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CASE REPORT

Lung US features of severe interstitial pneumonia: case report and review of the literature

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Abstract
Background Chlamydia pneumonia is reported to account for a relatively large number of cases of CAP. In elderly patients in particular, the clinical presentation can be a severe form of diffuse interstitial pneumonia. The chest X-ray presentation is aspecific. Lung US can show a typical pattern of diffuse interstitial lung syndrome; in some cases, like the present one, the association of multiple B lines with a coarse and thickened pleural line points to a more likely diagnosis of interstitial pneumonia.
Case report We present the case of an 87-year-old woman with severe interstitial chlamydial pneumonia, for whom lung US was very useful for directing diagnosis and for follow-up during therapy.
Conclusions The use of lung US in the diagnosis of interstitial syndrome is likely to improve the care of patients in whom the diagnosis is a consideration; it offers better characterization than a chest X-ray and is free from CT radiation. Furthermore, the concept of using lung US for monitoring a patient is one of the major innovations that has emerged from recent studies.

Keywords Lung US · Interstitial syndrome · CAP · B Pattern · Coarse pleuric line · Sub-pleural consolidations

Sommario
Background Chlamydia pneumoniae è riconosciuto come agente eziologico largamente rappresentato nelle polmoniti acquisite in comunità (CAP); nei soggetti più anziani può associarsi a gravi forme di polmonite interstiziale diffusa. La presentazione radiologica è aspecifica. L'ecografia polmonare può mostrare un quadro tipico di sindrome interstiziale diffusa; in alcuni casi, quale il nostro, l'associazione di multiple linee B con il reperto di una linea pleurica irregolare ed ispessita, può suggerire una più verosimile diagnosi di polmonite interstiziale.
Caso clinico presentiamo il caso di una paziente di 87 anni, ricoverata nel nostro reparto per grave polmonite interstiziale da Chlamydia, in cui il ruolo dell'ecografia polmonare si è dimostrato fondamentale nella diagnosi e nel follow-up in corso di terapia mirata.
Conclusioni l'ecografia polmonare può migliorare la gestione clinica del paziente con probabile diagnosi di polmonite interstiziale, per miglior caratterizzazione del quadro rispetto alla radiografia del torace, evitando il danno da radiazioni proprio della TC. L'utilità dell'ecografia polmonare nel monitoraggio del paziente durante terapia emerge sempre con più chiarezza in letteratura.

Background

Chlamydia pneumoniae is reported to account for a relatively large number of cases (6–20%) of CAP. The clinical course may vary from mild, self-limiting illnesses to severe forms of pneumonia, particularly in elderly patients and those with coexisting cardiopulmonary diseases. Laboratory methods for the diagnosis of *C. pneumoniae* infection include culture, antigen detection, serology, and PCR [1]. Radiological examination shows the presence of irregular or spotted segmented inflammatory infiltrates or augmented interstitial density [2]. Ultrasound evaluation of the thorax for the detection of pneumonia has been employed most in the critical care emergency department setting.

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However, recently, the application has spread to general practice and even to pre-hospital settings. The use of lung US in the evaluation of pneumonia is growing rapidly, and each clinical setting shows increased efficiency as accurate bedside diagnosis becomes possible [5]. Many studies have shown a close correlation between the interstitial involvement of lung disease and B-lines. B-lines are defined as discrete laser-like vertical hyperechoic reverberation artifacts that arise from the pleural line (previously described as 'comet tails'), extend to the bottom of the screen without fading, and move synchronously with lung sliding. In the evaluation of interstitial syndrome in urgent settings, the sonographic technique ideally consists of scanning eight regions in a quest for positive regions, which are defined by the presence of three or more B-lines in a longitudinal plane between two ribs. Two or more positive regions suggest a positive exam [4]. However, in clinical practice, a complete study of the thorax is not always possible in patients with respiratory failure (or in elderly bedridden patients or in trauma). Causes of interstitial syndrome include pulmonary edema of various etiologies, diffuse parenchymal lung disease (pulmonary fibrosis), and interstitial pneumonia. Widespread B lines that are confluent or give a 'white lung' picture direct the diagnosis toward a cardiogenic form.

If the patient presents with few, non-confluent B lines, especially those associated with sub-pleural thickening, the respiratory failure is more likely to have a pulmonary origin.

The presence of diffuse bilateral B-lines is characterized by 86–93% sensitivity and 93–98% specificity in the diagnosis of interstitial syndrome. As the circulatory and pulmonary systems are interconnected, an integrated lung-, heart-, and IVC US is mandatory. Left ventricular systolic and/or diastolic dysfunction or valvular heart disease is highly indicative of cardiogenic pulmonary congestion. The presence of a diffused interstitial pattern associated with a normal heart indicates a non-cardiac cause of pulmonary edema, for instance, ARDS, interstitial pneumonia, or diffuse parenchymal lung disease. Unlike cardiogenic pulmonary edema, the associated lung findings for non-cardiac causes include pleural line abnormalities, non-homogenous distribution of B-lines, and sub-pleural echo-poor area (or consolidation) [3]. Differential diagnosis between acute cardiogenic pulmonary edema (APE) and acute lung injury/acute respiratory distress syndrome (ALI/ARDS) may often be difficult. Pleuroparenchymal patterns in ALI/ARDS find characterization through lung US: spared lung areas, the presence of lung consolidations with air bronchograms, the reduction of pleural gliding, the thickening and coarse appearance of the pleural line, and a lung pulse are typical of ALI/ARDS. By contrast, in APE, alveolar-interstitial syndrome shows a homogeneous distribution, the pleural line is regular, the lung sliding is normal, and lung consolidation is not characteristic [6].

