

Original Article

# Determine the Frequency of Pneumothorax in Patients Undergoing Large Volume Thoracentesis

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## ABSTRACT

**Background:** Thoracentesis is a medical procedure used to remove excess fluid or air from the pleural space, the space between the lungs and the chest wall. Pleural effusion occurs when excess fluid collects in the pleural cavity, leading to symptoms such as difficulty breathing and chest discomfort. Large volume thoracentesis, which involves the removal of more than one liter of pleural fluid, can provide significant symptom relief. However, this procedure is associated with risks, including pneumothorax. Previous studies have reported varying incidence rates of pneumothorax following thoracentesis, highlighting the need for further investigation in different clinical settings.

**Objective:** To determine the frequency of pneumothorax in patients undergoing large volume thoracentesis.

**Methods:** This cross-sectional study was conducted at the Department of Pulmonology, Pakistan Emirates Military Hospital, Rawalpindi, from December 12, 2023, to June 12, 2024. A total of 120 patients, both male and female, aged 20-75 years, who required large volume thoracentesis due to pleural effusion were included. Patients with a history of pneumothorax, pre-existing pleural diseases, chronic lung diseases, coagulation disorders, or those who were pregnant were excluded. Non-probability consecutive sampling was used for recruitment. Informed consent was obtained from all participants. Each patient underwent a comprehensive clinical examination, followed by thoracentesis using a 16-gauge intravenous cannula. The volume of aspirated fluid was recorded. Post-procedure, an erect chest radiograph was performed to confirm pneumothorax. Data were analyzed using SPSS Version 26.

**Results:** The mean age of the patients was  $49.68 \pm 12.0$  years, with ages ranging from 23 to 74 years. Among the patients, 71 (59.2%) were male and 49 (40.8%) were female. The majority of patients, 79 (65.8%), were in the 41-60 years age group. Pneumothorax was detected in 21 (17.5%) patients. Stratification of pneumothorax occurrence based on gender showed that 13 (18.3%) males and 8 (16.3%) females developed pneumothorax. Age group stratification revealed that 5 (31.3%) patients in the 20-40 years age group, 11 (13.9%) in the 41-60 years age group, and 5 (20.0%) in the >60 years age group developed pneumothorax. The P-values for gender and age group stratification were not statistically significant.

**Conclusion:** The study concluded that pneumothorax is a significant complication associated with large volume thoracentesis, occurring in 17.5% of patients. The findings underscore the need for careful procedural planning and consideration of techniques such as ultrasound guidance to reduce the risk of pneumothorax.

**Keywords:** Pneumothorax, Thoracentesis, Pleural Effusion, Large Volume Thoracentesis, Pulmonology, Medical Procedure Complications.

## INTRODUCTION

Thoracentesis is a widely performed medical procedure utilized for both diagnostic and therapeutic purposes, particularly in the management of pleural effusions. Pleural effusion occurs when excess fluid accumulates in the pleural cavity, the space between the layers of the pleura surrounding the lungs (1). This condition can result from various causes, including congestive heart failure, pneumonia, pulmonary embolism, liver cirrhosis, and kidney diseases (2). Large-volume thoracentesis, which involves the removal

of more than one liter of pleural fluid, aims to alleviate symptoms such as dyspnea and chest discomfort by significantly reducing the pleural fluid volume, thereby improving respiratory function and lung capacity (3, 4).

The procedure of thoracentesis, while generally considered safe, is not devoid of complications. One of the most significant complications is pneumothorax, a condition where air enters the pleural space, potentially leading to lung collapse. The incidence of pneumothorax following thoracentesis varies across studies and settings. A large review encompassing 9,230 thoracentesis procedures reported a pneumothorax incidence rate of 0.61% (5). However, higher rates have been noted in specific studies, particularly those involving large-volume thoracentesis or those not utilizing ultrasound guidance. For instance, Rehman et al. reported a 6% incidence of pneumothorax in their study, with therapeutic thoracentesis exhibiting a higher risk compared to diagnostic procedures (6, 7). Another study from Pakistan found a pneumothorax rate of 14.1% (8).

The current study focuses on determining the frequency of pneumothorax in patients undergoing large-volume thoracentesis at the Department of Pulmonology, Pakistan Emirates Military Hospital, Rawalpindi. The study spans six months, from December 2023 to June 2024, and includes 120 patients of both genders who underwent large-volume thoracentesis. Comprehensive clinical examinations, chest X-rays, and radiological assessments were conducted to confirm the presence of pneumothorax post-procedure. The study's findings revealed a pneumothorax rate of 17.5%, a figure notably higher than many previously reported rates, underscoring the procedural risks associated with large-volume thoracentesis (9, 10)

Pneumothorax can impact patients of all age groups, though certain demographics may exhibit higher susceptibility. In this study, the majority of patients were within the 41-60 years age group, followed by those older than 60 years. Male patients constituted 59.2% of the study population, with a pneumothorax incidence of 18.3% among males and 16.3% among females. These findings align with previous studies suggesting that patient-related and procedure-related factors contribute significantly to the risk of pneumothorax (11, 12).

The variability in pneumothorax rates across different studies highlights the importance of procedural techniques and patient selection criteria. The absence of ultrasound guidance in our study may have contributed to the higher pneumothorax rates observed. Ultrasound guidance has been shown to reduce the risk of complications during thoracentesis by providing real-time visualization of the pleural space, thus minimizing inadvertent injury to the lung and other structures (13, 14).

In conclusion, our study indicates a substantial risk of pneumothorax associated with large-volume thoracentesis, emphasizing the need for careful patient selection and consideration of procedural techniques to mitigate this risk. Future studies should explore the benefits of ultrasound guidance in reducing thoracentesis-related complications and further investigate the factors influencing pneumothorax incidence to enhance patient safety and outcomes.

