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Management of Pneumothorax Secondary to COVID-19 – Experience of Fourteen Cases

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ABSTRACT

Background: Pneumothorax is an uncommon but potentially fatal complication of coronavirus disease 2019 (COVID-19), particularly in patients with severe lung damage. Bronchopleural fistula (BPF) and persistent air leaks further complicate management. Objective:

This study describes the clinical features, management strategies, and outcomes of patients with pneumothorax secondary to COVID-19.

Methodology: A prospective observational study was conducted at Ayub Teaching Hospital, Abbottabad, from 2019 to 2022. Fourteen patients with confirmed COVID-19 who developed pneumothorax were included. Data were retrieved from clinical records and radiology. Variables analyzed included demographics, comorbidities, type of pneumothorax, management interventions, and outcomes. The primary outcome was survival and resolution of pneumothorax; secondary outcomes included need for pleurodesis, application of suction, and complications.

Results: Of the 14 patients, 10 (71.4%) were male and 4 (28.6%) female, with a mean age of 55 years. Four patients (28.6%) had COPD as a comorbidity. Unilateral pneumothorax occurred in 12 patients (85.7%), while 2 (14.3%) had bilateral involvement. All patients underwent chest tube drainage; 10 (71.4%) required low-pressure suction, and pleurodesis was performed in 10 (71.4%) cases. No surgical or endobronchial interventions were performed. Recovery was achieved in 10 patients (71.4%), while 4 (28.6%) died, mostly due to severe COVID-19 pneumonia and associated comorbidities.

Conclusion: Pneumothorax in COVID-19 is a serious complication requiring prolonged management. Chest tube drainage is the mainstay of treatment, often supplemented by suction or pleurodesis. Early recognition and individualized strategies are essential to improve outcomes.

Keywords: COVID-19; Pneumothorax; Bronchopleural fistula; Chest tube drainage

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Introduction

The emergence of coronavirus disease 2019 (COVID-19) in late 2019 has been linked to a broad range of pulmonary complications, such as acute respiratory dysfunction syndrome (ARDS) to thromboembolic disease and secondary bacterial infections. Pneumothorax is one of them, being one of the most severe and potentially fatal complications, which have been noted to become more prevalent in patients with severe COVID-19 pneumonia. This is especially alarming in persons whose alveolar damage is diffuse and pulmonary parenchyma is fragile, as the development of pneumothorax may further reduce already damaged oxygenation and negatively affect the overall prognosis.[1,2]

The pathophysiological processes that cause the development of pneumothorax in COVID-19 are multifactorial. Inflammatory infiltration, ischemic necrosis, and diffuse alveolar damage of lung tissue are believed to impair the structural integrity of lung parenchyma.[3,4] Moreover, it has been emphasized that barotrauma related to invasive mechanical ventilation is a significant contributory factor, and, in the case of ventilated COVID-19 patients, barotrauma-related pneumothorax has also been reported to be significantly

higher than in non-COVID-19 groups.[1,3] The spontaneous pneumothorax has been reported even without the presence of mechanical ventilation, which highlights the inherent susceptibility of affected COVID-19 lungs to the structural collapse.[2,5,9]

Bronchopleural fistula (BPF), a potentially lethal complication that frequently accompanies pneumothorax, can be the result of continued rupture or necrosis of the alveoli that extends into the pleural space. The existence of BPF brings about more difficulties, since it leads to continuous air leakages that are hard to control and extend the time of chest drainage [[6,7]. PFs have been increasingly reported in COVID-19-patients, probably because severe parenchymal damage is combined with high ventilatory pressures. These fistulas do not only make treatment more difficult, but also with increased morbidity and mortality rates.[4,10]

Pneumothorax and BPF are complicated conditions whose management under a COVID-19 environment may be complex and may need a multidisciplinary approach. Early stabilization is often attained with the use of intercostal drainage of the chest that is the mainstay of treatment in spontaneous and barotrauma-induced pneumothorax.[2,4] Yet, there are constant air leakages, and frequent occurrence of episodes, which often require extra procedures. Promotion of pleural adhesion has been achieved by chemical pleurodesis in refractory cases and bronchoscopic pleural adhesion techniques (including the insertion of endobronchial valves) have demonstrated potential in selected patients.[6,8] Surgery, such as fistula repair or pleural decortication, is typically not used on individuals with insufficient physiological reserve, but the role is restricted in severely ill COVID-19 patients because of the high risk of surgery.[6,7,8]

