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ORIGINAL ARTICLE

Spontaneous Pneumothorax Complicating COVID-19 Pneumonia: AMulticenter Analysis

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ABSTRACT

Background: Spontaneous pneumothorax is a rare complication seen in patients of COVID-19 pneumonia. The risk factors associated with this complication and its incidence remain unknown largely. We herein, review and present the incidence, clinical characteristics and outcomes of spontaneous pneumothorax in 1767 patients admitted in three COVID treatment tertiary care centers in Lahore.

Study Design: Retrospective study

Place and Duration of Study: Services Institute of Medical Sciences Lahore and Bahria International Hospital Lahore from 15thApril 2020 to 15thMay 2021.

Methodology: One thousandseven hundred and sixty-seven patients who were diagnosed with a spontaneous pneumothorax were enrolled. Clinical characteristics of these cases were also reviewed and recorded.

Results: One thousand and five hundred patients had positive RT PCR from nasopharyngeal swab. Eleven (.62%) cases of COVID-19 patients who developed spontaneous pneumothorax were identified. The initial HRCT imaging showed typical and diffuse bilateral ground-glass opacities and consolidations, mainly in their peripheral, posterior and basal lung regions. Three patients had pneumothorax late in the course of disease after they were discharged home. We had only one mortality among those (11) cases and that was also not related to the pneumothorax directly but to development of sepsis and multi-organ failure.

Conclusion: Spontaneous pneumothorax is a rare complication seen in COVID-19 pneumonia.

Keywords: Pneumothorax, COVID-19, Spontaneous pneumothorax, Lung injury, Barotrauma, Pneumo-mediastinum

INTRODUCTION

Pneumothorax is defined as leakage and collection of air in pleural space due to trauma or as a result of any invasive procedure. The term spontaneous pneumothorax refers to the presence of air in the pleural space when no obvious precipitating factor (trauma or iatrogenic during an invasive procedure) could be identified. Primary spontaneous pneumothorax is defined as pneumothorax that occurs without any pre-existing lung condition while secondary (spontaneous) pneumothorax takes place on background of pre-existing lung disease.[1] The incidence of spontaneous pneumothorax as a complication of COVID-19 pneumonia is largely undetermined but some evidence reflects its incidence to be 1 to 2% in critically sick COVID-19 pneumonia patients.[2-5] It has been known that pneumothorax in cases of viral pneumonia carries poor prognosis.[6,7]

Mechanism of pneumothorax in COVID-19 is not clearly understood. Multiple mechanisms have been proposed including changes in lung parenchymaalong with cytokine storm. Diffuse alveolar damage may lead to alveolar tears due to increased intra-thoracic pressure from invasive or non-invasive mechanical ventilation or prolonged coughing.[6-9]

Our study describes the incidence and outcomes of spontaneous pneumothorax in COVID-19 patients admitted in two tertiary care centres.

MATERIALS AND METHODS

This retrospective analysis of medical records of patients admitted with COVID-19 pneumonia at two tertiary care centres; Services Institute of Medical Sciences Lahore &Bahria International Hospital Lahore from 15thApril 2020to 15thMay 2021.A total of 1767 cases with moderate to severe pneumonia were admitted, among them 1500 had positive RT PCR (polymerase chain reaction) for COVID19 in nasopharyngeal swab sampling. All of them had high resolution computed tomography (HRCT) on admission, additionally routine daily chest X-rays were done along with daily labs to calculate cytokine's release syndrome (CRS) including complete blood counts (CBC), C-reactive protein (CRP), Interlukin-6 (IL6), D-dimers, lactate dehydrogenase (LDH), serum ferritin. In CBC white blood cell count (WBCs), absolute lymphocyticcounts were also calculated for each case.The diagnosis of pneumothorax was based onchest imaging X-rays or CT scan. All cases who were found to have pneumothorax during their clinical course werereviewed in detail to explore the cause of pneumothorax. The data was entered and analyzed through SPSS-25.

RESULTS

Twenty-one (0.77%) out of 1767 cases had pneumothorax, tenof them were on mechanical ventilation and in 11 were identified as spontaneous pneumothorax cases (0.62%) as

no trauma, mechanical ventilation or interventional procedure could be associated with the event. Two among these 11 had pneumomediastinum. Eight patients were male and 3 were female and ages between 36 to 67 years (Table 1).

