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# Fatal Case of Tension Pneumothorax and Pneumoperitoneum Secondary to Mechanical Ventilation: A Radiological and Clinical Insight

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**Abstract:** ***A 74-year-old female presented to the emergency department with respiratory distress and cyanosis. Despite successful intubation, imaging revealed extensive barotrauma including tension pneumothorax, pneumoperitoneum, and pneumoretroperitoneum, following mechanical ventilation. The patient's family declined invasive interventions, and she expired shortly after. This case highlights the need for early detection and prompt management of ventilation-induced barotrauma, underlining the critical role of imaging in diagnosis and treatment planning.***

**Keywords:** Tension pneumothorax, pneumoperitoneum, mechanical ventilation, barotrauma, critical care radiology

## 1. Introduction

Endotracheal intubation and mechanical ventilation are the common aggressive procedures performed in emergency department, pre-operative anesthesia and intensive care unit [1]. Positive pressure ventilation can more likely cause lung injury in the underlying lung diseases and can induce barotrauma [1-4]. High pressure ventilation and overdistention of the lung lead to barotrauma, which in turn cause alveolar rupture, leading to interstitial alveolar emphysema, pneumothorax, pneumomediastinum, pneumoperitoneum, pneumoretroperitoneum and subcutaneous emphysema [1,5,6]. Barotrauma increases the patients' morbidity and mortality, with the mortality reaching up to 35% [7]. Its incidence is approximately 2.9% in mechanically ventilated patients [8]. This report aims to document a rare and fatal case of ventilation-induced tension pneumothorax and pneumoperitoneum, emphasizing the diagnostic utility of radiologic imaging and the critical need for early intervention."

## 2. Case Report

A 74-year-old female patient was sent to the emergency department by the ambulance with dyspnea, cyanosis and conscious disturbance. A history of brain tumor (B-cell lymphoma) status post operation and chemotherapy for 4 years was found. The laboratory data showed the findings of hypoxia (blood SpO2: 62%), normal white blood cell count but elevated band form (10300/μL; band form, 8.0 %), urinary tract infection (urine white blood cell count >100/high power; bacteria: 2 plus), and impaired renal function (blood creatinine, 4.49 mg/dL). Endotracheal intubation was immediately performed by the emergency doctor without difficulty.

Post-intubation chest radiograph showed the endotracheal tube in proper location in the trachea and pneumonia patches in both lower lungs [Figure 1]. Non-contrast-enhanced computed tomography (CT) of the brain, chest and abdomen performed one hour later revealed post-operative atrophy of the brain, minimal right pneumothorax, left tension pneumothorax, pneumoperitoneum, pneumomediastinum, pneumoretroperitoneum, and subcutaneous emphysema in the neck and bilateral thoracoabdominal regions and extending to the left thigh [Figure 2]. The electrocardiogram showed pulseless electrical activity. The family refused artificial life support including thoracostomy tube placement for the tension pneumothorax. The patient expired in a short time.

## 3. Discussion

It has been reported that 80% of patients developed pneumothorax within the first 3 days of mechanical ventilation [8]. Pneumothorax develops from pulmonary barotrauma in mechanically ventilated patients and is closely correlated with underlying diseases such as pneumonia, acute respiratory distress syndrome, chronic obstruction pulmonary disease, and emphysema [3]. Alveolar rupture allows free air to dissect centrally along the bronchovascular sheath to the mediastinum causing pneumomediastinum. From the mediastinum, it dissects along the fascial plane to the visceral spaces, extends upward around the trachea and esophagus of the neck causing subcutaneous emphysema, and downward into the retroperitoneal space through the esophageal hiatus of the diaphragm causing pneumoretroperitoneum (with air usually accumulating linearly along the margins of the kidneys and psoas muscles) [1,5,6]. The posterolateral area of the retroperitoneal space is anatomically continuous with the preperitoneal fat deep to the transversalis fascia, and from there, air dissects into the anterior abdominal wall [9].

