Causes of Pneumothorax in Patients of Advanced Age and Analysis of Mortality Rates

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Abstract

Aim: Spontaneous pneumothorax (SP) primarily affects young males but typically presents as a secondary condition in older adults. Secondary spontaneous pneumothorax (SSP) is a life-threatening condition that requires urgent intervention, often arising due to underlying chronic pulmonary diseases. This study aims to evaluate the etiological factors, clinical characteristics, treatment modalities, and mortality associated with SSP in patients aged 60 years and older based on current literature.

Methods: This study was conducted by retrospectively analyzing the outcomes of patients aged 60 and older who were followed up for SSP between October 2022 and July 2024.

Results: A total of 60 patients met the inclusion and exclusion criteria. The mean age was 72.03 ± 8.5 years (range: 60–91). Comorbidities were present in 54 patients (90%), while underlying pulmonary diseases were identified in 31 cases (51.66%). Conservative management was employed in six patients (10%), whereas 55 patients (91%) underwent tube thoracostomy. Pleurodesis was performed in 12 patients (20%), significantly reducing pneumothorax recurrence (p=0.001). Imaging revealed a significant association between bullous lung structures and pneumothorax recurrence (p = 0.008). Pneumonia was diagnosed in 35% of cases, and 13 patients with pneumonia had a statistically significant association with mortality (p< 0.001).

Conclusions: Secondary spontaneous pneumothorax is a life-threatening condition requiring timely intervention, particularly challenging in elderly patients. Data indicate that underlying lung disease and bullous structures on imaging increase the risk of pneumothorax recurrence. Prognostic factors associated with mortality include intensive care needs, complications, and pneumonia, highlighting their significance in management outcomes.

Keywords: *Advanced age; mortality; secondary spontaneous pneumothorax; secondary spontaneous pneumothorax*

1. Introduction

Pneumothorax, defined as the accumulation of air in the pleural space resulting from the partial or complete collapse of lung parenchyma, is classified as spontaneous, post-traumatic, and iatrogenic.[1,2] Secondary spontaneous pneumothorax (SSP) accounts for 10% of spontaneous pneumothorax (SP) cases.[3] Two distinct age peaks are observed in the age distribution of pneumothorax cases: the first occurs in young patients, while the second appears in the elderly population.[4] Primary spontaneous pneumothorax (PSP) is more common in younger individuals, whereas SSP is typically associated with underlying pulmonary diseases in older patients.[5] Smoking, tall stature, and being over 60 years of age increase the risk of PSP recurrence by up to 54% within four years.[6,7] Risk factors for SSP recurrence include age, pulmonary fibrosis, and emphysema.[7,8]

According to the guidelines of the British Thoracic Society (BTS) and the American College of Chest Physicians (ACCP), hospitalization is recommended for patients with spontaneous pneumothorax (SP), and intervention is required in cases where the pneumothorax exceeds 1 cm at the hilum or 2 cm at the apex.[9,10]

The presence of comorbidities in the elderly, complications related to pulmonary diseases, and impaired cardiopulmonary function complicate treatment. These factors may also lead to an increased risk of intensive care unit (ICU) admission, intubation, and mortality.[11] Therefore, in elderly patients, non-surgical treatment methods, such as chemical pleurodesis, are generally preferred.[12]

This study aims to evaluate the presence of underlying lung diseases in patients aged 60 and above with SSP, assess the development of complications during follow-up, and identify mortality and prognostic factors.

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2. Materials and Methods

This retrospective descriptive study was approved by the Non-Interventional Clinical Research Ethics Committee (Date: July 30, 2024, Decision No: 144). The study was conducted in compliance with the Declaration of Helsinki of the World Medical Association. Patients aged 60 years and older evaluated for pneumothorax between October 2022 and July 2024 were included. A total of 105 patients were assessed during the study period.

Sixty patients who met the inclusion and exclusion criteria were enrolled in the study. The study evaluated the following parameters for the patients: demographic characteristics, comorbidities, existing pulmonary diseases, number of pneumothorax episodes, the side of the pneumothorax, treatment approaches, the number of patients requiring chest tube placement, duration of chest tube placement, coexistence of pneumonia during pneumothorax, length of hospital stay, need for intensive care admission, length of stay in intensive care, and mortality rates. Eligible patients were managed conservatively, while tube thoracostomy was performed for those with an increase in pneumothorax size.

