CASE REPORT

Chest ultrasounds to guide manual reexpansion of a postoperative pulmonary atelectasis: a case report

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ABSTRACT

Reexpansion of a pulmonary atelectasis is often difficult, even after removing possible causes of bronchial obstruction. Chest ultrasounds, inexpensive and readily available at the patient bedside, may offer valuable support to guide recruitment maneuvers. We report the case of a 57-year-old woman that developed a complete collapse of the left lung seven days after undergoing an intestinal resection for perforation. A mucous plug occluding the main bronchus was removed with bronchoscopy, but persistent hypoxemia required mechanical ventilation; 24 hours later, an attempt to wean the patient from the ventilator failed. Chest X-rays revealed the persistence of a partial collapse of the left inferior lobe associated with a pleural effusion. A chest ultrasound confirmed the presence of a lung consolidation and of a modest pleural effusion. Manual reexpansion was then attempted, and ventilatory pressures as well as the duration of forced inspirations were based on real-time ultrasound images. Complete reexpansion was achieved within a few minutes and confirmed by chest X-ray. The patient was weaned from mechanical ventilation on the same day and discharged from ICU three days later. *(Minerva Anestesiol 2011;77:750-3)*

Key words: Pulmonary atelectasis - Pleura - Lung - Ultrasonography - Postoperative complications.

Partial or total lung collapse occurs in the perioperative period as a consequence of surfactant impairment, lung compression by diaphragm displacement, and alveolar gas resorption due to dysventilation or bronchial obstruction.[1-3] Consequent severe hypoxemia and the risk of infective complications require prompt diagnosis and treatment. Unfortunately, even when a clear cause such as a mucous plug is found and removed, pulmonary reexpansion is not always easily obtained.

Manual recruitment maneuvers may be usefully associated with continuous positive airway pressure or with mechanical ventilation in order to resolve a pulmonary atelectasis.[4-6] However, modalities are still debated, and marked differences exist among the protocols described in the literature, particularly regarding the pressure levels to be applied to the airways and the length of forced inspirations. Ideally, recruitment maneuvers should be titrated by simultaneously monitoring pulmonary reexpansion. We describe a case of partial lung collapse successfully treated by performing manual recruitment under ultrasound guidance.

Case report

A 57-year-old woman with a past medical history significant for diabetes mellitus, tabagism, COPD, renal transplantation, and coronary stenting underwent a colonic resection due to perforation of a diverticulum.

The patient developed tachypnea and arterial desaturation on postoperative day (POD) 7. Chest X-rays revealed a complete atelectasis of the left lung (Figure 1A); consequently, a bronchoscopy was performed, and a mucous plug that occluded the main bronchus was removed. The patient was successively moved from the surgical