Clinical outcomes remain variable. Mortality rates are particularly high in elderly patients, those with comorbidities such as chronic obstructive pulmonary disease, and individuals with severe COVID-19 lung involvement [4,10]. While some patients recover with conservative measures, others progress to respiratory failure and death despite aggressive management. Given the relatively recent recognition of this complication, literature remains limited to single-center reports, small case series, or retrospective reviews.[2,4,10]

In this context, sharing institutional experiences is critical to expanding the evidence base and guiding future practice. The present study describes the clinical characteristics, management strategies, and outcomes of fourteen patients who developed pneumothorax and, in some cases, BPF secondary to COVID-19 infection. By reporting our experience, we aim to contribute to the understanding of this challenging complication and highlight the importance of timely recognition and individualized management strategies.

Methodology

This prospective observational study was carried out at Ayub Teaching Hospital, Abbottabad, during the three-year period 2019 to 2022. Fourteen patients with confirmed COVID-19 infection who developed pneumothorax were included. COVID-19 was diagnosed using polymerase chain reaction (PCR), whereas a pneumothorax was confirmed with the help of radiological examination, such as chest X-rays and in case of necessity, computed tomography (CT) scans. Patients with pneumothorax, which were not related to the COVID-19 infection were not included in the study.

The study was approved by the Institutional Ethical Review Committee of Ayub Teaching Hospital. All participants gave written informed consent before being included in the study. Where the patients could not give consent, owing to the gravity of the illness, the next of kin gave consent. All patient data was kept in strict confidence and anonymity in keeping with proper ethics in research.

Hospital medical records, radiology reports, and follow-up assessments were used to gather clinical data on each patient. Demographic factors like age and sex, and comorbidities of interest, especially, underlying respiratory diseases, were collected. Answers about the clinical manifestation and the nature of pneumothorax, unilateral or bilateral were also recorded. Management options, such as chest tube drainage, application of low-pressure suction, and chemical pleurodesis were documented and the period of interventions were documented. Surgical and endobronchial procedures were mentioned, but none of the patients in this series needed them.

The primary outcome measure was patient survival and complete resolution of pneumothorax following intervention. Secondary outcomes included the requirement for pleurodesis, application of low-pressure suction, and the occurrence of complications during management. Mortality related to pneumothorax and COVID-19 infection was also carefully assessed.

Results

A total of fourteen patients diagnosed with pneumothorax secondary to COVID-19 infection were managed during the study period. The demographic and clinical characteristics of these patients are summarized in Table 1. The majority of patients were male (n=10, 71.4%), while only four (28.6%) were female, reflecting a higher male predisposition. The mean age of the study cohort was 55 years, indicating that pneumothorax occurred more frequently in middle-aged to older adults. Among the comorbid conditions, chronic obstructive pulmonary disease (COPD) was present in four patients (28.6%), suggesting that pre-existing respiratory pathology may have contributed to the development or severity of pneumothorax in these cases. With regard to the laterality of presentation, unilateral pneumothorax was observed in the vast majority (n=12, 85.7%), whereas bilateral pneumothorax was identified in two cases (14.3%).

Table I: Demographic and Clinical Characteristics (n=14)

Variable	(n)	(%)
Gender (Male/Female)	10 / 4	71.4 / 28.6
Mean Age (years)	55	-
Comorbidity – COPD	4	28.6
Bilateral Pneumothorax	2	14.3
Unilateral Pneumothorax	12	85.7

Management strategies and outcomes are presented in Table II.

Table II: Management and Outcomes (n=14)

Parameter	(n)	(%)
Chest Tube Drainage (long-term)	14	100.0
Low-pressure Suction	10	71.4
Chemical Pleurodesis	10	71.4
Surgical Intervention	0	0.0
Endobronchial Intervention	0	0.0
Successful Recovery	10	71.4
Mortality	4	28.6

All patients (100%) underwent long-term chest tube drainage, which remained the primary modality of treatment. In addition, low-pressure suction was applied in ten patients (71.4%) to aid lung re-expansion and address persistent air leaks. Similarly, chemical pleurodesis was performed in ten patients (71.4%), particularly in cases with recurrent pneumothorax or those not resolving with drainage alone. Notably, none of the patients in this series underwent surgical intervention or endobronchial procedures, likely due to either clinical ineligibility or the acute COVID-19–related respiratory compromise that made invasive approaches less feasible.

