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Original Article

Is it a coincidence that COVID-19 and pneumothorax coexist?

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ABSTRACT

Background: We aimed to investigate the relationship between COVID-19 and pneumothorax by examining patients who developed pneumothorax during the treatment of COVID-19 infection, and patients who were diagnosed with COVID-19 infection during hospitalization procedures due to pneumothorax.

Materials and Methods: We retrospectively analyzed patients who were hospitalized due to COVID-19 infection and developed pneumothorax, and patients who were hospitalized for pneumothorax with a positive COVID-19 test performed during hospitalization procedures, between May 2020 and January 2021. We recorded the demographic, clinical and radiological characteristics of the patients; treatment modalities, and response times to treatment. We investigated the relationship between COVID-19 infection and pneumothorax.

Results: Of the 25 patients included in the study, 20 (80%) were male and 5 (20%) were female. The average age was 45 (17-77). Sixteen (64%) had thoracic computerized tomography findings consistent with COVID-19. Bilateral pneumothorax was observed in three (12%) patients. Pneumothorax was seen in 7 (28%) patients during mechanical ventilation. Tube thoracostomy with wet suction control closed-drainage system was applied to all patients. The average length of stay in the hospital was 7.8 (3-20) days. Recurrent pneumothorax developed in two (8%) patients after discharge, while the mortality rate was 12%.

Conclusions: In patients with COVID-19 pneumonia, pneumothorax due to mechanical ventilation can develop, as well as pneumothorax can be observed even in asymptomatic COVID-19 cases. This condition needs immediate recognition and prompt treatment as a life-threatening event in COVID-19 patients.

Keywords: COVID-19, pneumothorax, SARS-CoV-2, tube thoracostomy

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Introduction

On March 11, 2020, WHO declared COVID-19 a pandemic due to the increased number of cases and countries affected and the risk of global spread. The clinical course of COVID-19 ranges from mild symptoms and even asymptomatic cases to severe illness [1,2].

Since the first COVID-19 cases were identified, pneumothorax has been considered a possible complication or association, although it is rare. In some retrospective studies on COVID-19, pneumothorax was observed in 1% of patients requiring hospitalization and in 2% of patients requiring intensive care unit admission [3,4]. A study conducted in 16 enters in UK compared the number of pneumothorax encountered during the pre-COVID-19 period with the COVID-19 pandemic period, and reported that pneumothorax could be a complication of COVID-19 infection, based on the number of pneumothorax that increased significantly during the pandemic period [3,5].

Pneumothorax is a life-threatening event that requires immediate diagnosis and treatment. If it occurs as a complication of an underlying lung disease, it is defined as secondary spontaneous pneumothorax. Pulmonary diseases associated with pneumothorax include emphysema, cystic fibrosis, granulomatous inflammation, necrotizing pneumonia, pulmonary fibrosis, eosinophilic granulomatous disease, lung cancer and sarcoidosis which cause fibrotic and/or cystic changes in the lung parenchyma.

Pneumothorax may also develop in mechanically ventilated patients due to high local pressure disrupting the lung tissue [6]. The use of mechanical ventilation is a risk factor for the development of pneumothorax in COVID-19 patients, and it has also been reported that pneumothorax is poor prognostic in COVID-19 patients undergoing mechanical ventilation [7]. However, there are studies showing that pneumothorax develops even in patients who do not have an underlying lung disease and do not need mechanical ventilation [5,8,9]. Although the mechanism of spontaneous pneumothorax of COVID-19 cannot be fully explained, it is thought to be associated with alveolar membrane damage [10,11].

We aimed to investigate the relationship between COVID-19 and pneumothorax by examining patients who developed pneumothorax while the treatment of COVID-19 infection was continuing, and patients who were diagnosed with COVID-19 infection during hospitalization procedures due to pneumothorax.

