

Comparative Study of Pneumothorax Cases in COVID-19 and Non-COVID-19 PatientsViral Shah^{1*}, Mehul Gajjar², Rajdeep Dhandhukiya³, Krutesh Sanjay Tripathi⁴¹Assistant Professor, Department of Pulmonary Medicine, SVP Hospital, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India²Associate Professor, Department of Emergency Medicine, Sheth L.G. General Hospital, Narendra Modi Medical College, Ahmedabad, Gujarat, India³Assistant Professor, Department of Pulmonary Medicine, SVP Hospital, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India⁴Senior Resident, Department of Pulmonary Medicine, SVP Hospital, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India

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Abstract:**Introduction:** The pneumothorax is a potential life threatening emergency if not treated in timely manner. Aim of this study to compare characteristics and outcome between Non COVID and COVID patients having pneumothorax.**Materials and Methods:** All patients who had pneumothorax were included in study and divided in two groups: Non COVID and COVID positive patients. Clinical and demographic detail of each patient was obtained from the hospital information system and entered in case records forms.**Results:** Total 104 patients having pneumothorax were included. Out of them, 63 (60.57%) were male. Trauma was most common cause in Non COVID patients. The mortality rate in COVID patients with pneumothorax (89.36%) was significantly higher than Non COVID patients (29.82%, $p < 0.001$).**Conclusion:** Pneumothorax in COVID-19 patients is more common in older age groups, often accompanied by comorbidities, and has a higher mortality rate compared to non-COVID-19 patients with pneumothorax.**Keywords:** Age, COVID, mortality, Pneumothorax, Trauma.

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Introduction

Pneumothorax is defined as the presence of air in the pleural cavity. It can be one of the life threatening respiratory emergencies if not managed timely. Treating pneumothorax can be very easy in experienced hand by introducing a chest tube or by large bore needle in 2nd intercostal space in midclavicular line on the affected side. Pneumothorax may be due to lung disease, blunt or penetrating chest trauma or unknown cause.[1]

COVID-19 pneumonia resulting from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections is a rapidly evolving condition that has become a challenge for the critical care physician owing to its highly infectious nature. [2] Since the onset of COVID-19 disease, it has been found that in 1–2% of patients with COVID-19 pneumonia, pneumothorax (PTX) requiring hospitalization can be encountered.[3] Complications such as severe pneumonia, pulmonary edema, and pneumothorax are described during COVID-19 disease. [4,5] In published studies, pneumothorax has been reported

as a complication of COVID-19 [8], with an incidence of 1% in hospitalized patients [4], 3% in hospitalized patients with pneumonia [6], 6% in mechanically ventilated patients [7], and 1% in deceased patients[8].

In the case of SARS-CoV-2 infection, if patients also have an associated lung pathology, there is a predisposition for pneumothorax, especially in those intubated and ventilated for a longer period.[3] Wang et al.[9] Observed that the reduction of NMB, recruitment manoeuvres, severe cough, and changes in lung structure and function are factors responsible for development of pneumothorax in COVID-19 patients. Elhakim et al.[10] Concluded that marked inflammatory response, fibrosis, and need for positive pressure ventilation in COVID-19 pneumonia are likely contributory to the development of pneumothorax in these patients. Martinelli et al.[3] Concluded that it was not an independent marker of poor prognosis, and that age >70 years and acidosis to be associated factors

responsible for poor prognosis. Two very recent studies concluded that baseline radiological findings of ground-glass opacities and consolidation and mechanical ventilation appeared to predict high risk of developing pneumothorax.[11,12] Natural history, etiology, progression and outcome of pneumothorax in COVID might be different as compared to pneumothorax in Non COVID patients.

Our study sought to comprehensively understand the prognostic factors and patient characteristics associated with the outcome in both groups.

Materials and Method

This cross sectional study was conducted at Department of Pulmonary medicine in collaboration with Department of Emergency Medicine of tertiary care hospital, Ahmedabad from 1st April 2020 to 28th February 2022.

All patients with confirmed diagnosis of pneumothorax were enrolled after getting approval from institutional ethics committee. Clinical and demographic detail of each patient was obtained from the hospital information system and entered in case records forms.

Exclusion criteria: patients who had cervico thoracic air accumulations—pneumomediastinum and pneumothorax and/or mixed thoracic effusions (air and liquid) associated or not with the COVID-19 disease. The therapeutic attitude for both groups was to eliminate the air from the pleural cavity and

surgically approach the lesion that determined the occurrence of pneumothorax (if possible). The group of patients with COVID-19 pneumothorax also received systemic COVID-19 therapy (kaletalopinavir/ritonavir, azithromycin, low molecular weight heparin, and intravenous immunoglobulin).

Collected data was entered and analysed in the Micro soft Excel version 2016. Qualitative variables were expressed as frequencies and percentages, and quantitative variables as mean with standard deviation (SD). Association between the qualitative variables was evaluated using the Chi-square test. A p value of < 0.05 was considered as statistically significant.