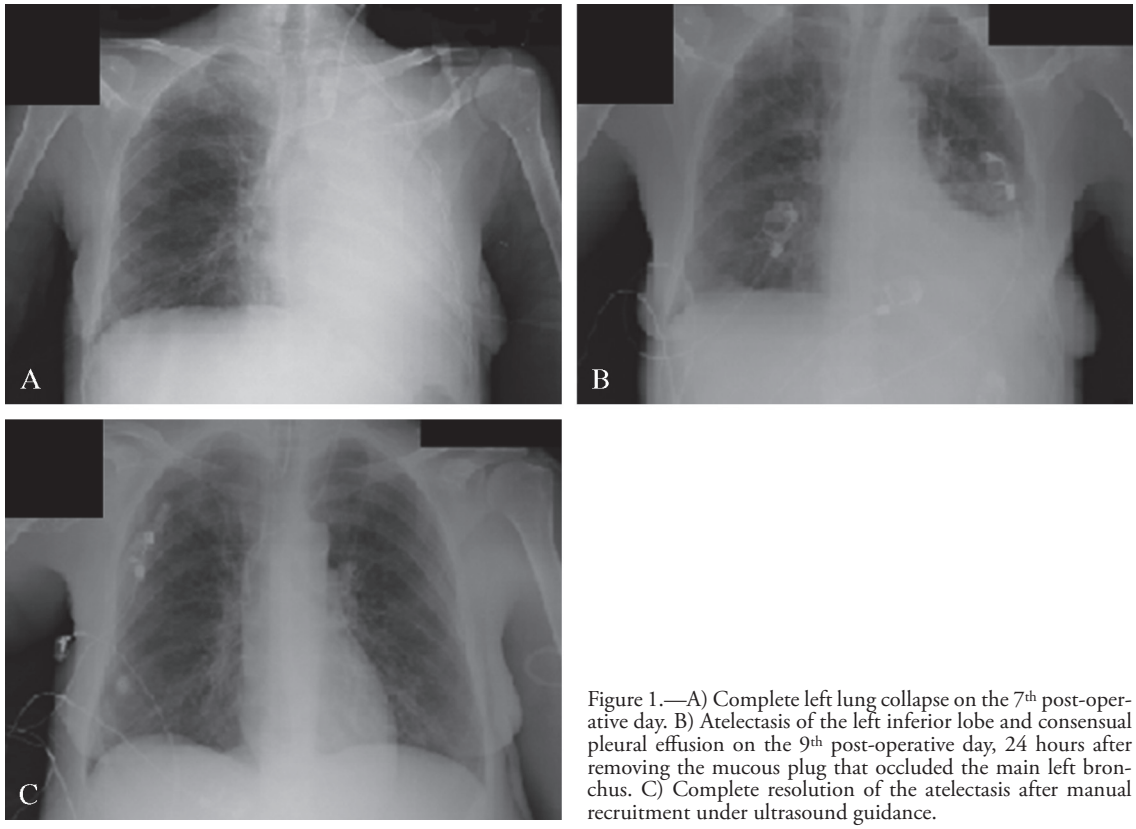

Figure 1.—A) Complete left lung collapse on the 7th post-operative day. B) Atelectasis of the left inferior lobe and consensual pleural effusion on the 9th post-operative day, 24 hours after removing the mucous plug that occluded the main left bronchus. C) Complete resolution of the atelectasis after manual recruitment under ultrasound guidance.

ward to the Surgical Intensive Care Unit (S-ICU), and non-invasive ventilation (NIV) (PS 10 cmH_20, PEEP 5 cmH_2O, and FiO_2 0.5) was started through a full facial mask to improve blood oxygenation and to favor pulmonary reexpansion. Two hours later, a tracheal tube was positioned because of non-compliance to NIV treatment, tachypnea (RF>40 acts/min), and use of accessory muscles of respiration; ventilation modality was reset to SIMV (CP 10 cmH_20, PS 10 cmH_20, PEEP 10 cmH_2O, and FiO_2 0.5). In the following 36 hours (postoperative days [PODs] 8 and 9), weaning from mechanical ventilation was attempted unsuccessfully, and the patient was reconnected to the ventilator after a few hours of spontaneous breathing. Chest X-rays still showed partial atelectasis of the left lung and a probable pleural effusion (Figure 1B). On POD 10, bedside lung ultrasound scanning was performed using a Hitachi H21 ultrasound device with a 3.5 MHz convex probe. A large tissue-like image without dynamic air bronchogram was apparent upon longitudinal scan of the left lung on the median axillary line (Figure 2A). At this point, alveolar recruitment was attempted under ultrasound guidance. The patient was ventilated with a 2-L adult manual resuscitation bag connected to a flow of 100% oxygen at 15 L/min and to a manometer. Pressure up to 65 cmH_2O was repeatedly applied for 5-10 seconds while progressive pulmonary reexpansion was indicated first by the appearance of vertical lines within the lung parenchyma, then by the appearance of pleural line hyperechogenicity associated with A-lines (Figures 2B, 2C). The entire procedure lasted about 10 minutes. The patient was then reconnected to the mechanical ventilator, and PEEP was increased to 12 cmH_2O. A few hours later, a new chest X-ray showed full recruitment of the left lung (Figure 1C). On the same day, the patient was successfully weaned from mechanical ventilation, and the tracheal tube was removed. On PODs 11-13, the patient underwent brief daily cycles of NIV lasting 1-2 hours and regularly performed incentive spirometry. She was moved from the S-ICU to the surgical ward on POD 12 and was discharged from the hospital 24 days later.

Discussion

There is overwhelming evidence showing that bedside lung ultrasounds are useful to diagnose many pathological lung conditions and to monitor their evolution.[8] Regarding pulmonary atelectases, ultrasounds support the diagnosis by showing the presence of a tissue-like image without dynamic air bronchograms, thus providing

