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Abstract

Background: Lung ultrasound (LUS) exerts a relevant role in early evaluation of lung and pleural diseases, especially in the emergency setting. In particular, LUS has been increasingly employed to differentiate malignant from benign pleural masses.

Case Report: we report the case of a 85 years old caucasian male referred to our emergency department for the onset of dyspnea, fatigue and atypical chest pain. LUS showed a mass with mixed echogenicity and irregular contours at right hemitorax, near the diaphragmatic surface, suspected for malignant neoplasia. Subsequent chest computed tomography and histological examination confirmed the diagnosis of malignant mesothelioma.

Conclusions: Mesothelioma is a challenging diagnosis for physicians due to no specific symptoms and lack of a reliable biomarker. LUS is a non-invasive and reliable imaging modality allowing to detect early signs of asbestosis and mesothelioma development such as pleural effuson, pleural thickening and masses.

Keywords

mesothelioma, ultrasound, lung, pleura, mass.

Introduction

Lung ultrasound (LUS) exerts a relevant role in early evaluation of pulmonary and pleural diseases, especially in the emergency setting [1-5]. From the early works of Lichtenstein et al [6, 7], the semeiotic of LUS has become increasingly codified and standardized, allowing the recognition and the differential diagnosis of serious and lifethreating diseases, such as acute pulmonary edema, pleural effusion and pneumothorax [4, 8-10]. In particular, in recent years, pleural line and diaphragm motility evaluation have been employed as a quantitative method to monitor ventilatory function, for example as a predictive factor in patients subjected to mechanical ventilation [11, 12]. Moreover, a qualitative sonographic examination of the pleura and diaphragm can be performed, thus allowing the diagnosis of complex diseases such as neoplastic masses [13, 14].

Case Report

A 85 years old caucasian male cames to our emergency department for the onset of dyspnea, fatigue and atypical chest pain localized at the lower segment of right hemithorax. His medical hystory was characterized by essential hypertension leading to hypertrophic cardiomyopathy, pacemaker implantation and benign prostatic hypertrophy. At physical examination upper airways were pervious, with a respiratory rate of 32 acts /minute and a peripheral oxigen saturation of 87% (FiO2: 21%). Heart rate was regular with 86 bpm and blood pressure was 110/70 mmHg. He was drowsy on presentation, but without any focal neurological deficits. Blood gas analysis revealed an hypoxemic normocapnic respiratory failure, which was treated with oxygen supplementation. At the same time, a LUS was performed to ascertain the reasons responsible for respiratory failure. Pleural sliding was reduced in middle and lower parts of right hemitorax and in lower segments of left hemitorax. Pleural line was diffusely and irregularly thickened and jagged. At the lower segment of right hemitorax, a slight pleural effusion was evidenced. In addition, similar areas of loculated pleural effusion were found in the middle and apical segments of right hemitorax. Moreover, we detected a mass with mixed echogenicity and irregular contours at the base of right hemitorax, attached to the diaphragmatic surface, with a maximum size of 1.5 cm. A similar area was reported at apex of the right hemitorax. Few B lines spread asymmetrically (Fig 1,2,3).

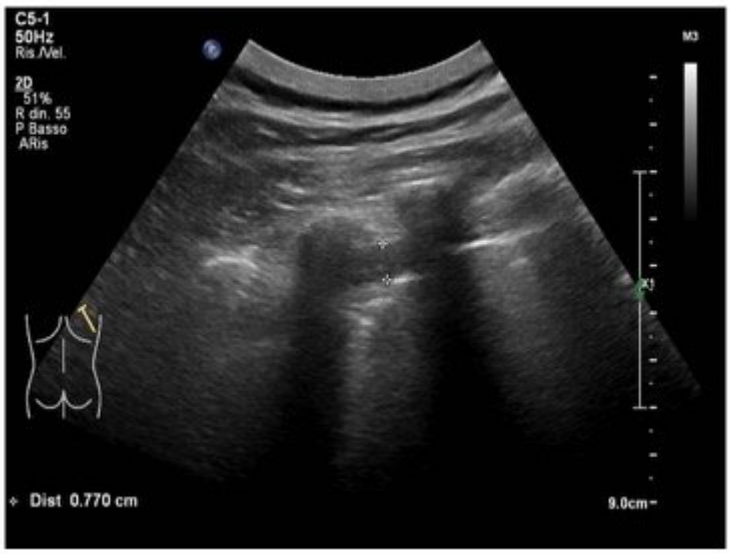

Figure 1: Mid-apical scan showing pleural line diffusely and irregularly thickened and jagged, with some small loculated pleural effusion.