Table 1: Demographic data of patients with spontaneous pneumothorax

Variable	Pneumo-mediastinum	Smoking	Mortality
Spontaneous pneumothorax (n=11)			
Male (n=8)	2	2	1(9.09%)
Female (n=3)	-	-	-
Pneumothorax with mechanical ventilation(n=10)			
Male (n=9)	1	6	-
Female (n=1)	-	-	-

Table 2: Biochemical characteristics of patients who developed spontaneous pneumothorax

Laboratory parameter	Mean	Range
WBCs (4.5-11.0×10^9/L)	8.0	2.3-16
Absolute Lymphocytic count (1000-4800/µL)	3200	1200-4500
CRP (<5 mg/L)	156	56-252
LDH (140-280 U/L)	388	330-540
Ferritin (24-336 µg/L)	800	300-1600
D-Dimers (<250 ng/ml)	400	240-680

DISCUSSION

Usually, the major cause for the development of secondary spontaneous pneumothorax is underlying respiratory disease. The list includes old tuberculosis with structural damage, chronic obstructive pulmonary disease (COPD) especially emphysema with bullous formation, Pneumocystis Jiroveci pneumonia (PJP), cystic fibrosis, lung cancer and other interstitial lung diseases.[10]

It has been difficult to understand the pathogenesis of spontaneous pneumothorax in COVID-19 until recently as more evidence has emerged and the cause has been proposed to be multi-factorial. Lung architecture changes seen on serial CT images starting from ground glass opacities (GGOs) usually involving multiple lobes bilaterally mostly in peripheral and posterior areas to pleural and septal thickening, sub pleural involvement, consolidations, bronchiectasis, cystic and fibrotic changes and crazy paving may be seen with advancement in disease.[11]

Dysregulated immune response or cytokine release storm can play its role by causing diffuse alveolar damage and may lead to tears or rupture when this diseased lung is subjected to increased intra-thoracic pressures by mechanical ventilation which could be invasive or non-invasive or by excessive coughing.[12,13]

Virus may cause direct damage to surfactant secreting type II pneumocytes leading to decreased production of surfactant resulting in increased stiffness of alveoli which eventually reduces lung compliance and rupture with air leakagewhen intra-pulmonary pressures rise beyond certain limits.[14]

Intravascular thrombosis resulting from microangiopathy induced COVID-19 due to its multisystem involvement causes breakdown of the alveolar wall due to ischemia.[15]

The risk of developing pneumothorax may be augmented due to the increased respiratory efforts by patients trying to compensate the ventilation perfusion mismatch (V/Q mismatch) leading to raised trans-pulmonary pressures.[16,17]

All the aforementioned factors potentiate the risk of pneumothorax even in spontaneously breathing patients who are not on any respiratory support. This is clearly evident from two of our cases who were actually discharged home and returned back with shortness of breath approximately two weeks after.

All cases who developed pneumothorax exhibited rising trends in inflammatory markers including CRP, ferritin, LDH, D-dimer, and IL-6 (Table 2). This observation is similar to recently published studies whichpoint out Cytokine storm as an important factor in pathogenesis of pneumothorax and as has been summarized above. The hyperactive and dysregulated immune response has been is associated with critical illness and increased mortality.[18]

When reviewed retrospectively it has been found that certain similar features especially cystic changes could be identified in imaging studies of these cases which have also been reported in literature and which can be predictive of development of pneumothorax.[19] If these findings are picked up early in the course of disease, treating clinicians can be warned of and certain measures can be taken to avoid this mishap especially if such cases are mechanically ventilated one can try to keep peak pressures low to avoid barotrauma. Regarding lowering the incidence of spontaneous pneumothorax, the debate is still open.

One common factor among these was prolonged coughing, 7 out of 11 patients had persistent cough as their presenting symptom. Cough may enhance leakage of air out of the alveoli by causing sudden change in length of pulmonary vasculature and associated bronchial architecture. Our observation is similar to Zantah et al.[20]

CONCLUSION

Spontaneous pneumothorax although a rare but lethal complication of COVID-19 pneumonia.The treating clinician should anticipate it as it can occur at any time and should keep checking for it during the course of the disease especially in case of sudden deterioration. All those cases who have baseline ground-glass opacities and cystic changesin the beginning of disease are at higher risk of developing pneumothorax especially if they are mechanically ventilated and subjected to high pressures.Prompt action may save lives so all those dealing with such patients should keep their index of suspicion wide and a low threshold of repeating images like chest x-rays or CT scan if in doubt.

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