*COVID*

MDPI

*Case Report*

# Survival by Mediastinal Chest Drain Due to Pneumomediastinum Resulting from COVID-19

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**Abstract:** Pneumomediastinum, pneumothorax, and subcutaneous emphysema may occur as rare complications of COVID-19. They are associated with worsened prognosis and survival from SARS-CoV-2 pneumonia. The treatment of pneumomediastinum involves supportive care and management of underlying diseases. Our case presents a female patient suffering from COVID-19 pneumonia with life-threatening mediastinal emphysema. According to guidelines, literature, and other clinical sources, no further therapy options were recommended, and survival was improbable. During an interdisciplinary case discussion, we decided to establish a mediastinal drain and tracheal cannula. This achieved a significant reduction of emphysema as well as an improvement in the patient's clinical condition and long-term survival. This case demonstrates a rarely used invasive therapy for pneumomediastinum. Furthermore, it demonstrates the importance of cooperation with other centers, interdisciplinary teamwork, and of presenting case reviews—especially when guidelines are unavailable.

**Keywords:** COVID-19; pneumomediastinum; mediastinal emphysema; mediastinal drain

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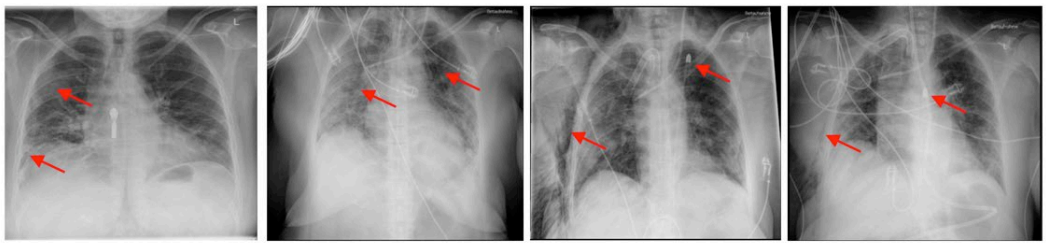
## 1. Introduction

The pathogen SARS-CoV-2, which first appeared in 2019, leads to varying manifestations and severities of disease. When viral pneumonia arises, with resulting acute respiratory distress syndrome, intensive medical therapy with long-term ventilation is often necessary. In rare cases, complications such as pneumothorax, subcutaneous emphysema, or severe mediastinal emphysema (also called pneumomediastinum) occur [1–3]. The pathogenesis of pneumomediastinum is most likely associated with alveolar rupture due to diffuse alveolar damage by viral influence and barotrauma due to mechanical ventilation [2]. It can be detected by computed tomography. These patterns of disease are associated with poor prognosis [4,5]. There are no published guidelines to follow once pneumomediastinum is diagnosed. In previous cases, they have been treated conservatively [2,3]. Interdisciplinary discussion and decision-making are important to find a strategy for treatment.

## 2. Case Description

A 58-year-old female patient was admitted to hospital by emergency services following the deterioration of her general condition with dyspnea and positive SARS-CoV-2 testing for one week. The patient's medical history included depression, hypertension, and obesity. The patient was on venlafaxine and candesartan. She had not been vaccinated against SARS-CoV-2. On admission her peripheral oxygen saturation was 96% on room

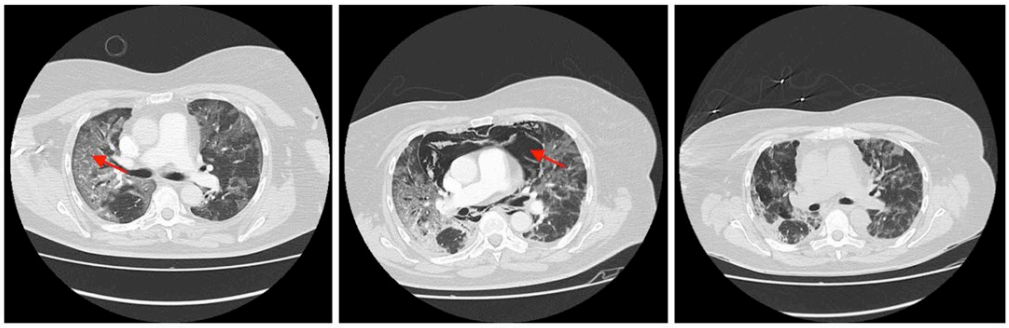
air, vital signs were unremarkable and she was afebrile. On admission chest X-ray showed bilateral peripheral consolidation and pleural effusion (Figure 1).



**Day 1** Chest X-ray with bilateral peripheral consolidation and pleural effusion
**Day 8** Chest X-ray with new onset pneumomediastinum after intubation
**Day 9** Chest X-ray after tracheotomy and mediastinal drain
**Day 12** Chest X-ray after retraction of the mediastinal drain

**Figure 1.** Chest X-Ray images showing the patient before, during, and after mediastinal chest drain.

During the following days, no invasive ventilation was necessary despite her condition deteriorating to dyspnea at rest and later tachypnoea with oxygen provided via a venturi mask. Dexamethasone has been started according to guidelines. Computed tomography subsequently revealed extensive bilateral areas of ground-glass opacities with peripheral and subpleural distribution, consistent with SARS-CoV-2 pneumonia (Figure 2).



