

# Spontaneous Pneumomediastinum: Clinical Presentation and Outcome in COVID-19 Patients

Javed Mirdad Tarar<sup>1</sup>, Kashif Nadeem<sup>2</sup>, Durre Sadaf Khan<sup>3</sup>, Muhammad Rashid<sup>4</sup>

- 1 *Consultant Thoracic Surgeon, Aseer Central Hospital, Abha Kingdome of Saudi Arabia*  
Data collection
- 2 *Consultant General Surgeon, Prince Mansoor Military Hospital, Taif Kingdome of Saudi Arabia*  
Manuscript writing, Data collection
- 3 *Post Graduate Resident, Department of Hematology, Combined Military Hospital, Multan Pakistan*  
Statistical analysis
- 4 *Consultant Thoracic Surgeon, Armed Forces Hospital, Al-Hada, Taif Kingdome of Saudi Arabia*  
References layout

## CORRESPONDING AUTHOR

**Dr. Kashif Nadeem**  
Consultant General Surgeon, Prince Mansoor  
Military Hospital, Taif Kingdome of Saudi Arabia  
Email: dr.kashif099@yahoo.com

Submitted for Publication: 19-06-2022  
Accepted for Publication 17-10-2022

**How to Cite:** Tarar JM, Nadeem K, Khan DS, Rashid M. Spontaneous Pneumomediastinum: Clinical Presentation and Outcome in COVID-19 Patients. *APMC* 2022;16(4):281-284. DOI: 10.29054/APMC/2022.1375

## ABSTRACT

**Background:** The novel corona virus disease has become the largest global pandemic of this century. Spontaneous Pneumomediastinum is one of the manifestations of COVID-19 patients. The association between PM and COVID-19 is neither well understood nor well studied. Therefore, we decided to conduct a study on COVID-19 patients who developed PM in our institution to elaborate its clinical aspects and outcome. **Objective:** The objective of the study was to establish the association of PM with COVID-19 and to determine its incidence, clinical manifestations and mortality rate. **Study Design:** Retrospective review. **Settings:** Aseer Central Hospital, Kingdom of Saudi Arabia. **Duration:** Eleven months from March 2020 to December 2020. **Methods:** All PCR confirmed COVID-19 patients admitted in our hospital who developed PM were included in our study. Retrospective analysis out their medical records and radiological review was carried out for all such patients. Data of clinical features, associated comorbidities and outcome was collected and descriptive analysis was made. **Results:** A total of 856 patients were admitted with PCR positive results for COVID-19. Out of these, 86(10%) pts developed PM. 93% pts required mechanical ventilation, whereas 7% of pts were spontaneously breathing with high flow nasal cannula oxygen therapy. 61(71%) pts developed concurrent pneumothorax. 58(67.4%) of pts required tube thoracostomy. Overall mortality was 70%(n=60), mainly in the subgroup of mechanically ventilated patients. **Conclusion:** Pneumomediastinum, a rarely seen phenomenon generally, is more frequently encountered in COVID-19 patients. The mortality rate is significantly higher in such patients who require artificial ventilation and have underlying medical comorbidities.

**Keywords:** Pneumomediastinum: PM, Mechanical ventilation: MV, Pneumothorax: PTX, Corona Virus Disease 2019: COVID-19.

## INTRODUCTION

Pneumomediastinum is the accumulation of air in the mediastinal spaces. The most common causes are trauma, positive pressure ventilation, or surgical procedures to the chest. It is also associated with pathologies and instrumentation of oesophagus. It is infrequently seen in respiratory tract viral infections.<sup>1</sup> Corona virus Disease 2019 (COVID-19) is the biggest health challenge of mankind today. Ever since its breakout, many unusual complications associated with it are reported. PM was reported to affect 4% of ARDS patients.<sup>2</sup> There are reports showing increased incidence of PM and PTX in patients of SARS COV-1 outbreak in 2003.<sup>3</sup> Incidence, clinical features and mortality of PM

associated with COVID-19 in not fully understood as only a few case reports are available in this context to date.<sup>4</sup>

Therefore, we decided to conduct a study by reviewing the medical charts of COVID patients who developed PM. Detailed review of their Radiological investigations was included in our study. Our purpose was to establish the association of PM with COVID-19 and to determine its incidence, clinical manifestations and mortality rate.

