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Original Contribution

Ultrasound artifacts mimicking pleural sliding after pneumonectomy

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Abstract

Study Objective: To determine the presence of pleural sliding on chest ultrasonography (US) in a series of patients admitted to a surgical intensive care unit (SICU).

Design: Prospective, observational study.

Setting: 16-bed SICU of a University hospital.

Patients: 8 patients (7 men, 1 woman), aged 64 – 73 years (mean 67.5 yrs). Seven patients underwent pneumonectomy for pulmonary neoplasms; one patient underwent an atypical lung resection after having undergone a pneumonectomy one year before.

Interventions: None.

Measurements: Chest ultrasounds were performed during mechanical ventilation and spontaneous ventilation after endotracheal tube removal. In both examinations, pleural sliding was searched bilaterally in brightness mode (B-mode) and motion mode (M-mode) on the anterior thoracic wall in the least gravitationally dependent areas.

Results: During mechanical ventilation, pleural sliding was always absent on the side of the pneumonectomy and present on the other side. During spontaneous ventilation, some artifacts mimicking pleural sliding were noted on the side of the pneumonectomy both in B-mode and M-mode (presence of the seashore sign) in all patients, except for the one patient who had undergone a pneumonectomy one year earlier. Those artifacts became more pronounced during deep breaths.

Conclusions: Ultrasound artifacts mimicking pleural sliding may be observed in the absence of the lung and may originate from the activity of intercostal muscles since they become more evident during deep breathing.

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1. Introduction

Ultrasound (US) of the lungs is a powerful tool to rule out the presence of a pneumothorax at the patient's bedside [1–3]. During US examination, the hyperechogenicity of the pleural line and presence of A-pattern (linear artifacts that parallel the pleural line and are disposed of at regular intervals, or a uniform background pattern finely sparkling under the echoic pleural line) rule out pleural effusion or parenchymal consolidations, but do not discriminate normally aerated and hyperinflated lung from pneumothorax.

Searching for lung sliding, which originates from the movement of the aerated lung under the parietal pleura, is of the utmost importance to rule out a pneumothorax [4]. In brightness mode (B-mode), lung sliding is manifested by the sliding sign, ie, a to-and-fro movement of the pleural line, which is homogeneously displayed below it. In motion mode (M-mode), a characteristic pattern known as the seashore sign, in which straight, horizontal lines are observed above the pleural line and flickering lines under it, is noted (Fig. 1). In the absence of lung sliding, straight, horizontal lines are observed both over and under the pleural line (the so-called stratosphere or barcode sign; Fig. 1) [5]. The lack of lung sliding has a sensitivity of 100% for pneumothorax [6], but specificity may be low in some settings because the sign may be missing if the visceral pleura is in contact with the pleural line but is immobile. Consequently, the presence of lung sliding precludes a pneumothorax, whereas the absence does not necessarily indicate that a pneumothorax is present [7]. However, one of our patients who had undergone a pneumonectomy a few hours earlier, presented a US pattern that simulated the presence of lung sliding.

The aim of this study was to search artifacts simulating pleural sliding in a group of patients who were admitted to our surgical intensive care unit (SICU) after undergoing a pneumonectomy.

2. Patients and methods

After approval by the Ethics Committee of the Catholic University of the Sacred Heart and written, informed consent, we enrolled 8 patients, 7 men and one woman, aged 64 to 73 years (mean 67.5 yrs), in this study. Seven patients underwent pneumonectomy for pulmonary neoplasms; one man had an atypical lung resection for pulmonary neoplasm one year after undergoing a pneumonectomy. After surgery, all patients were transferred to the SICU, where a mechanical ventilator was used. Sedation with propofol was targeted to a Ramsay sedation score of 3–4 (pt exhibiting a brisk or sluggish response to a light glabellar tap or loud auditory stimulus). Analgesia was obtained with an intravenous (IV) infusion of morphine (0.01-0.02 mg/kg/hr). As soon as the patient's condition stabilized, the sedation was stopped, the ventilator was disconnected from the patient, and the endotracheal tube (ETT) was removed.

Chest ultrasounds were performed twice in each patient, during mechanical ventilation and during spontaneous ventilation after the ETT was removed. During both examinations, for which the head of the bed was elevated 30°, lung sliding was searched for in B-mode and M-mode, bilaterally, in the least gravitationally dependent areas, usually the second and third intercostal spaces. Ultrasound examination was limited to this area because surgical dressing hindered the systematic examination of the operative hemithorax. During spontaneous ventilation, patients were asked to breathe deeply and the presence of lung sliding was assessed again. Ultrasound examinations were performed using a Hitachi H21 scanner (Hitachi Medical Corp., Tokyo, Japan) and a 3.5 MHz convex probe.

3. Results

During mechanical ventilation, all patients presented with the same findings at chest ultrasound. Hyperechogenic pleural lines and A-lines were observed bilaterally. Lung sliding was absent on the side of the pneumonectomy, as pointed out by the lack of the sliding sign in B-mode and the presence of the stratosphere sign in M-mode (Figs. 1, 2). On the other side, sliding of the visceral pleura under the parietal pleura was confirmed by the finding of the sliding sign in B-mode and the seashore sign in M-mode. Of note, the patient who underwent an atypical pulmonary resection displayed lung sliding on the side freshly operated on and its absence contralaterally (where a pneumonectomy had been performed one yr earlier).

During spontaneous ventilation, US pattern did not change on the side of the residual lung. Conversely, on the side of the pneumonectomy, a hyperechogenic pleural line and A-lines were still present but some artifacts mimicking the sliding sign and the seashore sign were observed in all but one patient. These signs were less pronounced than on the contralateral hemithorax and more easily recognizable during deep breathing (Fig. 1); in the woman, both the sliding sign and seashore sign (Videos 1 and 2) were clearly visible only during deep breathing (Fig. 2). Finally, the patient who underwent an atypical pulmonary resection continued to show no lung sliding (ie, presence of the stratosphere sign, no sliding sign) corresponding to the pneumonectomy, during spontaneous ventilation.

4. Discussion

False lung sliding was observed after a recent pneumonectomy during chest US examination. The artifacts mimicking lung sliding were probably associated with activity of the respiratory muscles since they were absent