

INCIDENCE OF PNEUMOTHORAX IN CASES WITH ARDS REQUIRING PEEP > 10 mmHg

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(Received, 27th June 2023, Revised 20th October 2023, Published 10th November 2023)

Abstract: This study aimed to determine the incidence of pneumothorax in patients with ARDS who require PEEP levels higher than ten mmHg. The study was conducted at the Department of Pulmonology and Critical Care, Central Park Teaching Hospital in Lahore, from January 2022 to June 2023. One hundred thirty-eight patients were enrolled in this cross-sectional study, and informed consent was obtained from all patients and their guardians. All patients underwent chest radiography or point of care ultrasound (POCUS) to identify pneumothorax. The results showed that 35 out of 138 patients (25.4%) had pneumothorax, and the mean PEEP value was 11.05±1.05. The study also found that male patients were more commonly affected than female patients (56.5% vs 42.8%). The practical implication of this study is that the diagnosis of pneumothorax is crucial in patients with ARDS, especially in the early stages, as this condition can lead to high mortality rates. The study can help pulmonologists choose better patient treatment options and avoid comorbidities. Conservative management may be recommended to patients if there are no clinical signs or symptoms of a severe condition and if the pneumothorax size is small. In conclusion, this study shows that patients with ARDS requiring PEEP levels higher than ten mmHg are at a higher risk of developing pneumothorax. Thus, early diagnosis and proper management are essential to improve patient outcomes.

Keywords: Pneumothorax, Mechanical Ventilation, Positive End-Expiratory Pressure, ARDS

Introduction

Respiratory system disorders are common complications globally. Pneumothorax is a frequent and potentially fatal common condition in patients with acute respiratory distress syndrome (ARDS), which is characterized by the condition in which air is found in the pleural space. The pleural space is between the visceral, interlobar fissures and the parietal pleura (Charalampidis et al., 2015; Goizueta and Bordoni, 2019). Patients with mechanical ventilation are at high risk for pneumothorax. ARDS is a condition of acute failure of the respiratory (arterial hypoxemia with PO₂/FiO₂ ratio less than 200 mmHg regardless of PEEP level), with bilateral radiographic infiltrates, without evidence of left atrial hypertension (or pulmonary artery wedge pressure less than 18 mmHg). ARDS is a severe acute lung injury (ALL) (Sampson et al., 2021; Wilkins et al., 2007). There are a number of causative factors for pneumothorax in ARDS, including mechanical ventilation settings, the clinical severity of ARDS, pneumonia, and trauma (Rankine et al., 2000). It is also associated with the duration of ARDS. As the term increases, the occurrence of pneumothorax rises (Gattinoni et al., 1994; Wang et al., 2021).

Positive end-expiratory pressure (PEEP) has been significant in managing patients with ARDS since the *initial description of ARDS* (Walkey et al., 2017). PEEP is the alveolar pressure in the lungs at expiration. It has been stated in the past that the application of PEEP is accused for pneumothorax development in patients with ARDS, but later on, other studies stated that no correlation between

high PEEP levels and pneumothorax frequency was found (Boussarsar et al., 2002; Terzi et al., 2014; Weg et al., 1998). However, a recent review study by Jing Zhou et al. stated that higher PEEP was associated with a significantly higher incidence of pneumothorax (Zhou et al., 2021).

The diagnosis of pneumothorax in patients with ARDS is essential at the initial stages because this condition is responsible for a high mortality rate. So, this study aims to prevent pneumothorax in cases with ARDS requiring PEEP > 10. That will help the pulmonologists choose better treatment applications for patients to avoid comorbidities. Thus, this study aimed to evaluate the incidence of pneumothorax in cases with ARDS requiring PEEP >10 mmHg.

Methodology

The study was conducted at the Department of Pulmonology and Critical Care in Central Park Teaching Hospital, Lahore, from January 2022 to June 2023. The research design was cross-sectional, and non-probability consecutive sampling was used. A sample size of 138 was calculated based on a prevalence of 10% of ARDS and a 95% confidence level. Patients diagnosed with ARDS between the ages of 20 and 80 of both genders were included in the study, while patients with chronic pulmonary disease, tuberculosis, or smoking history were excluded. After obtaining approval from the hospital's

ethical committee, 138 patients were enrolled, and their consent was obtained. All patients underwent a physical examination, and a unique number was given to each patient. A chest radiograph or point of care ultrasound (POCUS) was used to identify pneumothorax, and the size of the pneumothorax was measured on the upright chest radiograph. Patient demographics and clinical data were collected using a pre-designed questionnaire. Data analysis was carried out using SPSS (version 25.0), and the results were presented as tables and graphs.

