

Comparison of Findings of Pneumothorax in COVID-19 and Non-COVID-19 Patients: A Cross-Sectional Study



Abstract

Background

Pneumothorax has been frequently described as a complication of COVID-19 infections. COVID-19-related pneumothorax likely signifies greater disease severity. Our study aims to compare pneumothorax in COVID-19 and non-COVID-19 cases in a university hospital.

Materials and Methods

A cross-sectional study was conducted on 130 patients who developed pneumothorax, along with details of follow-up cases from August 1st 2019, to March 31st 2021. In indicated cases, the primary intervention was done with chest tubes or pigtail catheters.

Results

Among 130 patients with pneumothorax, 104 patients were non-COVID-19 patients (%) while 26 patients had concurrent COVID-19 infection. Of the total cases, 106 cases were male patients (%) while 24 were female (%). The mean age of the patients was 51.5 years (SD 16.9 years, ranging from 16-81 years). All the patients had complaints of chest pain, while 122 of them (%) had shortness of breath. Right-sided lung involvement was present in 74 patients (56.9%), left side involvement was 52 (40%), and bilateral involvement was 4 (3.1%). Regarding intervention, the chest tube was inserted in 110 (84.6%) patients, while a pigtail catheter was inserted in 20 (15.4%) patients. The mean duration of a chest tube or pigtail catheter insertion was 4.1 days (SD 1.6 days, Range of 2-12 days). The mean length of hospital stay was 5.2 days (SD 1.9 days, Range 3-14 days). The number of patients who were smokers was 72 (55.4%).

Conclusion

COVID-19 cases were associated with a greater severity and graver prognosis of pneumothorax than non-COVID-19 cases, including a longer hospital stay, higher incidence of persistent airway leakage, and need for catheter reinsertion.

Keywords: Catheter, Chest tubes, COVID-19, Pneumothorax.

Introduction

COVID-19 infection can result in a varying range of symptoms starting from mild common cold to pneumonia to severe complications such as pneumothorax, subcutaneous emphysema and pneumomediastinum[1]. The exact aetiology still remains unclear; however, these have been linked to the use of positive pressure respiratory support or those breathing spontaneously[1, 2]. Further, mechanical ventilation appears to be a predominant risk factor for developing pneumothorax with COVID-19 pneumonia due to increased intrathoracic pressure[3]. In COVID-19 pneumonia, pneumothorax often results from the inflammation of the lung parenchyma with severe lung injury and diffuse alveolar damage [3].

Here, we present a cross-sectional study performed on patients with pneumothorax to find its correlation with severe COVID-19 infection. Our study aims to describe the clinical characteristics of patients with these pathologies and consider whether the development of pneumothorax can be used as a marker of poor prognosis in the case of COVID-19.

Methods

A cross-sectional study was conducted in the Cardiothoracic and Vascular Surgery unit in Dhulikhel Hospital, Nepal, in patients who developed pneumothorax from August 1st, 2019, to March 31st, 2021. The outcome of pneumothorax in COVID-19 patients was compared with characteristics and outcomes of pneumothorax in patients without COVID-19. In indicated cases, the primary intervention was done with chest tubes or pigtail catheters (Figure 1). Regarding secondary pneumothorax, the British Thoracic Society guidelines indicate the insertion of chest tube drain in pneumothorax measuring >2cm or in the presence of breathlessness[9]. As recent studies have suggested, chest tube and pigtail catheters are equally effective for managing pneumothorax, and one of the two treatment modalities was selected.[10] Chest tubes made of PVC of size 20-28 French were used, and pigtail catheters of 14-16 French were used. All procedures were done at the bedside under local anaesthesia and without radiologic guidance. During the insertion of pigtail catheters, we typically employ a small (22 gauge) “finder needle” before inserting the larger needle provided with the kit. Air or pleural fluid should be easily withdrawn with the needle, and passage of the guidewire into the pleural space should be virtually effortless. The pigtail catheter is attached to a standard thoracic drainage system, and suction is applied for pneumothoraces[6]. Proper aseptic technique as per institute policy was followed.

