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Comparison of spontaneous and traumatic pneumomediastinum in the emergency department

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ABSTRACT

Objectives: This study aims to compare spontaneous and traumatic pneumomediastinum (PM) cases diagnosed in the emergency department by examining their clinical, laboratory, and radiological features, with the goal of clarifying differences between these causes.

Patients and methods: Between January 2022 and December 2023, a total of 26 patients (21 males, 5 females; median age: 34 years; range, 18 to 84 years) diagnosed with PM in the emergency department were retrospectively analyzed. Data collected included demographic details, presenting symptoms, imaging studies, laboratory values, hospital stay duration, and 90-day mortality. The patients were categorized as having spontaneous or traumatic PM.

Results: Of the patients, 13 had spontaneous and 13 had traumatic PM. The spontaneous group had a lower median age (39.46 *vs.* 48.77 years, p=0.218) and lower lactate levels (1.65 *vs.* 2.44 mmol/L, p=0.031). Chest radiography was used more in spontaneous cases (53.8% *vs.* 7.7%, p=0.030), while nearly all patients underwent computed tomography (CT) scans. Hospital admission was higher in spontaneous PM (69.2% *vs.* 23.1%, p=0.020), whereas traumatic PM showed higher referral rates. The 90-day mortality rate was 23.1% in both groups.

Conclusion: Spontaneous and traumatic PM differ in clinical and laboratory features. Higher lactate levels and trauma-related findings suggest more severe disease. The CT remains the primary diagnostic tool. Accurate classification and prompt risk assessment are essential for emergency management.

Keywords: Emergency department, pneumomediastinum, spontaneous pneumomediastinum, traumatic pneumomediastinum.

Pneumomediastinum (PM) is an uncommon condition marked by the presence of free air within the mediastinal space. It can appear in emergency departments (EDs) due to a range of causes. It may develop spontaneously, result from trauma, or occur iatrogenically, and requires careful diagnostic evaluation due to its non-specific clinical presentation.[1,2] While spontaneous PM, particularly in young, otherwise healthy individuals, can often be managed conservatively in the emergency setting, PM related to trauma, vaping, gastrointestinal perforation, or infections that trigger systemic inflammation, such as novel coronavirus disease 2019 (COVID-19), can lead to more severe outcomes.[3-6]

Imaging is crucial for diagnosis, with computed tomography (CT) being particularly important due to its high diagnostic sensitivity, as shown in several studies.[7,8] However, unnecessary additional tests may sometimes be performed, leading to wasted time and resources in patient care.[1] As PM can indicate potentially life-threatening conditions such as esophageal perforation, CT evidence of mediastinal fluid is vital for differential diagnosis.[4] In recent years, an increase in spontaneous PM cases has been noted during the pandemic, with ventilation pressures and inflammation thought to be contributing factors.[2,5]

In the present study, we aimed to compare spontaneous and traumatic PM cases diagnosed in the ED by examining their clinical, laboratory, and

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radiological features, with the goal of clarifying differences between these causes.

PATIENTS AND METHODS

This single-center, retrospective, observational cohort study was conducted at Hitit University Çorum Erol Olçok Training and Research Hospital, Department of Emergency Medicine between January 1st, 2022 and December 31st, 2023. A total of 35 patients diagnosed with PM and presenting to the ED were screened. The study population was identified through the hospital information system, relevant specialty consultations (thoracic surgery), and screening of patient referrals during the specified timeframe. Classification into spontaneous or traumatic PM was made according to documentation of a trauma history in the patients' medical records. Data collected included patient age, sex, presenting symptoms, coexisting conditions, admission location, length of hospital stay, 90-day mortality, and blood test results. Two patients younger than 18 years and one patient with incomplete data were excluded. Additionally, six patients were excluded because their 90-day mortality status could not be confirmed through the hospital information system. Finally, 26 patients (21 males, 5 females; median age: 34 years; range, 18 to 84 years) who met the inclusion criteria were recruited. Written informed consent was obtained from each patient. The study protocol was approved by the Hitit University Non-Interventional Research Ethics Committee (Date: 03.03.2024, No. 2024-04). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

Study power analysis and sample size calculation were performed using the G*Power version 3.1 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). With a statistical power of 95% and a significance level of 5%, it was determined that a total of 26 participants, 13 in each group, would be sufficient to yield reliable results for an independent samples t-test with a large effect size (d=1.47) as defined by Cohen.[9]

Statistical analysis was performed using the IBM SPSS version 26.0 software (IBM Corp., Armonk, NY, USA). The assumption of normality was first assessed using the Shapiro-Wilk test. For data showing a normal distribution, the independent two-sample t-test was applied, while the Mann-Whitney U test was used for data not normally distributed. The Fisher exact test was used to compare categorical variables between groups when the expected frequency was below five.[10] Pairwise comparisons of proportions were analyzed using the Bonferroni-corrected Z test. Continuous data were expressed in mean ± standard deviation (SD) or median (min-max), while categorical data were expressed in number and frequency. A p value of <0.05 was considered statistically significant.

