



### *Case Report*

## **PNEUMOMEDIASTINUM AS A COMPLICATION OF COVID-19 PNEUMONIA: CASE SERIES**

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### **ABSTRACT**

**Background:** Pneumomediastinum (PM) is a rare pathological entity that is divided into two categories: secondary - with a known etiological factor, and spontaneous - with no clear etiology. This publication aims to highlight the two categories of PM as a complication of COVID-19 pneumonia.

**Case series:** Six patients with PM as a complication of COVID-19 pneumonia were included in this study. Conventional chest X-rays and chest computed tomography were used to determine PM. In two of our patients, PM was a late consequence of COVID-19 pneumonia. In two others, PM was established during conservative treatment of COVID-19 pneumonia. And for the last two cases, PM was diagnosed after tracheal intubation and mechanical ventilation while treating acute respiratory distress syndrome (ARDS). Concomitant spontaneous pneumothorax was found in four of our patients, leading to the invasive management of PM – drainage of the mediastinum by chest tube insertion. Conservative treatment of PM was the method of choice for the other two cases. Death was established in four cases – a rate of 75 %.

**Conclusion:** With this case series, we highlight PM in its two forms - primary and secondary, as a serious complication of COVID-19 pneumonia. Our study highlights the importance of being aware of PM in COVID-19 pneumonia, even in patients managed without mechanical ventilation.

**Key words:** mediastinum, subcutaneous emphysema, pneumothorax.

### **INTRODUCTION**

Pneumomediastinum (PM) is divided into two categories: secondary - with a known etiological factor, and spontaneous - with no clear etiology (1, 2). At the beginning of the COVID-19 pandemic, some publications demonstrated PM as a complication of COVID-19 pneumonia. In our practice, we have also established this. The aim of this paper is to highlight the two categories of PM in patients with COVID-19 pneumonia.

### **Case series**

We present six patients with COVID-19 pneumonia and pneumomediastinum

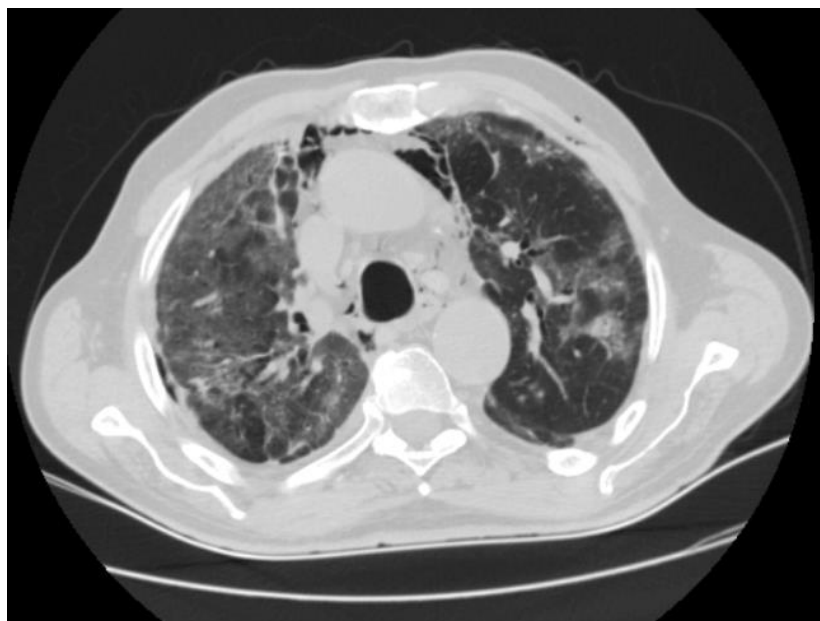
hospitalized in our tertiary thoracic surgery department. Four of these patients had a medical history of co-morbidities. COVID-19 infection was confirmed by PCR test. Conventional chest X-ray and/or computed tomography (CT) diagnosed the pneumonia and PM.

