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Pneumomediastinum: retrospective analysis of 19 cases and an innovation proposal in classification

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Abstract

Background: Guidelines to standardize treatment and follow-up strategies in pneumomediastinum cases are lacking. The aim of the study was to evaluate the etiology in pneumomediastinum cases and the results of treatment and follow-up.

Results: Nineteen patients with pneumomediastinum who were followed up in our clinic between 2015 and 2020 comprised the study population. Among the patients, 16 (84.2%) were male, and the mean age was 31.15 years. The chief presenting complaints were chest pain and dyspnea. Pneumomediastinum was spontaneous in 15/19 patients (including spontaneous pneumomediastinum with an underlying pathology in 3/15), traumatic in 3/19, and iatrogenic in 1/19. Spontaneous pneumomediastinum without underlying pathology was seen in younger adults (mean age: 23 years). Surgical intervention in traumatic and iatrogenic pneumomediastinum cases was compared with spontaneous cases and no statistically significant difference was observed ($p=0.178$). The mean hospital stay of all patients was 3.15 days. Only one patient had a recurrence and died, which was later determined to be a secondary spontaneous pneumomediastinum case.

Conclusion: Pneumomediastinum often occurs with an underlying pathology in advancing age and as spontaneous in younger patients. Therefore, “secondary spontaneous pneumomediastinum” subclass should be evaluated in the classification to facilitate to create a standard guideline and prevent overdiagnosis and overtreatment.

Keywords: Classification, Pneumomediastinum, Secondary spontaneous

Introduction

First reported by Hamman in 1939, pneumomediastinum (PM) is defined as the presence of free air in the mediastinum [1]. Secondary PM develops due to underlying esophageal and tracheal pathology or trauma, or history of surgical intervention, while primary/spontaneous PM etiology is unclear despite several contending theories [2].

Physicians generally prefer a conservative approach in primary/spontaneous PM, and patients are discharged after spontaneous resorption of mediastinal air, with rare recurrence. In contrast, surgical interventions including thoracotomy may be necessary, especially in complicated secondary PM cases, but there is no guideline for a standard approach in this regard [3].

In the present study, we share our clinical experience with PM cases in light of the literature.

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Materials and methods

Nineteen patients with PM who were followed up in our clinic between 2015 and 2020 were included in the retrospective study. We retrospectively analyzed the patients' data, including age, gender, presenting complaints, physical examination findings, comorbidities, CT images, diagnostic procedures such as bronchoscopy, esophagoscopy, follow-up periods, surgical interventions, complications, length of hospital stay, and recurrence.

We classified the PM patients who revealed no additional pathology in their examinations as primary/spontaneous PM, those with trauma history as traumatic, additional pathology as secondary spontaneous, and surgical intervention history such as transthoracic biopsy as iatrogenic.

Chi-square test was used to analyze differences between categorical variables. *P* value below 0.05 was considered significant.

Results

Sixteen of the patients (84.2%) were male and 3 (15.8%) were female. The mean age was 31.15 years (min: 20, max: 83). The mean age of primary/spontaneous PM patients was 23 years (min: 20, max: 34). All patients underwent thoracic CT. The mean hospital stay of all patients was 3.15 days. Only one patient had a recurrence 2 weeks after discharge and died due to respiratory failure on the 4th day of his second hospital stay.

Table 1 shows the patients' data, including chief complaints, physical examination findings, comorbidities, additional radiological findings, interventional diagnostic procedures, treatment, surgical interventions, length of hospital stay, recurrence, and survival. Pretracheal fasciotomy or tube thoracostomy was decided according to the depth of the patient's respiratory distress and additional findings developed during follow-up and in addition to all these, since there is no standard approach guideline, at the discretion of the responsible physician. No case of tension pneumomediastinum or case requiring VATS or thoracotomy was detected.

Surgical intervention in traumatic and iatrogenic pneumomediastinum cases was compared with spontaneous cases and no statistically significant difference was observed ($p=0.178$, $\chi^2=2.554$) (Table 2).

Discussion

The main finding in our study is that the mean age is quite low in patients without an underlying pathology in spontaneous pneumomediastinum cases (mean age: 23). In addition, an underlying disease was diagnosed in cases of spontaneous pneumomediastinum detected at an advanced age. There was no significant difference in the statistical analysis, since it was seen that proportionally

more surgical intervention was needed in traumatic and iatrogenic pneumomediastinum cases ($p=0.178$).