Pneumoperitoneum may be surgically or non-surgically related [10]. Eighty-five to ninety-five percent of pneumoperitoneum is due to hollow organ perforation. Non-surgical pneumoperitoneum constitutes the remaining 5-15% [6, 10], and is related to thoracic, abdominal, gynecologic, postoperative, or idiopathic causes [6, 11]. Mechanical ventilation, cardiopulmonary resuscitation and pneumothorax are the thoracic causes of non-surgical pneumoperitoneum [10], with the mechanical ventilation being the most common cause [7]. Pneumoperitoneum

occurred in up to 7% of patients receiving mechanical ventilation [11]. Most cases of non-surgical tension pneumoperitoneum are secondary to barotrauma in patients receiving mechanical ventilation for conditions such as pneumonia, respiratory distress or bronchial asthma [7].

Pneumothorax-associated pneumoperitoneum is rare [10, 12] and can be proposed by two mechanisms: the first is a direct pleuro-diaphragmatic defect, and the second is mediastinal perivascular connective tissues or diaphragmatic openings into the retroperitoneum and peritoneum [10].

If there is high clinical suspicion for tension pneumothorax, intervention should not be delayed [3]. Respiratory and hemodynamic signs of tension pneumothorax should be considered a medical emergency and addressed immediately, as this requires urgent needle decompression followed by chest tube thoracostomy. Small-bore chest tube is recommended as the first line management of pneumothorax [3].

A simple pneumoperitoneum with no clinical influence can be treated conservatively using a wait-to-see strategy [7]. However, non-surgical tension pneumoperitoneum needs emergency percutaneous decompression in order to relieve the cardiopulmonary compromise secondary to the increase in the intraabdominal pressure [6].

CT is the gold standard for evaluating pneumothorax, as well as the other abnormal air in the body as mentioned in the previous paragraphs [3]. Tension pneumothorax and tension pneumoperitoneum require immediate management to relieve intrathoracic and intraabdominal pressure in order to restore the cardiopulmonary function of the patients.

This case contributes to the limited pool of documented incidents linking simultaneous pneumothorax and pneumoperitoneum to mechanical ventilation, underscoring the importance of prompt recognition and radiologic assessment in preventing fatal outcomes.

In conclusion, mechanical ventilation can lead to life-threatening complications such as tension pneumothorax and pneumoperitoneum. Early recognition through imaging and timely clinical intervention are paramount. This case reinforces the necessity of vigilance in managing ventilated patients, particularly those with pre-existing pulmonary compromise

