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Entübe Edilmemiş COVID-19 Hastalarında Spontan Pnömotoraks İnsidansı ve Klinik Özellikleri

Spontaneous Pneumothorax Incidence and Clinical Features in Non-Intubated COVID-19 Patients

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ÖZ

Giriş: Bu çalışmada COVID-19 enfeksiyonu nedeniyle tedavi gören hastaların pnömotoraks insidansını ve sonuçlarını gözden geçirmeyi amaçladık.

Yöntem: 01 Nisan 2020 ile 01 Ocak 2021 tarihleri arasında COVID-19 semptomları ile acil servise başvuran toplam 41.525 vaka incelendi. Bu hastalardan 14.611'i hastaneye yatırıldı. PA akciğer grafisi ile spontan pnömotoraks (SP) tanısı alan hastaların klinik ve laboratuvar özellikleri değerlendirilerek çalışmaya dahil edildi

Bulgular: Çalışmaya SP tanısı alan ve PCR testi pozitif çıkan toplam 11 olgu dahil edildi. Bu olguların 8'i erkek, 3'ü kadındı. Yaş dağılımı 50-84 ve ortalama yaş 66,5 idi. Hiçbir olgumuz tanı öncesinde invaziv veya non-invaziv mekanik ventilasyon almamıştı. En sık görülen komorbiditeler kronik obstrüktif akciğer hastalığı (6/11) ve hipertansiyon (2/11) idi. Pnömotoraks altı olguda sağ, dört olguda sol taraflıydı. Bir olguda eş zamanlı olarak bilateral idi.

Sonuç: Spontan pnömotoraks, COVID-19 hastalarında nadir görülen bir durumdur ve patofizyolojik mekanizmaları halen bilinmemektedir. Entübe edilmemiş COVID-19 hastalarında spontan pnömotoraks insidansı, COVID-19 dışındaki vakalarda bildirilen rakamlara göre yaklaşık 10 kat daha sıktır. Bu sonuç, COVID-19 enfeksiyonuna ikincil sekonder SP insidansının beklenenden çok daha yüksek olduğunu göstermektedir.

Anahtar Kelimeler: COVID-19, pnömotoraks, viral pnömoni, tüp torakostomi, akciğer hastalığı

ABSTRACT

Objective: In this study, we aimed to review the pneumothorax incidence and results of patients receiving treatment due to COVID-19 infection.

Method: A total of 41,525 cases who were admitted to the emergency department between 01 April 2020 and 01 January 2021 with COVID-19 symptoms were reviewed. Of these patients 14,611 were hospitalized. Clinical and laboratory features of patients who had been diagnosed with spontaneous pneumothorax with PA chest radiography were evaluated and included in the study.

Results: A total of 11 cases who were diagnosed with spontaneous pneumothorax and had a positive PCR test were included in the study. Of these cases, 8 were male and 3 were female. The age distribution was 50-84 and the mean age was 66.5 years. None of our cases had received invasive or non-invasive mechanical ventilation before diagnosis. The most common comorbidities were chronic obstructive pulmonary disease (6/11) and hypertension (2/11). Pneumothorax was right-sided in six cases and left-sided in four cases. It was concurrently bilateral in one case.

Conclusion: Spontaneous pneumothorax is a rarely encountered condition in COVID-19 patients and its pathophysiological mechanisms are still unknown. The incidence of spontaneous pneumothorax in non-intubated COVID-19 patients is approximately 10-fold more frequent then normal population. This result demonstrates that spontaneous pneumothorax incidence secondary to COVID-19 infection is much higher than expected.

Keywords: COVID-19, pneumothorax, viral pneumonia, tube thoracostomy, lung disease

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INTRODUCTION

Pneumothorax is defined as an abnormal collection of air in the pleural space between the lung and the chest wall. It is classified into two main groups, spontaneous (Primary Spontaneous Pneumothorax, Secondary Spontaneous Pneumothorax (SSP), Catamenial Pneumothorax) and non-spontaneous pneumothorax (Traumatic Pneumothorax, due to barotrauma, Iatrogenic Pneumothorax) (1).

