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TANAFFOS

COVID-19 Pneumonia Associated with Pneumomediastinum and Pneumothorax: Epidemiology and Evolution

Rim Khemakhem [1], Issraa Wadhane [1], Wided Dhouib [2], Anis Baffoun [2], Mariam Jmal [2], Maroua Dammak [2], Abdelhamid Karoui [2], Imed Kanoun[2], Samy Kammoun [1,2]

[1] Department of Pneumology, HEDI CHAKER Hospital, University of Sfax, Sfax, Tunisia, [2] Military Field Hospital, University of Sfax, Sfax, Tunisia

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Correspondence to: Khemakhem R
Address: Department of Pneumology, HEDI CHAKER Hospital, University of Sfax, Sfax, Tunisia
Email address: khemakhem_rim@medecinesfax.org

Background: The occurrence of pneumomediastinum (PM) or pneumothorax (PTX) is a rare complication during COVID-19 pneumonia. The exact pathophysiological mechanisms remain unclear.

Materials and Methods: This retrospective study was carried out between March and July 2021, including hospitalized patients with COVID-19 who presented a PM or PTX during their evolution.

Results: Thirty-three patients were included in our study. The PM was spontaneous in 41.4% of cases (prevalence of 1.2%) and iatrogenic in 58.6% of cases (prevalence of 1.71%). Spontaneous isolated PTX was noted in 4 cases (12.1%). The management of pneumomediastinum was clinical and radiological monitoring in 30.3% of cases, and chest drainage in 21.2% (40% for spontaneous PTX, 83.3% for iatrogenic PTX, p=0.1). An association was found between mortality and the occurrence of PM (p=0.01), age (p=0,00), severity of radiological damage (p=0.03), severity of respiratory infection (p=0.01), the presence of signs of compression (p=0.03), and the use of mechanical ventilation (p=0.03).

Conclusion: COVID-19 patients with PM-PTX seem to have a higher mortality. Further research is needed to better identify risk factors and establish a consensus for managing it.

Keywords: Coronavirus; Pneumothorax; Severe acute respiratory syndrome; Treatment; Prognosis

INTRODUCTION

The COVID-19 pandemic was responsible for several hospitalizations worldwide and it was characterized by wide heterogeneity in clinical presentation. In 2021, we have seen an increase in the incidence of severe pneumomediastinum (PM), subcutaneous emphysema, and pneumothorax (PTX), following tracheal intubation and ventilation in patients with confirmed COVID-19. However, it also occurred in patients without any breathing support .

Data on the incidence, pathogenesis, and outcomes of those complications during the recent SARS-CoV-2 pandemic are limited (1-5). Moreover, the exact pathophysiological mechanisms remain poorly understood. Such changes seem to be disease-specific and may explain the higher incidence of pneumomediastinum and pneumothorax in COVID-19 (6, 7). Herein, we have studied the epidemiological and clinical characteristics of PM and PTX associated with COVID-19 infection and the prognostic factors.

MATERIALS AND METHODS

This retrospective study was conducted between March and July 2021 at a military field hospital. It included

hospitalized patients with a confirmed diagnosis of COVID-19 pneumonia who also had a concurrent or subsequent PTX or PM. All hospitalized patients had acute respiratory distress with moderate or severe COVID-19 pneumonia. The diagnosis of PM and PTX was confirmed by chest imaging. Demographic and clinical outcome data were collected from the hospital registry. Univariate analysis with chi-square was used for comparisons of categorical variables and Student's t-test was used for continuous variables. All statistical analyses were performed using SPSS version 18 (Statistical Package for the Social Sciences).

RESULTS

Thirty-three patients were included in our study, with a prevalence of 3.34% (for 986 hospitalizations during the same period). PM was spontaneous in 41.4% of cases (n=12) (prevalence of 1.2%) and iatrogenic in 58.6% of cases (n=17) (prevalence of 1.71%). PTX was associated with PM in 7 cases (21.2%) with the presence of signs of compression in 11 cases (33.3%) (Figures 1, 2). A spontaneously isolated PTX was noted in 4 cases (12.1%) (Figure 3).