Materials and Methods

This study is a single center retrospective study. The study was conducted in accordance with the principles of the Declaration of Helsinki. Written permissions were obtained for this study from the Scientific Study Committee and Republic of Turkey Ministry of Health. All patients with a diagnosis of pneumothorax who received treatment between May 2020 and January 2021, who had a positive COVID-19 PCR test result and/or had thoracic computerized tomography (CT) findings specific to COVID-19 infection were included in the study. Two patients who did not come for control after discharge and were not followed-up were excluded from the study. The demographic characteristics, comorbidities, smoking habits, clinical and radiological characteristics of the patients, the types of treatment applied, the response times to the treatment and the three-month follow-up period after discharge were recorded.

Results

Of the 25 patients included in the study, 20 (80%) were men and 5 (20%) were women and the average age is 45 (17-77). Eighteen (72%) had no history of additional disease. While 5 (20%) patients had diabetes, hypertension and/or coronary artery disease, only 2 (8%) patients had a history of chronic obstructive pulmonary disease (COPD). Twelve (48%) patients had no smoking history. Nine (36%) patients were active smoker and 4 (16%) patients were ex-smoker.

Nine of the patients (36%) had no CT findings compatible with COVID-19, and 16 (64%) had CT findings compatible with COVID-19.

Right pneumothorax was seen in 15 (60%) patients, and left pneumothorax in 7 (28%) patients; Bilateral pneumothorax was seen in 3 (12%) patients. The first pneumothorax attack was in 22 (88%) patients and only 3 (12%) patients had a history of previous pneumothorax. Pneumothorax was seen in 7 (28%) patients during mechanical ventilation. No mechanical ventilation was applied to 18 (72%) patients. Eight (32%) patients developed pneumothorax without any additional disease, smoking history or previous pneumothorax.

Tube thoracostomy was performed in all patients, and video-assisted thoracoscopic surgery (VATS) was

performed in 4 (16%) patients for prolonged air leak or recurrent pneumothorax. Average expansion time after tube thoracostomy was 3.2 (1-10) days. The average time for air leak was 4.76 (1-17) days. Tube thoracostomy termination time was 6 (2-20) days on average, but 3 patients who died when tube thoracostomy was not yet terminated were not included in this mean. The average length of stay in the hospital was 7.8 (3-20) days.

Recurrent pneumothorax developed in 2 (8%) patients after discharge, while the total mortality rate was 12%. The clinical and radiological characteristics of the patients, treatment methods applied, recurrence and mortality after treatment are summarized in table1 and durations related to treatment response and prognosis are summarized in table 2.

Table1. Clinical and radiological characteristics of the patients, treatment methods applied, recurrence and mortality after treatment.

	N=25	%
Gender		
Male	20	80
Female	5	20
Mechanical ventilation		
Yes	7	28
No	18	72
Finding about COVID-19 in CT		
Yes	16	64
No	9	36
Treatment		
TT	21	84
TT +VATS	4	16
Attack		
First	22	88
Recurrent	3	12
Mortality		
Yes	3	12
No	22	88

Abbrev.; CT: computarized tomography, TT: Tube thoracostomy, VATS: Video-assisted thoracoscopic surgery

Table 2. Average values of the times related to response to treatment and prognosis.

Air leak time (days)	4.76 (1-17)
Expansion time (days)	3.2 (1-10)
TT termination time (days)	6 (2-20)
Hospitalization time (days)	7.8 (3-20)

Abbrev.; TT: Tube thoracostomy

Discussion

Pneumothorax associated with severe acute respiratory syndrome coronavirus 2 (SARS- CoV-2) has been identified in the literature as a rare potential complication, with a rate of one percent in some studies examining patients with COVID-19 infection [3,4,12,13].

The mechanism of spontaneous pneumothorax in patients with COVID-19 infection is thought to be associated with alveolar membrane damage caused by cystic and fibrotic changes in the lung parenchyma [10,11].

