Ultrasound guided chest tube placement for basilar pneumothorax

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A 52-year-old woman with a history of COPD presented to the emergency department with severe shortness of breath. She reported 1 week of mild dyspnea, productive cough, and subjective fevers. Her shortness of breath acutely worsened just prior to presentation. She had suffered numerous prior spontaneous pneumothoraces, which had been treated with tube thoracostomies and chemical and mechanical pleurodesis. Her initial vital signs were heart rate 131 beats/min, respiratory rate 30 breaths/min, blood pressure 138/106 torr, oxygen saturation 100 % on non-rebreather mask, and temperature 36.9 °C. The physical examination revealed moderate respiratory distress with diffuse wheezing on the right and decreased breath sounds at the left base. On inspection of the chest, there was extensive scarring of the left chest wall from previous procedures. A portable chest X-ray study showed a moderate-sized, primarily basilar pneumothorax with adhesions to the chest wall (Fig. 1).

The patient developed worsening respiratory distress with an increase in heart rate to 160 beats/min and a respiratory rate of 50 breaths/min. Her blood pressure was unchanged. The decision was made by providers to perform an emergent tube thoracostomy due to concern for impending respiratory failure. Given the basilar location of her pneumothorax, traditional landmark guided

location for chest tube placement was felt to pose a high risk of lung injury. Instead, ultrasound was used to locate the pneumothorax, inflated lung, and the diaphragm to determine the optimal site for chest tube placement.

A point-of-care ultrasound examination was performed by the treating emergency physicians using a 12- to 4-MHz linear array transducer (Philips Sparq, Andover MA, USA). The probe was initially placed in the midaxillary line over approximately the 5th intercostal space at the site of traditional landmark guided chest tube placement. At this location, inflated lung was identified by the presence of comet tail artifacts, and confirmed with M-mode (Fig. 2). The ultrasound probe was then moved inferiorly, and each rib space was evaluated until the “lung point” was found. The “lung point” is the ultrasound finding that identifies the interface of normal lung as it transitions to pneumothorax. In this location, inflated lung is seen sliding in and out of a rib space. The probe was then moved further inferiorly until only a pneumothorax pattern was seen (Fig. 3). We then moved further inferiorly to ensure that we were at an adequate distance from the diaphragm to proceed.

Once the site was identified, we prepared for chest tube insertion. The probe and patient were prepped and draped in normal sterile fashion. Next, the probe was placed at the chosen insertion site so that the ribs inferior and superior to the insertion point were visualized. A finder needle was inserted under in-plane ultrasound guidance so that the needle could be visualized passing over the superior edge of the inferior rib into the chest cavity. Air was aspirated, and a small-bore chest tube was placed using traditional Seldinger technique. Upon connection to suction, the patient experienced immediate improvement in her respiratory distress. Repeat chest

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Fig. 1 **a** Asterisk basilar pneumothorax in a patient with adhesions. **b** Reinflated lung following thoracostomy, arrow pigtail catheter

Fig. 2 M-mode image of inflated lung

X-ray study showed resolution of her pneumothorax. She was admitted to the hospital, the chest tube was removed on day 2 of hospitalization, and the patient went home on day 3 without complication.

Ultrasound has been used extensively by pulmonologists; with studies showing its efficacy and increased safety for thoracentesis [1, 2]. However, there is a paucity of data on the use of real-time ultrasound guidance for chest tube placement in the emergent setting. It has been shown that non-pulmonologists can perform ultra-

sound-guided thoracic procedures with similar complication rates as pulmonologists [3]. In addition, emergency medicine studies have examined the use of ultrasound for confirmation of successful chest tube placement [4]. Ultrasound guidance allows for successful completion of the procedure with an arguably increased level of safety. This case demonstrates the use of ultrasound to localize a basilar pneumothorax, and safely guide the placement of a small-bore chest tube in an emergent situation.

Fig. 3 M-mode image of pneumothorax

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Statement of human and animal rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with human and animals performed by any of the authors.

Informed consent None.

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