Patients who developed pneumothorax due to penetrating or cutting injuries, firearm injuries, trauma, assault, or iatrogenic causes were excluded from the study. Patients who passed away after discharge were not included in the mortality section. A total of 45 patients with incomplete parameters were excluded from the study.

2.1. Statistical analysis

The statistical analyses of the data were conducted using IBM SPSS (version 26.0), TURCOSA (www.turcosa.com.tr), and the R programming language (version 4.3.0, www.r-project.org). The relevant software programs were used in combination, depending on the type of analysis and specific requirements. Categorical variables were summarized using frequencies and percentages. The normality of the distribution of numerical variables was assessed using both graphical methods (e.g., histograms, box plots, Q-Q plots) and analytical approaches (e.g., Shapiro-Wilk normality test). Comparison of scale scores between groups was performed using the Student's t-test and One-Way Analysis of Variance (ANOVA) tests. When the assumption of normal distribution was not met, the Mann-Whitney U test and Kruskal-Wallis tests were used. For comparisons between groups in terms of categorical variables, Chi-Square tests (e.g., Pearson, Fisher, etc.) were applied. Correlations between variables were examined using Pearson or Spearman correlation coefficients, depending on the normality assumption. A p-value of <0.05 was considered statistically significant for all analyses.

3. Results

During the study period, 105 patients aged 60 years and older who were monitored due to SSP, were evaluated. Forty-five patients were excluded for not meeting the study's inclusion criteria, leaving a total number of 60 patients in the final analysis. Among these, 51 (85%) were male, and 9 (15%) were female. The mean age was 72.03 ± 8.5 years, with female patients having a higher average age than male patients.

In 51.66% of cases, patients had underlying pulmonary conditions, including chronic obstructive pulmonary disease (COPD), asthma, parenchymal lung diseases, and small airway diseases. Additionally, 90% of patients had comorbidities, such as hypertension, diabetes mellitus, cardiovascular disease, neurological disorders, and renal disease (Table 1).

In the study, 6.66% of the patients were diagnosed with lung cancer. Extrapulmonary malignancies were noted as lymphoma, pancreatic cancer, laryngeal cancer, hypopharyngeal cancer, and cranial-site cancer. These were identified in 15 of the evaluated cases. In 20% of the patients, pleural effusion was observed on the side of the pneumothorax, with exudative fluid detected in eight patients. Pneumothorax was found on the right side in 32 patients. Mortality was observed in 16 patients (Table 1).

Thoracic imaging evaluations revealed the presence of bullous structures in the parenchyma in 32 patients (53.33%), all of whom were male (p<0.001). On the side where pneumothorax was detected, pleural fluid was observed in 12 patients. There was no statistically significant difference between genders (p=0.857). Among the cases with pleural fluid, 4 (6.66%) were transudative, and 8 (13.33%) were exudative. When evaluated according to the side of SSP detection, no statistically significant difference was found (p=0.885) (Table 1).

Table 1

Demographic characteristics

	Mean±SD (min-max)
Age (average, years)	72.03±8.05 (60-91)
Female (n=9)	79.33 ± 9.47 (65-91)
Male (n=51)	70.74 ±7.12 (60-85)
	Total (n=60) (n, %)
Concomitant lung disease	31 % 51.66
Lung cancer	4 % 6.66
Extrathoracic cancer	15 % 25
Comorbid condition	54 % 90
Anticoagulant	31 % 51.66
Patients with pleural fluid association on the side of pneumothorax	12 % 20
Transudate	4 % 6.66
Exudate	8 % 13.33
Pneumothorax side	
• left	28 % 46.66
• right	32 % 53.33
Mortality	16 % 26.66

Table 2

The assessment of bullous structures on chest computed tomography

	pulmonary bullae structure	p value
Number of pneumothorax attacks		
• first attack	21 % 35	0.008
• second attack	5 % 8.33	
• third attack	3 % 5	
• four or more attacks	3 % 5	
Concomitant lung disease	25 % 41.66	<0.001
Lung cancer	1 % 1.66	0.511
Extrathoracic cancer	7 % 11.66	0.550
Mortality	4 % 6.66	0.008

A total of 32 patients showed the presence of bullous structures in thoracic imaging. The presence of bullous structures in the parenchyma were more frequently observed in patients with a history of their first pneumothorax attack (p=0.008). Among patients with underlying lung disease, 41.66% had bullous structures (p<0.001). Four of the deceased patients had bullous structures on their thoracic computed tomography (p=0.008) (Table 2).

