



Pneumothorax: An Aspect of Pulmonary Barotrauma during Mechanical Ventilation of Acute Respiratory Distress Syndrome

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ABSTRACT

Acute respiratory distress syndrome (ARDS) is characterized by bilateral pulmonary lesions and poor lung compliance. Its basic treatment is mechanical ventilation. However, this last can lead to serious complications, including pulmonary barotrauma. Barotrauma is favored both by the underlying pulmonary pathology and by the use of excessive pressures delivered by the ventilator. The incidence of barotrauma during ARDS no longer exceeds 10% since the advent of tidal volume reduction and plateau pressure limitation.

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Introduction

Mechanical ventilation is an essential therapeutic facet in the management of acute respiratory distress syndrome. However, it may be responsible for serious side effects, including pulmonary barotrauma [1]. This observation reports an aspect of barotrauma during mechanical ventilation.

Observation:

A Patient aged 53, with no medical history, was admitted in the intensive care unit for the management of an acute respiratory distress due to a hypoxemic pneumopathy. The patient was initially treated with ceftriaxone. The evolution was marked by the appearance on day 2 of an acute respiratory distress syndrome: the chest x-ray showed bilateral opacities, arterial blood gases revealed a PaO₂ / FiO₂ ratio equal to 110 mmHg while echocardiography was normal. After intubation, the patient was placed under mechanical ventilation in a controlled volume mode. In order to limit the risks of barotrauma and volotrauma, protective ventilation was performed. The tidal volume was adjusted to 6 ml / Kg and the positive expiratory pressure was 8.

On the 5th day of mechanical ventilation, a thoracic asymmetry was noted. Pleuropulmonary examination objectified an airy effusion syndrome on the right side. A chest x-ray was performed and revealed a right pneumothorax of average abundance. The effusion was drained but subsequently the patient developed a refractory septic shock and a multiple organ-failure syndrome leading eventually to his death on the 10th day of admission.

Discussion:

Barotrauma's pneumothorax is due to an overpressure in the alveoli generated by mechanical ventilation, leading to an overdistension of the airways and thus to a bronchial or alveolar rupture causing air leakage. [3]

From a pathophysiological point of view, the reduction of the ventilated lung volume during ARDS (baby lung) is responsible for a significant compliance decrease with

increased insufflation pressures during mechanical ventilation. This overpressure can lead to alveolar rupture with extra-alveolar air intrusion defining barotrauma [4].

The alveolar rupture will cause air to leak in the peribronchovascular spaces and to propagate along these axes. A distal rupture will rapidly go to the pleura and cause pneumothorax. However, air can travel along the sheaths and go up exclusively to the mediastinum (pneumomediastinum), pericardium (pneumopericardium), subcutaneous tissues, at first the cervical ones (subcutaneous emphysema) and then the subdiaphragmatic spaces (pneumoperitoneum). Finally, rare cases have been described where the air enters directly into the venous system, responsible for gas embolisms [5].

Barotrauma is only one aspect of mechanical ventilation aggression during ARDS; other more subtle lung lesions are described: atelectrauma, biotrauma and volotrauma lesions. These lasts are ARDS-related and due to alveolar overdistension by excessive tidal volume [1-2].

These concepts are at the origin of the current recommendations for the mechanical ventilation of ARDS [6,7]. The latter advise a reduction in volumes (tidal volume = 6 ml / Kg of theoretical weight) and pressures (plateau pressure <30 cmH₂O) to prevent side effects [3,4]. In this observation, compliance to ventilatory recommendations did not prevent barotrauma. According to the ARDS network data, a high PEEP is an independent risk factor for barotrauma [8].

Conclusion:

Barotrauma is an air leakage due to alveolar rupture resulting from an overpressure induced by mechanical ventilation. Pneumothorax is the most typical form of barotrauma and represents an immediate life threat [9].

The occurrence of a respiratory and / or hemodynamic instability in the course of evolution of a mechanically ventilated ARDS patient must lead to the suspicion of the occurrence of a barotrauma.

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This complication can occur even if protective rules are respected. The realization of a chest X-ray or a thoracic CT-scan makes it possible to assess the lung injuries accurately [1].

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