The average time to onset of PM was 20 days. Participants were 24 men (72.7%) and 9 women with an average age of 53 years (27 to 69 years). The majority of patients had no pathological history (60.6%). Pulmonary history was noted in 7 cases (21.2%): three of them had chronic obstructive pulmonary disease, two had asthma, and two had sleep apnea syndrome. Six patients were diabetic and two had high blood pressure. The major symptoms of COVID-19 infection were dyspnea (97%), asthenia (42.4%), cough (36.4%), and fever (21.2%). The chest computed tomography (CT) scan showed usual images of COVID-19 with an extension of parenchyma lesions more than 50% in 42.4% of cases and between 25-50% in 51.5% of them. All patients had acute respiratory failure and were admitted to the intensive care unit. At admission, 36.4% of patients were treated with oxygen therapy, 12.1% required high-flow therapy, and 48.5% needed non-invasive ventilation (Continuous Positive Airway Pressure (CPAP): 36,4%, Bilevel Positive Airway Pressure (BiPAP): 12,1%). Only one patient (3%) needed invasive ventilation.

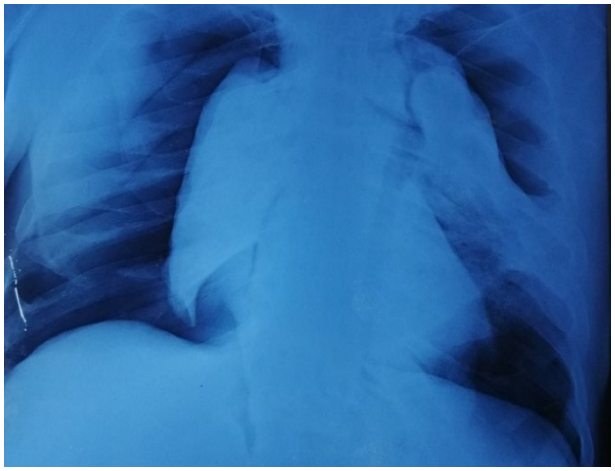

Figure 1. Chest X-ray of a COVID-19 patient revealing a bilateral compressive pneumothorax

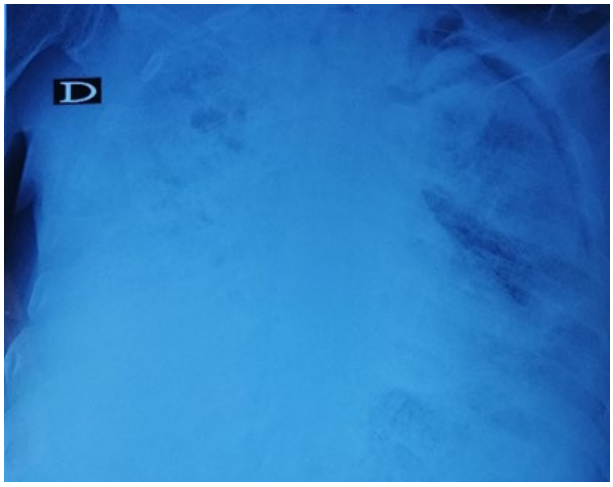

Figure 2. Chest X-ray of a COVID-19 patient revealing a left pneumothorax

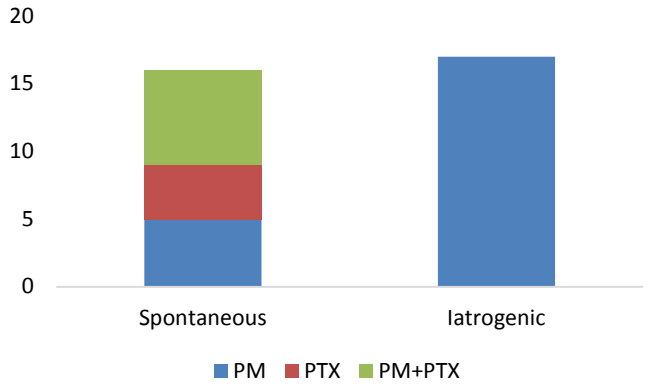

Figure 3. Cases of pneumomediastinum and pneumothorax associated with COVID-19 pneumonia in our study

PM: pneumomediastinum, PTX: pneumothorax, PM+PTX: pneumomediastinum associated with pneumothorax

The diagnosis was suspected due to a worsening respiratory condition in 23 cases (69.7%), subcutaneous emphysema in 13 cases (39.4%), chest pain in 9 cases (27.3%), and cough in 4 cases (12.1%). However, it was fortuitous in 4 cases (12.1%).