Results

Total 104 cases of Pneumothorax were identified during study periods out of which 47 (45.19%) were COVID positive and 57 (54.80%) were Non COVID. Majority of the patients of COVID 19 group were in 61-70 years age group, whereas, 51-60 years of age group was most common in Non COVID group. Out of total 104 patients, 63 (60.57%) were males and 41(39.42%) were females. Male predominance was reported in COVID patients as compared to Non COVID group (66.67 v/s 53.19 %). However, no any significant difference was observed regarding gender distribution in two groups (p - 0161).

Table 1: Clinico - epidemiological profile of patients with pneumothorax

Characteristics	COVID 19 (n - 47)	Non COVID19 (n - 57)	p value
Age			
0-10	1 (2.13%)	5 (8.77 %)	
11-20	0 (0%)	5 (8.77%)	
21-30	0 (0%)	5 (8.77%)	
31-40	4 (8.51%)	6 (10.53%)	
41-50	2 (4.26%)	5 (8.77%)	
51-60	8 (17.02%)	15 (26.31%)	
61-70	16 (34.04%)	8 (14.04%)	0.012
71-80	14 (29.79%)	7 (12.28%)	
81-90	2(4.26%)	1 (1.75%)	
91-100	0 (0%)	0 (0%)	
Mean age	66.23 ± 6.75	55.44 ± 5.78	
Gender			
Male	25 (53.19%)	38 (66.67%)	0.1616
Female	22 (46.81%)	19 (33.33%)	
Male: female ratio	1.1: 1	2.1 : 1	
Pneumothorax			
Unilateral	40 (85.11%)	51 (89.47%)	0.5027
Bilateral	7 (14.89%)	6 (10.53%)	

Hypertension (COVID: 63.83%, Non COVID: 22.81%), diabetes mellitus (COVID: 48.94%, Non COVID: 22.81%), sepsis (COVID: 80.85%, Non COVID: 22.81%), AKI (COVID: 27.66%, Non COVID: 10.53%) were major comorbidities among both the group. Trauma was most common cause in Non COVID patients while it was rare in COVID patients (28.07 % v/s 2.12%). In both categories of patients unilateral pneumothorax was more common.

Table 2: Comparison of Comorbidities between two groups

Co morbidities	COVID 19 (n - 47)	Non COVID19 (n - 57)	p value
HTN	30 (63.83%)	13 (22.81%)	0.0002
DM	23 (48.94%)	13 (22.81%)	0.0053
IHD	13 (27.66%)	3 (5.26%)	0.0016
AKI	13 (27.66%)	6 (10.53%)	0.2442
CKD	1 (2.12%)	1 (1.75%)	0.8902
CV Stroke	4 (8.51%)	1 (1.75%)	0.1089
Hypo Thyroid	6 (12.77%)	5 (8.77%)	0.5098
TB	0 (0%)	6 (10.53%)	-
COPD	1 (2.12%)	6 (10.53%)	0.8888
Cancer	1 (2.12%)	3 (5.26%)	0.4079
Sepsis	38 (80.85%)	13 (22.81%)	<0.0001
RTA/Trauma	1 (2.12%)	16 (28.07%)	0.0037
Obesity	1 (2.12%)	0 (0%)	-
Asthma	1 (2.12%)	1(1.75%)	0.8902
Vit. D deficiency	3 (6.38%)	0 (0%)	-
ILD	1 (2.12%)	0 (0%)	-
Pulmonary embolism	2 (4.26%)	0 (0%)	-
No any comorbidities	0 (0.0%)	8 (14.0%)	-

The outcome in the group of patients with Non COVID was better than COVID. The total number of patients who recovered from non COVID pneumothorax were 70.18% and those who expired were 29.82%. However, the COVID patients were having mortality rate of 89.36% and recovery rate of 10.64%.

