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Case Report

# Spontaneous pneumomediastinum, pneumopericardium, pneumothorax, and subcutaneous emphysema in a patient with COVID-19

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ABSTRACT

In this paper, we describe a case of COVID-19 pneumonia complicated by alveolar air leakage syndrome without prior positive pressure ventilation. Our patient was a 55-year-old non-smoker male with a previous history of marginal B-cell lymphoma diagnosed ten years ago who presented to the emergency department with cough, dyspnea, and respiratory distress. The COVID-19 diagnosis was confirmed based on a polymerase chain reaction (PCR) test for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The unenhanced chest computed tomography (CT) obtained on the first day of admission demonstrated bilateral multifocal ground-glass opacities and consolidation, extensive pneumomediastinum, bilateral pneumothorax, a rim of pneumopericardium, and right-sided subcutaneous emphysema. Despite the initiation of supportive care, antiviral and antibiotic therapy, he passed away due to septic shock. In conclusion, spontaneous alveolar air leakage, characterized by spontaneous pneumomediastinum, pneumopericardium, pneumothorax, and subcutaneous emphysema, is a rare complication of COVID-19, which may be linked with a severe course of the disease.



## Introduction

In December 2019, several cases of viral pneumonia were reported from Wuhan city in China, and further investigations indicated that they were caused by a novel coronavirus, severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) [1]. This disease was officially named Coronavirus Disease 2019 (COVID-19) by World Health Organization (WHO) on February 12, 2020 [1]. The primary symptoms of the disease include fever, dry cough, and myalgia, but some patients may develop pneumonia with dyspnea and hypoxemia and rapidly develop acute respiratory distress syndrome (ARDS), respiratory failure, consequently multiple organ failure and eventually death [2]. By February 19, 2021, SARS-

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CoV-2 has infected more than 110 million cases and claimed more than 2 million lives [3]. This disease is associated with higher mortality rates in patients with comorbidities, for example, malignancies or immunocompromised patients [4,5].

Since pneumonia is the most common manifestation of COVID-19, chest computed tomography (CT) has been widely utilized for diagnosis, severity assessment, and monitoring the disease progression [6]. The most common chest CT features of COVID-19 include peripheral ground-glass opacities with or without reticular opacities and consolidations [7]. On the other hand, as the COVID-19 outspread globally, numerous unusual complications in infected patients have been reported [8,9]. Regarding this, alveolar air leak, characterized by the travel of air into the mediastinum or pleural space via bronchovascular sheaths following ruptured alveoli, has been described in hospitalized COVID-19 patients mostly after invasive ventilation [10].

Herein, we present a case of COVID-19 pneumonia, with a past medical history of lymphoma, complicated by spontaneous pneumomediastinum, pneumopericardium, pneumothorax, and subcutaneous chest wall emphysema without prior positive pressure ventilation.

## Case presentation

A 55-year-old nonsmoker mildly overweight (body mass index [BMI] of 26.54 kg/m$^2$) male with a previous history of marginal B-cell lymphoma diagnosed ten years ago presented to the emergency department with 15 days of severe dry cough, myalgia, and progressive nonexertional shortness of breath. At presentation, he was ill-appearing and suffering from respiratory distress with oxygen saturation of 74% in ambient air, which was improved to 88% on a nonbreather mask at 12 L/min. His respiratory rate was 32 breaths/min, pulse rate was 110 beats/min, temperature 38.1°C, and blood pressure 110/80 mmHg. On examination, course bilateral respiratory sounds alongside chest wall crepitation was detected. Initial laboratory tests were remarkable for the following: leukocyte count 64.027 $\times$ 10$^9$/L (predominantly lymphocytes), hemoglobin 10.7 g/dL, platelets 35 $\times$ 10$^9$/L, C-reactive protein 71 mg/L, and lactate dehydrogenase (LDH) 1075 U/L. He tested positive for COVID-19 via reverse transcription-polymerase chain reaction (PCR) test for SARS-CoV-2 from a nasopharyngeal swab. The initial chest X-ray revealed bilateral air space consolidation opacities and pneumomediastinum (Fig. 1). The unenhanced chest CT obtained on the first day of admission demonstrated bilateral multifocal ground-glass opacities and consolidation, extensive pneumomediastinum, bilateral pneumothorax, a rim of pneumopericardium, and right-sided subcutaneous emphysema extending from mid-chest up to cervical region (Fig. 2). He was initiated on broad-spectrum antibiotics (meropenem and vancomycin), remdesivir (200 mg loading dose on the first day followed by 100 mg daily), intravenous methylprednisolone (125 mg every 12h), and intermittent noninvasive ventilation with continuous positive airway pressure (positive end-expiratory pressure (PEEP) 6-10 cm$H_2O$). Despite these therapeutic measures, his clinical course was deteriorated by septic shock, and passed away on the eighth day of admission.

