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# Spontaneous pneumomediastinum (Hamman's syndrome)<sup>☆</sup>

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### ABSTRACT

**Introduction:** Spontaneous pneumomediastinum is defined as the presence of free air in the mediastinum in the absence of any obvious precipitating cause. The purpose of this study was to review our experience with this condition, discuss mechanisms and provide a management algorithm.

**Methods:** A retrospective audit of patients admitted with spontaneous pneumomediastinum between 2003 and 2008 was performed. A total of 17 patients were identified. **Results:** Common predisposing factors for spontaneous pneumomediastinum were alcohol excess, asthma and illicit drug use. Vomiting and coughing were common precipitating factors. There was no morbidity, mortality or recurrence. Patients were admitted under a number of different specialities.

**Discussion:** Spontaneous pneumomediastinum is a benign self-limiting condition that requires early differentiation from more serious causes, in particular Boerhaave's syndrome.

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## Introduction

Spontaneous pneumomediastinum is defined as the presence of mediastinal free air in the absence of an obvious precipitating cause. The first case series of spontaneous pneumomediastinum was published by Louis Hamman in 1939 and therefore the condition is called Hamman's syndrome.<sup>1</sup> The pathophysiological process was experimentally demonstrated by Macklin and Macklin in 1944.<sup>2</sup> Barotrauma causes alveolar rupture which then allows air to flow down a pressure gradient from the alveolus to the mediastinum via the pulmonary interstitium and pulmonary hilum (The Macklin effect). Spontaneous pneumomediastinum is usually a benign self-limiting illness affecting young males. However, it is a condition that is not widely recognised by clinicians. The

aim of this paper is to review our experience, discuss mechanisms and provide a new management algorithm.

## Methods

A retrospective case note review of patients with spontaneous pneumomediastinum was performed over a five-year period from April 2003 to April 2008. All surgical patient's clinical details are recorded using the Lothian Surgical Audit System (LSAS). The LSAS and ICD (International standard classification of disease and related health problems) version 10 database from the hospital information system were both examined retrospectively to identify patients. The patients were treated at the Royal Infirmary of Edinburgh or the Royal

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Sick Children's Hospital of Edinburgh, and all case records analysed. Details of demographics, causative factors, presenting signs and symptoms, investigations, treatment and outcomes were recorded.

**Results**

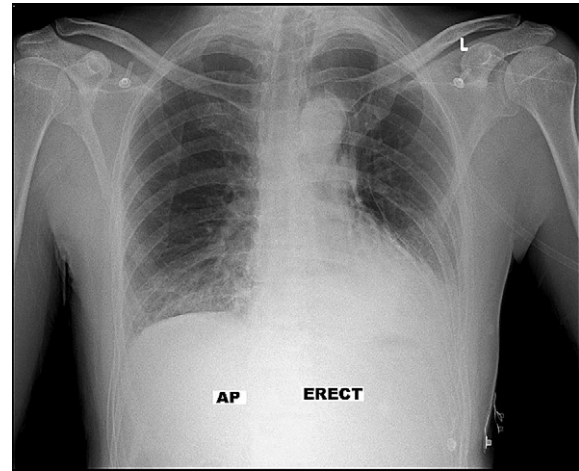
A total of 17 patients were identified with spontaneous pneumomediastinum. The male to female ratio was 14:3. The median age of presentation was 19 years with a range of 12-35 years.

Predisposing factors to spontaneous pneumomediastinum occurred in 10 out of the 17 patients (Table 1). The most common factor was ethanol intoxication seen in four patients. Of the potential precipitating causes of lung alveolar rupture, vomiting and coughing were the most common factors in nine patients. Only three patients had no obvious precipitating or predisposing factors.

The most common presenting symptom was chest pain in three quarters of the patients and dyspnoea in a third Table 2. Unsurprisingly subcutaneous emphysema was a common finding and was present in 14 of the 17 patients. Hamman's sign (mediastinal crunch heard on auscultation in time with each heart beat) was noted in three patients. None of the patients had signs of serious systemic toxicity.