RESULTS

Of a total of 26 patients, 13 had spontaneous and 13 had traumatic PM. The location of hospitalization differed significantly between the groups (p=0.020). Ward admission was noted in 69.2% of spontaneous PM cases, whereas only 23.1% of traumatic PM cases were admitted to the ward. The median lactate level was higher in traumatic PM patients (2.44) than in spontaneous PM patients (1.65) (p=0.031). The groups also differed in the use of radiography (p=0.030); radiographs were performed in 53.8% of traumatic PM cases and 7.7% of spontaneous cases. No statistically significant differences were found between the groups regarding age, sex, or other clinical variables (p>0.05). Table 1 summarizes the demographic and clinical features of patients with spontaneous and traumatic PM. Chest pain was the most common presenting symptom in both groups. One patient with spontaneous PM presented with nausea and vomiting (Figure 1).

Among the traumatic PM cases, pneumothorax was present in 69.2%, costal fractures in 76.9%, and hemothorax in 53.8%. Pulmonary contusions were observed in 84.6% of patients, upper extremity fractures in 23.1%, head injuries in 7.7%, and abdominal injuries in 15.4%. Analysis of the trauma mechanisms showed that traffic accidents and falls accounted for 38.5% of cases (Figure 2). Table 2 details the distribution of selected clinical features among the 13 traumatic PM patients.

DISCUSSION

The present study compared the clinical, laboratory, and imaging characteristics of patients diagnosed with PM in the ED, grouping them

Table 1
Analysis of demographic and clinical characteristics according to the type of pneumomediastinum

	Spontaneous PM (n=13)					Traumatic PM (n=13)						
	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	Test statistic	*p*
Age (year)				26	18-84				43	18-82	–1.232	0.218*
Sex											-	1.000†
Female	3	23.1				2	15.4					
Male	10	76.9				11	84.6					
Presenting symptom											1.061	1.000†
Chest pain	7	53.8				8	61.5					
Dyspnea	5	38.5				5	38.5					
Nausea and vomiting	1	7.7				0	0					
Hospitalization											9.828	**0.020**†
Ward	9[a]	69.2				3[b]	23.1					
ICU	3[a]	23.1				4[a]	30.8					
Discharged	0[a]	0				1[a]	7.7					
Transferred to another center	0[a]	0				5[b]	38.5					
DAMA	1[a]	7.7				0[a]	0					
Length of stay (day)				2	1-29				2	1-17	–0.437	0.662*
WBC (10^9/L)			10.07±4.05					14.74±7.25			–2.027	0.054‡
Hgb (g/dL)				14.5	9.4-15.9				13.9	10.8-17.1	–0.41	0.682*
Platelet count (10^9/L)			222.23±44.53					225.38±55.33			–0.160	0.874‡
Lactate (mmol/L)				1.65	0.81-11.44				2.44	1.14-5.63	–2.155	**0.031***
CRP (mg/dL)				3.83	3.13-225				4.75	3.22-140	–1.131	0.258*
Albumin (g/dL)				4.6	2.5-5				3.9	3.7-4.5	–1.416	0.157*
Creatinine (mg/dL)				0.7	0.2-3.2				0.8	0.5-1.3	–1.301	0.193*
Chest X-Ray performed											-	**0.030**†
No	6	46.2				12	92.3					
Yes	7	53.8				1	7.7					
CT performed											-	0.480†
No	2	15.4				0	0					
Yes	11	84.6				13	100					
90-day mortality											-	1.000†
No	10	76.9				10	76.9					
Yes	3	23.1				3	23.1					

PM: Pneumomediastinum; SD: Standard deviation; ICU: Intensive care unit; DAMA: Discharge against medical advice; WBC: White blood cell count; Hgb: Hemoglobin; CRP: C-reactive protein; CT: Computed tomography; [a,b] No difference between groups sharing the same letter (Bonferroni-corrected Z test); * Mann-Whitney U test; † Fisher exact test; ‡ Independent two-sample t test.

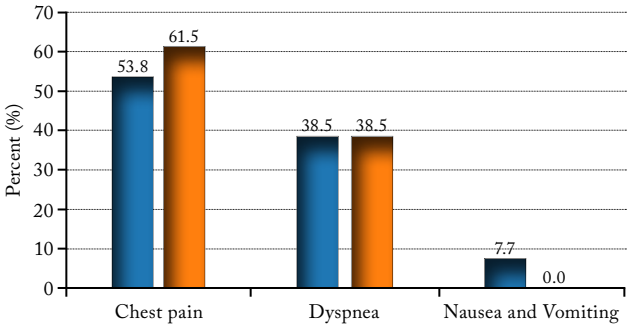

Figure 1. Graph showing the distribution of presenting symptoms by type of pneumomediastinum.

