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OLGU SUNUMU
CASE REPORT

COVID-19 pneumonia and pneumothorax: case series

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ABSTRACT

COVID-19 pneumonia and pneumothorax: case series

Barotrauma is a commonly reported complication in critically ill patients with ARDS caused by different etiologies, it's rate is reported to be around %10. Pneumothorax/pneumomediastinum in COVID-19 patients seem to be more common and have different clinical characteristics. Here we report 9 patients who had pneumothorax and/or pneumomediastinum during their stay in the ICU.

Patients who were admitted to ICU between March 2020 and December 2020, were reviewed for presence of pneumothorax, pneumomediastinum and subcutaneous emphysema during their ICU stay. Demographic characteristics, mechanical ventilation settings, documented ventilation parameters, outcomes were studied.

A total of 161 patients were admitted to ICU during the study period, 96 were invasively ventilated. Nine patients had developed pneumothorax, pneumomediastinum and/or subcutaneous emphysema during their admission. Five of them were men and median age was 66.6 years. All patients

were intubated and mechanically ventilated. All patients were managed conservatively. One patient was discharged from ICU, the others were lost due to other complications related to COVID-19. Upon detection of pneumothorax and/or mediastinum all patients were managed conservatively by limiting their PEEP and maximum inspiratory pressures and were followed by daily chest X-rays (CXR) for detection of any progress. None of the patients showed increase in size of their pneumothorax and/or pneumomediastinum. Hemodynamically instability due to pneumothorax and/or pneumomediastinum was not observed in any of the patients. Tension pneumothorax was not observed in any of the patients. Most common reason for death was sepsis due to secondary bacterial infections.

Acute deterioration with rapid oxygen desaturation or palpation of crepitation over thorax and neck in a COVID-19 patient should prompt a search for pneumothorax or pneumomediastinum. Conservative management may be an option as long as the patients are stable.

Key words: *COVID-19; pneumothorax; pneumomediastinum*

ÖZ

COVID-19 pnömonisi ve pnömotoraks: olgu serisi

Barotravma, kritik hastalarda farklı etiyolojilere bağlı ARDS tablosunda sık bildirilen bir komplikasyon olup, %10 oranında olduğu bildirilmektedir. COVID-19 hastalarında pnömotoraks/pnömomediastinum daha yaygın görülmektedir ve farklı klinik özelliklere sahiptir. Burada, YBÜ'de kaldıkları süre boyunca pnömotoraks ve/veya pnömomediastinum gelişen 9 hastayı bildiriyoruz.

Mart 2020 ile Aralık 2020 arasında YBÜ'de takip edilen hastalar, kaldıkları süre boyunca pnömotoraks, pnömomediastinum ve subkutan amfizem gelişmesi açısından incelendi. Demografik özellikleri, mekanik ventilasyon ayarları, kaydedilen ventilasyon parametreleri, sağkalım durumları incelendi.

Çalışma süresince YBÜ'ye toplam 161 hasta kabul edildi, 96 hastaya invaziv mekanik ventilasyon uygulandı. Dokuz hastada pnömotoraks, pnömomediastinum ve/veya subkutan amfizem gelişti. Hastaların beşi erkekti ve ortanca yaş 66.6 yıldı. Tüm hastalar entübe edildi ve mekanik olarak havalandırıldı. Bir hasta YBÜ'den taburcu edildi, diğerleri COVID-19 ile ilgili diğer komplikasyonlar nedeniyle kaybedildi. Pnömotoraks ve/veya pnömomediastenin saptanması üzerine, tüm hastalar, PEEP ve maksimum inspiratuar basınçları sınırlandırılarak konservatif olarak tedavi edildi ve herhangi bir ilerlemenin tespiti için günlük göğüs röntgenleri (CXR) çekilerek izlendi. Hastaların hiçbirinde pnömotoraks ve/veya pnömomediastinum boyutlarında artış görülmedi. Hastaların hiçbirinde pnömotoraks ve/veya pnömomediastinuma bağlı hemodinamik instabilite gözlenmedi. Hiçbir hastada tansiyon pnömotoraks görülmedi. En yaygın ölüm nedeni, ikincil bakteriyel enfeksiyonlara bağlı sepsisti.