Although its etiology is not known exactly, apical bulla and bleb ruptures are assumed to have a role. SSP is more common in middle-aged and elderly patients and in the etiology the most common reasons are chronic obstructive pulmonary disease (COPD), tuberculosis, interstitial lung disease, pneumonia and malignancy. In the published literature, the incidence of Spontaneous Pneumothorax has been reported as 18-28/100,000 per year for males and 1.2-6/100,000 per year for females (2-4).

In January 2020, the virus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) causing COVID-19 disease spread rapidly and brought about a worldwide pandemic (5).

In COVID-19 disease, it is assumed that spontaneous pneumothorax develops with alveoli rupture as a result of structural changes in the lung parenchyma, as with cystic fibrosis (6). Moreover, the increase of intrathoracic pressure caused by long-term coughing fits and mechanical ventilation are among the factors in the pathogenesis of the disease (6-8).

Very few case reports have been published on pneumothorax as a complication of COVID-19 viral pneumonia (5,7). We aimed to review the incidence of pneumothorax using the results of 14,611 patients treated in our institution due to COVID-19 infection..

MATERIALS AND METHODS

This retrospective study was approved by the Institutional Review Board (2011-KAEK-25 2021/03-04) and the informed consents were waived by approval of Institutional Review Board. 14,611 of these patients who had been diagnosed with COVID-19 infection with Polymerase Chain Reaction (PCR) test and/or posteroanterior (PA) chest radiography and/or thorax computerized tomography (CT) were hospitalized. Patients were diagnosed with SSP with PA chest radiography or thorax CT while investigating the etiology due to falling oxygen saturation at different times during treatment. When thorax CTs of the cases during hospitalization were examined, ground glass appearance and pneumonic infiltrations suggesting COVID-19 infection were observed in all of them.

Cases whose diagnosis was verified with polymerase chain reaction (PCR) test or whose symptoms supported COVID-19 infection as a result of low dose thorax computed tomography (CT) findings and who were hospitalized and treated were included in the study. Files of 11 patients who were diagnosed with Spontaneous Pneumothorax using clinical and imaging methods without a history of invasive or non-invasive mechanical ventilation between 01 April and 01 December 2020 were analyzed. Demographic features and laboratory data of the cases included in the study were recorded separately for each patient. Among the parameters were; age, gender, side and size of the pneumothorax, treatment method, chest drain removal time and comorbidities. Laboratory values of the patients at the time of admission were checked, including number of white blood cells (WBC) and absolute lymphocyte count, as well as lactate dehydrogenase (LDH), high sensitivity C-reactive protein (CRP), D-dimer, ferritin, fibrinogen, aspartate aminotransferase (AST) and alanine aminotransferase (ALT). All patients' PA chest radiography and low dose thorax CT images were examined. Demographic characteristics and laboratory data of the patients at the time of first admission are shown in Table 1 and Table 2.

RESULTS

Totally 14,611 of the patients who had been diagnosed with COVID-19 infection with PCR test and/or PA chest radiography and/or thorax CT were hospitalized. But only 11 hospitalized cases had a diagnosis of SSP were included in the research study. 8 of the cases were male and 3 of them were female. The age distribution was 50-84 and the mean age was 66.5 (Table 1). None of our cases had received invasive or non-invasive mechanical ventilation prior to the diagnosis. When the patients were analyzed in terms of comorbidities, the most common comorbidities were COPD (6/11), hypertension (2/11), diabetes mellitus (1/11) and bronchial asthma (1/11). One case did not have any comorbid disease. Pneumothorax was right-sided in six cases and left-sided in four cases. It was concurrently bilateral in one case (Picture 1). Considering the size of the pneumothorax, one case had small, eight cases had medium and two cases had a large size of pneumothorax. Since pneumothorax percentage was low in one case (Picture 2), resorption was achieved in three days with oxygen-therapy without a tube thoracostomy procedure (Picture 3). Tube thoracostomy was performed on the side of the pneumothorax in nine cases and concurrently bilateral in one case. Tube removal time was 5-13days with a mean of 8.8 days (Table 1). When the cases' primary laboratory data were examined, WBC count was 5.13-15.07, lymphocyte count was 5.8-29.5, PLT was 119-275, LDH was 380-1050, CRP was 19.5-166, ferritin was 432-1238, AST was 28-101.9, ALT was 28.9-90.2, D-Dimer was 1.62-47.59 and fibrinogen was 413-743 (Table 2). Pneumothorax diagnosis was made with bedside PA chest radiography in all cases. When previous low dose CT images of all cases with pneumothorax diagnosis were examined at the time of hospitalization, ground glass opacity symptoms suggesting viral pneumonia were detected in all cases (Picture 4). We had no cases with SSP diagnosis at the outpatient clinic level. All of the diagnosed patients were in-patients. Patients were given 5-10/L/min oxygen therapy. COVID-19 viral infection treatment was planned in accordance with the recommendations of pulmonologists following laboratory tests, thorax CT and clinical evaluation results. One case died on the 25th day of the treatment due to multi-organ failure.