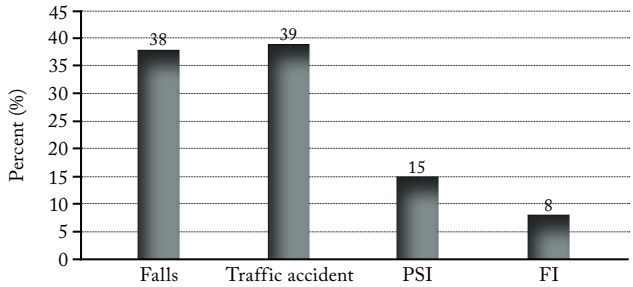

Figure 2. Distribution of injury types among traumatic PM patients.
PSI: Penetrating sharp injury; FI: Firearm injury; PM: Pneumomediastinum.

as either spontaneous or traumatic PM. The predominance of male patients in both groups is consistent with existing research, which indicates that spontaneous PM is more commonly seen in young, healthy males.[11,12] The higher median age in the traumatic PM group may reflect the increased likelihood of trauma, invasive interventions, or serious systemic illnesses in these patients.[13]

Imaging results showed that chest X-rays were used more often in spontaneous PM cases, while CT scans were more commonly performed for traumatic PM. This suggests that CT improves diagnostic precision, particularly for traumatic PM. Choi et al.[14] similarly found that the presence of subcutaneous emphysema on radiography often indicates pneumothorax or PM on CT. When CT is not practical, such as for patients with unstable vital signs in the ED, radiographic findings become critically important for guiding management.

Serum lactate is a commonly used biomarker that indicates tissue hypoxia and inadequate perfusion.[15,16] Elevated lactate levels can help guide early fluid resuscitation in trauma patients and may also predict mortality risk.[17,18] Çınar et al.[19] showed that rising lactate levels in patients with thoracic trauma are an important indicator of prognosis. Işık et al.[20] reported that lactate levels were higher in traumatic cases while examining the causes of PM. Similarly, our study found that lactate levels were significantly higher in patients with traumatic PM. This increase may result not only from hemodynamic instability, but also from adrenergic system activation due to pain and stress. However, lactate can also be elevated in other

Table 2
Coexisting pathologies and injury patterns in patients with traumatic PM

	n	%
Pneumothorax	9	69.2
Rib fracture	10	76.9
Hemothorax	7	53.8
Pulmonary contusion	11	84.6
Presence of upper extremity fracture	3	23.1
Presence of intracranial pathology	1	7.7
Presence of intra-abdominal pathology	2	15.4
Injury type		
Traffic accident	5	38.5
FI	1	7.7
PSI	2	15.4
Falls	5	38.5

PM: Pneumomediastinum; FI: Firearm injury; PSI: Penetrating sharp injury.

conditions such as sepsis, gastrointestinal bleeding, and kidney or liver dysfunction, which may limit its reliability as a prognostic marker. Patients with traumatic PM had higher lactate levels and were more likely to be admitted to intensive care. High blood lactate levels influence the decision to admit patients to intensive care.

Further analysis showed that clinical outcomes indicated spontaneous PM cases were more often admitted to the ward, while traumatic PM patients were referred more frequently. It is well established that spontaneous PM usually has a good prognosis and is usually treated conservatively.[21,22] However, it is notable that the mortality rate in our study was unexpectedly high at 23.1% for both groups. This may be due to the presence of comorbid conditions or differences in how cases were classified. Reports have shown that in PM cases related to COVID-19, PM can develop even in patients not on ventilators, which may signal a worse prognosis.[12,23] Many patients with traumatic PM had to be referred to other centers, as our hospital did not have a thoracic surgeon, requiring a multidisciplinary approach for their follow-up.

Nonetheless, this study has certain limitations. First, since it was a single-center retrospective study, the data may be incomplete or inaccurate. The classification of PM as spontaneous or traumatic relied on clinical evaluation, which means some cases might have been misclassified. Furthermore, imaging was evaluated using radiology reports without independent review. Although subcutaneous emphysema was confirmed by CT or radiography, its extent or severity could not be evaluated. Therefore, further multi-center, prospective studies are needed to clarify which biomarkers and imaging findings can better determine prognosis in PM cases.

In conclusion, our study results demonstrate the clinical distinctions between spontaneous and traumatic PM in emergency settings. Higher lactate levels and trauma-related findings indicate a more severe course in traumatic cases. Computed tomography remains crucial for diagnosis. Identifying features specific to the underlying cause can help guide management and improve patient outcomes. Additional studies are needed to confirm these findings.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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