In two of our patients - case #1 (a 72-year-old man with arterial hypertension) and case #2 (a 75-year-old man with lung emphysema, arterial hypertension, and post-myocardial infarction), PM was expressed as a late consequence of COVID-19 pneumonia - on the 47th and the 28th day respectively after diagnosis of COVID-19 infection. These patients were admitted with clinical symptoms of dry cough, shortness of breath, chest pain, and subcutaneous neck emphysema. Thoracic CT established the state of

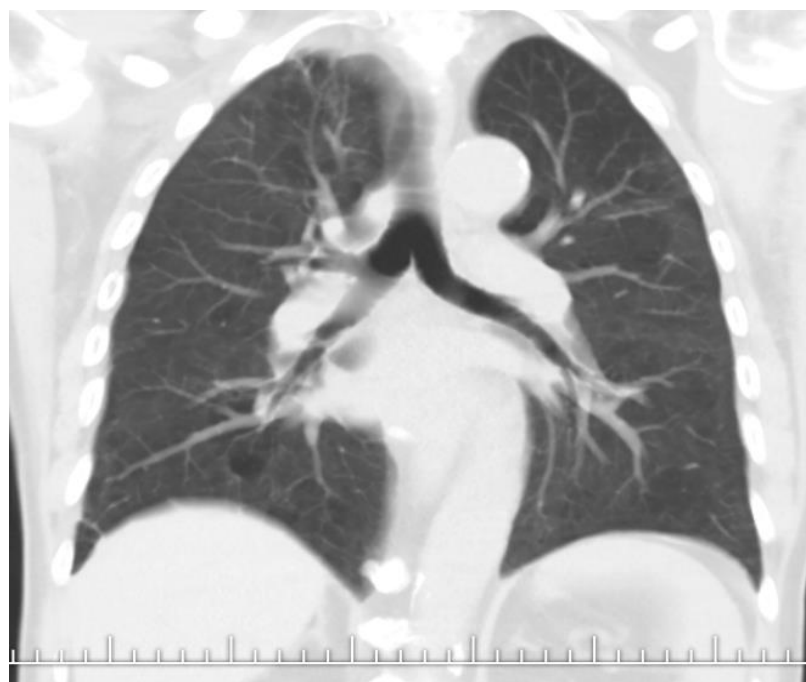
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PM in both patients (**Figure 1**). Conservative treatment was initiated.

After 10 days of treatment, the 75-year-old man was discharged in good condition with a significant reduction of PM (**Figure 2**).



**Figure 1.** Chest CT on the 47th day of COVID-19 infection (case #1): bilateral pneumonitis with reticular and patchy ground-glass opacities, PM, and discrete subcutaneous emphysema.



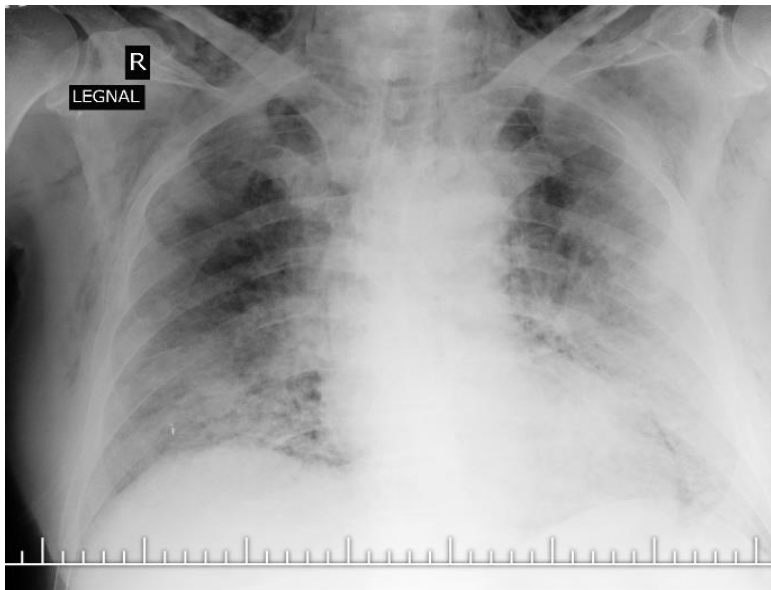
**Figure 2.** Chest CT (case #1): on the 10<sup>th</sup> day of hospital admission: a significant resolution of mediastinal emphysema.

However, for the 72-year-old man, on the second day of hospitalization, he presented with severe

dyspnea and progression of subcutaneous emphysema to the chest, neck, face, and arms. A

follow-up chest X-ray determined the PM had progressed with right-sided apical pneumothorax. A chest tube drain was inserted (**Figure 3**). The patient's respiratory status continued to worsen

over the day and he was transferred to the ICU. Unfortunately, the patient died from hypoxemic respiratory failure two days after chest drain insertion.



