Pneumothorax with coronavirus disease 2019 in non-ventilated patients: a single-center retrospective case series

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July 11, 2021

Abstract

Of the 1061 patients of coronavirus disease-2019 admitted to our field hospital, eight patients (0.75%) had pneumothorax. The mean age of incidence was 79.9 years; six of these patients (75%) died. Although pneumothorax is a rare complication of coronavirus disease-2019, it suggests a poor prognosis in elderly patients.

Introduction

Since the end of 2019, severe acute respiratory distress syndrome coronavirus 2 (SARS-CoV-2) has spread worldwide. More than 1 billion people have been affected, and more than 2.5 million people have died^{1.}

Although it is a rare complication, some cases of pneumothorax in coronavirus disease (COVID-19) have been reported. Generally, barotrauma of the ventilator is considered to be a well-known cause of pneumothorax, with diffuse alveolar injury due to pneumonia contributing to it. In February 2020, under the governance of Kanagawa prefecture, Japan, we started the treatment of COVID-19 patients, and in May 2020, we made a field hospital for COVID-19 patients. Patients who needed intubation were sent to another hospital that treated severely ill patients. This is the first report on the incidence and clinical features of patients with pneumothorax among non-ventilated patients with COVID-19, excluding the influence of a ventilator.

Case history/examination

This was a single-center, retrospective, observational case series. An isolated field hospital for COVID-19 patients was constructed in Kanagawa prefecture next to Shonan Kamakura General Hospital, which managed this temporary hospital. The target patients were patients with and without oxygen demand but were elderly, having underlying disease that can be considered as risks of COVID-19 including pulmonary disease, cardiovascular disease, chronic kidney disease, diabetes mellitus, and others ² ³. Patients requiring intubation were transferred to other hospitals that were specialized in the treatment of severely ill patients. Patients who did not wish to undergo intubation stayed at this hospital.

Differential diagnosis, investigations and treatment

The COVID-19 patients were diagnosed using polymerase chain reaction (PCR) test or quantitative antigen test. All patients underwent computed tomography (CT) at admission and on demand by the physicians. The medications for pneumonia included dexamethasone, remdesivir, and favipiravir. We used nasal cannula, oxygen mask, and high-flow nasal cannula (HFNC), but did not use ventilator or noninvasive positive pressure ventilation (NPPV). The diagnosis of pneumothorax was made using chest radiography (Figure 1) or CT

(Figure 2). The requirement for obtaining informed consent from patients was waived due to the retrospective nature of the study. Patients were allowed to withdraw from the study at any time.

Outcome and follow-up

Of the 1061 patients, 599 were men and 462 were women. The average age of the patients was 68.4 (16-103) years, and they were admitted to this field hospital between May 18, 2020 and February 28, 2021. The number of patients with pneumothorax was eight (three men and five women; Table 1), with an incidence of 0.75%. All patients had preceding pneumonia on CT at admission, except for a young patient (no. 8) who was considered to have complicated primary spontaneous pneumothorax. All patients were over 80 years old, except for one woman, who was 20 years old. At the time of diagnosis of pneumothorax, four patients were administered oxygen with a nasal cannula, and the other four were not administered oxygen. The mean age of patients with pneumothorax was 79.9 (20-96) years. Considering the laterality of pneumothorax, six were on the left side, and two on the right. Four patients required tube drainage and the other four were managed with conservative measures.

Six of the eight patients died (75%) after an average of 9.3 (1-32) days from the onset of pneumothorax. All patients who died did not consent to intubation or resuscitation, although they received conservative therapy including the administration of oxygen, remdesivir, favipiravir, antibiotics, anticoagulants, steroids, and nutrition therapy. The mean duration between onset of COVID-19 and pneumothorax was 20.3 (4-37) days. Two patients were current smokers and two were past smokers. The smoking status of the other four patients was unknown. Two patients had a history of chronic obstructive pulmonary disease. Six of the eight patients were administered dexamethasone and the onset of pneumothorax occurred after an average of 19.8 (3-32) days from its initiation. With age limited to over 80 years, the mortality in COVID-19 pneumothorax patients was high (85.7%, six of seven).

