A case report of lung ultrasound missing a pneumothorax due to patient positioning

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Abstract

Lung ultrasound is increasingly utilized as a diagnostic tool for the detection of a pneumothorax. The effect of small changes in patient positioning on the accuracy of lung ultrasound to detect a pneumothorax is not well studied. We present the first known case of lung ultrasound missing a pneumothorax because of suboptimal patient positioning, and discuss the implications of our findings for clinicians that utilize lung ultrasound and for future research.

Keywords

Lung ultrasound, critical care ultrasound, pneumothorax, patient position

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Introduction

Point-of-care ultrasound is rapidly evolving into the standard of care across many specialties. Lung ultrasound (LUS) is recommended for the detection of a pneumothorax (PTX) because it is more accurate and faster than chest radiography.^{1,2} The effect of small changes in patient positioning on the accuracy of LUS to detect a PTX is not well studied. Herein, we present the first-known published case of LUS missing a PTX because of patient positioning.

The case report

A gentleman in his 50s was admitted to the intensive care unit (ICU) for a right-sided healthcare associated pneumonia requiring mechanical ventilation. A chest computed tomography (CT) scan was performed which revealed a large right hydropneumothorax (Figure 1). Prior to chest tube placement and 12 hours after the CT scan, the pulmonary ultrasound team performed an LUS to detect the PTX. The pulmonary ultrasound team consisted of a pulmonary fellow and an intensivist with registered diagnostic medical sonographer certification. The LUS was conducted with a SonoSite X-Porte system using

a low-frequency phased array transducer (P21x) and a high-frequency linear transducer (L25xp), with both set to the lung preset. The LUS was performed with the patient in the semi-recumbent position. As per ICU protocol, the head of the bed (HOB) was initially left at 30°. For reference, the angle of the HOB will be reported as 0° being completely flat and 90° being completely upright. The patient was scanned using a modified method proposed by Volpicelli.³ Every lung interspace was scanned bilaterally along the mid-clavicular and mid-axillary lines. Every zone had lung sliding and B-lines so the PTX was not initially detected. The scan was then repeated after lowering the patient in 10° increments from 30° to 0°. The PTX was still not detected with the patient between 10° and 30°, because lung sliding and B-lines were found at every lung interspace. The right-sided PTX was finally detected once the patient was placed into a

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Figure 1. CT image showing the right-sided pneumothorax. CT: computed tomograph.

Figure 2. Lung ultrasound performed with the patient in a 0° position showing a lung point [arrow], which confirms the presence of a pneumothorax. A pleural effusion is also present (star).

0° position. With the transducer over the anterior chest in the mid-clavicular line, absent lung sliding, an A-line pattern and a lung point became readily apparent in this position (Figure 2 and Video 1). This LUS pattern reverted back to lung sliding with B-lines when the patient was returned to 10° position (Figure 3 and Video 2).

Discussion

We present the first-known case report of a PTX missed by LUS because of a subtle change in patient position. Our case emphasizes the importance patient positioning has on the ability of LUS to detect a PTX.

A 2013 meta-analysis found LUS was highly accurate for the detection of a PTX, although sensitivities ranged between 47% and 100%.⁴ Regarding patient position, these studies used imprecise terms such as “supine” or did not specify the position of the patient,

Figure 3. Lung ultrasound performed with the patient in a 10° position. Findings include lung sliding and B-lines across the entire pleural surface, which rule out a pneumothorax. A pleural effusion is also present (star).

which may have resulted in patients being scanned in different positions. This heterogeneity could have contributed to the wide ranges in sensitivity, especially considering the impact a 10° change in position had in our case. These issues have led to some uncertainty regarding the optimal patient position for LUS to detect a PTX. Without definitive data demonstrating the optimal patient position, an expert panel has recommended that the least gravitationally dependent areas of the lung in a supine patient should be explored to detect a PTX.² The basis for this recommendation stems from the principle that free-flowing air should rise to the least gravitationally dependent areas of the thorax.⁵ In a patient at 0°, this would be the anterior chest around the fourth intercostal space. However, the PTX can be missed as the HOB is raised because air can relocate to the apex of the thoracic cavity and away from the ultrasound probe. We suspect this gravitational relocation of air led to our inability to initially detect the PTX. It was detected once the patient was placed into a 0° position, because the air was redistributed back to the anterior thorax and under our ultrasound probe. Our case supports the recommendation to scan the least gravitationally dependent areas of the lung in a supine patient. However, we would stress a “0° position” is a more precise term than a “supine position” because many providers may consider a patient to be supine at angles greater than 0°. Despite this recommendation, many patients are still being scanned in a semi-recumbent position. This is largely because a LUS is commonly used in larger protocols to determine the etiology of dyspnea or hypotension rather than an isolated search for a PTX.^{6–8} Physician behavior is unlikely to change unless data emerges demonstrating the accuracy of LUS to detect a PTX is optimal with the patient in a 0° position.

Conclusion

To our knowledge, this is the first case report demonstrating that a clinically significant PTX could have been missed by a 10° variance in patient position. The optimal patient position for LUS to detect a PTX has not been conclusively determined because the importance of patient positioning has yet to be formally evaluated. Future research should use more precise terms regarding the position of the patient and explore to what extent it affects the accuracy of LUS to detect a PTX. Until such data exists, clinicians are reminded that LUS has the potential to miss a PTX if the patient is not in a 0° position.

Declaration of Conflicting Interests

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Supplementary Material

Videos 1 and 2 are available online at <http://journals.sagepub.com/doi/suppl/10.1177/1742271X17708473>.

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