**Figure 3.** Chest X-ray (case #2) – on the 2<sup>nd</sup> day of admission: progression of PM with concomitant apical right-sided pneumothorax.

In the next two patients - case #3 (a 78-year-old woman with ischemic heart disease) and case #4 (a 55-year-old man), PM was diagnosed after initiation of tracheal intubation because of acute respiratory distress syndrome (ARDS): for the

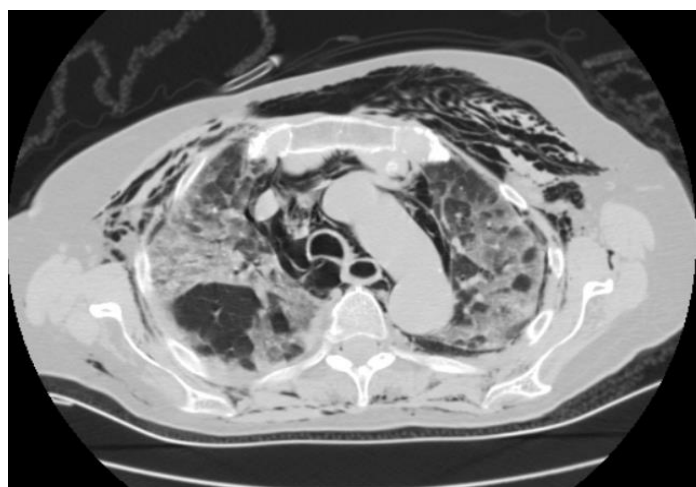
woman - on the 2<sup>nd</sup> day of intubation and on the 1<sup>st</sup> day of intubation respectively for the man. There was no evidence of tracheal injury in either patient. Subcutaneous neck emphysema and PM were confirmed on chest X-ray (**Figure 4**).



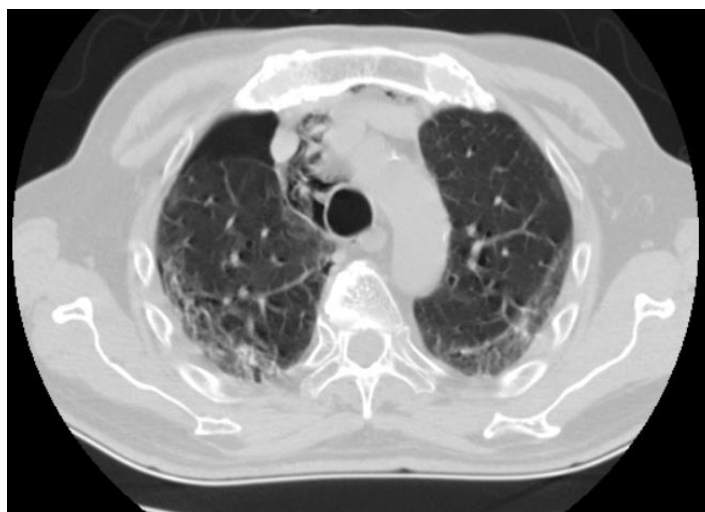
**Figure 4.** Chest X-ray (case #3) - on the 2<sup>nd</sup> day of intubation: pneumomediastinum with right-sided shifting of the mediastinum and apical left-sided pneumothorax.

The woman's respiratory status progressively worsened and she died of multiple organ dysfunction syndrome on the 4th day of intubation. As for the 55-year-old man, a day after establishing PM, a follow-up chest X-ray demonstrated an increase of free air in the mediastinum with shifting of the mediastinal structures to the right hemithorax with apical left-sided pneumothorax. A left-sided chest tube drain was inserted. The man's respiratory function improved, his chest drain was removed 6 days later, and the endotracheal tube was removed after 10 days, followed by cycles of non-invasive ventilation for a further 5 days. The patient was discharged after 21 days of hospitalization with a significant resolution of PM.

And in the final two patients - case #5 (a 79-year-old woman with arterial hypertension) and case #6 (a 58-year-old man), PM was expressed during conservative treatment of COVID-19 pneumonia. These patients became acutely hypoxic, and physical examination revealed well-presenting subcutaneous chest and neck emphysema. The PM was determined by chest CT on the 7th day of COVID-19 diagnosis for case #5 and on the 7th day respectively for case #6. Furthermore, concomitant pneumothorax was found in both patients: left-sided for the woman and right-sided with an opposite shifting of the mediastinal structures for the man (**Figure 5 and Figure 6**).