This relationship may also be secondary to the underlying undiagnosed bullous lung disease [14]. Other possible trigger factors are mechanical ventilation and prolonged cough, which is a common symptom of COVID-19 disease [3,10,15]. McGuinness et al [7] reported a 15% rate of barotrauma, including both pneumothorax and pneumomediastenes, in patients undergoing mechanical ventilation . Aiodfi et al [16] reported two patients who developed pneumothorax during mechanical ventilation for COVID-19 pneumonia. Ucpinar et al [17] reported that some patients with COVID-19 developed pneumothorax associated with risk factors such as mechanical ventilation, while viral pneumonia itself as the only factor in the development of pneumothorax in some patients. A multicenter study reported that out of 1619 patients with a confirmed diagnosis of COVID-19, 22 (1.4%) observed spontaneous pneumothorax and 50% of patients were not mechanically ventilated when diagnosed with pneumothorax [9]. Similarly, in 18 (72%) of the 25 patients we examined in our study, no mechanical ventilation was applied. In a study conducted with 71 patients reported from 16 centers in England, hey revealed the association of COVID-19 pneumonia and pneumothorax even in patients who had no previous lung disease and did not need mechanical ventilation [5]. Similar to the literature, our study showed that pneumothorax can be observed in asymptomatic COVID-19 cases, as well as patients with COVID-19 pneumonia can develop pneumothorax due to mechanical ventilation. As understood from the literature, most of the reported cases of pneumothorax associated with COVID-19 do not have traditional risk factors or underlying predisposing lung disease [17,18]. In our study, coexistence of COVID-19 pneumonia with pneumothorax was observed in 8 (32%) patients who did not have any additional disease, smoking history, or history of previous pneumothorax and who

were not mechanically ventilated. In the study conducted with 71 patients reported from 16 centers in England, they stated that pneumothorax was not an independent marker for poor prognosis in the coexistence of COVID-19 and pneumothorax [5]. However, there are also studies suggesting that this association is a serious prognostic marker [7,19,20]. In our study, three patients who developed pneumothorax while being followed up in the intensive care unit due to COVID-19 infection, rapidly worsening the general condition within two days and the death of these three patients support the view that pneumothorax is a poor prognostic for COVID-19 infection. In addition, prolonged air leak in four patients and recurrent pneumothorax development in two patients in the first month after discharge suggest that COVID-19 infection is a poor prognostic factor for pneumothorax. In our study, 36% of the patients had no thoracic CT findings compatible with COVID-19, suggesting that the asymptomatic COVID-19 infection in these patients may have been diagnosed incidentally due to spontaneous pneumothorax. In patients with suspected COVID-19, pneumothorax should be considered as a cause of acute decompensation that may worsen the prognosis. COVID-19 patients treated with non-invasive and invasive forms of mechanical ventilation require close monitoring, as the risk of ventilator-associated pneumothorax may be increased [21]. Management of pneumothoraces in these patients is very important to prevent the development of potentially life-threatening tension pneumothoraces. The limitation of our study is that it is a single center study and the number of patients is small. It is aimed to be a guide for more studies on the subject. Future multi-center studies are needed to better understand the relationship between pneumothorax and COVID-19, and to contribute to prognosis and treatment.

In conclusion, pneumothorax is a possible complication of COVID-19 pneumonia. It may develop due to mechanical ventilation or can be observed in asymptomatic COVID-19 cases and it should be considered in the differential diagnosis for COVID-19 patients who develop sudden respiratory decompensation. As a life-threatening event, it needs immediate recognition and prompt treatment.

Declaration of conflicting interests

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Ethics approval

Approval was obtained from the Local Ethics of

Authors' contribution

SB; conceptualized and drafted the article, wrote the paper MA,PE,SKM; drafted the article, collected and analyzed data, ALA,SVB; collected data.

