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Case Series

Subcutaneous emphysema and pneumomediastinum in COVID -19 patients: ICU course of four cases and review of literature

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Abstract

Objective: Since April 2021, there has been significant increase in number of COVID-19 cases in India. As the caseload increased, so did the complications like pneumomediastinum (PM) and subcutaneous emphysema (SE).

Case Presentation: We present clinical course of 4 patients as case series of COVID-19 pneumonia who developed PM and SE during their management. Two cases with the need of non-invasive ventilation (NIV) recovered and two cases that needed invasive mechanical ventilation (IMV) ultimately expired.

Conclusion: This case series highlights the importance of positive pressure ventilation via NIV and IMV as a predisposing factor for PM and SE as well as the need of strict vigilance by clinicians managing COVID-19 patients in IMV.

Keywords: COVID-19,Non invasive ventilation, Invasive mechanical ventilation

Introduction

Since April 2021, India has witnessed a surge in the number of COVID-19 cases as well as hospitalisation and associated complications. There was a substantial increase in the daily number of confirmed cases (over three cases lakh per day) and the number of daily deaths.

COVID-19 infection is characterised by hypoxemic respiratory failure in which patients require supplemental oxygen, non-invasive ventilation (NIV), and invasive mechanical ventilation (IMV) to maintain the oxygenation (1,2). The clinical spectrum of the disease process involves destruction of alveolar epithelial cells, presence of infiltrates, thrombosis, acute respiratory distress syndrome (ARDS) resulting in a reduction of the ventilation area in lungs due to decreased PaO_2 (3). In severe COVID-19 cases, supplemental oxygen is needed to maintain oxygenation with the requirement of positive pressure ventilation (NIV and IMV) in some cases which predisposes the airways and alveoli to increased airway pressures resulting in air- leaks (4). These air leaks may present in various forms like pneumomediastinum (PM), subcutaneous emphysema (SE) and pneumothorax that further increase the risk of adverse outcome. PM is rare in viral pneumonias, but few cases have been reported in COVID-19 infections. It is characterised by air in the mediastinal structures with no apparent cause (trauma or iatrogenic). We present a series of four cases of severe COVID-19 pneumonia who developed PM and SE in intensive care unit (ICU) along with their clinical course and final outcome (clinical course in Tables 1 and 2).

Case Presentations

Case 1

A 49-year-old male patient was admitted with complaints of fever and breathlessness for a period of 7 and 3 days, respectively. In addition, his oxygen saturation (SpO_2) was 74% in room air, and his respiratory rate was 29/min. He was confirmed by Reverse transcription polymerase chain reaction (RT-PCR) as positive COVID-19 pneumonia. High-resolution computed tomography (HRCT) findings of chest showed features consistent with COVID -19 pneumonia with a calculated CT Severity index of 18/25. He was first managed in the isolation ward with oxygen supplement 10 L/min on a non-rebreathing mask, but he was transferred to ICU the next day because of worsening dyspnea and oxygen saturation. He was given NIV (CPAP) trail with PEEP of 8 cm of H_2O and FiO_2 of 80%. After 2 days, he had swelling and palpable crepitation along the upper part of chest and base of the neck. X-ray chest was done which revealed SE and PM (Figure 1, left side). He was managed well with NIV for 10 days and later wore a non-rebreathing mask. Serial X-rays showed regression of