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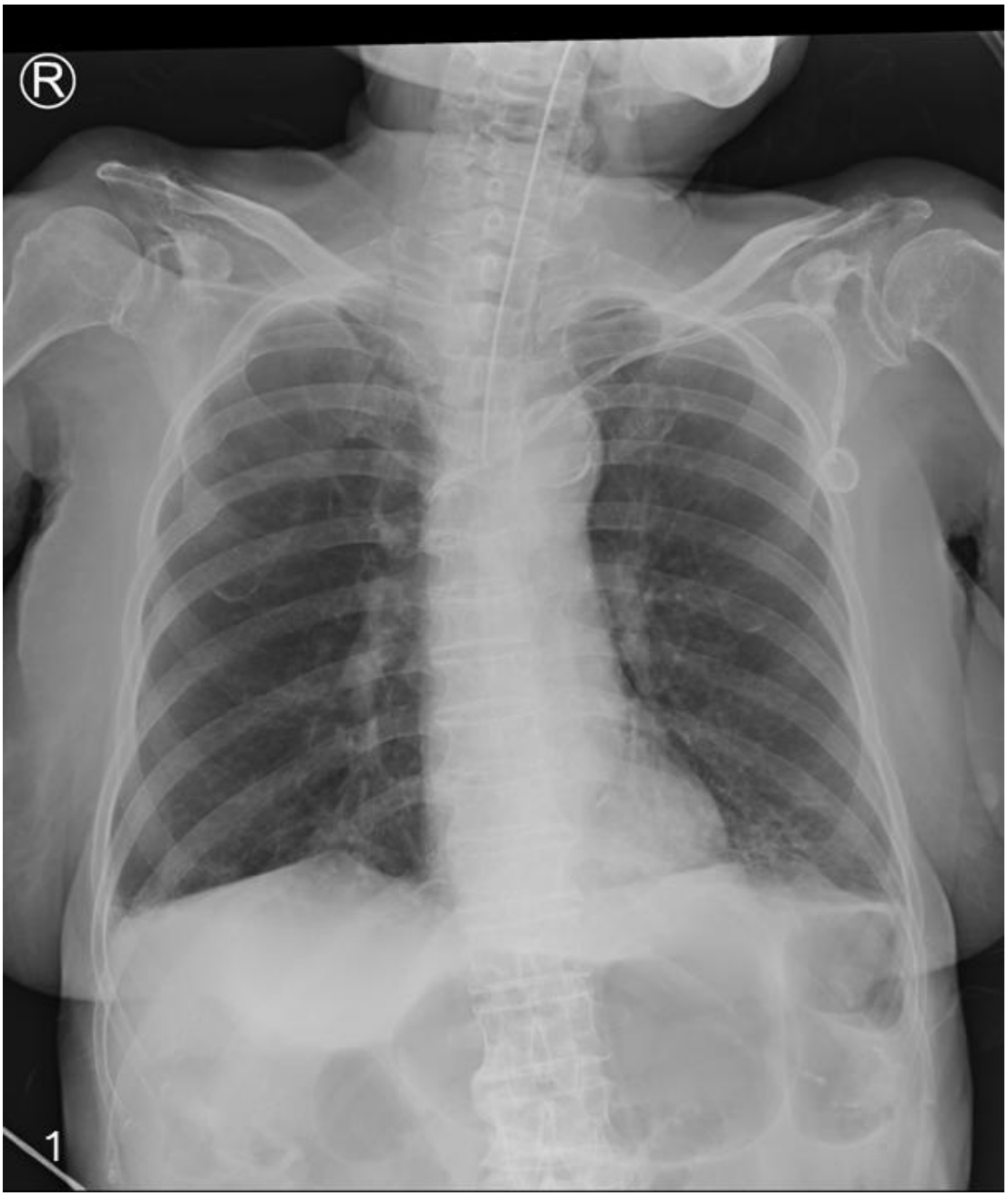


**Figure 1**: Chest anteroposterior radiograph shows the endotracheal tube in proper location in the trachea, pneumonia patches in both lower lungs, and the previously inserted Port-A catheter with the tip at the location of the left brachiocephalic vein.