## Discussion

Air leak syndrome, including pneumomediastinum, pneumopericardium, pneumothorax, or subcutaneous emphysema, has considerable prevalence; and is primarily caused by chest trauma, cardiothoracic surgery, esophageal perforation, and mechanical ventilation [11,12]. However, spontaneous alveolar air leakage is a rare phenomenon especially following viral pneumonia. Although an incidence of 11.6% previously had been reported concerning the severe acute respiratory syndrome (SARS) outbreak [13], a much lower incidence (0.72%) has been reported in patients with COVID-19 [9].

This condition is hypothesized to be a result of diffuse alveolar damage with an increased intra-alveolar pressure [13,14]. This pathophysiological process is known as the Macklin effect [15]. The air leaks through the damaged alveoli into the pulmonary interstitium leading to pneumomediastinum. This air may travel into the pleural or pericardial space due to the pressure accumulation in the mediastinum resulting in pneumothorax and pneumopericardium, respectively [12]. Moreover, the air may occasionally escape via the thoracic inlet and cause subcutaneous emphysema. Emerging postmortem investigations of COVID-19 have identified diffuse alveolar damage as the predominant pattern of pulmonary injury in COVID-19 pneumonia and ARDS [16]. Although we could not perform an autopsy on our patient, the same pathophysiological mechanisms could be assumed considering the severe clinical presentation of the disease. As a middle-aged man with prior history of hematologic malignancy, our patient was susceptible to severe COVID-19; and the alveolar air leakage may be a reflection of extensive alveolar damage and poor prognosis.

Alongside diffuse alveolar damage, several factors can contribute to the development of the air leak syndrome in patients with COVID-19. Forceful coughing with sudden alveolar over-distension can increase intra-alveolar pressure and rupture the alveoli [9,12]. Our patient had a substantial cough during the past two weeks before the presentation to the emergency department. It can be expected that these coughing spells exerted significant strain on the already injured alveoli, initiating the air leakage. Moreover, steroids, that are used in the management of ARDS in COVID-19, have been postulated to contribute to weakening the pulmonary interstitial tissue leading to alveolar air leakage [12]. However, in our patient, the air leakage was developed before the administration of corticosteroids.

While the alveolar air leak is usually self-limiting in healthy individuals, its appearance in patients with severe acute respiratory syndrome (SARS) infection has been demonstrated as a potential predictor of disease severity, higher rates of intubation, and mortality [13]. It is a matter of concern whether the same applies to COVID-19 patients. In this context, several case reports recently have described a severe course of disease in COVID-19 patients