COVID-19 hastasında hızlı oksijen desatürasyonu ile akut kötüleşme veya toraks ve boyunda krepitasyon palpasyonu; pnömotoraks veya pnömomediastinum araştırması yapılmasını gerektirmelidir. Konservatif tedavi, hastalar stabil olduğu sürece bir seçenek olabilir.

Anahtar kelimeler: *COVID-19; pnömotoraks; pnömomediastinum*

INTRODUCTION

COVID-19 disease caused by the SARS-CoV-2 agent was firstly reported in Wuhan, China in December 2019, and in March 2020 it was declared by the World Health Organization as a viral pneumonia pandemia (1). Approximately 20% of patients are admitted to the intensive care units (ICU) due to complications of the infection and severe acute hypoxemic respiratory failure (1-3). Patients with ARDS are managed with lung protective mechanical ventilation practices restricting tidal volumes to 6 ml/kg and plateau pressures to 30 cm H_2O, in line with the guideline recommendations. (4).

Barotrauma is a commonly reported complication in critically ill patients with ARDS caused by different etiologies, it's rate is reported to be around %10. It is generally associated with higher airway pressures (5). Pneumothorax and pneumomediastinum are defined as the presence of free air in the pleural and mediastinal cavities, respectively. Subcutaneous emphysema occurs when air gets into tissues under the skin. Both pneumothorax and pneumomediastinum are known complications of mechanical ventilation due to intubation. Even without barotrauma, pneumothorax or pneumomediastinum can be present in the COVID-19 patients.

However, pneumothorax and pneumomediastinum in COVID-19 patients seem to be more common and have different clinical characteristics. Here we report 9 patients who had pneumothorax and/or pneumomediastinum during their stay in the ICU.

Patients admitted to the third level medical ICU of a university hospital, designated as the pandemia ICU, between March 2020 and December 2020, were reviewed for presence of pneumothorax, pneumome-

diastinum and subcutaneous emphysema during their ICU stay. A general informed consent had been taken from relatives of each patients upon ICU admission for scientific use of their de-identified medical records. Demographic characteristics, mechanical ventilation settings, documented ventilation parameters, outcomes were studied.

A total of 161 patients were admitted to ICU during the study period, 96 were invasively ventilated. Nine patients (9% of mechanically ventilated) had developed pneumothorax, pneumomediastinum and/or subcutaneous emphysema during their admission. Five of them were men and median age was 66.6 years. All patients were intubated and mechanically ventilated.

One patient was discharged from ICU, the others were lost due to other complications related to COVID-19. Patients' characteristics are presented in Table 1. Routine treatment of critically ill COVID-19 patients included favipravir 2x1600 mg/day loading, followed by 2x600 mg/day for 10 days. Upon detection of pneumothorax and/or mediastinum all patients were managed conservatively by limiting their PEEP and maximum inspiratory pressures because the pneumomediastinum or pneumomediastinum was small. They were followed by daily chest X-rays (CXR) for detection of any progress. None of the patients showed increase in size of their pneumothorax and/or pneumomediastinum. Hemodynamically instability due to pneumothorax and/or pneumomediastinum was not observed in any of the patients. Tension pneumothorax was not observed in any of the patients. Most common reason for death was sepsis due to secondary bacterial infections.

Case 1

77-year-old male, with diabetes mellitus (DM) and hypertension, was admitted to the ICU on the 2nd day of hospitalization with due to increased oxygen need. High flow nasal oxygen therapy (HFNO) (FiO_2 0.6 and 60 l/min flow) was started upon admission. He was intubated on the 2nd day of ICU admission due to severe hypoxia (SpO_2 %81 on HFNC with FiO_2 1 and 60 l/min flow). Ventilator was set to PEEP: 14 cmH_2O, Vt: 6ml/kg, FiO_2: 0.6 and peak inspiratory pressure was 23 cmH_2O. On the subsequent day SpO_2 was 93% with a PEEP of 10 cmH_2O and FiO_2 of 0.6. On the 4th day of intubation, pneumothorax was detected on CXR performed for worsening hypoxemia and thoracic computed tomography (CT) was reported presence of pneumomediastinum and pneumothorax (Figure 1). He died on the 16th day, because of multi-organ failure due to gram-negative sepsis.