## METHODS

Retrospective review of the medical records of PCR confirmed COVID 19 patients was carried out in our study. Only those patients were included who had radiologically Pneumomediastinum either on CXR or CT scan. 86 patients qualified this inclusion criteria out of

total 856 COVID 19 positive hospitalized patients in our institution. Univariate analysis was used to assess the data of these patients. Chi-square test and student t-test were used for comparison of categorical and continuous variables respectively. Statistical analyses were performed using 26.0 SPSS version.

## RESULTS

A total of 856 patients with COVID 19 were admitted in our hospital from March 2020 to December 2020. These patients were tested with nasopharyngeal swabs and positive PCR results were utilized to label them harbor Corona Virus 19. Out of these, 86(10%) patients were found to have PM either on Chest X-ray or CT imaging and were included in our study. These patients ranged from 45 to 81 years of age with median 58.7 years. 80% of these patients were males whereas 20% were females. Most prevalent subgroup was 60-70 years of males with underlying other medical comorbidities. 80(93%) pts required intubation and mechanical ventilation during their hospital stay. These artificially ventilated patients required high settings with median FiO<sub>2</sub>: 80% , PEEP : 15, RR : 22 and TV : 470 ml. 95%(n=82) pts had underlying medical comorbidities including Diabetes, Hypertension, End stage renal disease, morbid obesity with BMI ≥ 30 and Chronic Liver disease.

**Table 1: Demographics**

Variable		Patients	Percentage
Age		45-81 Years	Median = 58.7
Gender	Male	69	80%
	Female	17	20%
Requirement of Ventilation		80	93%
Comorbidities	DM	59	68.60%
	HTN	53	61.62%
	ESRD	7	8%
	Obesity	29	33.72%
	CLD	16	18.60%

61(71%) pts developed either concomitant or concurrent pneumothorax. Almost all of these patients were on ventilator and were complexed with other medical comorbid conditions. 29%(n=25) pts had isolated Pneumomediastinum and all of these patients belonged to spontaneously breathing subgroup. The patients of PM with associated pneumothorax, 67.44% cases required intercostal tube insertion, whereas none of the patients with isolated PM required tube thoracostomy. 60 patients died and the overall mortality was 70%. This mortality was highest in the subgroup of mechanically ventilated patients.

**Table 2: Mortality**

Group	Number of Patients	Mortality Percentage %
Mechanically Ventilated	57	66.2%
Spontaneously Breathing	3	3.48%
Overall Mortality	60	70%

**Figure 1: COVID pneumomediastinum**

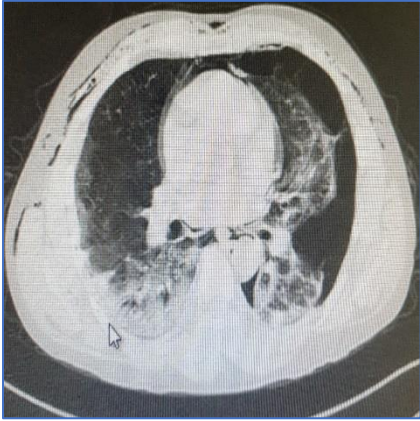
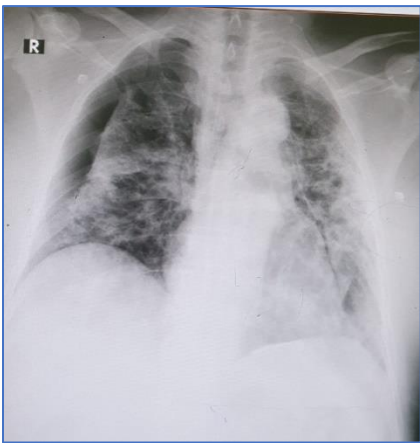
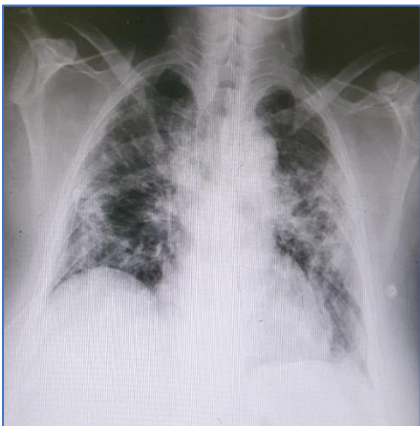