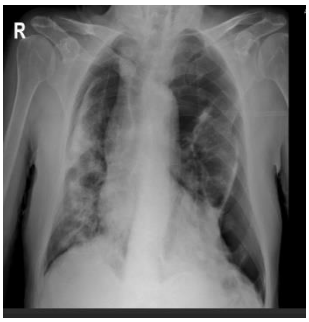

Figure 1. Simultaneous Bilateral Spontaneous Pneumothorax

Figure 2. Small Percentage of Spontaneous Pneumothorax

Figure 3. Spontaneous Pneumothorax rRsolved with Conservative Treatment

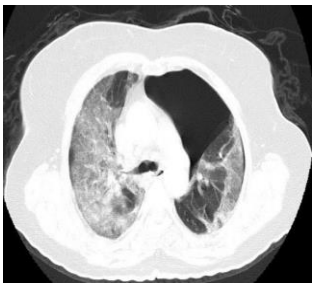

Figure 4. Ground Glass Opacity on Thorax CT

Table 1. Demographic Characteristics of Patients

Patient Number	Age (year)	Gender	Pneumothorax side	Pneumothorax size	Treatment	Thorax tube removal time / day	Comorbidity
1	60	M	Right	Small	Oxygen	-	COPD
2	64	M	Right	Middle	Tube thoracostomy	5	COPD
3	75	M	Bilateral	Middle	Tube thoracostomy	Right 8 Left 13	COPD
4	75	F	Left	Large	Tube thoracostomy	6	COPD + Hypertension
5	68	F	Right	Middle	Tube thoracostomy	8	Asthma
6	57	M	Right	Middle	Tube thoracostomy	7	-
7	64	F	Left	Large	Tube thoracostomy	9	COPD
8	55	M	Left	Middle	Tube thoracostomy	10	Diabetes Mellitus
9	84	M	Right	Large	Tube thoracostomy	12	COPD
10	72	M	Left	Middle	Tube thoracostomy	11	COPD
11	58	M	Right	Middle	Tube thoracostomy	8	Hypertension

COPD= Chronic obstructive pulmonary disease

Table 2. Laboratory Data of the Patients

	Patients										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
White Blood Cell (3,5-10,5 mcl)	8.85	15.07	6.75	9.72	5.13	9.25	14.22	10.4	11.3	7.4	12.7
Lenfosit (% 19,3-42,5)	5.8	10.6	29.5	5.8	19.6	6.2	19.6	7.4	12.4	9.2	8.4
PLT (150-450 mcl)	119	234	236	204	242	205	236	221	245	201	275
LDH (135-225 U/L)	410	380	698	510	1050	430	545	610	495	520	710
AST (0-32 U/L)	62	28	101.9	39	56	68	70	59	71	90	69
ALT (5-33 U/L)	57	28.9	90.2	35	15.7	57	62	52	65	82	51
CRP (0-5 mg/L)	125	19.5	43.3	166	67.4	38.2	5.85	29.4	38.2	25.4	43.2
D-Dimer (0-0.5 µg/L)	1.62	5.65	47.59	3.66	0.22	2.24	1.14	5.3	2.9	4,9	38.4
Ferritin (5-150 ng/ml)	432	800	1238	603	189	724	710	510	535	638	725
Fibrinojen (20-400 mg/dl)	743	413	433	574	621	525	444	644	490	568	470

DISCUSSION

COPD has the first place in the etiology of SSP. In a SSP series of 100 cases published in Türkiye, COPD was at the top in terms of etiology with a 40% rate (9). 7/11 of our cases presented COPD as a comorbid disease. SSP incidence was reported as 6.3% in males and 2% in females per year among 100,000 individuals in the USA (10). In our study, the incidence of SSP was detected as 75.2 /100,000. This situation suggests that COVID-19 infection can trigger SSP development.

