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## Spontaneous Pneumomediastinum: Descriptive Study of Our Experience With 36 Cases

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Spontaneous pneumomediastinum is defined as a primary process characterized by the presence of air or gas in the mediastinum. We report all the cases of spontaneous pneumomediastinum diagnosed in our hospital between January 1996 and December 2004. We developed a protocol for data collection that included the following: medical history, triggers, signs, radiology, treatment, hospital stay, and complications. During this period we diagnosed 36 cases—25 men (69.4%) and 11 women (30.6%)—with a mean age of 36.8 years (range, 11-90 years) and a mean hospital stay of 8.56 days (range, 1-53 days). The most common clinical presentation was chest pain, either isolated (27%) or with associated dyspnea (19.4%). A triggering factor was identified for 14 patients (38.8%). There was no associated morbidity or mortality. In view of our findings, we concluded that spontaneous pneumomediastinum is an uncommon entity with considerable clinical variability and that correct diagnosis requires a high level of suspicion. Radiography provides the best evidence for diagnosis.

**Key words:** *Spontaneous pneumomediastinum. Respiratory emergencies. Dyspnea, young adults. Mediastinal emphysema.*

Neumomediastino espontáneo: estudio descriptivo de nuestra experiencia basada en 36 casos

El neumomediastino espontáneo se define como la presencia de aire o gas en el mediastino de forma primaria. Presentamos todos los casos de neumomediastino espontáneo hallados en nuestro hospital entre enero de 1996 y diciembre de 2004. Para ello, elaboramos un protocolo de recogida de datos que incluyó: antecedentes personales, desencadenantes, semiología, radiología, tratamiento, estancia y complicaciones. En este período diagnosticamos 36 casos —25 varones (69,4%) y 11 mujeres (27,5%)—, con una edad media de 36,8 años (rango: 11-90) y estancia media de 8,56 días (rango: 1-53). El cuadro clínico más habitual fue el dolor torácico, aislado (27%) o asociado a disnea (19,4%). En 14 pacientes (38,8%) hubo factor desencadenante. No hubo morbimortalidad asociada al proceso. Por todo ello, se concluye que el neumomediastino espontáneo es una entidad infrecuente, con gran variabilidad clínica, cuyo diagnóstico correcto exige un alto índice de sospecha, y la radiografía de tórax es la prueba idónea para ello.

**Palabras clave:** *Neumomediastino espontáneo. Urgencias respiratorias. Disnea en jóvenes.*

### Introduction

Pneumomediastinum is defined as the presence of air or gas in the mediastinum. Its etiology may be primary (spontaneous pneumomediastinum) or secondary (traumatic pneumomediastinum).<sup>1</sup> Spontaneous pneumomediastinum was defined as a specific clinical syndrome by Laennec in 1819. In 1944 Macklin and Macklin<sup>2</sup> described the pathophysiologic mechanisms of the syndrome, and their description is still valid today. Since then few cases have been reported, and with few exceptions, these have tended to be isolated cases rather than large series.<sup>3</sup> Trigger factors have been

described as all those noniatrogenic factors contributing to an increase in the pressure gradient between the alveoli and the interstitium.<sup>3-8</sup> Clinical presentation varies widely from one series to another and there are no pathognomonic signs or symptoms.<sup>3,9,10</sup> The presence of Hamman's sign (pericardial crunch synchronized with the heart beat) is quite variable (5%-85%) and is not currently considered to be a characteristic sign.<sup>9</sup>

We report a series of 36 cases of spontaneous pneumomediastinum diagnosed and treated in our hospital between January 1996 and December 2003.