PM not occurring due to secondary causes such as iatrogenic, trauma, mechanical ventilation, and comorbidity is called primary (spontaneous) PM (Fig. 1) [4]. Primary PM is a very rare condition, primarily seen in young male individuals, with an incidence of 1:7000–1:45,000 [5]. The mean age of all patients in our study was 31.15, but concerning only spontaneous PM, the mean age is 23. This data suggests that the physician should consider secondary causes in PM patients as the age increases.

Although the etiology of primary PM is not clear, there is a theory that air with increased pressure dissects through the loose connective tissue and along the subcutaneous planes into the mediastinum [6]. In addition, the pathophysiologic process of PM known as the Macklin effect involves alveolar rupture, especially in blunt traumas, and as a result, air traveling along bronchovascular structures into the mediastinum [7]. Studies show that PM may be accompanied by pneumothorax if mediastinal gas migrates through the mediastinal pleura into the pleural space [4]. In the present study, we did not encounter pneumothorax among our spontaneous PM cases. However, we had a patient with iatrogenic PM and pneumothorax secondary to the interventional procedure (transthoracic biopsy).

In our study, secondary causes such as underlying malignancy and interstitial lung disease (ILD) were found especially in pneumomediastinum cases with advanced ages. In the classification of PM, the terms primary and spontaneous are used interchangeably. However, this usage falls short of explaining secondary spontaneous cases which are not traumatic or iatrogenic [4]. In parallel with the theories on the etiology of pneumomediastinum [6], it is supported that it is a triggering factor in advanced age spontaneous pneumomediastinum cases. In addition, when the literature was examined together with the small number of cases, it was seen in the study of Çelik et al. that 6 of 23 patients were over 40 years old, and secondary causes were observed in 5 of these patients (83%). Malignancy was found in two patients, emphysematous lung in one patient, tuberculosis in one patient, and asthma in one patient [7]. In addition, although there are always case reports and small case series like our study, Alemu et al. evaluated 339 cases published in PubMed, in 57 patients (16.8%) asthma, 19 (5.6%) ILD, and 12 patients (3.5%) found malignancy [8]. Since the age rates of the cases with secondary causes were not specified separately in this study, no additional interpretation of age could be made, but this study, in which all case reports were evaluated [8], strongly supports the need for a definition of secondary spontaneous

Table 1 Characteristics of pneumomediastinum cases

Sira	Age	Gender	Symptoms	History	Physical examination findings	Comorbidities	Additional radiological findings	Interventional diagnostic procedure	Etiology	Treatment approach	Surgical intervention	Hospital stay (day)	Recurrence	Mortality
1	46	Male	Neck pain, cough	After cough	Subcutaneous emphysema	0	Subcarinal lymph node	FOB	Secondary	Conservative	0	3	-	-
2	23	Male	Chest pain	After cough	0	0	FOB	FOB	Spontaneous	Conservative	0	2	-	-
3	83	Male	Dyspnea	After-cough	0	Parkinson's	Interstitial lung disease	FOB	Secondary	Conservative	0	2	+ (2 weeks after discharge)	+ (4th day after recurrence)
4	20	Male	Chest pain	After cough	0	0	0	FOB	Spontaneous	Conservative	0	2	-	-
5	21	Male	Chest pain, cough	After cough	0	0	0	FOB	Spontaneous	Conservative	0	3	-	-
6	34	Male	Chest pain	Trauma	Skin abrasion	0	0	FOB	Traumatic	Conservative	0	4	-	-
7	21	Male	Chest pain, cough	After cough	0	0	0	FOB	Spontaneous	Conservative	0	5	-	-
8	20	Male	Dyspnea	After cough	0	0	0	FOB	Spontaneous	Conservative	0	6	-	-
9	58	Male	Dyspnea	Trans-thoracic biopsy	Subcutaneous emphysema	Left pneumonectomy	Left pneumonectomy, right pneumothorax	FOB	Iatrogenic	Surgical intervention	Tube thoracostomy	3	-	-
10	20	Male	Chest and neck pain	After cough	0	0	0	FOB	Primary	Conservative	0	2	-	-
11	25	Male	Chest pain	After cough	Subcutaneous emphysema	0	0	FOB	Spontaneous	Conservative	0	3	-	-
12	25	Male	Dyspnea, hoarseness	After cough	Subcutaneous emphysema	0	0	FOB	Spontaneous	Surgical intervention	Pretracheal fasciotomy	4	-	-
13	34	Male	Chest and back pain, hoarseness	Postprandial	0	0	0	FOB + esophagoscopy	Spontaneous	Conservative	0	4	-	-
14	22	Female	Chest and neck pain	After cough	Subcutaneous emphysema	0	0	FOB + esophagoscopy	Spontaneous	Conservative	0	4	-	-
15	23	Female	Difficulty swallowing	Trauma	0	0	0	FOB + esophagoscopy	Traumatic	Conservative	0	1	-	-
16	23	Female	Dyspnea	After cough	Subcutaneous emphysema	0	0	FOB	Spontaneous	Surgical intervention	Tube thoracostomy	5	-	-