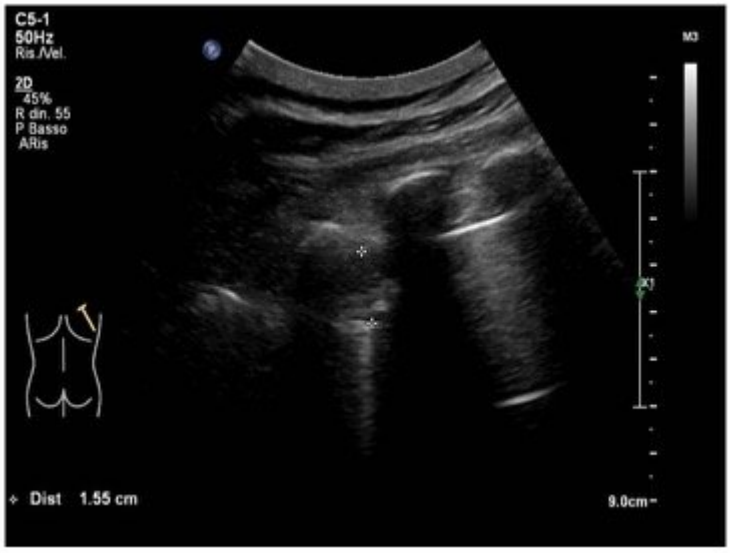

Figure 2: A mass with mixed echogenicity and irregular contours at the lower part of right hemitorax, attached to the diaphragmatic surface

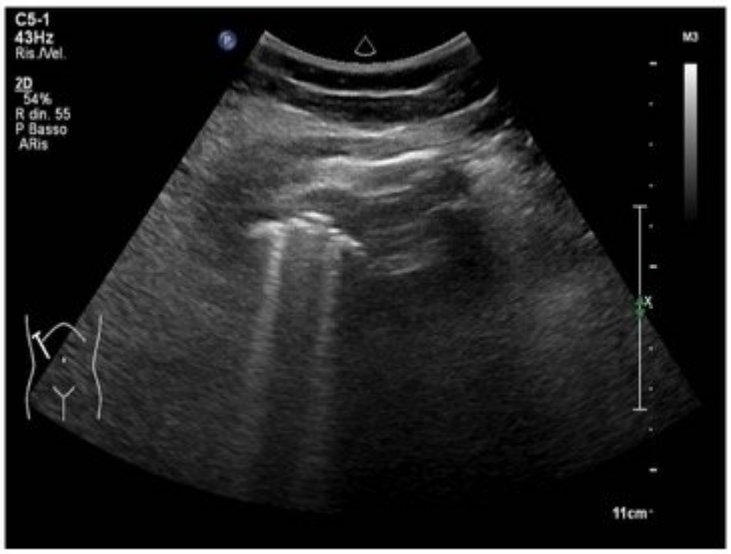

Figure 3: Comet-tail artifacts (B lines) are generated at the interface between mass-compressed atelectatic lung and normal ventilated lung.

Following these sonographic findings, a chest computed tomography (CT) was performed showing in the apical segment of right hemitorax an opacity with net margins, and a pleural effusion layer, partially loculated, in the apical segment and along the margino-costal line in the right hemitorax. There was a parenchymal hypoventilation of the homolateral lower segment. Moreover, a pleural thickening at basal segment of right hemitorax (maximum thickness of 1.5 cm) and of the the great fissure were seen.
Subsequently, an ultrasound-guided biopsy of the apical pleural mass was performed, which confirmed the suspicion of malignant pleural mesothelioma (MPM). Later, the patient was assigned to thoracic surgeons to perform a thoracoscopy and to continue the diagnostic and therapeutic management.