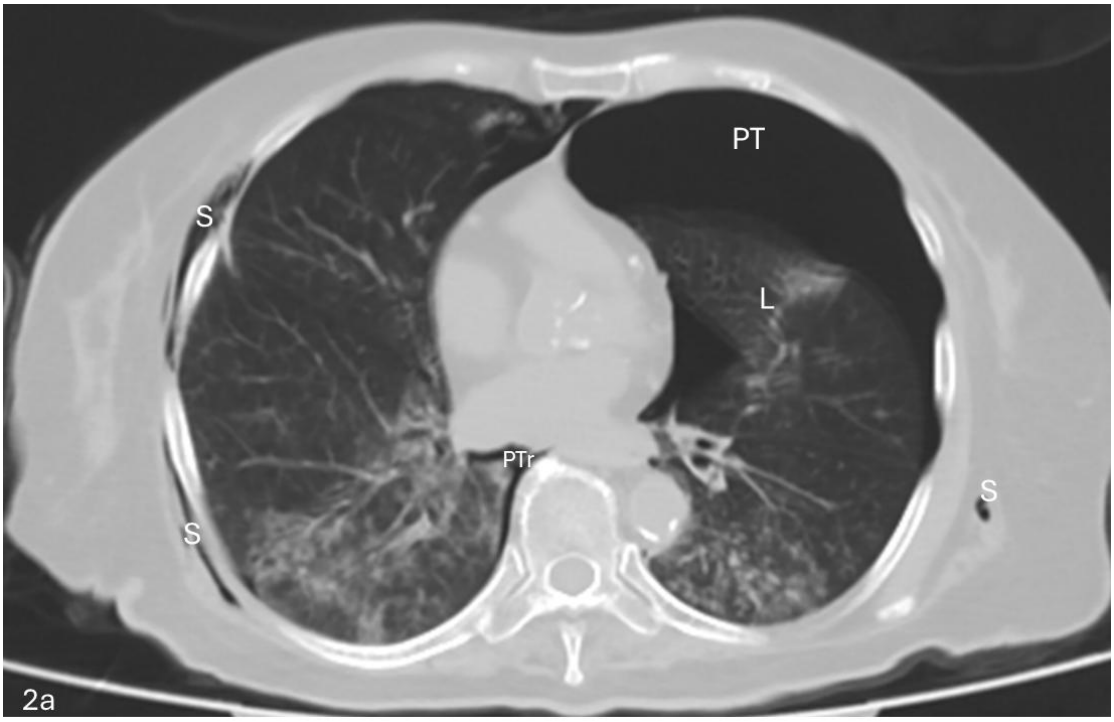


**Figure 2a**

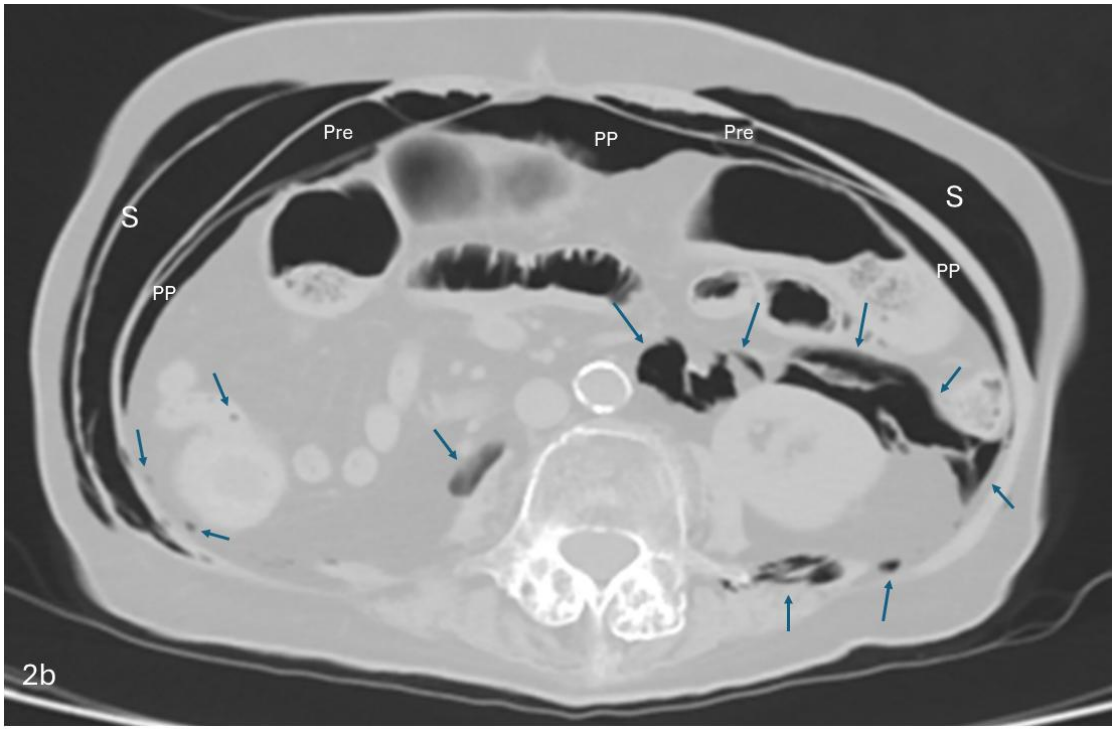


**Figure 2b**

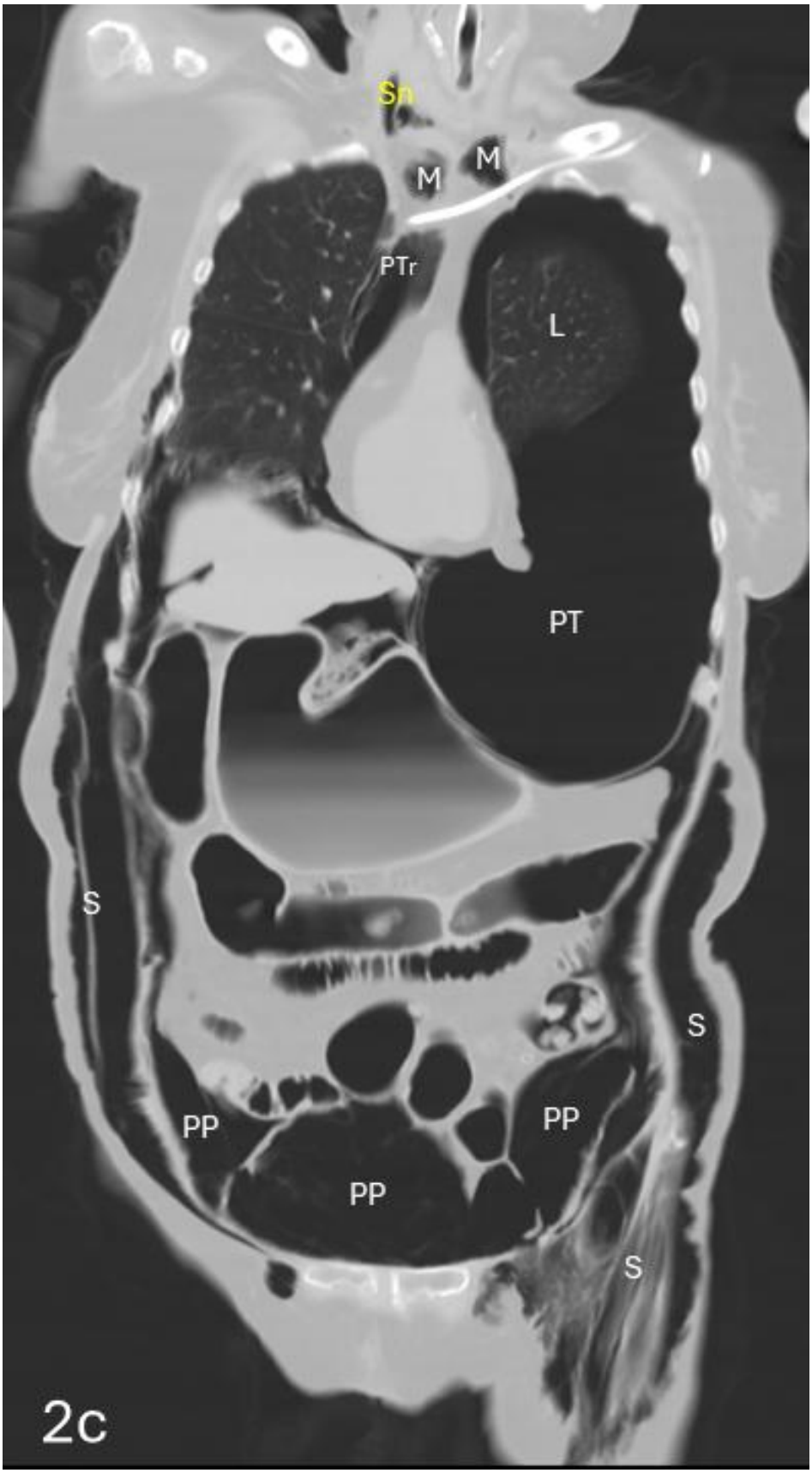


**Figure 2c**

**Figure 2** Non-contrast-enhanced CT with axial images at the thoracic **(a)** and abdominal **(b)** levels, and the reformatted coronal image at the left brachiocephalic vein level **(c)** demonstrate minimal right pneumothorax (PTr), left tension pneumothorax (PT) causing partial atelectasis of left lung (L), subcutaneous emphysema (S) in bilateral thoracoabdominal walls, with extending to the left thigh, subcutaneous emphysema in the neck (Sn), pneumomediastinum (M), pneumoperitoneum (PP), air in the preperitoneal space (Pre), and pneumoretroperitoneum **(arrows in 2b)**. Pneumonia patches are seen in both lower lobes **(2a)**. The Port-A catheter is in the left brachiocephalic vein **(2c)**.