Discussion

Spontaneous pneumothorax is believed to be caused by the rupture of alveoli, although the precise cause is unknown. It may be a direct rupture or via the mediastinum^{4.} In secondary spontaneous pneumothorax, weakness of the alveoli due to emphysema or necrotic pneumonia can be a cause of pneumothorax⁵. Acute respiratory distress syndrome is also a cause of secondary pneumothorax⁶ in addition to mechanical ventilation. Among COVID-19 patients, 1%-2% had pneumothorax^{7,8}. Zantah reported six patients with pneumothorax, and four of them were under mechanical ventilation⁹. Martinelli reported 38 patients with invasive ventilatory support among 71 patients with pneumothorax¹⁰.

At our institute, the incidence of pneumothorax was 0.75% (8/1061). Patients in this hospital were not ventilated in principle because of divided hospital function in moderately ill patients, as per the policy of the prefectural government. We did not use NPPV for infection control. None of the patients with pneumothorax used HFNC; therefore, we can exclude the influence of barotrauma. Alternatively, the main cause of the pneumothorax could be alveolar weakness, as all patients except one young woman were over 80 years of age, and due to the high rate of steroid use (75%) and alveolar injury due to pneumonia. The limitation of this study is the small number of patients with pneumothorax in single institution, due to which we could not identify the risk factors of pneumothorax.

In acute Middle East respiratory syndrome, pneumothorax is associated with a poor prognosis¹¹. Martinelli et al. reported that the mortality rate of COVID-19 was significantly higher in patients over 70 years of age than in those < 70 years of age¹⁰. At our institute, the overall mortality was 7.26% (77/1061), and that of patients over 80 years of age was 18.3% (61/334). The mortality rate of patients with pneumothorax over 80 years of age was as high as 85.7% (6/7). In conclusion, although pneumothorax is a rare complication, it can be a predictive factor of poor prognosis in elderly patients with COVID-19. Further studies including autopsy is required to clarify the relation between pneumothorax, COVID-19, and underlying diseases.

Acknowledgements

We are grateful to Mr. Kenta Ebisawa who managed this temporary field hospital, and all past and present workers.

Disclosure

Approval of the research protocol: This retrospective study was approved by the ethics committee of Shonan Kamakura General Hospital.

Informed consent: The requirement for obtaining informed consent from patients was waived due to the retrospective nature of the study. Patients were allowed to withdraw from the study whenever they wished.

Registry and the registration no. of the study: N/A

Animal studies: N/A

Conflict of interest: None

Author Contributions: JK contributed to writing article; HK, YA, TK, HY, and SH contributed to conception and revision of article; CI, RS, NI, KM, TM, TN, YS, and YI contributed to data collection and patient care; and RF and HK contributed to manuscript review.

Data Sharing and Data Accessibility:

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Table 1 Clinical features of pneumothorax patients in coronavirus disease

No	Age	Sex	History	Smoking	Pneumon	O2 iá(L/min)	side	ICD	Days from COVID- 19 onset	Dex	Days from Dex initiation	I
1	89	М	Parkinson HT	unknown	+	4	right	-	19	+	26	ċ
2	82	М	HT COPD	past	+	-	right	+	11	-	-	а
3	88	\mathbf{F}	HT TB dementia	unknown	+	-	right	-	4	+	3	Ċ
4	96	F	HT COPD	unknown	+	-	right	-	37	+	32	Ċ
5	94	F	Dementia tSAH	unknown	+	0.5	left	+	35	+	30	Ċ
6	88	\mathbf{F}	Asthma CHF B A	none	+	0.5	right	+	20	+	21	Ċ
7	82	М	Prostate	past	+	1	right	+	22	+	7	Ċ
8	20	F	none	none	-	-	left	-	14	-	-	а

COVID-19: coronavirus disease, HT: hypertension, COPD: chronic obstructive pulmonary disease, CHF: congestive heart failure, RA: rheumatoid arthritis, Dex: dexamethasone, tSAH: traumatic subarachnoid hemorrhage, ICD: intercostal drain, TB: tuberculosis

Figure Legends

Figure 1 Chest radiograph of pneumothorax in coronavirus disease (patient no. 1)

Figure 2 Computed tomography of pneumothorax in coronavirus disease (patient no. 5)