Results

One hundred thirty-eight patients were enrolled with a mean age of 61.19±12.6 years. Male patients were dominant in our study (male=56.5% and female=42.8%) Table 1, Fig 1). The presence of pneumothorax was found in 35 (25.4%) patients (Table 2, Fig 2). The mean PEEP value was 11.05±1.05 (Table- 1)

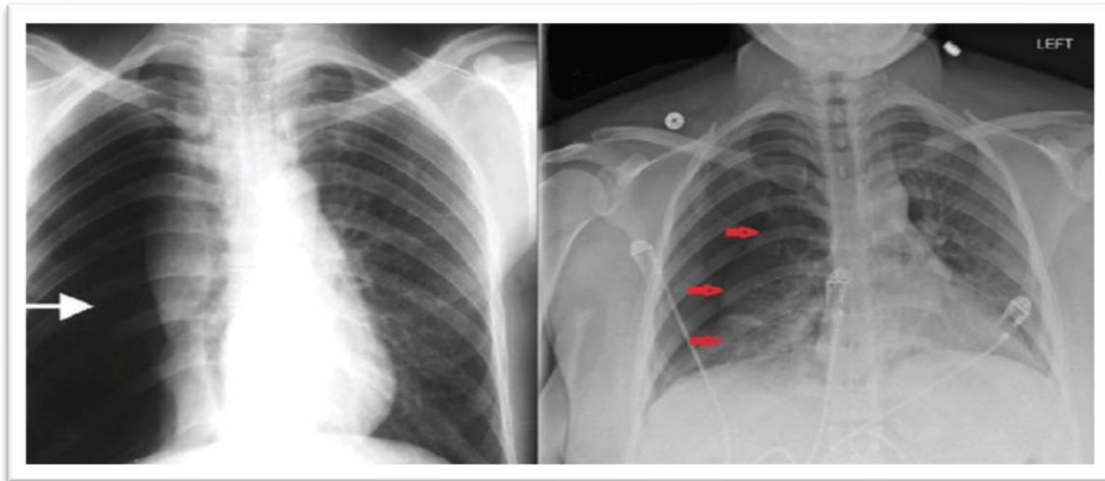


Figure 1 Chest X-ray Showing Large Right Pneumothorax with Collapsed Lung

Table 1: Distribution of Patients According To Gender And Mean Age And PEEP Value Of Patients (n=161)

| Variable | Frequency | Percentage |
|--------------------|-------------|------------|
| Gender: | | |
| Male | 78 | 56.5 |
| Female | 59 | 42.8 |
| | Mean | ±SD |
| Age (Years) | 61.19 | 12.6 |
| PEEP | 11.05 | 1.05 |

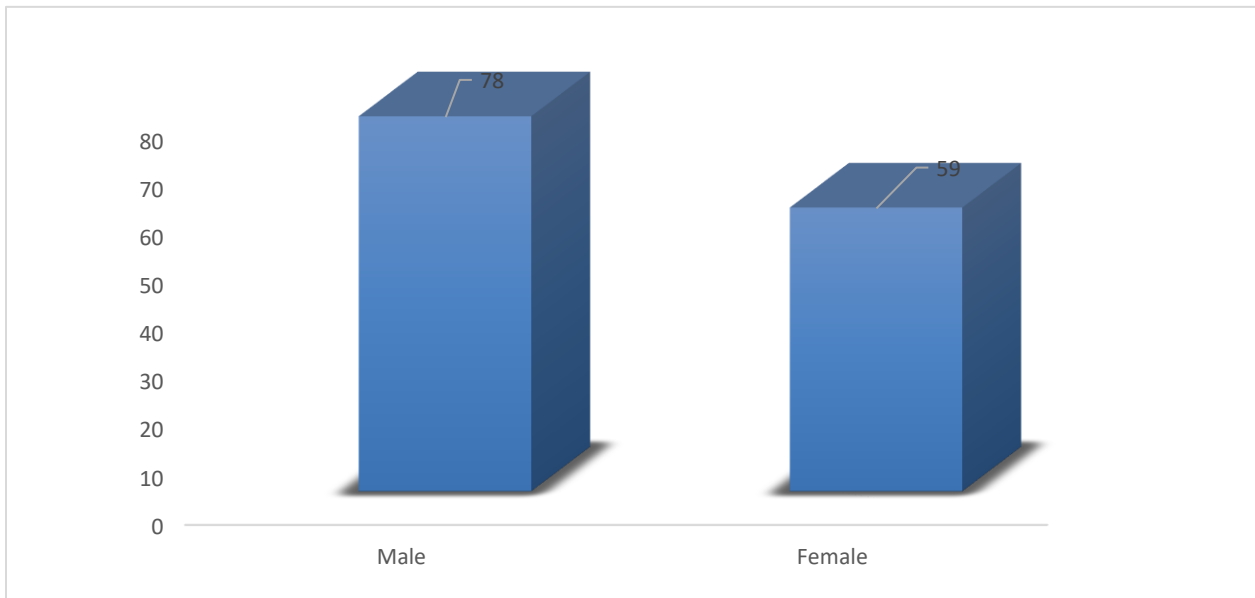


Figure 1: Graphical Representation of Patients based on Gender (n=138).

