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A case of secondary tension pneumothorax in COVID-19 pneumonia in a patient with no prior history of lung disease

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Abstract

Complications that arise in patients with severe COVID-19 pneumonia are acute respiratory distress syndrome, often leading to mechanical ventilation, shock requiring vasopressors, acute kidney injury, stroke, thromboembolic phenomena, and myocardial injury. To date, there are four cases of tension pneumothorax in patients with COVID-19, published in literature. We present a 33-year-old man with no prior history of lung disease who was admitted to our hospital on account of hypoxic respiratory failure secondary to COVID-19 pneumonia. During his hospitalization, he developed sudden onset of chest pain which worsened with coughing. A chest X-ray showed a right-sided pneumothorax with left-sided mediastinal shift. He required placement of chest tubes with eventual resolution of the pneumothorax several days later. This case highlights the need for clinical recognition, consideration of differential diagnoses, prompt evaluation, appropriate imaging, and management of this severe life-threatening unusual complication of COVID-19 pneumonia.

Keywords

COVID-19 pneumonia, tension pneumothorax, pneumomediastinum, pneumothorax

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Introduction

In late December 2019, a previously unidentified infection was reported in patients in Wuhan, China, who presented with a cough, fever, dyspnea, and acute respiratory distress syndrome (ARDS).[1] Virus genome sequencing was done in five patients with pneumonia hospitalized between 18 and 29 December, which revealed the presence of a previously unknown β-coronavirus strain.[2] The World Health Organization (WHO) officially named the disease as coronavirus disease 2019 (COVID-19); coincidentally, the Coronavirus Study Group of the International study group proposed on the same day (11 February 2020) to name the new virus SARS-CoV-2.[3] Retrospective studies conducted during the early stages of the pandemic in Wuhan, China, have shown that pneumothorax was observed in 1%–2% of COVID-19-positive patients.[4,5] To date, there have only been four case reports describing the occurrence of a tension pneumothorax in patients with COVID-19 pneumonia.[6–9] We present a 33-year-old man hospitalized with COVID-19 pneumonia with no prior existing lung disease who developed a secondary tension pneumothorax.

Case report

A 33-year-old man with no significant past medical history presented to the emergency department with progressive shortness of breath, a cough, and fevers for more than 3 weeks. He did not smoke tobacco but reported occasional marijuana smoking. On arrival to the emergency department, he was hypoxic (oxygen saturation being 88%) on room air and required placement of a nonrebreather mask at 15 L per minute. On physical examination, he exhibited diaphoresis, tachypnea, and had bilateral crackles on lung auscultation. His laboratory tests showed a white blood cell count of $15.6 \times 1000\,\mu/L$ (normal range $4.8–10.8 \times 1000\,\mu/L$), lymphopenia of 8% (normal range 10%–50%), and an elevated

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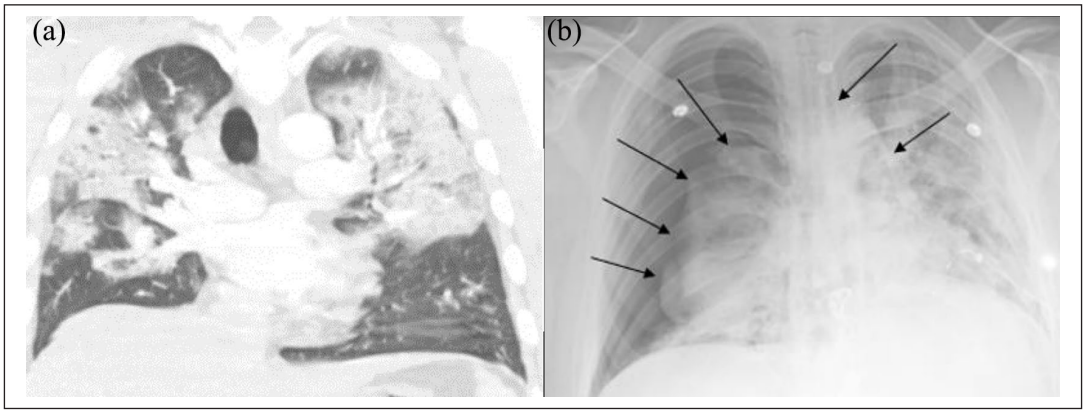

Figure 1. (a) A CT scan of the chest demonstrating bilateral dense infiltrates without any cystic lesions. (b) A Chest X-ray showing a right-sided early tension pneumothorax with mediastinal shift. (Arrows showing extent of the tension pneumothorax.)