The gold standard in diagnosis is 'real-time polymerase chain reaction' (RT-PCR) test performed to detect viral nucleic acids. Thorax CT is an important imaging method to aid diagnosis and evaluate the extent and progression of the disease (11). In a previous study, the most frequent CT findings were, respectively, ground glass opacity (50.2%), ground glass opacity with consolidation (44.4%) and consolidation (24.2%) (12). Pulmonary lesions in our cases with pneumothorax were in the form of ground glass opacity and consolidation.

COVID-19 infection can cause acute respiratory distress syndrome (ARDS) due to pneumonia developing in the lungs. In case the disease is in its late period, alveoli lead to septal thickenings and fibrotic changes in the lungs (13).

In our study, all SSP patients had pulmonary involvement. Pneumothorax usually develops secondary to barotrauma in intensive care units. SSP cases without a history of invasive or non-invasive mechanical ventilation were involved in the study. How pneumothorax occurs in Covid-19 pneumonia cases without barotrauma is not completely understood.

COVID-19 infection can cause bronchial wall weakening secondary to airway inflammation and severe effects on alveoli caused by cytokine release. In addition, edema, vascular congestion and micro-thromboembolisms contribute to the occurrence of pneumothorax by causing rupture of existing bullas in the lung (14). On the other hand, it is assumed that increase of intrathoracic pressure by persistent coughing fits caused by viral infection with thickening of the alveoli wall secondary to the infection and ruptures in the alveoli can have a role in the development of pneumothorax (15).

In a study conducted by Yang et al., records of 92 patients who had died of COVID-19 were examined and pneumothorax was detected in one case, with a pneumothorax incidence of1.1% (16). Zantah et al. reported in their study that PCR tests of 902 patients out of 3000 patients with suspicion of COVID-19 were positive and radiological pneumonic infiltration was detected in the lungs. Spontaneous Pneumothorax developed in six of these cases and the incidence was 0.66%. However, only two of these six cases did not have invasive or non-invasive mechanical ventilator history (17). In another research study, 11 literature reviews were performed and 18 cases of spontaneous pneumothorax were detected secondary to COVID-19 infection. Conservative thoracostomy was applied to eight of these cases and tube thoracostomy to 10 of them. It has also been indicated that thoracoscopic bleb resection was performed on two of the patients who underwent tube thoracostomy (14).

In our study, we performed conservative treatment with one case by continuing existing oxygen therapy since the pneumothorax percentage was low. Following concurrent bilateral SSP development in one case, we performed bilateral tube thoracostomy. With this, left lung expansion was achieved on the eighth day and right lung expansion was achieved on the 13th day and the chest drains were removed. Our other cases were treated with tube thoracostomy. Expansion defects did not develop in any of the cases. In case of acute worsening in the clinical condition of the patient, thromboembolisms and pneumothorax are the first complications to be

considered in cases followed-up due to COVID-19.

In conclusion, spontaneous pneumothorax is a rarely encountered condition in COVID-19 patients and its pathophysiologic mechanisms are still unknown. The incidence of spontaneous pneumothorax in non-intubated COVID-19 patients is approximately 10-fold more frequent then normal population. This result demonstrates that the incidence of SSP secondary to COVID-19 infection is much higher than expected. In addition, the high mean age of the cases is also quite remarkable. Physicians can be recommended to take these situations into consideration.

Ethics Committee Approval: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study conformed to the provisions of the Declaration of Helsinki (as revised in 2013). This retrospective study was approved by the Institutional Review Board (2011-KAEK-25 2021/03-04) and the informed consents were waived by approval of Institutional Review Board.

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