### Case Analysis

We present a descriptive, retrospective study of all the cases of spontaneous mediastinum diagnosed and treated at the Hospital General Universitario J.M. Morales Meseguer in Murcia between January 1996 and December 2003. Ours is a secondary care hospital serving a population of 250 000

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TABLE 1  
Data Collection Protocol

1. Patient details: medical record number, age, and sex
2. Medical history: pulmonary disease, upper respiratory disease, use of inhaled street drugs, smoking habit, place of residence (rural or urban), and occupation
3. Trigger factors of the spontaneous pneumomediastinum episode: cough, vomiting, Valsalva maneuver, physical effort, inhalation of street drugs, catarrh, asthma attack
4. Symptoms of the spontaneous pneumomediastinum episode: chest pain, dysphonia, cough, odynophagia, torticollis, others (specify)
5. Clinical signs associated with the spontaneous pneumomediastinum episode: tachycardia, tachypnea, cervical crackling, Hamman's sign, bronchospasm.
6. Test complement: differential leukocyte count, oxygen saturation, PaO <sub>2</sub> , PaCO <sub>2</sub> , pH, electrocardiogram
7. Results of posteroanterior and/or lateral chest radiography, chest computed tomography, esophagogram
8. Conservative/invasive treatment
9. Hospital stay
10. Complications
11. Ward to which patient was admitted

inhabitants, with an average of 87 600 emergency room consultations per year.

Through the hospital admissions' Minimum Basic Data Set (MBDS) we obtained the identity of all those patients who had been admitted with a diagnosis of spontaneous pneumomediastinum between the above-mentioned dates. We

developed a protocol for data collection, shown in Table 1. The protocol was implemented using the patients' clinical records obtained from the MBDS.

Our series consisted of 36 patients, 25 (69.4%) men and 11 (30.6%) women, with a mean age of 36.8 years (range, 11-90 years). The mean number of cases diagnosed each year was 4.5 (range, 2-13). This accounted for 0.0051% of the hospital's annual emergency consultations.

Fifty percent of the cases (n=18) were admitted to the general surgery ward, with a mean of 2.25 cases per year (range, 1-7). The remaining 50% were distributed between the internal medicine and respiratory medicine wards, with a mean of 2.25 cases per year (range, 1-3).

The mean overall hospital stay was 8.56 days (range, 1-53 days). The mean stay for patients admitted to the general surgery ward was 6 days (range, 1-18 days), compared to 8.7 days (range, 1-53 days) for those admitted to the other 2 wards.

Table 2 shows the patients' signs and symptoms upon presentation to the emergency room and Table 3 the relevant medical history and trigger factors. The most frequent symptom was chest pain (27.8%), followed by chest pain with associated dyspnea (19.4%), and isolated dyspnea (22.2%). There were no particularly frequent clinical signs. The presence of Hamman's sign was very infrequent (5.6%). Regarding blood test results, it is noteworthy that 94.4% of patients showed no variation in values, while 2 patients with pneumonia showed slight leukocytosis. All the patients were diagnosed by simple posteroanterior and lateral chest radiography (Figure), and no further imaging tests were needed in any case. Simple radiography was also used to monitor course of disease.

TABLE 2  
Signs and Symptoms Upon Emergency Room Presentation

Reason for Consultation	Number of Cases	%	Reason for Consultation	Number of Cases	%
Chest pain	10	27.8	Cervical crackling	5	13.9
Chest pain with dyspnea	7	19.4	Wheezing	5	13.9
Dyspnea	8	22.2	Tachypnea	2	5.6
Neck pain	5	13.9	Tachycardia	2	5.6
Persistent cough	4	11.1	Hamman's sign	2	5.6
Dysphonia	2	5.6	Leukocytosis	2	5.6
			Pneumomediastinum on simple chest x-ray	36	100

TABLE 3  
Information From Patient Records\*

Past medical history
Lung disease (21 patients [58.3 %])
Asthma (14 patients [66.6 %])
COPD (7 patients [33.4 %])
Smoker (12 patients [33.3 %])
User of inhaled street drugs (1 patient [2.8 %])
Trigger factors†
Asthma attack (4 patients [11.1 %])
COPD exacerbation (1 patient [2.8 %])
Physical effort (2 patients [5.6 %])
Pneumonia (2 patients [5.6 %])
Upper respiratory infection (4 patients [11.1 %])
Use of inhaled street drugs (1 patient [2.8 %])

\*Percentages were calculated on the total number of patients (n=36) with the exception of the rates for asthma and COPD (n=14). COPD indicates chronic obstructive pulmonary disease.

†Information available for 14 patients.