References

1. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, Wang B et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020; 323: 1061-9.
2. Berlin DA, Gulick RM, Martinez FJ. Severe Covid-19. N Engl J Med. 2020; 383: 2451-60.
3. Chen N, Zhou M, Dong X, Qu J,Gong F, Han Y, Qui Y et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020; 395: 507-13.
4. Yang X, Yu Y, Xu J, Shu H, Xai Ji Lui H, Wu Y et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med 2020; 8 :475-81.
5. Martinelli AW, Ingle T, Newman J, Nadeem I, Jackson K, Lane ND. COVID-19 and pneumothorax: a multicentre retrospective case series. Eur Respir J 2020; 56: 2002697.
6. McCool FD. Diseases of the diaphragm, chest wall, pleura and mediastinum. In: Goldman L, Schafer AI, editors. Goldman- Cecil medicine. 26th ed. Philadelphia: Elsevier; 2020. p.602-12.
7. McGuinness G, Zhan C, Rosenberg N, Azour L, Wickstorm M, Mason DM, Thomas KM et al. High incidence of barotrauma a in patients with COVID-19 infection on invasive mechanical ventilation. Radiology 2020: 297; E252-E262.
8. Wang W, Gao R, Zheng Y, Jiang L. COVID-19 with spontaneous pneumothorax, pneumomediastinum and subcutaneous emphysema. J Travel Med 2020; 27: taaa062.
9. E Ekanem, S Podder, N Donthi, H Bakhshi, J Stodghill, S Khandhar, A Mahajan, M Desai. Spontaneous pneumothorax: An emerging complication of COVID-19 pneumonia. Heart Lung 2021; 50: 437-40.

10. Zhou C, Gao C, Xie Y, Xu M. COVID-19 with spontaneous pneumomediastinum. Lancet Infect Dis 2020; 20: 510.

11. Liu K, Zeng Y, Xie P, Ye X, Xu G, Liu J, Wang H et al. COVID-19 with cystic features on computed tomography: a case report. Medicine (Baltimore). 2020; 99: e20175.

12. Yang F, Shi S, Zhu J, Shi J, Dai K, Chen X. Analysis of 92 deceased patients with Covid-19. J Med Virol 2020; 92: 2511-15.

13. Salehi S, Abedi A, Balakrishnan S, Gholamrezanezhad A. Coronavirus disease 2019 (COVID-19): a systematic review of imaging findings in 919 patients. AJR Am J Roentgenol 2020; 215: 87-93.

14. Noppen M. Spontaneous pneumothorax: epidemiology, pathophysiology and cause. Eur Respir Rev 2010; 19: 217-9.

15. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, Liu L et al. Clinical characteristics of coronavirus disease 2019 in China. New Engl J Med 2020; 382: 1708-20.

16. Aiolfi A, Biraghi T, Montisci A, Bonitta G, Micheletto G, Donatelli F, Cirri S et al. Management of persistent pneumothorax with Thoracoscopy and blebs resection in COVID-19 patients. Ann Thorac Surg 2020; 110: e413-e415.

17. Ucpinar BA, Sahin C, Yanc U. Spontaneous pneumothorax and subcutaneous emphysema in COVID-19 patient: case report. J Infect Public Health 2020; 13: 887-9.

18. Flower L, Carter JPL, Lopez JR, Henry AM, 2020. Tension pneumothorax in a patient with COVID-19. BMJ Case Rep 2020; 13: e235861.

19. López Vega JM, Parra Gordo ML, Diez Tascón A, Ossaba Vélez S. Pneumomediastinum and spontaneous pneumothorax as an extrapulmonary complication of COVID-19 disease. Emerg Radiol 2020;27: 727-30.

20. Das KM, Lee EY, Al Jawder SE Enani MA, Singh R, Skakni L, Al-Nakshabandi N et al. Acute Middle East respiratory syndrome coronavirus: temporal lung changes observed on the chest radiographs of 55 patients. JR Am J Roentgenol 2015; 205: W267–S274.

21. Quincho-Lopez A, Quincho-Lopez DL, Hurtado-Medina FD. Case Report: Pneumothorax and Pneumomediastinum as Uncommon Complications of COVID-19 Pneumonia: Literature Review. Am J Trop Med Hyg 2020; 103: 1170-6.

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