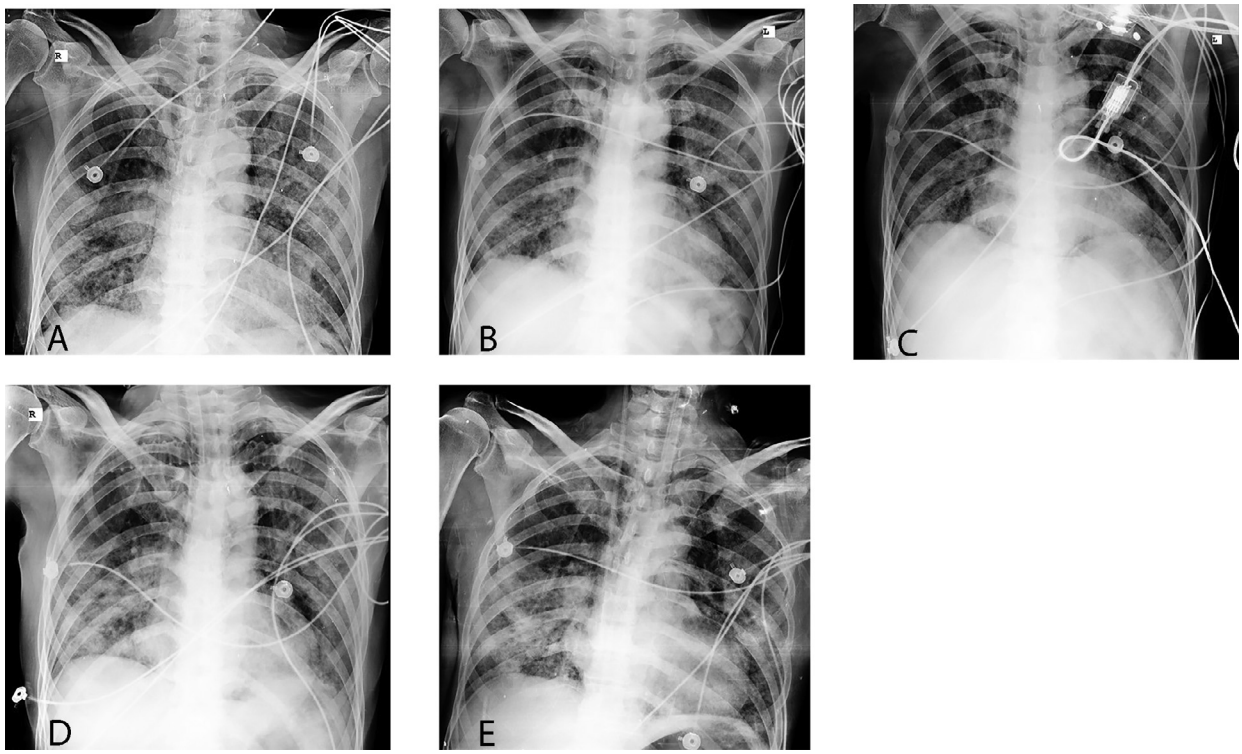


**Fig. 1 – Chest radiographs of a 55-year-old male with COVID-19 pneumonia from (A) the first day of admission (December 11, 2020), through (B) the fifth, (C) the sixth, and (D) the seventh day of admission, until (E) the last day when he passed away (December 18, 2020). The X-rays revealed bilateral air space consolidation opacities and pneumomediastinum with worsening throughout admission.**

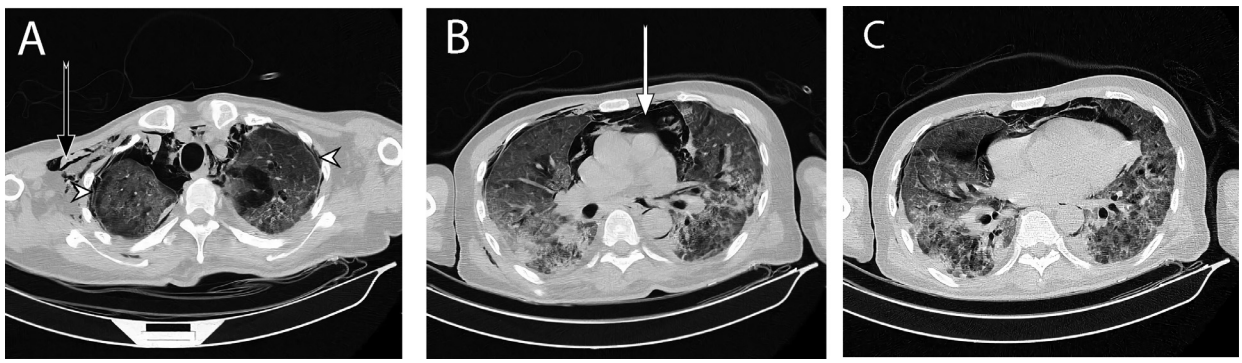


**Fig. 2 – Axial noncontrast chest CT scan images of the patient acquired on the first day of admission (December 11, 2020) show bilateral ground-glass opacities and consolidation, (A) bilateral pneumothorax (white arrowheads), subcutaneous emphysema (black arrow), (B) extensive pneumomediastinum (white arrow), and (C) a small rim of pneumopericardium.**

with spontaneous pneumomediastinum [12,14]. Further investigation is warranted to assess whether spontaneous alveolar air leakage has a prognostic value in patients with COVID-19.

In conclusion, spontaneous alveolar air leakage, characterized by spontaneous pneumomediastinum, pneumopericardium, pneumothorax, and subcutaneous emphysema, is a rare complication of COVID-19, which may be linked with a severe course of the disease.

## Declarations

### *Ethics human rights*

The authors declare that the work described has been carried out in accordance with the Declaration of Helsinki of the World Medical Association revised in 2013 for experiments involving humans.

### *Informed consent and patient details*

The authors declare that this report does not contain any personal information that could lead to the identification of the patient. Informed consent was obtained from the patient and his son before the death of the patient.

### *Author contributions*

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### *Availability of data and material*

Not applicable.

## Declaration of competing interest

The authors declare that they have no competing interest.

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