Case 2

73-year-old male with hypertension and chronic obstructive pulmonary disease (COPD), was admitted to the ICU on his 7th day in the wards because of increasing need for oxygen. He was administered dexamethasone 6 mg/day and anakinra 200 mg/day. On the 5th day of ICU admission he was intubated. On the 9th day desaturation developed. His PEEP was set to 8 cmH_2O and peak inspiratory pressure was 24 cmH_2O. CXR revealed pneumothorax. CT confirmed presence of pneumomediastinum and pneumothorax. He died on 10th day of ICU.

Case 3

A 56-years-old female with hypertension and acute leukemia, was admitted to ICU on the 7th day of hospitalization for increasing need of oxygen. Dexamethasone 6 mg/day were administered. She was on HFNO until she was intubated on the 6th day of ICU. Volume control mode with a PEEP of 10 cmH_2O; peak inspiratory pressure was 30 cmH_2O. On the 12th day of ICU, a crepitation was detected over the neck of the patient. Pneumothorax was observed in CXR (Figure 2). She died on 15th ICU day.

Case 4

59-year-old male with hypertension, was readmitted due to severe hypoxemia 48 hours post-ICU discharge. He had been managed with HFNO in prone position on his first ICU admission and had received remdesivir in addition to favipiravir, anakinra 200 mg/day and dexamethasone 6 mg/day. He had been discharged on 3 lt/min oxygen by nasal cannula. His admission PaO_2/FiO_2 was 75 and had to be intubated rapidly. Control CXR after intubation revealed pneumothorax. He was managed on pressure control mode with a PEEP of PEEP: 8 cmH_2O and peak inspiratory pressure of 32 cm H_2O, which was gradually decreased to 24 cmH_2O with prone positioning. A CT was performed on the 4th day when crepitation over the neck was detected during daily physical examination. It revealed accompanying pneumomediastinum (Figure 3). He was discharged from ICU on day 15th.

Table 1. Demographics and clinical characteristics of patients

	Age	Gender	Comorbidities	Days on ward before ICU admission	Intubation day (after ICU admission)	Intubation day PaO_2/FiO_2 ratio	Mechanical ventilation parameters			Time to diagnosis from intubation	Management	Outcome
							Mode	PEEP	PIP(max)			
Case 1	77	Male	HT, DM, obesity	2	2	95	VCV	10	29	4 days	Conservative	Dead
Case 2	73	Male	HT, COPD	7	5	125	VCV	8	24	4 days	Conservative	Dead
Case 3	56	Female	Acute leukemia, HT	7	6	53	VCV	10	30	6 days	Conservative	Dead
Case 4	59	Male	HT	Readmission	0	75	VCV	8	34	On the intubation day	Conservative	Alive
Case 5	66	Male	HT, DM, ankylosing spondilitis	3	5	83	PCV	8	26	10 days	Conservative	Dead
Case 6	60	Female	Chronic hepatic failure, DM	12	6	105	VCV	10	31	6 days	Conservative	Dead
Case 7	80	Male	Alzheimer disease	9	0	40	PCV	8	35	10 days	Conservative	Dead
Case 8	57	Male	Restless leg	4	0	132	PCV	10	38	2 days	Conservative	In ICU on mechanical ventilation
Case 9	72	Male	HT, DM, coronary artery disease	0	0	105	VCV	8	29	4 days	Conservative	In ICU on mechanical ventilation

ICU: Intensive care unit, HT: Hypertension, DM: Diabetes mellitus, COPD: Chronic obstructive pulmonary disease, PEEP: Positive end-expiratory pressure, PIP: Peak inspiratory pressure, VCV: Volume-controlled ventilation, PCV: Pressure-controlled ventilation.