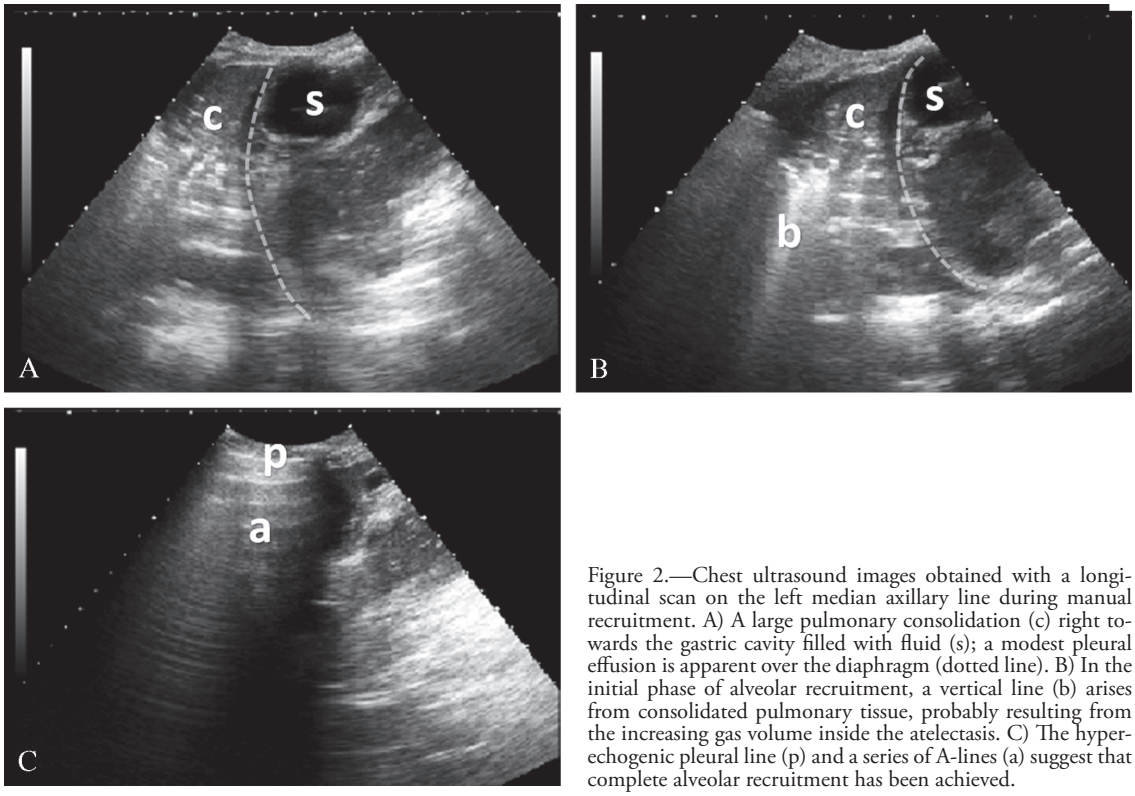

Figure 2.—Chest ultrasound images obtained with a longitudinal scan on the left median axillary line during manual recruitment. A) A large pulmonary consolidation (c) right towards the gastric cavity filled with fluid (s); a modest pleural effusion is apparent over the diaphragm (dotted line). B) In the initial phase of alveolar recruitment, a vertical line (b) arises from consolidated pulmonary tissue, probably resulting from the increasing gas volume inside the atelectasis. C) The hyperechogenic pleural line (p) and a series of A-lines (a) suggest that complete alveolar recruitment has been achieved.

crucials elements to discriminate among atelectases, consolidations, and pleural effusions.[9] This case report shows that ultrasounds can also be utilized for the management of pulmonary atelectases.

In our patient, we first employed lung ultrasounds to visualize the atelectasis and to evaluate the size of the pleural effusion, which yielded clinically negligible results. Then, we performed manual recruitment by choosing ventilatory pressures and the duration of forced inspirations on the basis of the changes induced on ultrasound images. The results of recruitment maneuvers are markedly dependent on the way in which they are carried out. Unfortunately, the effects are also dependent on patient characteristics, for instance on chest compliance, making it difficult to standardize recruitment maneuvers. Usually, the success of recruitment is evaluated a posteriori by computed tomography or by the improvement of pulmonary gas exchanges, respiratory mechanics, and intrapulmonary gas volumes.[10] However, such methods do not provide feedback during recruitment. Bedside ultrasounds may provide such feedback. Indeed, they have been recently utilized to test the effectiveness of recruitment maneuvers in a patient affected by ARDS.[11] In our patient, manual re-expansion of a localized atelectasis in the absence of ALI or ARDS offered an ideal field of application for bedside ultrasounds because a limited portion of the lung was affected, and the risk of de-recruitment was much lower than in patients affected by ARDS.[2]

Before US examination, we did not try any recruitment protocol in addition to mechanical ventilation because the basal hypoventilation was partly attributed to the presence of a lung effusion. US examination was carried out in order to evaluate the amount of such effusions, and the decision to perform manual recruitment was based on the absence of a significant effusion. During the recruitment, we applied a relatively high pressure (65 cmH_2O) in comparison with

those commonly employed.[7] However, ventilatory pressures to a peak greater than 60 mmHg have been safely utilized by other authors, [12] and pressures up to 100 cmH_2O may be occasionally reached by respiratory therapists when manually ventilating severely restricted lungs.[13] However, ultrasound guidance limited the duration of the exposure to high ventilatory pressure to the minimum necessary to achieve full alveolar recruitment.

Conclusions

In conclusion, this case report suggests that chest US may usefully guide manual reexpansion of pulmonary atelectases providing that bronchial patency is restored.

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