Table 1. Case description

	Age/Gender	Chief complaints	Baseline investigation	CT findings	Inflammatory markers	ABG baseline
Case 1	49 y/male	Fever, breathlessness	Hb: 11.8 gm% Tlc: 8000/mm^3 P/L/M/E: 80/14/2/51 Platelet: 2l akh/mm^3 AST/ALT: 61/141	Multiple patchy ground glass opacity, linear opacities CT severity 18/24	IL: 6-8.6 pg/mL CRP: 25 mg/L Ferritin: 1489 ng/ml, D-dimer: 1010 ng/mL FEU, LDH: 690 U/L	PaO_2: 71, $PaCO_2$: 26, pH: 7.5, Lactate: 1.5
Case 2	56 y/Female	Fever, cough, breathlessness, co-morbidity-DM	HB: 12.8gm% TLC: 18300/mm^3 P/L/M/E: 71/15/09/05, Platelet: 2.96 lakh//mm^3 Urea/Creatinine: 39/0.5 AST/ALT: 47/ 116	Multiple patchy ground glass opacity, linear opacities CT severity 21/25	IL-6: 20.6 pg/mL CRP: 36.4 mg/L Ferritin: 1008 ng/mL D-dimer: 630 ng/mL FEU, LDH: 470 U/L	PaO_2: 56, PaO_2 37, pH: 7.43, Lactate; 3.3
Case 3	35 y/male	Fever, breathlessness	HB: 11.8 gm% TLC: 7400/mm^3 P/L/M/E: 91/05/01/03, Platelet: 1.86 lkakh//mm^3 Urea/Creatnine: 24/0.7 AST/ALT: 289/330	18/25	IL-6: 25.9 pg/ml CRP: 46.7 mg/L Ferritin-1405 D-dimer: 1343 ng/mL FEU, LDH-980 U/L	PaO_2: 69, $PaCO_2$: 33, pH: 7.33, Lactate: 0.8
Case 4	41 y/Female	Fever, breathlessness, Co-morbidity- hypothyroidism	HB: 12.5 gm% TLC: 9300/mm^3 P/L/M/E: 85/09/01/05 Platelet: 2.16 lakh//mm^3 Urea/Creatnine: 33/0.9 AST/ALT: 56/62	23/25	IL-6: 36.9 pg/mL CRP: 46.7 mg/L Ferritin:1405 D-dimer: 1530 ng/mL FEU, LDH-1680 U/L	PaO_2: 69, $PaCO_2$: 27, pH: 7.39, Lactate: 1.4

Table 2. Case description

	Type /duration of ventilation	Total duration of ICU stay	Day of SE and PM	Medications	Outcome
Case 1	NIV: 12 days	25	3	Steroids, Remdesivir, Enoxaparin	SE resolution on 18th day, PM on 16th day, Shifted from ICU in stable condition
Case 2	NIV: 10 days	18	4	Steroids, Remdesivir, Enoxaparin	SE resolution on 14th day, PM on 12th day, Shifted from ICU in stable condition
Case 3	NIV-IMV: 7 days, 2 days	9	2	Steroids, Enoxaparin	SE & PM-persisted Expired
Case 4	NIV-IMV: 5 days, 1 day	8	3	Steroids, Remdesivir, Enoxaparin	SE & PM-persisted Expired

PM and SE (Figure 1, right side). Upon further clinical improvement, he was transferred from ICU to the isolation ward

Case 2

A 56-year-old female patient with history of fever, cough and breathlessness for 7 days was confirmed by PT-CPR as positive COVID-19 pneumonia. She was admitted into our hospital with complaints of being unable to maintain SpO_2 on non-rebreathing mask for 1 day. She was put on NIV (CPAP) with FiO_2 of 70%. Her SpO_2 and PaO_2 improved, but she developed swelling and crepitation over lower part of the neck on the fourth day of admission. Her X-ray chest revealed SE and pneumo-mediastinum. She was followed with serial X-rays and showed improvement over few days and was transferred from ICU after 20 days with minimal requirement of supplemental oxygen.

Case 3

A 35-year-old male patient was admitted with history of fever and cough for 5 days and breathlessness for 1 day.

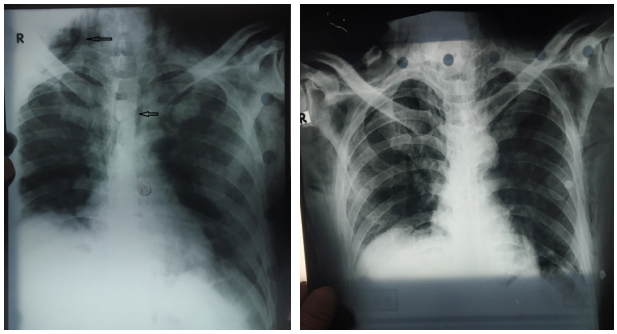

Figure 1. The presence of PM and SE on left (black arrow) and regression on right.