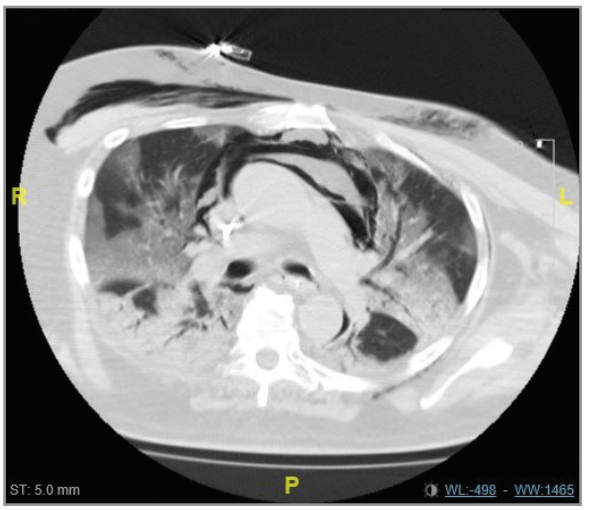

Figure 1. Thorax computed tomography shows pneumomediastinum.

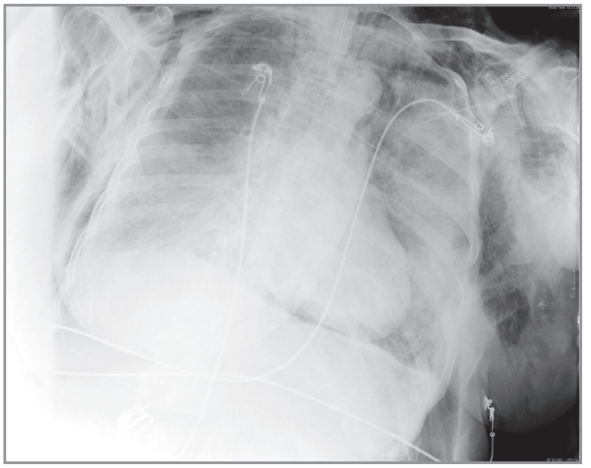

Figure 2. Chest X-ray indicates continuous diapraghm sign.

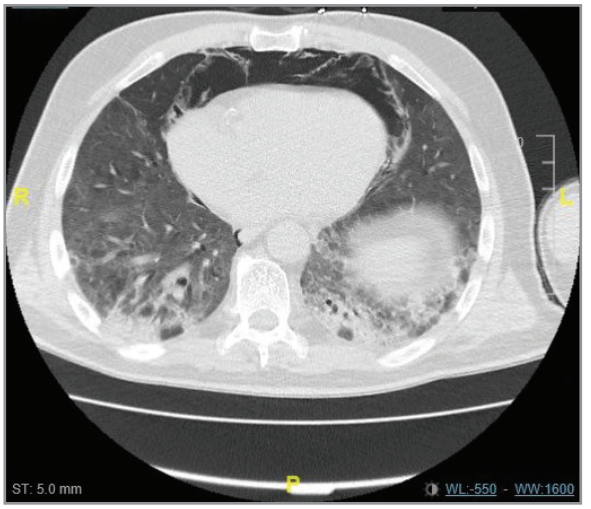

Figure 3. Thorax computed tomography.

Figure 4. Thorax computed tomography shows extensive subcutaneous emphysema with pneumomediastinum.

Case 5

66-year-old male with DM, hypertension and ankylosing spondylitis was admitted to the ICU on the 3rd day of his hospital admission. He was administered dexamethasone 1x6 mg and anakinra 200 mg/day. He was on non-invasive mechanical ventilation (NIMV), when he was intubated on the 5th. On the 10th day of intubation, under PEEP of 8 cmH_2O pneumothorax and pneumomediastinum were detected on CT (Figure 4). He died on 25th day of ICU.