**Day 3** Chest computed tomography with atypical milky glass-like infiltrates
**Day 8** Chest computed tomography with new onset of massive mediastinal emphysema
**Day 16** Chest computed tomography after removing mediastinal drain and tracheal cannula

**Figure 2.** Computed tomography images showing the patient's lung before, during, and after pneumomediastinum.

On day 8, the patient's condition acutely deteriorated. She became significantly hypoxemic and peripheral oxygen saturation was 70% on 15 L of oxygen via a mask. She showed massive respiratory distress, trying to compensate with hyperventilation. Tachycardia and hypertension expressed the critical hemodynamic situation.

Due to elevated D-dimers, computed tomography was performed to rule out pulmonary embolism. The scan showed a new onset of massive mediastinal emphysema (exclusion of pulmonary artery embolism and pneumothorax) in addition to the known opacities (Figure 2).

The patient was transferred to intensive care and endotracheal intubated. Ventilation was performed with a fraction of inspired oxygen ($FiO_2$) of initially 100%, with subsequent reduction to 70%. After intubation respiratory acidosis (pH 7.25, $pCO_2$ 58 mmHg) was present due to restrained ventilation (inspiratory pressure (Pinsp) 25 mbar, positive end-expiratory pressure (PEEP) 8 mbar). Therefore, an adjustment to Pinsp 30 mbar/ PEEP 12 mbar was conducted. Prone positioning was performed. The pneumomediastinum remained unchanged in chest X-ray (Figure 1). Antibiotic treatment was started with tazobactam, clarithromycin, and metronidazole.

Due to increasing deterioration and existing life-threatening conditions, a multidisciplinary case discussion was performed. The interdisciplinary decision was made to place a mediastinal drain and dilation tracheotomy on day 9. A chest tube (16 French) was inserted in the upper mediastinum. Due to the fact of the tracheal cannula, a subxiphoid approach was chosen. In radiological imaging, the drain was shown positioned at the apex of the left lung. The drain was retracted 10 cm in order to be positioned within the upper mediastinum on day 12.

Radiologically higher-grade mediastinal emphysema could no longer be demonstrated and the subcutaneous emphysema had also clearly regressed (Figures 1 and 2). Ventilation pressures could be steadily reduced and increasingly prolonged continuous positive airway pressure (CPAP) phases were performed. In the following days, ventilation was no longer necessary. On day 16, the mediastinal drain and the tracheal cannula were removed. The patient was transferred to a peripheral ward on day 18 and could be discharged home on day 28 with low flow oxygen via nasal cannula.

Three months later she remained alive, not needing oxygen at all.

## 3. Discussion

SARS-CoV-2 leads to varying manifestations and severities of disease. When viral pneumonia arises, with resulting acute respiratory distress syndrome, intensive medical therapy with long-term ventilation is often necessary. Complications such as pneumothorax, subcutaneous emphysema, or severe mediastinal emphysema (also called pneumomediastinum) can occur [1–3]. They are associated with poor prognosis [4,5].

Pneumomediastinum has various etiologies. It can occur spontaneously, secondary to respiratory diseases such as asthma, or in the context of barotrauma, for example during long-term ventilation. The pathophysiology involves the rupture of alveoli with air leakage along the bronchial system into the mediastinum, also known as the Macklin effect [6]. The body often reabsorbs the pathological air accumulation, so that supportive care with analgesia and treatment of the primary disease is sufficient [2,3].

In rare cases, emphysema becomes hemodynamically relevant. Comparable to tension pneumothorax, the valve mechanism results in a tension component with constriction of the mediastinum and reduction of venous return with subsequent cardiovascular collapse. In such cases, placement of a mediastinal drain, Video Assisted Thoracoscopic Surgery, or thoracotomy offer possible therapeutic opportunities, but there are no published guidelines to follow [7].

Pneumomediastinum may occur as a complication in the setting of SARS-CoV-2 disease. It can appear in isolation or in association with pneumothorax and subcutaneous emphysema. Most likely, diffuse alveolar damage from the virus leads to an increased likelihood of alveolar rupture. It has been demonstrated that the incidence of mediastinal emphysema increased within the years 2019 to 2022 during the COVID-19 pandemic [8].

There has been a range of case reports with these disease patterns associated with the virus since the Corona pandemic [2,3]. Therapy has mostly been based on conservative approaches, including existing treatment concepts for viral pneumonia, such as the administration of cortisone or antibodies and invasive ventilation. The setting of lower ventilation pressures to reduce the pressure gradient at the alveoli and the associated permissive hypercapnia has been widely discussed. Pneumothorax can be relieved with a pleural chest drain if necessary [9–11].

In this case, no conservative approach was possible. The patient developed increasing respiratory insufficiency and hemodynamic deterioration. Both lower and higher ventilatory pressures or prone positions did not lead to improvement. According to other clinical centers and the literature, there were no options at this stage of SARS-CoV-2 pneumonia for further treatment. After the placement of the drain, a remarkable reduction in emphysema was demonstrated by radiological imaging. Within a few days, the patient could be weaned off ventilation.

It should be acknowledged that the placement of the mediastinal drain and the tracheal cannulation were performed almost simultaneously. Accordingly, the influence of tracheotomy on the marked improvement of emphysema cannot be excluded. The literature offers no relevant data in this regard.

Only one other case report has been published showing invasive therapy for pneumomediastinum due to COVID-19. In that case, subcutaneous and mediastinal emphysema led to increasing airway obstruction in a 48-year-old male patient. Both subxiphoid and suprasternal mediastinal drainage were placed, and pericardial fenestration was also performed. The patient's condition improved promptly as well [12].

All in all, our case report presents an opportunity for treatment if pneumomediastinum resulting from COVID-19 threatens a patient's hemodynamic stability.

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