His SpO_2 was 93% on 4 l/min oxygen in the COVID-19 isolation ward. He was transferred to ICU due to the fall of saturation. He was put on NIV (CPAP) with FiO_2 of 0.8. After one day, he developed swelling around the neck, palpable crepitation (sub-cutaneous emphysema) and X-ray chest showed PM and SE (Figure 2 shows PM and SE with a black arrow). There was no further progression of SE and PM, but after 3 days his ARDS progressed with

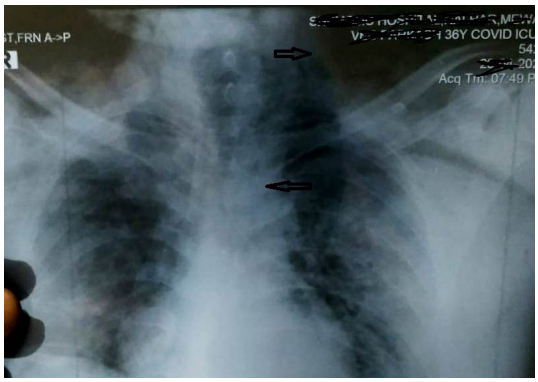

Figure 2. X-ray chest showing bilateral chest infiltrates consistent with COVID-19 pneumonia and presence of SE and PM (the black arrow).

decreased oxygenation. The patient was intubated and put on IMV, but he ultimately expired.

Case 4

A 41-year-old female patient with history of fever and cough for the duration of 5 days and with hypothyroidism developed shortness of breath. Her SpO_2 was 70% in room air. She was transferred to ICU and her SpO_2 was 93% with NIV. Later on, she developed swelling over the lower part of the neck on day three with X-ray chest showing SE and PM. She had progressive worsening of hypoxemia and increased respiratory rate. She was intubated and put on ventilatory support (IMV), but due to worsening hypoxemia she expired 2 days later.

Discussion

A total of four patients developed PM and SE during the course of management in ICU. Their mean age was 45.25 ± 7.94 years and onset of PM and SE was 3 ± 0.7 days from the start of mechanical ventilation. Two patients required intubation and IMV due to progression of hypoxemia, but finally expired on day 9 and day 8 from the day of admission. PM and SE regressed in two patients and over the course of treatment and were shifted out from ICU on day 18 and day 15 in stable condition (ICU course depicted in Table 1 and Table 2).

Spontaneous PM is a rare condition which usually occurs in patients with pre-existing lung disease like asthma, chronic obstructive pulmonary disease. But recently with the occurrence of COVID-19, there have been reported cases of PM and SE in COVID-19 patients who otherwise had no pre-existing pulmonary pathology. In most of the mild cases, it is a self-limiting disease, but has potential of serious circulatory and respiratory compromise, thus, it needs to be monitored carefully (5). Pathogenesis of PM and SE in COVID-19 has been either due to intubation associated trachea-bronchial injury or alveolar rupture secondary to high airway pressures needed to maintain oxygenation (6,7). Airway damage is also evident from histopathology specimens that show diffuse alveolar damage and hyaline membrane formation like in ARDS (8).

Presence of PM and SE in COVID-19 patients during the course of management does not always lead to adverse clinical outcomes. The presentation of 4 cases of PM and SE with two different clinical outcomes highlights the variable clinical spectrum of the COVID-19 disease. In the present study, two patients were managed with NIV alone showing gradual resolution of air from tissues and recovered from the disease. By the same token, another two patients required IMV and their condition further deteriorated due to worsening hypoxemia and ultimately died. PM can occur both in patients who are mechanically ventilated or unrelated to it (5,9). Thein et al described two cases of PM wherein one survived and the other one expired and concluded that PM may not always lead to adverse outcomes (10). Wang et al described a case of PM diagnosed at the time of presentation with CT scan with adverse outcome (11).

We choose to follow the patients with X-ray because of infection control issues and critical nature of patient conditions as the follow up of patients with CT scan remains a problematic issue. Although CT scan is a definitive diagnostic tool in COVID-19, portable X-ray chest remains an important part in identification and follow up of lung abnormality in COVID-19 patients (12). All four patients were managed conservatively for PM (as none of them showed its progression that would compromise hemodynamics) similar to management of PM in COVID-19 in most of the case reports mentioned earlier (13,14).

Two patients that received IMV expired due to worsening hypoxemia. Case reports or case series of patients with COVID-19 have revealed that those receiving IMV, the mortality rate was on a rise (15,16).

Conclusion

This case series highlights that PM and SE (although rare in viral pneumonias) can present as a complication in COVID-19 patients and the initiation of positive pressure ventilation via NIV and IMV can be a predisposing factor. A strict vigilance by clinicians managing COVID-19 patients especially on IMV is therefore required.

Authors' contributions

ON and RPS collected and organized the data. All authors were involved in active management of patients in ICU and read and finalized the final manuscript.

Ethical issues

Informed written consent was taken from all patients/relatives.

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