When examining the treatment approach and management process in patients diagnosed with SSP, it was found that 6 out of 60 patients (10%) were followed up with conservative treatment. A patient who experienced a second attack of SSP, managed with oxygen therapy, was later treated with tube thoracostomy during follow-up. The number of patients followed up with tube thoracostomy was determined to be 55 (91.66%) (p=0.697). Tube thoracostomy was performed on 45 patients (75%) during the first pneumothorax attack. When comparing patients who underwent tube thoracostomy about mortality, no statistically significant difference was observed (p=0.725) (Table 3).

The average total hospital stay was 17.83 days (p=0.471).

The average duration of chest tube placement was 9.65 days (p=0.025). In cases monitored in the ICU, the average duration of chest tube placement was found to be 8.58 days (p=0.819) (Table 4).

The number of patients monitored with a Heimlich valve was recorded as 3 (5%). The number of patients who underwent pleurodesis was 12 (20%), 6 of whom (10%) received pleurodesis during their first pneumothorax attack. One patient underwent autologous blood patch pleurodesis, and 11 patients underwent pleurodesis with talc powder. No mortality was observed during the follow-up of patients who underwent pleurodesis (p=0.025). The number of patients followed in the intensive care unit was 31 (51.66%), 28 of whom (46.66%) were followed for the first pneumothorax attack. 25% of these patients died (p<0.001). In 12 patients monitored after the first attack, complications (such as bronchopleural fistula, empyema, prolonged air leak, atelectasis, etc.) were observed.

Two of our cases with inoperable lung cancer were diagnosed with a bronchopleural fistula and empyema due to a central tumor. In the patient with a poor general condition, antibiotic therapy was initiated; one patient passed away on the 4th day after chest tube placement, while the other passed away on the 2nd day. One of the three patients followed for empyema (aged 64) refused both medical and surgical treatment and was managed with a Heimlich valve. The other two patients (aged 65 and 82) died due to multi-organ failure. In an 80-year-old patient, pulmonary edema developed, and the patient passed away on the 10th day after chest tube placement. Atelectasis developed in six patients. Three patients, aged 70, 78, and 90, recovered with expansion defects. The three patients (aged 70, 75, and 78) had atelectasis along with prolonged air leakage; these patients passed away due to general condition deterioration and multi-organ failure. Mortality occurred in 9 patients with complications, which was statistically significant (p<0.001).

Among the patients with concurrent pneumonia during follow-up, 13 (21.66%) were found to have died (p<0.001). In the group of patients monitored in the ICU, 15 patients experienced mortality, and a statistically significant relationship was observed between intensive care follow-up and mortality (p<0.001) (Table 5).

Table 3

The number of secondary spontaneous pneumothorax attacks, management of pneumothorax, and clinical outcomes in patients

	Number of pneumothorax attacks				p value
	1	2	3	4 or more attacks	
O_2 therapy	5 %8.33	1 %1.66	0	0	0.721
Tube thoracostomy	45 %75	4 %6.66	3 %5	3 %5	0.697
Surgical intervention performed	1 %1.66	0	0	0	0.973
Hemlich Valf	1 %1.66	0	1 %1.66	1 %1.66	0.026
Pleurodesis	6 %10	1 %1.66	3 %5	2 %3.33	0.001
Follow-up in the ICU	28 %46.66	2 %3.33	0	1 %1.66	0.237
Complications	12 %20	2 %3.33	0	0	0.689
Pneumonia	18 %30	2 %3.33	0	1 %1.66	0.862

Table 4

Follow-up Duration Data of Patients with Chest Tube Placement

Variable	Duration (Median[Q1-Q3])	p value
Duration of chest tube placement (n=55)	9.65 [5, 12]	0.025
Total hospitalization duration	17.83 [6, 20]	0.471
ICU stay duration (n=31)	8.58 [4, 12]	0.819

** Values are summarized as Mean ± Standard Deviation or Median [First quartile(Q1), Third quartile(Q3)] depending on the underlying distribution of the variables.*

Table 5

Management of pneumothorax and clinical outcomes in patients

	Mortality	p
Complications (n=14)	9 % 15	<0.001
Pneumonia (n=21)	13 % 21.66	<0.001
Follow-up in the ICU (n=31)	15 % 25	<0.001
	Mean±SD	p
Chest drain duration (n=55)	7.625 ± 5.05	0.542
ICU follow-up duration (n=31)	23± 11.156	0.010

* *ICU: Intensive care unit*

4. Discussion

In this study, we examined cases of SSP in patients aged 60 and above. The prevalence in males in the literature ranges from 61% to 91%.[13,14] Consistent with the literature, our study showed a higher number of male patients, with 51 (85%) males. COPD has been identified as the most common cause of SSP development.[4,15] In the 31 (51.66%) patients who were followed up, underlying lung diseases were detected, and it was observed that the number of cases was higher in males.