**Figure 2: COVID pneumonia**



**Figure 3: COVID pneumothorax (CT chest: Coronal view)**



**Figure 4: COVID pneumothorax (CT Chest: Axial view)****Figure 5: COVID Pneumothorax on Chest X-ray****Figure 6: Pneumothorax resolved after chest tube placement**

## DISCUSSION

Although relatively rare entity, Spontaneous Pneumomediastinum (SP) is seen with increased incidence in H<sub>1</sub>N<sub>1</sub> viral pneumonias.<sup>5</sup> 123 patients were reported to have SP in year 2002 during the SARS outbreak.<sup>6</sup> The chances to contract this condition in viral pulmonary infection increases many folds if the patient

requires mechanical ventilation. The underlying factors including mechanical injury, hypercoagulability and exaggerated inflammatory and deranged immune response all play role in the development of PM.<sup>7</sup> Consequently, the morbidity increases in direct proportion and mortality is higher in such patients.

The exact mechanism involved in the development of PM in these patients is yet to be elaborated. However, it is thought to be due to the barotrauma inflicted by high airway pressures against the least compliant lungs of COVID-19 patients. Alveolar damage found on autopsy of such patients strongly justifies this theory.<sup>8</sup>

## PATHOGENESIS

Resultant to the high pressure/volume controlled mechanical ventilatory strategies, alveolar injury occurs with is the main culprit in development of this pathology. After this, the free air enters the interstitial tissue spaces where it may either be retained as primary interstitial emphysema or continue to dissect along the peribronchial/perivascular sheaths towards the hilum of lung. This air can assemble to form Pneumomediastinum there. Furthermore, rupture of pleura may result in pneumothorax or this air may track along the visceral and parietal pericardium to result in Pneumopericardium.<sup>9</sup> Tracheal edema associated with intubation, manipulation of endotracheal tube and frequent vigorous suctioning are additional contributory factors to this condition.<sup>10</sup> Maclin effect, although originally described in trauma patients, may be postulated for the development of PM in COVID-19 patients.<sup>11-13</sup>

10% of our intubated patients with COVID-19 developed PM. It is in accordance with the findings of Dick AK *et al.*<sup>14</sup> Few other reports also show similar incidence of PM associated with SARS-COV 1 patients.<sup>15,16</sup>

We found that spontaneously breathing patients managed with high flow nasal canula (HFNC) oxygen therapy did not require chest tube insertion for their isolated PM. These patients never exhibited any compressive mediastinal symptoms and hence were improved with conservative medical management. Similar results were recorded by others where conservative management was found to be a reasonable approach in patients with isolated PM.<sup>14</sup>

Pneumothorax is a well-established sequel of PM in ARDS patients.<sup>15</sup> The occurrence of this incidence in previous studies was around 35%. This is in contrary to our findings where this incidence is almost double. This significantly increased ratio could either be attributed to the fact that COVID-19 viral pneumonia leads to more lethal pulmonary damage. Moreover, increased incidence of mechanical ventilation coupled with high settings



could be the strong underlying factors for this high rate of pneumothorax in our study.

The mortality rate in our study was 70%. Similar high mortality rate of over 60% was recorded in a report from different health systems in N.Y city summarizing the outcome of 5279 COVID-19 patients. Our results showed high mortality in patients with concomitant pneumothorax who were mechanically ventilated and had multiple underlying comorbidities. Richardson S *et al* had likewise observations as they quoted similar high mortality rates in their findings.<sup>16</sup>

## CONCLUSION

PM, although seen rarely in other historical viral pneumonias, is encountered more frequently in COVID-19 patients. Mechanical ventilation, surgical trauma and underlying medical comorbidities contribute to high mortality in COVID-patients who developed Pneumomediastinum.

## LIMITATIONS

This study is done in single center, so no limitations found.