Case report

An 87-year-old woman presented in the Emergency Room (ER) for increasing dyspnea with no fever or other associated symptoms. In the ER, she presented with tachypnea, desaturation, and severe respiratory acidosis. She underwent blood tests with a normal blood count (particularly without leukocytosis); the chest X-ray was suggestive of a diffuse interstitial micronodular disease compatible with lung fibrosis. Heart US excluded signs of ventricular systolic and/or diastolic dysfunction or valvular heart disease. After an oxygen cycle with CPAP (5 h) and improvement in blood-gas exchanges, the patient was transferred to our Medicine Department. In the first days of hospitalization, she remained afebrile, apparently asymptomatic for dyspnea with low oxygen flow; a blood test confirmed a normal leukocyte count with a mild RCP (5.3 mg/dl, normal <0.5) and a BNP increase (248 pg/ml, normal <50). She presented with bibasilar pulmonary crackles, ankle swelling, and valid diuresis. ECG showed a regular sinus rhythm with prominent P waves and right bundle branch block. However, blood gas analysis showed persistence of severe respiratory acidosis, and other CPAP cycles were necessary. Our first diagnostic hypothesis was a case of unrecognized lung fibrosis complicated by a pulmonary embolism or a cancer. The lung US, conducted with a 3.5–5 MHz convex probe (Esaote MyLab25Gold), showed an irregular, coarse pleural line, many B-lines with any gradient of distribution, rare sub-pleural consolidations corresponding to the right medium pulmonary lobe on the order of 5–7 mm, and the absence of spared areas, like an interstitial diffuse lung disease. The patient underwent a chest CT that allowed the exclusion of a pulmonary embolism or fibrosis, describing a 'tree in bud' pattern that was compatible with small airway phlogosis. Even if the clinical picture was not typical of an infective origin, the patient underwent blood and urine cultures and microbiological assays, which showed positivity for *Chlamydia pneumoniae* serologies at elevated titer (positive Chlamydia pneumoniae IgA 1:128, pos > 1/32; negative IgG). A targeted antibiotic therapy with azithromycin (500 mg/die iv) was started with progressive clinical and blood-gas exchange improvement. The chest US performed during antibiotic therapy showed progressive regularization of the pleural line and reduction in the number of B-lines; sub-pleural consolidations disappeared. After 10 days of therapy with azithromycin, the patient presented with the normalization of blood-gas exchange with low oxygen flow therapy (1L/min), and she was transferred to rehabilitation.

Conclusions

The use of US in the evaluation of the respiratory tract dates back to the 1970s, when it was employed for the study of pleural opacities. Since then, it has also emerged as a fundamental tool for use during thoracentesis (US-guided), the biopsy of subparietal pulmonary nodules, the assessment of mediastinal pathology, pleural sclerotherapy, and chest-tube placement. Moreover, today, contrast-enhanced US (CEUS) is used for the characterization of pulmonary nodules. More recently, lung US has emerged in the study of a number of lung diseases that were former studied exclusively using chest CT, for instance, lung fibrosis and interstitial lung disease. Although this approach has been assessed in several clinical studies, there is no widely accepted classification system of interstitial lung disease based on both clinical and US findings. The one that Fraser et al. proposed based on anatomical and clinical features was incorporated into the European Respiratory Society (ERS)/American Thoracic Society (ATS) International Multidisciplinary Consensus Classification (2002). The US classification is based on indirect criteria (artifacts) for the diagnosis of interstitial lung disease that Soldati and Lichtenstein proposed: comet-tail artifacts in the anterior and lateral regions of the thorax (B lines), subpleural thickening, and the irregularity of the parietal pleural line. Unilateral or bilateral slowing of the physiological 'gliding sign' displays direct correlation to the severity of the disease [7].

Lung US is increasingly being utilized in emergency and critical settings. Recent studies have demonstrated that, if a chest CT scan is used as a reference, the diagnostic accuracy of lung US is better than that of a chest X-ray in adult patients with clinically suspected CAP when an experienced sonographer performs it [3]. Based on a comparative analysis of clinical, instrumental, laboratory, and US findings, it seems reasonable to affirm that, in expert hands, thoracic sonography can also be used to assess interstitial pneumonia [6]. Use of sonography in the diagnosis of interstitial syndrome is likely to improve the care of patients in whom the diagnosis is a consideration. Furthermore, the concept of using lung US for monitoring the patient is one of the major innovations that has emerged from recent studies [4]. We described this case to underline the observation that lung US was more precise than a traditional chest X-ray at diagnosis, even in the presence of atypical clinical presentations, allowing a rapid and easily available follow-up. The advantages of the correct use of bedside lung US in the emergency setting are striking, particularly in terms of saving the patient from radiation exposure, delaying or even avoiding transportation to the radiology suite, and guiding lifesaving therapies [3]. Although many traditional imaging applications are still indicated and will be used indefinitely for patients with possible pneumonia, lung US can substantially decrease the practical delays associated with plain chest radiography and, in some cases, can obviate the need for chest CT when a definitive diagnosis is obtained on US imaging, allowing the avoidance of large radiation doses [5].

Compliance with ethical standards

Conflict of interest We declare no conflict of interest or financial support for this article.

Ethical approval Authors declare that procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration.

Informed consent The Authors declare that all patients of IRCCS San Matteo of Pavia give at admission written informed consent to analyze in the future their data for research purposes, approved from our Bioethical Committee.

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