The 18 patients admitted to the general surgery ward were young and had no relevant medical history. The rest of the patients were admitted either to the respiratory medicine ward (n=10) or the internal medicine ward (n=8), depending on whether they had other associated diseases. We were able to identify a trigger factor for only 14 patients (38.9%). The most frequent triggers were asthma attacks (10%) and catarrh (10%). There was only 1 case associated with the use of inhaled street drugs, that of a 30 year-old habitual user of inhaled cocaine. In our series, 58.3% of patients diagnosed had a previous history of respiratory disease (asthma and/or chronic obstructive pulmonary disease [COPD]). A third of the patients were smokers (at least 20 cigarettes per day). No differences in incidence were found to be associated with place of residence (rural or urban) or with occupation. None of the patients underwent surgery, and there were no associated complications. There were no deaths related to the episode of pneumomediastinum.



Figure. Chest x-ray, posteroanterior and lateral views: signs of spontaneous pneumomediastinum.

## Discussion

Spontaneous pneumomediastinum is a clinical syndrome characterized by the presence of air in the mediastinal space that is not due to previous injury or surgery.<sup>1</sup> While frequency is estimated to be low, the real incidence has not been established as few publications mention this entity and reports have always been of small series. The incidence we report is considerably lower than that observed by other authors,<sup>3</sup> probably due to an overestimation of real incidence.

We found spontaneous pneumomediastinum to be frequently associated with preexisting respiratory disease (asthma and COPD). This high association with asthma has not been observed in the series reported by Panacek et al<sup>10</sup> or in the majority of recent studies.<sup>9,11,12</sup> One recently published study showed an association with asthma that was considerably higher than that reported in the rest of the literature, however.<sup>3</sup> We also found a high association with smoking and this has seldom been mentioned in the literature.<sup>9</sup> Unlike other authors, we found a very low association with the use of inhaled street drugs.<sup>9,13,14</sup> It must be remembered that ours was a retrospective study, and so there may have been some recall bias in the data collected. Regarding the possibility of classification biases reported with the use of the MBDS,<sup>15</sup> it should be pointed out that our study used the MBDS only as a starting point, and that clinical histories were subsequently reviewed to verify the correct classification of the episode. We believe, therefore, that any classification bias that may exist is minimal.

In the literature, spontaneous pneumomediastinum has been associated with trigger factors in approximately 75% of cases. The most common trigger factors are cough, physical exercise, and drug abuse.<sup>9,14</sup> In our series we found a lower association with trigger factors, and of these the most frequent were related to diseases of the lung and airways.

The most common clinical picture at presentation in our series was very similar to that reported in nearly all other published series.<sup>3,9,10,11,16</sup> Clinical findings were few and, while similar to those published in other studies, the frequency of each was lower.<sup>3,9,10,11,14,16</sup> We found the incidence of Hamman's sign to be low.

For all patients, simple chest radiography gave a firm diagnosis and allowed the course of disease to be monitored adequately. The diagnostic capacity of chest radiography is such that we do not consider it necessary to use computed tomography in managing this disease, as some authors recommend,<sup>11,17,18</sup> or to perform esophagograms or electrocardiograms.<sup>3,10</sup>

With conservative treatment (analgesia and oxygen therapy), all of the cases were resolved. There were no associated complications or mortality. The mean hospital stay in our series was somewhat higher than in others,<sup>3,9,10</sup> probably due to the absence of any other associated underlying disease in the patients in other series. In our series, more than half the patients had associated diseases, thus accounting for longer periods of hospitalization. Studies have recently been published in which a correlation was found between longer hospital stay and the presence of comorbidity.<sup>19,20</sup> Mean hospital stays in the general surgery ward (young patients with no relevant medical history) were very similar to those published.<sup>3,9,10,12</sup>

Given the success of conservative management of spontaneous pneumomediastinum and the absence of complications, the suitability of outpatient treatment and follow-up could be considered in stable patients, as other authors have suggested.<sup>10,13</sup>

Due to the considerable clinical variability and low incidence of spontaneous pneumomediastinum, correct diagnosis of this disease requires maintaining a high level of suspicion, especially in young patients (between 20 and 40 years), men (3:1), those with a

history of bronchial asthma or smoking, and those who present with a clinical picture that includes the spontaneous appearance of chest pain, either isolated or with associated dyspnea. Simple chest radiography (posteroanterior and lateral) will lead to a definitive diagnosis.