D-dimer greater than 35 mg/L. His rapid COVID-19 polymerase chain reaction (PCR) test (Cepheid, Sunnyvale, California, USA) was positive, and a chest X-ray showed patchy bilateral opacities with consolidations. He received a dose of tocilizumab and was started on ceftriaxone, doxycycline, and hydroxychloroquine. Due to his elevated D-dimer level, a computerized tomography (CT) angiography of the chest was obtained which showed extensive bilateral areas of consolidation, ground-glass opacities, and areas of septal thickening. There was no evidence of pulmonary embolism, blebs, or bullae (Figure 1(a)). A duplex ultrasound of his lower extremities showed a nonocclusive deep venous thrombus in the popliteal vein of his left leg. He was started on anticoagulation with low-molecular-weight heparin. Due to worsened hypoxia and respiratory distress, he was placed on oxygen support with a high-flow nasal cannula and admitted to an intermediate care unit. Ten days into his admission, he reported sudden onset of right-sided chest pain, which was described as worse with coughing. A chest X-ray showed a large, right-sided pneumothorax with early signs of left mediastinal shift on imaging (Figure 1(b)). The patient was otherwise hemodynamically stable. He underwent emergent chest tube placement with an 8-French pigtail catheter being placed with connection to a wall-mounted suction device. A post-procedure chest X-ray showed lung re-expansion. However, a follow-up chest X-ray obtained 5 h later showed re-expansion of the pneumothorax, and examination of his external chest tubing revealed blockage with a thick clot which could not be aspirated; thus, he underwent placement of a larger bore 24-French chest tube. A repeat chest X-ray showed improvement in size with the pneumothorax now being described as small. The patient underwent serial chest X-rays with his chest tube being removed on hospital day 25. The patient was discharged home eventually on hospital day 27.

Discussion

Our patient was a nonsmoker with no prior history of cystic lung disease or emphysema. He did not exhibit any signs or symptoms suggestive of a connective tissue disorder. He was not on noninvasive positive pressure ventilation at the time of the event. Thus, he did not have the aforementioned predisposing factors for development of a tension pneumothorax. Although there have been several case reports highlighting the occurrence of spontaneous pneumothorax or pneumomediastinum in patients with COVID-19 pneumonia,[10] there have been only four prior case reports of patients with COVID-19 pneumonia who developed a tension pneumothorax. Yasukawa et al.[7] described a tension pneumothorax in a patient with no significant past medical history who was admitted with COVID-19 infection. The patient was later discharged on hospital day 12 and returned with worsened pleuritic chest pain with imaging showing a large new right pneumothorax with evidence of left mediastinal shift. He was treated with chest tube placement, and a follow-up chest X-ray revealed a large bulla. Flower et al.[6] also described a 36-year-old man with a history of tobacco smoking and childhood asthma who had presented with 3 weeks of symptoms and was found to have a left-sided tension pneumothorax on admission. Spiro et al.[8] described a 47-year-old man but no prior lung disease who presented to their hospital, 25 days after the onset of symptoms and 4 days after his initial discharge with a right-sided tension pneumothorax. These cases were similar to ours in that they were not on mechanical ventilation or noninvasive positive pressure ventilation and developed the event in the third to fourth week after development of initial signs and symptoms of COVID-19 infection, and all required chest tube placement with eventual resolution of the pneumothorax. Deliwala et al.[9] described a patient with COVID-19 pneumonia, intubated for respiratory failure, who developed a fatal tension pneumothorax as a result of ventilator-induced lung injury in the setting of severe ARDS. The underlying mechanisms leading to the development of pneumomediastinum, a spontaneous pneumothorax, or tension pneumothorax are not entirely certain. It is not clear whether the occurrence of a tension pneumothorax is as a result secondary to COVID-19 infection itself or a manifestation of disease progression. Common histopathological findings in COVID-19 patients

are severe capillary congestion and reactive pneumocyte changes corresponding to exudative diffuse alveolar damage. Proliferative diffuse alveolar damage has also been described.[11,12] These histopathological features are similar to those seen in SARS and Middle East respiratory syndrome (MERS) coronavirus infection. The sustained inflammation and alveolar injury lead to further distension of alveoli and disruption of alveolar septa. During the earlier SARS outbreak in 2004, Chan et al.[13] retrospectively reviewed high-resolution chest CT scans of 27 patients who had a confirmed diagnosis of SARS. Thin or thick reticular lines were noted to have developed in airspace opacities producing a lattice effect with distortion of vascular and bronchial anatomy with formation of blebs in the second to third week of illness. During this subacute phase of disease, spontaneous pneumothorax and pneumomediastinum were noted in a considerable proportion of the patients in this study (25.9%).[13] The formation of cysts in lung tissue in response to cellular exudates has also been described. These lesions may result in emphysema or bullae. These findings have been described in patients who did or did not receive mechanical ventilation, suggesting that invasive mechanical ventilation is not always the cause. These changes have also been described in SARS and MERS coronavirus infection.[14,15] Thus, we postulate that our patient developed a secondary tension pneumothorax in the setting of possible cystic change with bullae, along with increased trans-alveolar pressure from coughing resulting in an air leak. It may be possible that the development of a tension pneumothorax may represent a severe sequela along a continuum where cysts and bullae form, and pneumothorax and pneumomediastinum occur because of lung injury related to COVID-19 infection with a tension pneumothorax occurring possibly due to greater force of coughing in the setting of greater degree of lung damage. However, as the COVID-19 pandemic is a rapidly evolving situation, more studies would need to be carried out to ascertain and verify the exact mechanisms and etiology of this phenomenon.

Conclusion

Although it was earlier recognized that acute pulmonary embolism and myocardial injury were potential complications of severe COVID-19 infection, the sudden development of chest pain in patients with COVID-19 pneumonia should prompt the clinician to consider potential development of a pneumothorax (either simple or tension) or pneumomediastinum. This case highlights the need to recognize the signs, obtain prompt clinical imaging, and consider emergent needle decompression and chest tube placement in this unusual complication of COVID-19 pneumonia.

Declaration of conflicting interests

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Ethical approval

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Informed consent

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