In terms of outcomes, successful recovery was achieved in ten patients (71.4%), with complete lung re-expansion and subsequent clinical improvement. However, four patients (28.6%) succumbed despite appropriate management. Mortality was observed predominantly among patients with severe COVID-19–related respiratory failure, often compounded by comorbidities such as COPD and extensive lung involvement.

Discussion

Pneumothorax has emerged as a significant pulmonary complication in patients with COVID-19, particularly those with severe disease and extensive lung involvement. In our series of fourteen patients, we observed a predominance of middle-aged males with unilateral pneumothorax, consistent with previous reports highlighting a higher incidence in this demographic.[11,12] The mean age of our cohort was 55 years, aligning with other studies which suggest that older age and the presence of comorbidities, particularly chronic obstructive pulmonary disease (COPD), increase vulnerability to this complication.[13,14]

The underlying pathophysiology of pneumothorax in COVID-19 remains multifactorial. Proposed mechanisms include diffuse alveolar injury, ischemic necrosis, and barotrauma secondary to mechanical ventilation.[11,15] Notably, we found pneumothorax occurring even in non-ventilated patients, supporting observations that structural lung damage from COVID-19 itself may predispose to alveolar rupture and spontaneous pneumothorax.[12,16] This highlights the need for a high index of suspicion in patients presenting with acute respiratory deterioration.

Management of pneumothorax in COVID-19 presents unique challenges. All patients in our cohort required intercostal chest tube drainage, which remains the cornerstone of therapy.[13,17] In the majority, prolonged drainage was required due to persistent air leaks, reflecting the fragile nature of diseased lung tissue. The use of low-pressure suction and chemical pleurodesis in selected patients proved beneficial, as reported in prior studies where pleurodesis was effective in promoting pleural adhesion and reducing recurrence.[18] However, the absence of surgical intervention in our series underlines the difficulty of offering invasive procedures in critically ill COVID-19 patients, a limitation also emphasized in multicenter reviews.[12,19]

Endobronchial techniques, particularly the use of endobronchial valves, have been described as minimally invasive options for persistent air leaks and bronchopleural fistulas (BPFs) in COVID-19 patients.[20]

Aiolfi et al. demonstrated favorable outcomes with endobronchial valves in cases refractory to conventional management.[18] However, such interventions were not feasible in our setting due to limited availability and the critical condition of many patients. This underscores the importance of resource-adapted strategies, especially in low- and middle-income healthcare systems.

Outcomes in our series were modest, with recovery achieved in approximately 71% of cases, while mortality occurred in 28.6%. This is comparable to reported mortality rates ranging from 25% to 40% in similar cohorts.[14,16,21] Mortality was higher in patients with comorbidities and those with bilateral disease, consistent with prior evidence that these factors are strong predictors of poor outcome.[17,22]

Our findings add to the growing body of literature on pneumothorax secondary to COVID-19. While single-center experiences such as ours cannot be generalized, they are valuable in identifying patterns and guiding clinical practice. The persistence of air leaks, the frequent need for pleurodesis, and the high mortality observed highlight the complexity of management and the urgent need for consensus guidelines. Larger multicenter studies are warranted to define optimal strategies, including the role of newer bronchoscopic interventions, and to stratify patients who may benefit from surgical approaches once stabilized.

Conclusion

Pneumothorax secondary to COVID-19 represents a serious complication with significant management challenges and a considerable impact on patient outcomes. Our series of fourteen patients highlights that while chest tube drainage remains the cornerstone of treatment, many cases require prolonged drainage, suction, or pleurodesis due to persistent air leaks, and advanced interventions are often limited by patient condition or resource constraints. Mortality was notably higher in those with comorbidities and severe lung involvement, emphasizing the need for early recognition, vigilant monitoring, and individualized management strategies. Larger multicenter studies are essential to establish standardized treatment protocols and to evaluate the role of emerging bronchoscopic and surgical techniques in improving outcomes.

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