Table 3: Frequency Of Pneumothorax In Enrolled Patients (no=138)

| Pneumothorax | Frequency | Percentage |
|--------------|-----------|------------|
| Yes | 35 | 25.4 |
| No | 103 | 74.6 |

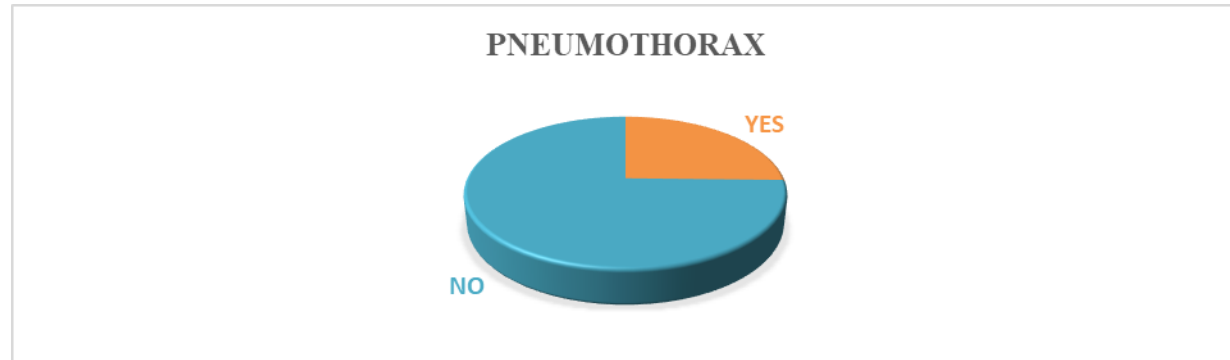


Figure 2: Graphical Representation of patients based on Pneumothorax presence (n=138).

Table 3 presents data on the occurrence of pneumothorax among 138 enrolled patients, categorizing them into "Yes" for those who experienced pneumothorax and "No" for those who did not. Of the total sample, 35 patients (25.4%) had pneumothorax, while 103 patients (74.6%) did not. The table clearly represents the distribution, offering both raw frequency numbers and the corresponding percentages, thereby offering insights into the prevalence of pneumothorax within the studied patient cohort.

Discussion

Pneumothorax, also known as *Collapsed lung*, is when air collects between the parietal and viscera pleurae. It can be a complete lung collapse or only a portion of the lung is collapsed. It is a rare condition but needs care on a priority basis. Mechanical ventilation is used for patients with ARDS; several parameters are frequently changed until compliance is attained. However, pneumothorax is a complication that is noticed during the application of positive airway pressure. There is evidence of an association of Pneumothorax and ARDS patients with high PEEP value. So, the present study evaluated the incidence of pneumothorax in cases with ARDS requiring PEEP >10. Our study found that in 25.4% of patients, pneumothorax condition was developed. Its incidence varies from center to center, as Colt et al. (Colt et al., 1999) stated in their study that pneumothorax was generated in 5.4% of patients. In their research, Sihoe et al. (Sihoe et al., 2004) said that 1.7% (6/ 356) of severe acute respiratory syndrome patients with ARDS. Another study by Gattinoni et al. (Gattinoni et al., 1994) stated the incidence of pneumothorax in 48.8% of patients. Based on our research data, pneumothorax is a common and severe complication in patients with ARDS. Therefore, prevention and treatment of pneumothorax are very important to minimize the mortality rate of patients with ARDS, especially those who require mechanical ventilation (PEEP >10).

The incidence of pneumothorax in ARDS patients is associated with a number of multiple factors, including chronic pulmonary diseases, smoking, severity and duration of ARDS, mechanical ventilation settings, and changes in lung structure and function during ARDS. However, in our study, we excluded patients with a smoking history and with

chronic pulmonary diseases. It has been stated that a 14%-87% incidence of pneumothorax occurs in patients with ARDS who were on ventilators for management (Hsu and Sun, 2014; Jantz and Pierson, 1994). Mechanical ventilation will increase gas flow through pleura defects, leading to more rapid intrapleural pressure rise with earlier mechanical compressive effects and rapid progress to cardiorespiratory collapse and death (de Lassence et al., 2006). Pneumothorax must be suspected in all forms of barotrauma. It has been stated in various research studies that patients who received mechanical ventilation have an incidence of barotrauma of 4%-15% (Hsu and Sun, 2014; Strange, 1999). The literature has described that the incidence of pneumothorax is relatively higher in males than in females (Tsuboshima et al., 2020), as in our study, the male ratio was increased.

Conclusion

It is concluded that patients with ARDS requiring PEEP >10 developed pneumothorax. So conservative management may be recommended to ARDS patients if there are no clinical signs or symptoms of severe condition and if the pneumothorax size is small.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.

Approved by the department Concerned.

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

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[Citation: Ahmad, M. Iqbal, A. Bashir, I. Naeem, O.M. Arshad, U. Kiran, M. (2023). Incidence of pneumothorax in cases with ARDS requiring peep > 10 mmhg *Biol. Clin. Sci. Res. J.*, 2023: 529. doi: <https://doi.org/10.54112/bcsrj.v2023i1.529>]

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