Bedside ultrasonographic diagnosis of pneumothorax

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Abstract: Pneumothorax (PTX) is the presence of an excessive amount of air between the two layers of the pleura. The clinical results depend on the extent of lung collapse. Bedside lung ultrasonography (BLUS) is a valuable way to diagnose PTX in the emergency department. The lung point is a pathognomonic sign of PTX. Here, we present a previously healthy 17-year-old male with left shoulder pain for 2 days, who was referred to the emergency department (ED). He had no history of trauma. BLUS was performed by the emergency physician. The lung point was detected with BLUS, and he was diagnosed with primary spontaneous PTX. Needle aspiration was performed. The patient was followed up with BLUS. Evidence of PTX was absent in BLUS after 6 h, and the patient was discharged for follow-up by a respiratory physician. In this case, the lung point in BLUS helped us make an accurate diagnosis of primary spontaneous PTX and invasive management of disease was arranged accordingly.

Keywords: lung point, pneumothorax, bedside ultrasound

Introduction

Pneumothorax (PTX) is the presence of an excessive amount of air between the two layers of the pleura. Spontaneous PTX is a commonly encountered diagnosis in the emergency department (ED). Primary spontaneous PTX occurs in people without underlying lung disease and in the absence of an inciting event [1]. Bedside lung ultrasonography (BLUS) is a valuable way to diagnose PTX in ED. In BLUS, PTX can be diagnosed according to the presence of the lung point (LP) and stratosphere sign and loss of comet-tail artifacts and lung sliding. The LP is pathognomonic for PTX with 100% specificity [2]. Here, we present a case that was diagnosed by BLUS with the aid of the presence of the LP.

Case Report

A previously healthy 17-year-old male with left shoulder pain for 2 days was referred to the ED. The patient reported this pain to be worse with deep inspiration. His past medical history was unremarkable for any disease or trauma. On physical exam, his vital signs were normal, and he was cooperative and able to speak in full sentences. Chest auscultation did not detect any abnormality other than decreased breath sounds on the left lung compared to the right lung. The electrocardiogram of the patient was normal. An emergency physician performed BLUS using a linear array transducer (M7®, Mindray Bio-Medical Co., Shenzen, China), which showed loss of normal lung sliding and comet-tail artifact in the anterior superior part of the left lung, and the presence of the stratosphere sign in M mode with loss of color change in Power Doppler (PD) mode under the pleural line (Figs 1 and 2). The LP was detected at the anterior superior part of the left lung while the patient was sitting. The depth between the skin and pleural line was measured as 13 mm by BLUS. A chest X-ray (CXR) was ordered to exclude any underlying pathology that cannot be detected by ultrasound. CXR did not reveal any pathology other than PTX (Fig. 3), and needle aspiration was performed. An 18-gauge needle placed in the second intercostal space in the m idlecavicular line was preferred for this procedure and 660 cc air was aspi-
rated [3]. We repeated the BLUS after needle aspiration and we found that all ultrasonographic findings of the PTX were absent. After 6 h of observation with oxygen support, the patient was discharged for follow-up by a respiratory physician.

Discussion

Between each rib lies the pleura, which can be identified as a hyperechoic line, below the artifacts created by the lung–chest wall interface that are present in the BLUS. Lung sliding is defined as a to-and-from movement of the visceral pleura with respect to the parietal pleura during respirations. The comet-tail artifact is a hyperechoic reverberation artifact arising from the pleural line and spreading toward the lower edge of the screen in the vertical orientation [4–7]. Lung sliding and comet-tails are absent in patients with PTX because air inhibits the propagation of sound waves necessary to form the comet-tail artifact and lung sliding. Using the M mode, the sonographer is able to represent lung sliding motion at the interface of the parietal and visceral pleura in still images. In the M mode, the seashore sign is an irregular
tracing along the x-axis at the depth of the pleura due to normal motion caused by lung sliding. The stratosphere sign is a smooth motionless base-line on the x-axis due to the absence of lung sliding (Fig. 1). PD can be used to detect lung movement underneath the pleura (Fig. 2). PD is an additional color flow imaging technique that, owing to its increased sensitivity to motion, is valuable in low-motion states when optimal Doppler angles cannot be obtained. With PD, the sonographer sees color changes underneath the pleura with each breath of the patient in the absence of PTX [8]. Bullous emphysema, pulmonary fibrosis, adult respiratory distress syndrome, and right main stem intubation can cause loss of lung sliding and yield false positive ultrasonographic findings of PTX. In addition, subcutaneous emphysema can generate a different type of comet-tail artifact, which arises above the pleural line and can also cause false positive results. All of these findings illustrate the lack of perfect specificity for the diagnosis of PTX in patients with dyspnea [9–11]. As an emergency physician, we need a diagnostic sign that has 100% specificity for PTX because invasive management is typical. Lichtenstein et al. described this pathognomonic ultrasonographic sign as the LP. The LP is characterized by the on-off appearance of a normal lung pattern (lung sliding present) replacing the PTX pattern (lung sliding absent) in a particular location along the chest wall [2, 12]. This finding represents the transition point from the normal lung to the PTX and is pathognomonic for PTX, with specificity greater than 99% [13]. From the practical point of view, it is easier to obtain the image when the patient is in the sitting position and to detect the LP in the anterior region of the lung because air collects in the upper part of the lung due to its low gravity.

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