Table 1 (continued)

Sıra	Age	Gender	Symptoms	History	Physical examination findings	Comorbidities	Additional radiological findings	Interventional diagnostic procedure	Etiology	Treatment approach	Surgical intervention	Hospital stay (day)	Recurrence	Mortality
17	21	Male	Chest pain, fever	After cough	Cryptic tonsillitis, Scalene lymphadenopathy	Retropharyngeal abscess	Retropharyngeal abscess	FOB	Secondary	Conservative	0	3	-	-
18	24	Male	Chest pain	After cough	Subcutaneous emphysema	0	0	FOB	Spontaneous	Conservative	0	1	-	-
19	49	Male	Dyspnea	Trauma	0	0	0	FOB	Traumatic	Surgical intervention	Pretracheal fasciotomy	3	-	-

Table 2 Distribution of surgical intervention among groups in pneumomediastinum cases and chi-square analysis

	Surgical intervention		Conservative approach		χ^2	<i>p</i>
	<i>N</i>	%	<i>N</i>	%		
Spontaneous	2	13.3	13	86.7	2.554	0.178
Not spontaneous	2	50	2	50		

pneumomediastinum. As in the classification of pneumothorax [9], it may be viable to classify the cases, especially young adults ones, in which no underlying pathology is detected, as “primary spontaneous PM,” and the cases that occur spontaneously but are later linked to a detected pathology such as malignancy or Boerhaave syndrome, as “secondary spontaneous PM.” In addition, classifying other cases as acquired, traumatic, or iatrogenic would be further explanatory.

In our study, the most common complaints were chest pain (11/19) and dyspnea (6/19) after coughing (14/19). In addition, subcutaneous emphysema was palpated in PM in 7/19 patients. While bronchoscopy was performed in all patients, including esophagoscopy in 3 patients, tube thoracostomy was required in 2 patients and pretracheal fasciotomy was required in 2 patients. In addition, mortality was observed in 1 patient.

The chief complaints in PM patients are acute dyspnea and chest pain, mainly extending from the retrosternal region to the neck, in addition to less frequent symptoms of hoarse voice, difficulty swallowing, sore throat, and cough [10]. Spontaneous PM is mostly observed in younger patients whose mediastinal tissues are loose and flaccid, in contrast to elderly individuals with age-related pulmonary fibrosis, preventing air movement into the mediastinum. Therefore, PM should be considered in young patients presenting with acute dyspnea, chest pain, or both [11]. Besides, in malignant PM, which can cause compression of organs, patients may present with shock, accompanied by loss of consciousness.

On physical examination, subcutaneous emphysema can be palpated, especially in cases with progressed air leak [11]. In addition, Hamman’s sign, a crunching or clicking noise, can be heard during systole on cardiac auscultation [1]. Since higher noise intensity is typical in malignant PM, cervical venous engorgement due to anomalous return, hypotension, tachycardia, tachypnea, or pulsus paradoxus may manifest.

