

Spontaneous Pneumothorax as a Complication of COVID-19

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Abstract

Coronavirus disease 19 (COVID-19) has been associated with significant morbidity and mortality. Our understanding of the clinical spectrum of disease continues to evolve, with increased reports of multi-organ complications. Spontaneous pneumothorax has emerged as a concerning complication in patients hospitalized with COVID-19. Retrospective studies, which have primarily been case reports and small case series, suggest that pneumothoraces may occur in 1%-2% of patients with COVID-19. This potentially lethal complication is thought to occur in mechanically ventilated patients and those with underlying lung disease. We recently published our institutional experience during the early phase of the pandemic where we identified 22 cases of spontaneous pneumothorax in patients admitted to our health system with COVID-19.

Keywords: COVID-19; Spontaneous pneumothorax; Ventilated patients

Abbreviations

BCG: *Bacillus Calmette-Guérin*; TURBT: Transurethral Resection of Bladder Tumor; CT: Computed Tomography; TEVAR: Thoracic Endovascular Aortic Repair; *M.bovis*: *Mycobacterium bovis*

Introduction

COVID-19 has primarily been characterized as a respiratory disease with pulmonary infiltrates present in the majority of cases. The most common chest Computed Tomography (CT) findings of COVID-19 described in the literature is multiple patchy, ground-glass opacities that progress to or co-exist with bilateral consolidations in multiple lobes with a peripheral distribution [1,2]. We conducted a retrospective study of patients with COVID-19 admitted at five hospitals within the Inova Health System in Virginia, USA who developed spontaneous pneumothoraces between February and May 2020 [1]. At that time, cystic features of COVID-19 on chest imaging, including presence of pneumothoraces had only been described in a few case reports. Since then, more than 100 case reports and series have been published recognizing pneumothoraces and pneumomediastinum as a significant complication of COVID-19.

Case Presentation

In our study population of 1619 hospitalized patients with COVID-19, 22 patients (1.4%) developed pneumothorax, which is consistent with the reported prevalence of pneumothoraces in patients with COVID-19 [2]. These patients initially presented with a wide range of illness ranging from mild respiratory distress to Acute Respiratory Distress Syndrome (ARDS). Data on demographic, comorbidities, inflammatory markers, mechanical ventilatory support and treatment methods were collected and can be found in our previous publication [1].

The median length of hospitalization was 18.5 days with the diagnosis of pneumothorax made between days 1 and 30 (median of 9 days). Ten (45%) patients developed left-sided pneumothorax, eleven (50%) patients developed right-sided pneumothorax and one (5%) patient developed bilateral pneumothoraces.

All pneumothoraces were diagnosed on chest x-ray, with the most common reason for obtaining chest imaging being respiratory distress, worsening hypoxia, and monitoring of pneumothoraces. Managing pneumothoraces in this patient population can be a unique challenge as a previous study has shown no resolution after placement of chest drains [3]. In our study, 16 patients (73%) had chest tubes placed and were primarily tracked with serial radiographs. One of our patients had rapid progression of bullous disease, which was diagnosed on a chest CT scan, resulting in a misplaced chest tube. The patient eventually required surgical intervention. This suggests that interval cross sectional imaging may be of value in patients who do not improve after placement of chest tubes.

Results and Discussion

Spontaneous pneumothoraces are known to occur classically in patients with underlying pulmonary conditions and those subjected to mechanical ventilation. The incidence of pneumothoraces is even higher in patients with ARDS and correlates with severity of disease, barotrauma and volutrauma caused by mechanical ventilation. However, the etiology of pneumothoraces in patients with COVID-19 appears to be multifactorial and not always directly associated with high ventilator settings. Results differ across studies, likely due to the varied severity of pulmonary disease. One case series identified 62 out of 75 patients with COVID-19 who were diagnosed with pneumothoraces while mechanically ventilated, despite implementation of lung protective strategies [4]. Most of these patients were classified as having severe ARDS.

It is also important to note that pneumothoraces may have been present, but not diagnosed prior to intubation. In another retrospective

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study, 4 out of 6 patients with COVID-19 developed pneumothoraces, which the authors argued were likely, associated with mechanical ventilation [5]. However, the patients reportedly had high lung compliance indicated by low peak inspiratory pressures and plateau pressures decreasing the risk for development of pneumothorax while on mechanical ventilation.

In our study, only 19% of the patients had underlying lung pathology such as Chronic Obstructive Pulmonary Disease (COPD) or asthma and less than half of the patients who had pneumothoraces were ventilated at the time of diagnosis. This suggests that COVID-19 itself and its associated inflammation is likely an independent risk factor for the development of pneumothorax and can occur anytime during the course of the hospitalization. The initial formation of cysts to eventual consolidation resulting in bullae has now been documented and is not restricted to patients receiving positive-pressure ventilation, indicating that barotrauma is not the sole cause of pneumothoraces [1]. The formation of cysts is postulated to be a consequence of ischemic parenchymal damage and inflammation from cytokine activation [6].

There have been numerous studies in the past year investigating the prognostic potential of various inflammatory markers and correlation with severity of COVID-19. A recently published case control study comparing the characteristics of patients with and without COVID-19 who developed pneumothoraces and patients with COVID-19 who did not develop pneumothoraces, noted that patients with COVID-19 and pneumothoraces had increased leukocyte count, lymphopenia and increased hospital death compared to the other two groups [7]. Our study found the crude mortality of all patients admitted with COVID-19 between February and May 2020 to be lower (15.8%) compared to patients with COVID-19 who developed pneumothorax (36%).

We also noted that the deceased patients with COVID-19 and pneumothorax had a trend towards higher levels of inflammatory markers (ferritin, C-reactive protein, fibrinogen, and leukocytes) at the

time of diagnosis of pneumothorax. In addition, patients who died were more likely to be older (median age 63), overweight (median BMI 28.3) and have higher prevalence of co-morbidities such as hypertension, diabetes, and congestive heart failure compared to those who remained alive, which is consistent with previous studies [4,5].

Conclusion

Though the incidence of spontaneous pneumothorax in patients admitted with COVID-19 remains relatively low, it is likely underdiagnosed and associated with worse clinical outcomes. Clinicians should be attuned to this potentially lethal complication as the prompt diagnosis, treatment and careful monitoring are crucial to mitigate morbidity and mortality in this population.

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