In the BTS guidelines, in cases where there is no hemodynamic instability in the clinic, if the pneumothorax is smaller than 1 cm at the hilum level, conservative treatment with bed rest is recommended.[9] In a case with minimal pneumothorax, six patients were followed with conservative treatment. During the observation

period, one patient required a tube thoracostomy.

In the studies by Schoenenberger et al. it was reported that surgery was required in 34% of cases of secondary spontaneous pneumothorax (SSP) due to prolonged air leaks [16]. In elderly patients, due to the presence of severe systemic diseases and underlying pulmonary conditions, pleurodesis is recommended over surgery to prevent recurrence.[10] In cases where air leakage from the chest tube persists for more than seven days, we recommend surgical intervention due to prolonged air leakage. In our study, one patient underwent surgical intervention. The patient accepted surgery on the 12th day and was discharged on the 6th postoperative day. In our series, tube thoracostomy and closed underwater drainage systems were applied to 55 patients (91.66%), with three of them being followed with a Heimlich valve. Pleurodesis was performed in 12 patients (20% of the cases). The study shows that in cases where pleurodesis was applied, the recurrence and mortality rates were statistically significantly lower. It has been reported in the literature that the recurrence rate following the first episode varies between 16% and 52%.[17] In our series, pneumothorax recurrence was observed in 12 cases (9%).

Among these mechanisms are the increase in distal air trapping due to airway obstruction caused by the tumor, the development of pulmonary infarction resulting from tumor embolism, and the formation of a broncho-pleural fistula due to subpleural metastasis.[18, 19] Two of our patients with inoperable lung cancer had a concomitant bronchopleural fistula and empyema. During their follow-up, one patient passed away on the 4th day, and the other on the 2nd day.

In the cases followed, among 26 patients with underlying lung disease and a diagnosis of lung cancer, bullous structures were observed in seven patients with extrathoracic cancer. Mortality was detected in 6.66% of patients with bullous structures.

Surgical indications include recurrent pneumothorax, extensive bullous lung disease, prolonged air leakage, and lung expansion defect.[9,20] In SSP, surgical intervention was considered for patients who did not show expansion after a certain period, before complications developed. Due to the presence of comorbidities, low performance scores, intubation during follow-up, and the development of multi-organ failure, these patients were considered high-risk for surgical intervention. It has been statistically shown that the mortality rate is significantly higher in cases that develop complications and are followed in the intensive care unit.

Studies have demonstrated that the incidence of pneumonia in patients at the time of admission and during follow-up can rise to 11%.[21-24] In our study, 35% of patients were followed up with pneumonia. Pneumonia was present in 21.66% of the deceased patients. A statistically significant relationship was found between pneumonia and mortality ($p<0.001$).

5. Conclusion

Underlying lung disease, concomitant comorbidities, and the development of complications can complicate the management of SSP in elderly patients. The primary goal of the treatment approach is to reduce the recurrence rate and limit mortality by preventing complications. SSP is a recurrent condition, and predicting recurrence in advance is challenging.

In our study, when evaluating the clinical course of elderly patients with SSP, the presence of bullous structures in imaging emerged as a significant risk factor, even in the absence of a diagnosed underlying pulmonary disease. In our study, the development of pneumonia, the need for intensive care unit admission, and the occurrence of complications during follow-up were found to be associated with mortality. These findings are important for determining prognosis. It is anticipated that these data will help us identify goals that can improve survival and quality of life.

This study was conducted at a single center, which limits its generalizability. There is a need for more extensive, multicenter studies.

Statement of ethics

Ethical approval was obtained from the Kayseri City Hospital Clinical Research Ethics Committee. (Date:2024/No:144).

Conflict of interest statement

The author declare that they have no conflict of interest.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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