Regarding outcome variables, the mean duration of the

intercostal drain (chest tube or pigtail) and duration of hospital stay were compared. Persistent pneumothorax was defined as an air leak lasting longer than 72 h from the conclusion of the surgical procedure[7]. Cases where air leak did not stop in five days, were further managed by chemical pleurodesis using 50ml 10% betadine. COVID-19 cases are defined as per the guideline set by the World Health Organization[8].

Outcomes were compared based on the duration of chest tube/pigtail insertion, length of hospital stay and presence or absence of persistent pneumothorax, need for chemical pleurodesis, surgical emphysema, reinsertion of chest tube/ pigtail catheter and the need for ICU admission.

All the data of the procedure and patient information were taken from the hospital software after proper consent from the patients and concerned authority from the hospital, and clinical manifestations and complications were analyzed retrospectively. Monthly follow-up of the cases was done to note the patency. The study was conducted according to the guidelines of Strengthening the reporting of cohort studies in surgery (STROCSS) 2019.



Figure 1. Chest X-ray showing insertion of the chest tube.

Results

There were a total of 130 patients that including 104 cases of pneumothorax in non-COVID patients and 26 cases in COVID patients. Of the cases, 106 were male patients (81.5%) while 24 were female (18.5%). The mean age of the patients was 51.5 years (SD 16.9 years, range 16-81 years).

In terms of symptoms, 122 patients had shortness of breath, and all the patients complained of chest pain.

The number of patients who were smokers was 72 (55.4%). In terms of side, right side involvement was 74 (56.9%), left side involvement was 52 (40%), and bilateral involvement was 4 (3.1%). Regarding the type of intervention for pneumothorax, a chest tube was inserted in 110 (84.6%) patients, while a pigtail catheter was inserted in 20 (15.4%) patients. The mean duration of a chest tube or pigtail catheter insertion was 4.1 days (SD 1.6 days, range 2-12 days). The mean length of hospital stay was 5.2 days (SD 1.9 days, Range 3-14 days).

Table 1: Duration of chest tube/ pigtail catheter insertion and length of hospital stay in COVID negative and positive patients.

Variables	COVID negative cases (mean)	COVID positive cases (mean)	p value
Duration of chest tube/ pigtail	3.8	5.3	<0.01
Length of hospital stay	4.7	7.2	<0.01

Table 2: Outcome of chest tube/pigtail catheter insertion in COVID negative and positive patients.

Variables	Sub groups	COVID negative cases	COVID positive cases	p value
Persistent pneumothorax	Yes	8	20	<0.01
	No	96	6	
Need for chemical pleurodesis	Yes	4	14	<0.01
	No	100	12	
Reinsertion of chest tube/ pigtail catheter	Yes	0	4	<0.01
	No	0	22	
Need for ICU	Yes	0	8	<0.01
	No	104	18	
Outcome of cases	Good	104	24	<0.01
	Expired	0	2	

Discussion

The term pneumothorax refers to an abnormal collection of air in the pleural cavity, space between parietal and visceral pleura[3]. It is often caused due to chest trauma and iatrogenic procedures (traumatic pneumothorax), underlying diseases of the lung (secondary spontaneous pneumothorax) or in the absence of any event or underlying lung disease (primary spontaneous pneumothorax)[3][4]. COVID-19 infection also results in severe complications such as

pneumothorax, and pneumomediastinum, apart from causing pneumonia with parapneumonic effusion[1]. These complications due to COVID-19 in critically ill patients are linked to positive pressure ventilation systems and invasive and non-invasive mechanical ventilation as the management of patients with the severe disease requires such respiratory support[1]. Therefore the incidence rate of pneumothorax in critically ill patients with invasive mechanical ventilation (IVM) is up to 15% [3, 5].