Thirty (30.3%) patients had only oxygen therapy with clinical and radiological monitoring of the PM and PTX (spontaneous PM: 66.7%, iatrogenic PM: 11.8%, p=0.03), chest drainage was done in 21.2% of cases (40% for spontaneous PTX, 83.3 % for iatrogenic PTX, p=0.1). Fourteen patients (42.4%) were intubated and required mechanical ventilation and 15.2% required non-invasive ventilation. The mean duration of hospitalization was 30 days (27 days for spontaneous PM, and 34 days for iatrogenic PM, (p=0.3). The outcome was favorable in 42.4% of cases (83.3% for spontaneous PM, 17.6% for iatrogenic PM, p<10-3). A significant association was found between mortality and the occurrence of PM (p=0.01), advanced age (p<10-3), severity of radiological damage (p=0.03), severity of respiratory infection (p=0.01), the presence of signs of compression (p=0.03), and the use of mechanical ventilation (p=0.03) (Table 1).

Table 1. Prognostic factors in COVID-19 pneumonia associated with pneumomediastinum and pneumothorax

	Survival	Non-survival	P
Age	44,71 years old	60.41 years old	p<10-3
Tabaco use	0%	9%	p=0.21
Delay of admission >1 week	15%	27.2%	p=0.37
Severity of radiological damage	6%	45%	p=0.03
Severity of respiratory infection	12%	45%	P=0.01
Signs of compression	0%	33,3%	p=0.03
Mechanical ventilation	0%	42%	p=0.03
Non-invasive ventilation	9%	6%	P=0.62

DISCUSSION

Our study showed a prevalence of PM/PTX in COVID-19 patients at 3.34%. All patients had acute respiratory failure and were admitted to the intensive care unit. The CT scan showed usual images of COVID-19 with an extension of parenchyma lesions more than 50% in 42.4% of cases and between 25-50% in 51.5% of them. COVID-19 infection can be responsible for severe pneumonia leading to acute respiratory distress syndrome (ARDS). Chest CT scan shows ground glass opacities, evolving into consolidative changes, and in the late stages of the disease, fibrotic changes (8, 9).

Similar changes including severe lung injury and diffuse alveolar damage were thought to contribute to the mechanism of spontaneous pneumothorax complicating severe acute respiratory syndrome (SARS) (10). Spontaneous PM in COVID-19 patients may occur as a result of the cytokine storm-induced diffuse alveolar injury or direct viral infection of type I and type II pneumocytes. All these make alveoli more liable to rupture resulting in alveolar membrane rupture, the resultant gush of air circulates through the peri-bronchial and perivascular sheaths to the mediastinum, popularly known as the "Macklin phenomenon" (11, 12).

For patients who needed non-invasive ventilation and mechanical ventilation, higher PEEP might potentially lead to increased susceptibility for barotrauma in critically ill intubated COVID-19 patients. Kangas-Dick et al. (13) found that out of the 346 intubated COVID-19 patients, 34 (10%) had PM and that it may be associated with an increased mortality rate in critically ill intubated COVID-19 patients. Other studies indicated that only 1–2% of COVID-19 patients developed pneumothorax (14, 15) which is similar to the results of our study.

Several single case reports and small case series of PM associated with COVID-19 have been published, and most of those cases were treated conservatively (16, 17). In our study, 30% were managed in the same way.

There are no consensus guidelines for managing COVID-19 patients with PM. Wali et al. (12) managed patients aggressively by placing chest drains, whereas Volpi et al. (18) had more conservative treatment.

We found that the mortality rate in patients with a concurrent or subsequent PM was 58.4%.

In fact, COVID-19 patients with PM seem to have a more complicated clinical course and poor outcome (13, 18). The empirical results reported herein are similar to the literature's features.

To the best of our knowledge, this is the first study in Tunisia that included this group of patients. However, the results should be considered in the light of some limitations. We had a relatively small sample size and studied both spontaneous and iatrogenic PM/PTX which could impact the results' interpretation. Therefore, more studies are needed to determine the true prognostic significance of concurrent or subsequent PM-PTX in the setting of COVID-19 and to define guidelines for managing PM and PTX associated with COVID-19 infection.

CONCLUSION

COVID-19 patients with PM-PTX seem to have a more complicated clinical course and poor outcomes with higher mortality. More studies are needed to better identify the risk factors associated with this complication and to define a consensus for managing it.

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