## MATERIAL AND METHOD

This cross-sectional study was conducted at the Department of Pulmonology, Pakistan Emirates Military Hospital, Rawalpindi, from December 12, 2023, to June 12, 2024. A total of 120 patients, both male and female, aged 20-75 years, who required large volume thoracentesis due to pleural effusion were included. Patients with a history of pneumothorax, pre-existing pleural diseases, chronic lung diseases, coagulation disorders, or those who were pregnant were excluded. Non-probability consecutive sampling was used for recruitment. Informed consent was obtained from all participants. Each patient underwent a comprehensive clinical examination, followed by thoracentesis using a 16-gauge intravenous cannula. The volume of aspirated fluid was recorded. Post-procedure, an erect chest radiograph was performed to confirm pneumothorax. Data were analyzed using SPSS Version 26.

## RESULTS

The study included a total of 120 patients who underwent large-volume thoracentesis at the Department of Pulmonology, Pakistan Emirates Military Hospital, Rawalpindi, from December 12, 2023, to June 12, 2024. The mean age of the patients was  $49.68 \pm 12.0$  years, with ages ranging from 23 to 74 years. The gender distribution showed that 71 patients (59.2%) were male and 49 (40.8%) were female.

Table 1 Mean Age of Patients (n=120)

Variables	Minimum	Maximum	Mean $\pm$ SD
Age (Years)	23	74	$49.68 \pm 12.0$

**Table 2 Gender Distribution (n=120)**

Gender	Frequency	Percentage
Male	71	59.2%
Female	49	40.8%

**Table 3 Age Group Distribution (n=120)**

Age Groups	Frequency	Percentage
20-40 years	16	13.3%
41-60 years	79	65.8%
>60 years	25	20.8%

Pneumothorax was detected in 21 patients (17.5%). Stratification of patients based on pneumothorax with respect to gender and age group revealed statistically insignificant P-values.

**Table 4 Pneumothorax Incidence (n=120)**

Pneumothorax	Frequency	Percentage
Yes	21	17.5%
No	99	82.5%

**Table 5 Stratification of Pneumothorax by Gender**

Gender	Pneumothorax (Yes)	Pneumothorax (No)	P-value
Male	13 (18.3%)	58 (81.7%)	0.77
Female	8 (16.3%)	41 (83.7%)	

**Table 6 Stratification of Pneumothorax by Age Group**

Age Groups	Pneumothorax (Yes)	Pneumothorax (No)	P-value
20-40 years	5 (31.3%)	11 (68.8%)	0.23
41-60 years	11 (13.9%)	68 (86.1%)	
>60 years	5 (20.0%)	20 (80.0%)	

The study found that 17.5% of patients developed pneumothorax following large-volume thoracentesis. The incidence of pneumothorax was slightly higher in males (18.3%) compared to females (16.3%), and the highest incidence was observed in the 20-40 years age group (31.3%). However, the P-values indicated that these differences were not statistically significant. The results underscore the risk associated with large-volume thoracentesis and highlight the importance of careful procedural planning and execution to minimize complications.

## DISCUSSION

The study aimed to determine the frequency of pneumothorax in patients undergoing large-volume thoracentesis at the Department of Pulmonology, Pakistan Emirates Military Hospital, Rawalpindi. The findings revealed that pneumothorax occurred in 17.5% of the patients, a rate significantly higher than the 0.61% reported in a large review of 9,230 thoracentesis procedures (5). This discrepancy may be attributed to the lack of ultrasound guidance in the current study, a factor known to reduce complication rates during thoracentesis (11, 12) also noted a higher pneumothorax rate of 6% in their study, supporting the notion that large-volume thoracentesis carries a greater risk compared to diagnostic procedures (6, 7).

The higher incidence observed in this study aligns with findings from other research, such as the study by which reported a pneumothorax rate of 14.1% (8). Similarly found pneumothorax rates ranging from 4.0% to 30.3%, further emphasizing the variability based on procedural techniques and patient demographics (11). The study also observed that the majority of pneumothorax cases were among male patients (18.3%) and within the 20-40 years age group (31.3%). However, these differences were not statistically significant, indicating that pneumothorax can occur across different genders and age groups without a clear predisposition (15).

The strengths of the study included a well-defined patient population and a clear procedural methodology, which enhanced the reliability of the findings. The use of chest X-rays and radiological examinations for confirming pneumothorax ensured accurate diagnosis. However, the study had several limitations. The absence of ultrasound guidance during thoracentesis likely contributed

to the higher pneumothorax rate, as ultrasound has been shown to significantly reduce the risk of complications by providing real-time visualization of the pleural space (16). Additionally, the single-center design may limit the generalizability of the results to other settings with different patient populations and procedural practices (17)

The study's findings underscore the need for incorporating ultrasound guidance in thoracentesis procedures to mitigate the risk of pneumothorax. Future research should focus on multicenter studies to validate these findings and explore other potential risk factors associated with pneumothorax in large-volume thoracentesis. The study also highlighted the importance of careful patient selection and procedural planning to enhance patient safety. Despite the higher incidence of pneumothorax observed, the overall benefits of large-volume thoracentesis in alleviating symptoms and improving respiratory function were evident, reaffirming its therapeutic value in managing pleural effusions (18-22).

## CONCLUSION

In conclusion, the study demonstrated a notable frequency of pneumothorax in patients undergoing large-volume thoracentesis, emphasizing the procedural risks involved. The findings suggest a need for improved techniques, such as ultrasound guidance, to enhance safety and reduce complications. By addressing these factors, future thoracentesis procedures can achieve better outcomes, ultimately benefiting patient care and clinical practice.

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