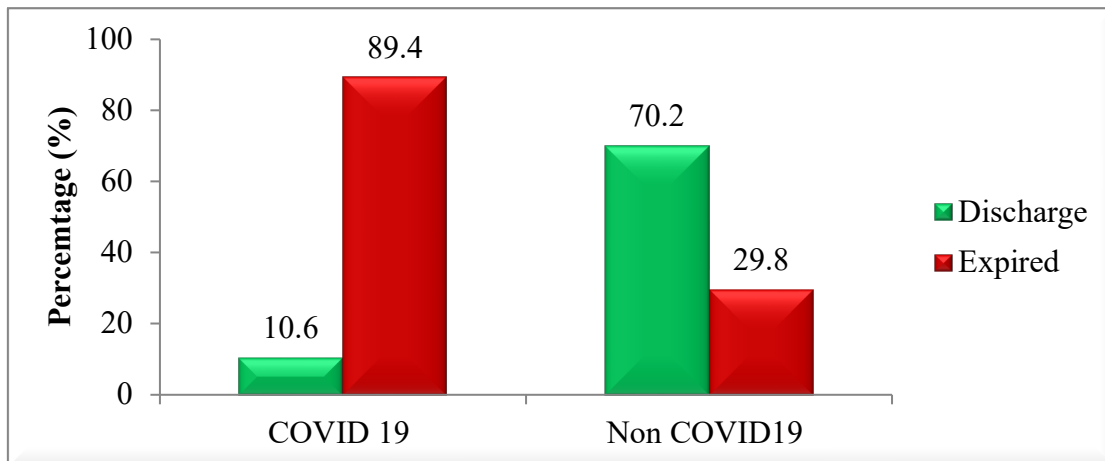


Figure 1: Comparison of mortality rate between two groups

The rate of pneumothorax in male was 0.3968 and females 0.5366 and the risk ratio were 0.7395. Odds value in male was 0.6579 and female 1.1579 with Odds ratio for gender distribution was 0.5682. It means the risk of pneumothorax was equal for male and female rather than preference to any gender. The rate for unilateral was 0.4396 and bilateral 0.8947.

Odds for either unilateral or bilateral pneumothorax were 0.7843 and 8.5 and Odds ratio was 0.0923; The Log Odds was -2.382.

It means, the pneumothorax can be found unilateral or bilateral equally without statically significant difference than preference to any particular site.

Table 3: Standard measures for Rates, Risk Ratio, Odds, Odds Ratio and Log Odds

Variable	Rate	Risk ratio	Odds	Odds ratio	Log Odds
Gender					
Male	0.3968	0.7395	0.6579	0.5682	-0.5653
Female	0.5366		1.1579		
Pneumothorax					
Unilateral	0.4396	0.4913	0.7843	0.0923	-2.383
Bilateral	0.8947		8.5		
Outcome					
Discharges	0.1111	0.1561	0.125	0.0506	-2.9839
Expired	0.7119		2.4706		

Discussion

COVID 19 leading to ARDS may be a cause of pneumothorax. Intense inflammation and fibrinous exudates, along with stiffening of the alveolar walls could contribute to pneumothorax. The present study showed that most common age group of COVID 19 patients with pneumothorax was 61 to 72 years, which aligns with the finding of the of Miro et al.[13] In present study, 53.19 % of patients were male which is similar to the study conducted by Matrinelli et al.[3] who reported a male preponderance of 77.0%. In the present study, it was observed that comorbidities were more common in COVID-19 patients with pneumothorax compared to non-COVID-19 patients. A study conducted by Udwardia et al.[14] also reported that 66% of COVID-19 patients with pneumothorax had comorbidities. The present study found that unilateral pneumothorax was more common, which is similar to the findings of Martinelli et al.[3]

In the present study, we found a mortality rate of 89.36% in COVID-19 patients with pneumothorax. Similar high incidence rates were reported by Udwardia et al.[14] (73.0%) and Martinelli et al.[3] (63.1%). Singh A et al.[15] reported that COVID-19 patients who developed pneumothorax had 2.7 times higher mortality in COVID-19 patients who developed pneumothorax. A mortality rate of 72.2% was observed in COVID-19 patients with pneumothorax. Therefore, we believe that pneumothorax is an independent marker of poor prognosis in COVID-19 patients and is associated with significantly high mortality. High levels of serum CRP and IL-6 are strongly associated with venous thromboembolism, acute kidney injury, critical illness, and mortality in COVID-19 disease. This also additionally explains the poorer prognosis and significantly higher mortality in COVID-19 patients who developed pneumothorax.[16]

The stiff lung due to ARDS, higher incidence of comorbidities, and barotrauma may contribute to the higher mortality in COVID-19 patients with pneumothorax. The intense and on-going inflammation caused by the coronavirus epidemic may have more severe consequences compared to non-COVID diagnoses, especially in cases of trauma. COVID-19 is indeed a significant factor in the development of pneumothorax, which can worsen the prognosis.

The presence of comorbid conditions further increases the severity of the disease. Advanced age is also associated with more severe disease. The use of high flow nasal cannula, bipap therapy, and mechanical ventilation can increase the risk of pneumothorax in COVID patients. Positive pressure ventilation can make patients more susceptible to pneumothorax compared to that not on ventilation. High flow nasal cannula, with its higher oxygen

flow rate of up to 60 liters per minute, can potentially damage inflamed alveoli and lead to pneumothorax.[17] Early detection of the pneumothorax early is crucial for managing COVID patients, as on-going inflammation can worsen during their ICU stay, even after initial bipap or ventilator use. Failure to detect it early can lead to tension pneumothorax and increased mortality.

Conclusion

Pneumothorax in COVID-19 patients is more common in older age groups, often accompanied by comorbidities, and has a higher mortality rate compared to non-COVID-19 patients with pneumothorax. Non-COVID-19 patients generally have better outcomes compared to COVID-19 patients.

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