

Case Report
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Pneumoperitoneum Secondary to Pneumothorax Post-Intubation in a Patient with Difficult Airway

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ABSTRACT

The use of mechanical ventilation can be performed in situations where patients need ventilatory support to maintain adequate oxygenation. Its inappropriate use can cause some complications, among them: pneumothorax and pneumoperitoneum. Our report describes a 28-year-old man admitted to the ICU with a diagnosis of Covid-19 requiring mechanical ventilation with orotracheal intubation due to acute respiratory failure. During the patient's clinical evolution he presented bilateral pneumothorax with evolution and progression to secondary pneumoperitoneum, where we sought to understand the relationship between the two conditions.

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Introduction

Pneumothorax is characterized by the presence of free air within the thoracic cavity between the visceral and parietal pleurae. It can develop, in great part, due to congenital defects, pneumopathies and iatrogenic medical procedures. Among all the causes of hospital admissions, 0.2% correspond to pneumothorax¹. It is generally characterized by intense dyspnea, chest pain, tachycardia, deviation of the trachea contralateral to the affected lung, hyperpnea and abolished vesicular murmur on the affected side, jugular stasis, and hypotension [1].

Pneumoperitoneum is the retention of air within the abdominal cavity. The etiologies can be classified into surgical and non-surgical, the latter accounting for 10% of the cases in the literature [3]. This condition is caused by visceral perforation in 85% to 95% of all occurrences. The causes in the other 5% to 15% are diverse, being most often related to medical interventions [4]. Its association with pneumothorax is a rare complication when compared to the others, but it can have a fatal outcome [2].

In the current pandemic scenario, 14% of patients develop severe disease, which is characterized by hypoxia (saturation <94%), tachypnea (≥ 30 breaths/min) or respiratory failure, and impairment greater than 50% of the lung parenchyma on imaging exams [5,6]. Among these cases, 5% need intensive care, with an average stay of three to four weeks. Therefore, cases of pneumothorax

due to procedure iatrogenies have also increased in recent times [6,7]. In view of this, the article reports the possible causes of pneumoperitoneum secondary to pneumothorax in difficult intubations.

Case Report

A 28-year-old man was admitted to the ICU for acute respiratory failure due to COVID-19 infection (SARS-COV 19) with significant ventilatory distress. Patient was morbidly obese (BMI 56 kg/m²), with no other pathological or surgical history.

The patient was admitted to the ICU with a blood pressure of 90x40 mmHg, a heart rate of 122 bpm, and O₂ saturation of 88%. Initial tests showed a leukocytosis of 17,500 cells/mm³ and C-reactive protein of 228 mg/L. The test for COVID 19 was positive, and a CT scan of the chest was performed, which showed more than 50% involvement of the lungs bilaterally.

It was decided to proceed to orotracheal intubation for ventilatory management of the patient for acute respiratory failure, done after rapid sequence with etomidate and intravenous succinylcholine. The procedure was carried out by the intensivist physician, who described the procedure as difficult because it was classified as Mallampati IV.

After orotracheal intubation, mechanical ventilation was started in assisted-controlled mode (ACV) with tidal volume of 10 ml/kg of ideal weight, respiratory rate of 17 bpm with PEEP (positive end expiratory pressure) of 8 cmH₂O.

After clinical stabilization, 2 hours after the procedure, the patient presented a drop in oxymetry with altered hemodynamic parameters and presented extensive subcutaneous emphysema in the cervical region and anterior chest wall. Gasometry was performed at this moment, which showed pH: 7.53; PaCO₂: 28 mmHg; PaO₂: 221 mmHg; HCO₃⁻: 21 mmol and lactate: 11.5 mmol/L. Clinically diagnosed after physical examination with pneumothorax bilaterally and promptly performed water-sealed chest drainage bilaterally and later confirmed with chest radiography.

Soon after, physical examination revealed rapidly progressive abdominal distension, where a new CT scan of the abdomen and pelvis with intravenous contrast was performed, which showed extensive pneumoperitoneum, without apparent lesion of hollow viscera or signs of intestinal perforation (Figure 1).



Figure 1: CT scan of the abdomen with intravenous and oral contrast showing extensive pneumoperitoneum without signs of perforation of hollow viscera. Contrast is observed within the loops, with no signs of extravasation

Discussion

One of the main pathophysiological findings of COVID-19 infection is diffuse alveolar injury, a condition that results in an overall fragility of the lung parenchyma structure due to excessive inflammatory mediators and increased alveolar pressure. This generates a lower blood flow and consequently a lower nutritional intake, making the parenchyma more susceptible to rupture, causing a decrease in elasticity, weakening and tolerance of the alveolar walls [8].

The alveolar rupture resulting from the pathological process of infection causes air to extravasate from its compartments to adjacent structures, leading to subcutaneous, interstitial and mediastinal emphysema [8]. The patient with signs of respiratory failure presents in the forms of arterial hypoxemia and/or hypercapnia, the clinical pictures are similar, and O₂ pulse oximetry and gasometry are fundamental for the correct diagnosis. These patients have an increased probability of needing mechanical ventilation to maintain the necessary hemodynamic stability proportional to their clinical condition [9].

The patient under mechanical ventilation with moderate to high PEEP (positive end expiratory pressure) is exposed to a series of possible complications, which may have a simple resolution or even result in more severe repercussions, such as pneumothorax. The latter can occur due to exaggerated alveolar dilatation; air under pressure causes delamination of the perialveolar and peribronchial spaces, causing air to travel toward the mediastinum. This increased pressure in the mediastinum due to the air escaping from the alveoli perforates the parietal pleura, thus progressing to a pneumothorax [10]. Another possible mechanism for the development of pneumothorax may have been due to a tracheal

rupture, because in the case report, the patient was classified as Mallampati IV at the time of intubation, i.e., characterizing a difficult intubation and with increased risk for complications [11].

Pneumoperitoneum is formed due to the presence of air in the abdominal cavity, thus there are several mechanisms that can lead to this condition: (1) diaphragmatic malformations by the insertion of the aorta and inferior vena cava in it [12]; (2) use of a high insufflation pressure and moderate PEEP, which increase the mean pulmonary pressure, leading to a hypertensive pneumothorax with consequent pneumoperitoneum; (3) pressurized air entering the abdominal cavity through the mesentery, generating the Macklin effect; (4) low compliance and mechanical ventilation, increasing inspiratory pressure [1]. In the reported case, pneumoperitoneum was a possible consequence of pneumothorax [12,13].

Conclusion

In view of the facts mentioned and despite the few studies on the case, the diagnosis of nonsurgical pneumoperitoneum is facilitated when there is a temporal association between a causal procedure and the occurrence of pneumoperitoneum. Next, one of the most frequent causes of the occurrence of nonsurgical pneumoperitoneum in critically ill patients is due to mechanical ventilation. As a result, the use of mechanical ventilation should be performed with caution, maintaining lung preservation, avoiding pneumothorax that can induce pneumoperitoneum. Finally, according to the evidence, it is believed that in this case report, pneumoperitoneum secondary to pneumothorax was caused by the use of mechanical ventilation associated with decreased lung compliance, resulting from de novo Coronavirus disease.

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