## SUGGESTIONS / RECOMMENDATIONS

Prompt and early diagnosis of Pneumomediastinum in COVID-19 patients is warranted in order to reduce mortality.

## CONFLICT OF INTEREST / DISCLOSURE

No conflict of interest of any authors are found.

## ACKNOWLEDGEMENTS

We are obliged to all patients and my colleagues who participated in this study.

## REFERENCES

1. Brander L, Ramsay D, Dreier D, Peter M, Graeni R. Continuous left hemidiaphragm sign revisited: a case of spontaneous pneumopericardium and literature review. *Heart*. 2002 Oct;88(4):e5.

2. Weg JG, Anzueto A, Balk RA, Wiedemann HP, Pattishall EN, Schork MA, et al. The relation of pneumothorax and other air leaks to mortality in the acute respiratory distress syndrome. *N Engl J Med*. 1998 Feb 5;338(6):341-6.
3. Yam LY, Chen RC, Zhong NS. SARS: ventilatory and intensive care. *Respirology*. 2003 Nov;8 Suppl(Suppl 1):S31-5.
4. Wang J, Su X, Zhang T, Zheng C. Spontaneous Pneumomediastinum: A Probable Unusual Complication of Coronavirus Disease 2019 (COVID-19) Pneumonia. *Korean J Radiol*. 2020 May;21(5):627-628.
5. Singh BP, Shetty GS, Vijayan PA, Gopalakrishna U, Chandan G, Santini A, et al. Management of Pneumomediastinum Associated with H1N1 Pneumonia: A Case Report. *J Crit Care Med (Targu Mures)*. 2019 Feb 4;5(1):28-33.
6. Chu CM, Leung YY, Hui JY, Hung IF, Chan VL, Leung WS, et al. Spontaneous pneumomediastinum in patients with severe acute respiratory syndrome. *Eur Respir J*. 2004 Jun;23(6):802-4.
7. Akhmerov A, Marbán E. COVID-19 and the Heart. *Circ Res*. 2020 May 8;126(10):1443-1455.
8. Fox SE, Akmatbekov A, Harbert JL, Li G, Quincy Brown J, Vander Heide RS. Pulmonary and cardiac pathology in African American patients with COVID-19: an autopsy series from New Orleans. *Lancet Respir Med*. 2020 Jul;8(7):681-686.
9. Lee YJ, Jin SW, Jang SH, Jang YS, Lee EK, Kim YJ, et al. A case of spontaneous pneumomediastinum and pneumopericardium in a young adult. *Korean J Intern Med*. 2001 Sep;16(3):205-9.
10. Wali A, Rizzo V, Bille A, Routledge T, Chambers AJ. Pneumomediastinum following intubation in COVID-19 patients: a case series. *Anaesthesia*. 2020 Aug;75(8):1076-1081.
11. Ye Q, Wang B, Mao J. The pathogenesis and treatment of the 'Cytokine Storm' in COVID-19. *J Infect*. 2020 Jun;80(6):607-613.
12. Murayama S, Gibo S. Spontaneous pneumomediastinum and Macklin effect: Overview and appearance on computed tomography. *World J Radiol*. 2014 Nov 28;6(11):850-4.
13. Macklin MT, Macklin CC. Malignant interstitial emphysema of the lungs and mediastinum as an important occult complication in many respiratory diseases and other conditions: an interpretation of the clinical literature in the light of laboratory experiment. *Medicine*. 1944 Dec 1;23(4):281-358.
14. Kangas-Dick A, Gazivoda V, Ibrahim M, Sun A, Shaw JP, Brichkov I, et al. Clinical Characteristics and Outcome of Pneumomediastinum in Patients with COVID-19 Pneumonia. *J Laparoendosc Adv Surg Tech A*. 2021 Mar;31(3):273-278.
15. Peiris JS, Chu CM, Cheng VC, Chan KS, Hung IF, Poon LL, et al. Clinical progression and viral load in a community outbreak of coronavirus-associated SARS pneumonia: a prospective study. *Lancet*. 2003 May 24;361(9371):1767-72.
16. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. *JAMA*. 2020 May 26;323(20):2052-2059.