Discussion

MPM is an aggressive tumor involving pleural surface displaying a median survival from 8 to 14 months from first diagnosis [15, 16]. MPM incidence is higher in men, probably due to occupational risk factors, and it increased over recent years [15-17]. Indeed, MPM is mainly related to asbestos occupational exposure [15, 17], but other less common risk factors are erionite, chest wall radiation and simian virus 40 [15, 18]. A typical triad of pleural effusion, dyspnea, and chest wall pain characterize patients affected by MPM in 60% of cases [17, 19, 20]. Other symptoms such as laryngeal nerve palsy or dysphagia, or superior vena cava obstruction syndrome and peritoneal involvement are due to tumor invasion and diffusion [15, 17]. Notably, many patients are asymptomatic, and mesothelioma can be incidentally detected on imaging [15]. In our patient, the clinical and anamnestic evaluation allowed early to address the diagnosis towards a neoplastic pleural disease, subsequently confirmed by histological examination as MPM. Indeed, our patient reported on his past history an exposure to several fine powders, including asbestos, since he worked as a mason.
First of all, LUS can detect sonographic signs of asbestosis in exposed subjects, such as irregular pleural surface with peripheral lung consolidation and diffuse bilateral interstitial syndrome with non-homogeneous distribution (pulmonary asbestosis) [13, 14]. Furthermore, sonographic findings suggesting MPM include pleural-based masses, pleural thickening >1 cm, nodular pleural thickening and diaphragmatic nodularity [13, 14, 21]. Mesothelioma pleural masses are hypoechoic lesions or with a mixed echo-pattern at ultrasound examinations, often related to a pleural thickening and surrounded by aerated lung [22]. Moreover, ultrasound has been demonstrated to be more accurate than chest CT scan for detection of cancer chest wall invasion [23]. Pleural effusion is a common finding in patients affected by MPM, that can be detected on ultrasound as an anechoic or hypoechoic space within the thorax. Ultrasound examination better characterizes the internal complexity of a pleural effusion in comparison with standard radiography and chest CT scan [24]. The contemporary presence of nodules or masses on the hemidiaphragm may represent metastatic foci, and it's quite typical of a malignant pleural effusion [24-26]. Pleural effusion induces compressive atelectasis of the nearest lung, by reducing the air amount until reaching alveolar consolidation pattern. At the interface between atelectatic lung and normal ventilated lung, there is often an echogenic boundary from which comet-tail artifacts are generated. An ultrasound-guided thoracentesis may be performed for diagnostic or therapeutic purposes [20, 27, 28]. Ultrasound allows to select the safest insertion site, the best angle, and to measure the depth for needle insertion into a pleural effusion, thereby decreasing complication rate, including pneumothorax or injury to nearest organs [29-31]. Moreover, one of the biggest advantages to employ ultrasound for monitoring the positioning of device and checking the amount of pleural effusion is the reduction of radiation exposure due to x-ray controls and the greater easiness and speed of execution.
In our case, LUS evaluation showed a minimum amount of pleural effusion, especially detected with breathing changes (curtain sign alteration). Subsequently, the examination of anterior, lateral and posterior scans of the diaphragmatic profile showed the presence of solid mass attached to the diaphragmatic muscle of a maximum size of 1.5 cm. Furthermore, mid-apical scans showed additional asymmetric and irregularly distributed pleural nodules, with some small loculated pleural effusion. Subsequently, an ultrasound-guided biopsy of pleural masses was performed, thus confirming the suspicion of MPM. Even if clear data about ultrasound superiority still lack in compaison with CT guidance, ultrasound-guided biopsy has been demostrated to be a safe procedure to make diagnosis by using needle aspiration or a cutting biopsy needle, displaying a high sensitivity and a decreased patient radiation dose [32-34]. US-guided cutting-needle biopsy (CNB) and standard pleural biopsy (SPB) procedures provide adequate material for histological analysis in 90.7 and 93.0% of cases, respectively, while the combination of CNB and SPB significantly improve the sensitivity, NPV and diagnostic accuracy versus each technique alone [35].
Finally, subjects who report previous asbestos exposure or present with a pleural effusion should be carefully monitored [36]. LUS can be employed as an additional examination to monitor patients occupationally exposed to asbestos who have already performed CT scan and whose disease is detectable by ultrasound as well [13, 14].

Conclusions

Mesothelioma is a challenging diagnosis for emergency physician due to no specific symptoms and lack of a reliable biomarker. Radiological imaging should be performed in all patient with anamnestic and clinical suspicion of MPM. In particular, LUS is a non-invasive and reliable imaging modality allowing to detect early signs of asbestosis and mesothelioma development such as pleural effuson, pleural thickening and nodules. LUS can play a main role in the follow-up of these pathological findings or to monitor subjects with referred asbestos exposure. Moreover, ultrasound seems to be an optimal choice to guide pleural fluid sampling or mass biopsies in order to perform biochemical and cytological examination [15, 36, 37]. Therefore, in our opinion, LUS is nowadays an undeniable tool to make MPM diagnosis and to guide its clinical and therapeutical management.

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