LUS.

237x237mm (72 x 72 DPI)



## 6. Conclusions

This study provides further evidence that bedside LUS is superior to conventional CXR in many situations. Bedside sonographic evaluation of the lung by the attending EP in the ED is a reliable easy-to-use method and accurate enough to be routinely used in patients presenting with pleuritic pain.

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

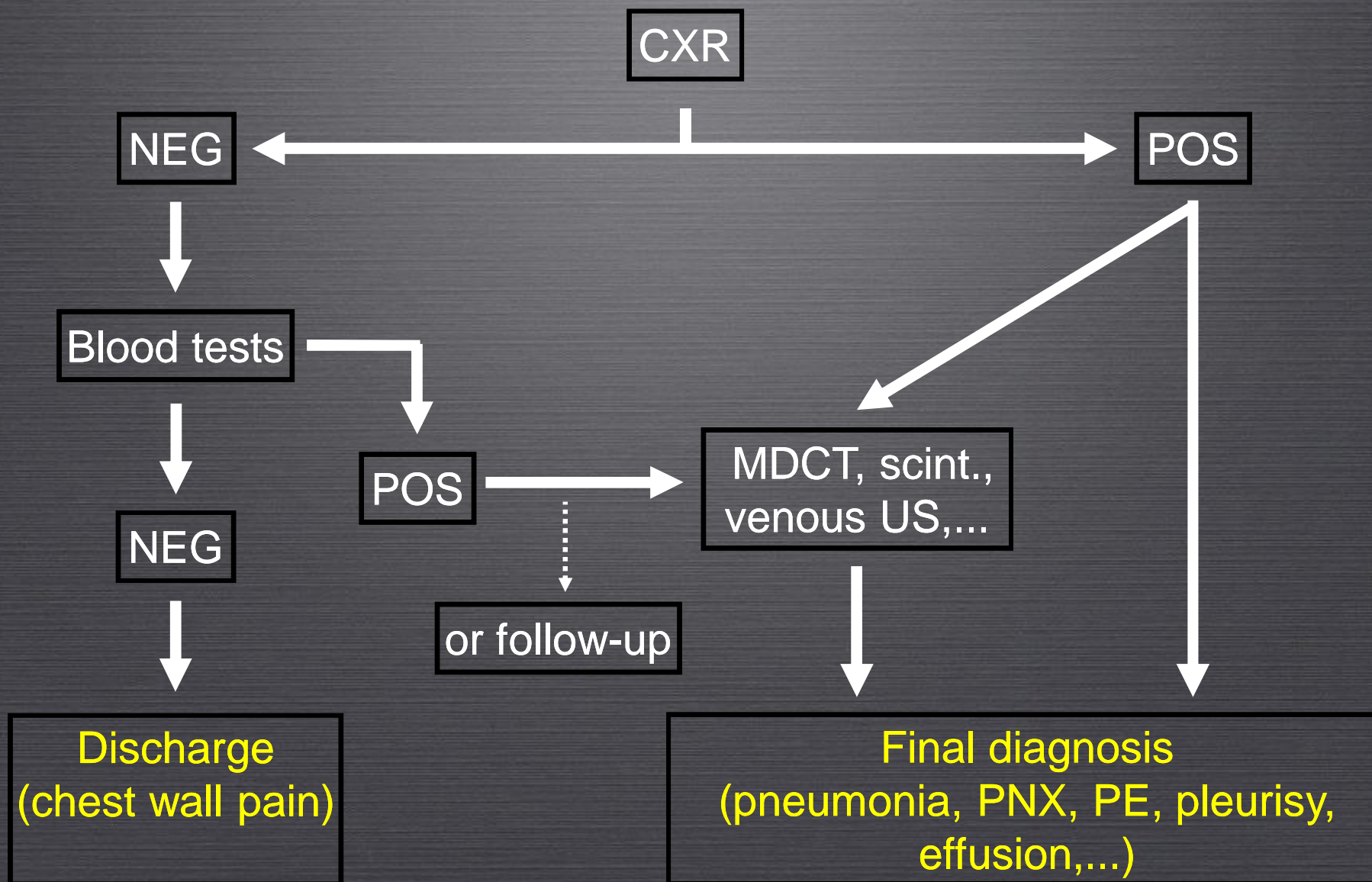
## **International evidence-based recommendations for point-of-care lung ultrasound**

B-D4-S6 (strong: level B)

- Lung ultrasound should be considered in the detection of radio-occult pulmonary conditions in patients with pleuritic pain.



# Assessment of pleuritic pain in the ED (LUS not available)



# Assessment of pleuritic pain in the ED (availability of LUS)