Case 6

60-year-old female with DM, hypertension and chronic hepatic failure comorbidities was admitted to ICU from wards on 12th day of hospitalization. She was treated with dexamethasone 1x6 mg/day and followed under NIMV. She was intubated on the 6th day of ICU because of sudden hypoxemia and deterioration. On the 12th day of ICU crepitation was detected over her neck. PEEP setting was 10 cmH_2O. CXR detected pneumothorax. She died on 20th day of ICU.

Case 7

80-year-old male with Alzheimer's disease was admitted to ICU on 9th day of hospitalization. He was intubated upon ICU admission. On the 10th day of intubation, subcutaneous crepitation over the neck region was detected and pneumomediastinum line was observed on the CXR. PEEP was set to 10 cmH_2O. He died on 24th day of ICU.

Case 8

57-year-old male with restless leg syndrome was admitted to ICU on his 4th day on the wards. He was intubated on admission. On the 6th day, CXR obtained after respiratory deterioration revealed subcutaneous emphysema and a linear band of mediastinal air. Ventilator settings were reviewed to decreased airway pressure. He is still on pressure control mechanical ventilation.

Case 9

72-year-old male with DM, hypertension, coronary artery disease was admitted to ICU from the emergency department and subsequently intubated. On the 4th day, crepitation over thorax and neck were palpated. CT revealed subcutaneous emphysema and pneumomediastinum. He is still on pressure control mechanical ventilation.

DISCUSSION

Pneumothorax during mechanical ventilation is commonly associated with barotrauma due to high airway pressures. However, there are case reports on increased incidence of spontaneous and iatrogenic pneumothorax and/or pneumomediastinum in COVID-19 patients (6-8).

In a case series from the UK, pneumothorax and pneumomediastinum cases during COVID-19 pneumonia were reported (8). Seventy-one cases collected retrospectively from 16 different centers were analyzed. Remarkably, pneumothoraces in cases spontaneously breathing comprised almost 30% of these patients. In our case series all patients, were intubated because of severe ARDS. Pneumothorax was detected in the first week of ICU admission, except for two. Median age was over 60 and mortality was high. UK case series reported that survival was higher (70.9% vs 41.7%) in younger patients (<70 years) with pneumothorax and they also concluded that pneumothorax may not be a poor prognostic marker (8). However, gravity of our patients preclude us from making such a comment. They had severe ARDS, and most were complicated with secondary bacterial infections or cardiac involvement later in the disease course.

In another study from the USA, barotrauma due to invasive mechanical ventilation was observed in 89 of 601 (15%) patients. The frequency of pneumothorax in mechanically ventilated patients with ARDS was reported to be significantly higher compared to the period before COVID-19 (9).

Interestingly, spontaneous pneumothorax has been reported even in patients who are not intubated during the course of COVID-19 (8,10,11). As well, plateau pressures of our patients were generally lower than 30 cmH_2O and patients were deeply sedated. This leads to the questions: Does COVID-19 cause vulnerability for barotrauma? Should lower airway pressures be aimed for these patients?

It is hypothesized that cystic and fibrotic changes in the lung parenchyma that occur early during COVID-19 course may be causing a vulnerability for pneumothoraces (8). These structural changes may be leading to alveolar tears. As well, it may be considered that mucus plugs may be facilitating local intra-alveolar pressure increases by acting as check-valves. Moreover, unlike non-COVID-19 patients, it was observed that lung tissue did not collapse enabling conservative management despite ongoing positive airway pressure ventilation. These points need further evaluation.

CONCLUSION

Acute deterioration with rapid oxygen desaturation or palpation of crepitation over thorax and neck in a COVID-19 patient should prompt a search for pneumothorax or pneumomediastinum. Conservative management may be an option as long as the patients are stable and no progression is seen.

CONFLICT of INTEREST

The authors reported no conflict of interest related to this article.

AUTHORSHIP CONTRIBUTIONS

Concept/Design: LT, NDA

Analysis/Interpretation: LT, FGSS, UE

Data Acquisition: LT, FGSS, UE,

Writing: LT, NDA

Critical Revision: LT, IAK, MBY, CY, NDA

Final Approval: LT, CY, NDA

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