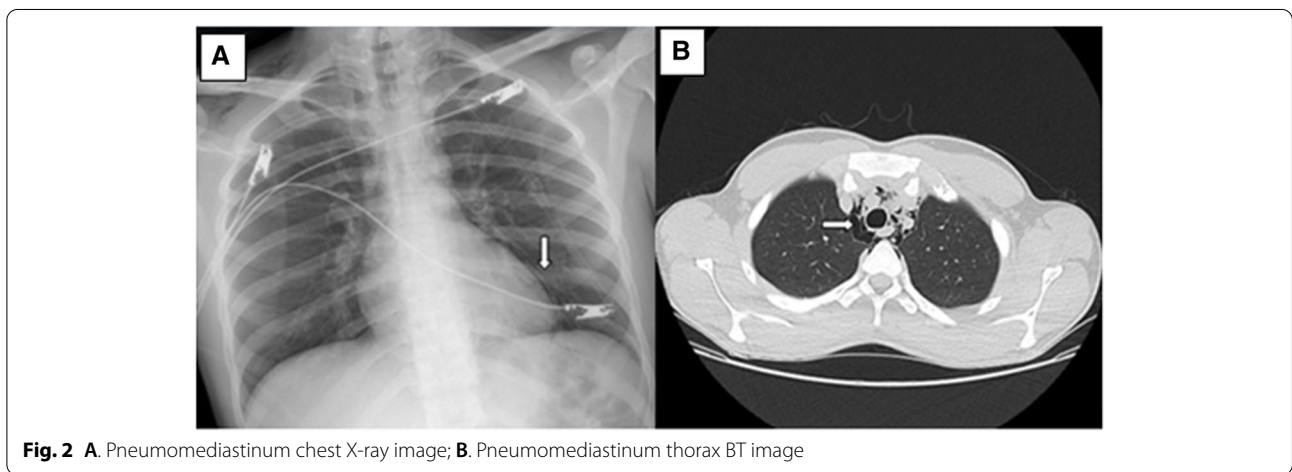
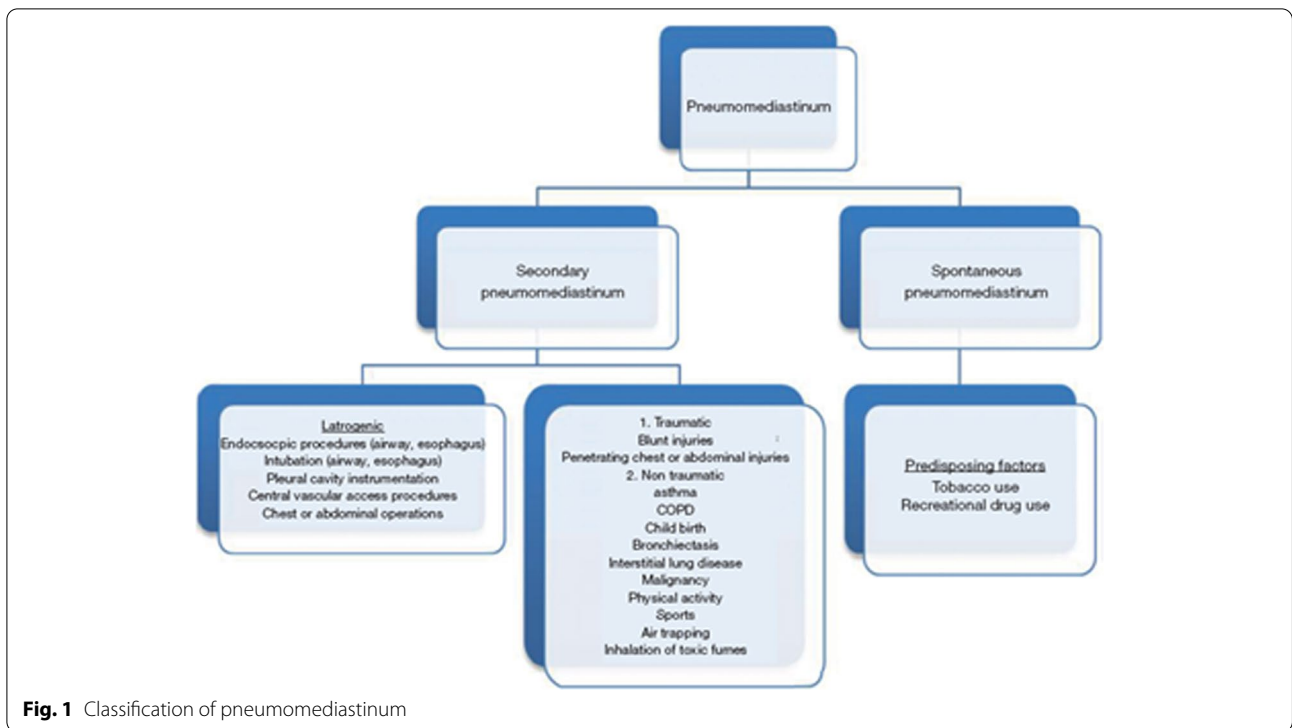
Although chest X-ray is usually the first examination, thoracic CT is the gold standard in diagnosing PM since it shows the air density and reveals the underlying organ pathology (Fig. 2) [4]. In our clinic, we prefer thoracic CT at initial hospital admission in all patients. We detected severe ILD in an 83-year-old patient on thoracic CT. PM, which is generally benign in young individuals, should be