#### REFERENCES

1. Fraser RG, Pare JA, Fraser RS. Diagnóstico de las enfermedades del tórax, Madrid: Ed. Panamericana; 1992.
2. Macklin MT, Macklin CC. Malignant interstitial emphysema of lungs and mediastinum as an important occult complication in many respiratory diseases and other conditions: an interpretation of the clinical literature in the light of laboratory experiment. *Medicine (Baltimore)*. 1944;23:281-358.
3. Hernández Sánchez MJ, Burillo Putze G, Alonso Lasheras JE, Casañas Cullén JM. ¿Cambios en la forma de presentación del neumomediastino espontáneo? *Emergencias*. 1998;10:9-13.
4. Chu CM, Leung YY, Hui JY, Hung IF. Spontaneous pneumomediastinum in patients with severe acute respiratory syndrome. *Eur Respir J*. 2004;23:802-4.
5. Koullias GJ, Korkolis DP, Wang XJ, Hammond GL. Current assessment and management of spontaneous pneumomediastinum: experience in 24 adult patients. *Eur J Cardiothorac Surg*. 2004;25:852-5.
6. Luke LC, Ahee P. Spontaneous pneumomediastinum. *Arch Emerg Med*. 1992;9:250-3.
7. Shyamsunder AK, Gyaw SM. Pneumomediastinum: the Valsalva crunch. *Md Med*. 1999;48:229-302.
8. Pittman JAL, Poundsford JC. Spontaneous pneumomediastinum and ecstasy abuse. *J Accid Emerg Med*. 1997;14:335-6.
9. Santiago Aguinaga JJ, Martínez-Bayarri Ubillos M. Neumomediastino espontáneo. Análisis de 16 casos. *Emergencias*. 2000;12:321-5.
10. Panacek EA, Singer AJ, Sherman BW, Prescott A, Rutherford WF. Spontaneous pneumomediastinum: clinical and natural history. *Ann Emerg Med*. 1992;21:1222-7.
11. Koullias GJ, Korkolis DP, Wang XJ, Hammond GL. Current assessment and management of spontaneous pneumomediastinum: experience in 24 adult patients. *Eur J Cardiothorac Surg*. 2004;25:852-5.
12. Pickup C, Nee P, Randall P. Radiographic features in 1016 adults admitted to hospital with acute asthma. *J Acc Emerg Med*. 1994; 11: 234-7.
13. Yellin A. Spontaneous pneumomediastinum. *Chest*. 1992;101:93-5.
14. Abolnik Y, Lossos IS, Brewer R. Spontaneous pneumomediastinum: a report of 25 cases. *Chest*. 1991;100:93-5.
15. Sagner M, Gómez A. Estancias medias alargadas y grupos relacionados con el diagnóstico como indicadores de eficiencia en la gestión clínica. *Rev Calidad Asistencial*. 2003;18:575-9.
16. Jougon JB, Ballester M, Delcambre F. Assessment of spontaneous pneumomediastinum: experience with 12 patients. *Ann Thorac Surg*. 2003;75:1711-4.
17. Gardikis S, Tsalkidis A, Limas C, Antypas S. Spontaneous pneumomediastinum: is a chest-x-ray sufficient? *Minerva Pediatr*. 2003;55:293-6.
18. Martin MF, Hlaawatsch A, Heussel CP, Schwaden F. The radiologic findings in pneumomediastinum. Value of conventional radiography and comparison with computerized tomography. *Radiology*. 1997;39:709-14.
19. Crockett AJ, Cranston JM, Moss JR, Alpers JH. An association between length of stay and co-morbidity in chronic airflow limitation. *Int J Qual Health Care*. 2000;12:41-6.
20. Kinnunen T, Saynajakangas O, Tuuponen T, Keistinen T. Impact of comorbidities on the duration of COPD patients' hospital episodes. *Respir Med*. 2003;97:143-6.