**Figure 5.** Chest CT (case #5): bilateral patchy ground-glass opacities in the lungs, PM, left-sided pneumothorax, and significant expressed subcutaneous emphysema..



**Figure 6.** Chest CT (case #6): – bilateral pneumonitis, pneumomediastinum, right-sided pneumothorax, and subcutaneous emphysema..

Both patients had a chest tube drain inserted and were transferred to the ICU. Unfortunately, both patients died of hypoxemic respiratory failure - the man on the 2nd day after chest drain insertion and the woman on the 3rd day.

Written informed consent was obtained from the patients at admission for their anonymized information to be published.

## DISCUSSION

PM is noted as a complication of COVID-19 pneumonia (2 – 9). In our thoracic surgery practice, we experienced an increased incidence of PM in patients with COVID-19 pneumonitis. Therefore, we decided to highlight the importance of PM with its two types - secondary and spontaneous, in COVID-19 pneumonia.

In four of the presented six cases, PM was considered spontaneous. These were patients without tracheal intubation and mechanical ventilation. We accepted a destructive viral effect on the alveoli as the main predisposing factor for PM in these cases. Additionally, impeded healing caused by steroids used in the treatment of patients with COVID-19 infection was another predisposing factor. Moreover, arterial hypertension, documented in three of these four patients is already reported as a co-morbidity contributing to spontaneous PM in COVID-19 pneumonia (3, 5, 6). Lung emphysema, which was established in one of our patients, is also noted to be a predisposing factor for spontaneous PM. As a trigger for this type of PM, we considered the cough experienced by all patients. We hypothesized that COVID-19 pneumonitis leads to alveolar rupture with interstitial emphysema, and from here, the air dissects along the bronchial and vascular structures into the mediastinum.

For our other 2 cases, PM was considered "secondary". These were patients in a state of ARDS. For that reason, mechanical ventilation with positive airway pressure support was used. The positive end-expiratory pressure causes alveolar rupture by dissecting the air into the mediastinum (11, 12). Therefore, barotrauma can be accepted as the etiological factor in this form of PM.

Spreading of the air from the mediastinum into the subcutaneous space, established in all our cases, serves as a form of mediastinal decompression to avoid two life-threatening conditions – pneumothorax and cardiac tamponade (6, 10). The most expressed subcutaneous emphysema was observed in two patients with tension PM. Tension PM is a state when a large amount of air in the mediastinum leads to shifting of the mediastinal structures and respiratory worsening of the patient (14).

Furthermore, we established concomitant spontaneous pneumothorax - in four of our patients. We concluded this pneumothorax to be "secondary" as a result of alveolar rupture due to viral-induced pneumonitis and/or positive pressure ventilation (13-15).

The COVID-19 pandemic has overturned the attitude that most cases of PM are self-limiting (2, 4, 5). We observed an extremely high death rate (75%), demonstrating how fatal this entity in COVID-19 pneumonia patients is.

A conservative or invasive approach is used to manage PM in COVID-19 patients. When there is no progression of mediastinal emphysema - a conservative approach is used. However, in the majority of reported cases of PM in COVID-19 pneumonia, invasive management is required - aiming to provide decompression of the mediastinum (9-11, 13). In our cases, the concomitant unilateral pneumothorax was the condition that determined invasive management – chest tube drainage. What is more, some authors recommend bilateral chest drainage in every case of COVID-19 pneumonia, complicated with PM. They advocate this aggressive approach to prevent concomitant pneumothorax (14, 15).

As a limitation of our study, we can point out the retrospective design and relatively small number of cases included. Despite these limitations, we demonstrate the significance of PM in COVID-19 pneumonia.

## CONCLUSION

We highlight pneumomediastinum in its two forms - primary and secondary, to be a serious complication of COVID-19 pneumonia, that may

also be seen in the post-COVID-19 period. Our study emphasizes the need to be aware of pneumomediastinum in COVID-19 pneumonia, even in patients with no mechanical ventilation.

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**Conflict of interest.** The authors declare no financial and not-financial conflict of interest.

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NOVAKOV IV., et al.

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