COVID-19 infection causes diffuse inflammation of the lung parenchyma resulting in severe lung injury and diffuse alveolar damage, which could be one of the mechanisms for developing spontaneous pneumothorax[6]. Furthermore, oedema and collapse of the edematous portion of the lung in the dependent regions lead to reduced lung volumes and cause tachypnea and hypoxemia[5]. This further results in surfactant dysfunction, loss of lung tissue, fibrosis, cyst formation and finally, alveolar rupture contributing to the development of pneumothorax in COVID-19 patients[6][4]. On the contrary, rupture of the pneumatocele and infarction caused by underlying pulmonary thromboembolism could be other less common possible mechanisms of pneumothorax in COVID-19 infections[6]. In COVID-19 patients under mechanical ventilation, pneumothorax is probably due to overdistention of the alveoli, causing an alveolar rupture and barotrauma[7][4].

Clinically, acute deterioration in covid-19 patients with hypoxia indicates pneumothorax, often presenting with shortness of breath [6]. In our study, most patients presented with chest pain and shortness of breath and were diagnosed with pneumothorax. But, in radiographic imaging, pneumothorax is one of the uncommon findings in patients with COVID-19 infections[6]. The common imaging finding in patients with COVID-19 infections is ground-glass opacities involving the lower lobes[6].

In a study by Ekanem et al., spontaneous pneumothorax is considered one of the potential complications of COVID-19, with a mortality rate of 36% and an increased rate of severity[8].

Martinelli et al. reported a high incidence of 84.5% of pneumothoraces in their study of 71 hospitalized COVID-19 patients[5]. The study showed the need for chest tube drainage in eleven patients and right upper lobe bullectomy performed in one patient[5]. Further, in their study, more than half of the patients improved and were discharged. However, our study showed a low incidence of pneumothorax in COVID-19 cases compared with non-COVID-19 cases with an increased need for ICU admission and an increased mortality rate in COVID-19-related pneumothorax which is contrary

to their study.

In a study by Wang et al., 23.8% (5/21) developed pneumothorax in critically ill COVID-19 patients indicating greater disease severity with mortality rates of 80%[9]. Besides, our study also showed a high mortality rate representing pneumothorax as a marker of poor prognosis among the covid positive patients.

Miro et al., in their study, have mentioned that COVID-19 patients with pneumothorax had a 12.9, 4.2, and 15.7-folds increased risk of ICU admission, prolonged hospitalization, and higher in-hospital mortality than those without pneumothoraces[10]. Our study also showed the increased length of hospital stay, increased incidence of persistent pneumothorax with the need for pleurodesis, need for ICU admission and increased mortality rate in COVID-19-related pneumothorax. A higher incidence of persistent pneumothorax (20 versus 8; $p < 0.01$) was noted in COVID-19-related pneumothorax with the need for chemical pleurodesis in such patients. Additionally, our study demonstrated the need for ICU stays in COVID-19-related pneumothorax, adding to the severe course of its disease.

Aiolfi et al. reported two patients with COVID-19 treated with thoracoscopy and bleb resection for persistent pneumothorax, whereas chemical pleurodesis was performed in one patient[11]. Though the initial definitive management of patients with pneumothorax is chest tube drainage, thoracoscopic surgery might be indicated in patients with persistent pneumothorax for better outcomes and more effective air leak control[11]. In our study of 20 patients with persistent pneumothorax, chemical pleurodesis was done in 14 cases.

Conclusion

The above study reveals that COVID-19-associated pneumothorax is more severe than non-COVID-19 cases. There is a greater duration of a hospital stay along with a higher incidence of persistent airway leakage and the need for catheter reinsertion.

Limitation of the study

Consequently, we cannot accurately use our study to determine the incidence of this association within Nepal.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Author contribution

Registration of research studies

Guarantor

Consent for publication

Informed consent was obtained from each participant.

Availability of data and materials

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Declaration of competing interest

None

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