assessed carefully in elderly patients since it may be due to secondary causes.

In addition to routine bronchoscopy, esophagoscopy is not performed in all patients in our clinic in case of findings not involving the gastrointestinal tract. In one of our cases, we diagnosed a 46-year-old male patient with small cell lung cancer as a result of a biopsy taken from the carinal area with bronchoscopy, together with the suspicion in the CT findings. In the presence of symptoms such as vomiting and hemoptysis or clinical suspicion that may radiologically explain PM etiology, advanced tests such as bronchoscopy and esophagoscopy can be performed. Oesophagography with opaque material may also be used if perforation is suspected [12].

While most of the patients followed up in our clinic were followed with a conservative approach including antibiotic therapy, interventional procedure was performed in only 4 patients. In addition, we did not have any patient who needed exploration with video-assisted thoracoscopic surgery (VATS) or thoracotomy. A conservative approach is generally preferred in cases without underlying disease (primary/spontaneous PM). Patients should be monitored for at least 24 h, and infection and vital sign parameters should be assessed under analgesic treatment and oxygen support [8]. Although prophylactic antibiotic therapy is not typically recommended [13], there are also publications recommending routine antibiotic therapy despite the risk of developing mediastinitis [10]. In patients presenting with respiratory noise (i.e., a clinical picture with progressive dyspnea, pain, hoarseness, tamponade) and a large, progressing air density, the physician can perform decompression using skin incision, pretracheal fasciotomy, tube thoracostomy, and, in emergency cases, VATS/ thoracotomy [8]. Tube thoracostomy is generally adequate, especially during follow-up when the mediastinal air with increased pressure dissects through the mediastinal pleura, causing pneumothorax. Unfortunately, there is no standard guideline for the interventional approach, and the decision depends on the patient’s clinical picture [14]. Despite our small population size, this suggests that traumatic PM is likely to have a more aggressive clinical course.

The patients can be discharged if no additional pathology is present and no increase in the volume of pneumomediastinum is observed on chest X-rays.



Although recurrence is not common, patients should be followed up carefully, and the underlying pathology should be thoroughly investigated in case of frequent recurrences [13].

The valuable aspect of our study is that despite the small number of patients, it includes all subclasses in the etiology of PM, supporting the place of age in the etiology. In addition, when evaluated together with the study [8] examining 339 case reports published in the literature until 2018, the curiosity about the age of secondary spontaneous pneumomediastinum patients emphasized in the

same study constitutes the value of this study. In addition, the most important limitation is the small number of patients.

To conclude, PM generally occurs secondary to underlying conditions such as malignancy and ILD in advanced ages and spontaneously in younger adults. Therefore, a “secondary spontaneous PM” definition is necessary along with a standard guideline for accuracy in diagnosis and management, preventing defensive medicine leading to overdiagnosis and overtreatment for primary spontaneous PM.

Abbreviations

CT: Computed tomography; ILD: Interstitial lung disease; PM: Pneumomediastinum.

Code availability

Not applicable

Authors' contributions

Dr. Çetin designed the study together with Dr. Türk. Dr. Findık contributed to the organization and planning of the study. Other authors assisted in editing. The English of the manuscript is checked by a native English speaker. The author(s) read and approved the final manuscript.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

Availability of data and materials

Available

Declarations**Ethics approval and consent to participate**

Local ethical committee approval was taken for the study. Consent was not obtained from the participants as it was a retrospective study.

Consent for publication

Consent for publication was taken from all authors.

Competing interests

There is no potential conflict of interest to declare.

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Received: 5 October 2021 Accepted: 9 December 2021

Published online: 06 January 2022

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