All of the patients were found to have pneumomediastinum on a chest x-ray (Fig. 1). Further investigations were as follows: ten had a contrast swallow, four had a CT chest, two had a gastroscopy and one patient had a bronchoscopy. The median serum white cell count was  $8 \times 10^9/L$  (measured range  $5-21 \times 10^9/L$ ). No morbidity or mortality occurred in this group of patients and none developed recurrence.

The derived frequency of spontaneous pneumomediastinum at the Royal Infirmary of Edinburgh over the study period was one per 32,000 admissions to the Accident and Emergency department. Patients admitted to the Edinburgh Royal Infirmary were admitted under four different specialties as shown in Fig. 2. Two children with spontaneous pneumomediastinum were admitted to a separate hospital, the Royal Hospital for Sick Children. These patients were treated by the specialist Paediatricians and were not included as admissions to the Edinburgh Royal Infirmary.



**Fig. 1 – Chest x-ray showing mediastinal gas along left heart border (white arrows).**

**Discussion**

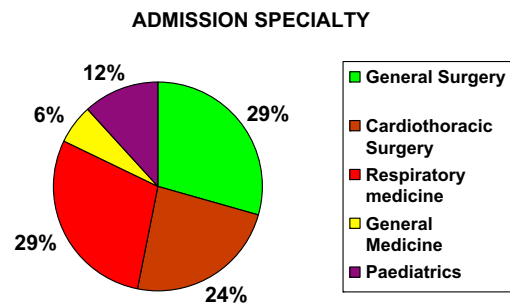
Our study shows that spontaneous pneumomediastinum occurs predominantly in young males in agreement with many other case series.<sup>3,4</sup> Our incidence of one per 32,000 hospital accident and emergency admissions also compares well to the reported incidence in the literature, which ranges from one in 800<sup>5</sup> to one in 42,000.<sup>4</sup>

Pneumomediastinum can be produced by three different mechanisms: 1) Disruption of a cutaneous or mucosal barrier (usually the tracheobronchial tree or the oesophagus) which allows the entry of gas into the mediastinum; 2) Gas producing organisms in the mediastinum or adjacent chest; 3) Rupture of an alveolus. This last mechanism is known as spontaneous pneumomediastinum.<sup>3</sup> The mechanism described by Macklin and Macklin has already been discussed.<sup>2</sup> Once the gas is in the mediastinum, it can then track to the cervical soft tissues or even into the retroperitoneum. The Macklin effect can be detected with CT scanning of the chest (Fig. 3).<sup>6</sup>

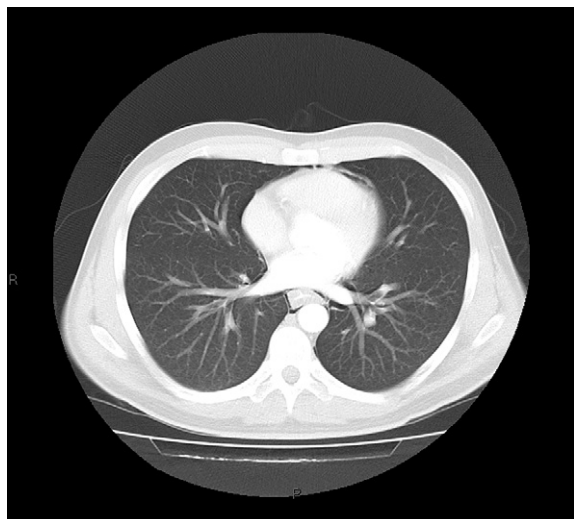
Alveolar rupture may occur by increasing alveolar pressure with the Valsalva manoeuvre and/or decreasing the interstitial pressure with forceful breathing. Precipitating causes of the Valsalva manoeuvre described to cause spontaneous pneumomediastinum include coughing, sneezing, vomiting, defecation, inhalation of cocaine, giving birth and blowing up

**Table 1 – Predisposing and Precipitating factors for spontaneous pneumomediastinum.**

Predisposing factors	No. of patients (%)	Precipitating factors	No. of patients(%)
Asthma	3(18)	Vomiting	6(35)
Marfans syndrome	1(6)	Coughing	3(17)
Ethanol intoxication	4(24)	Exercising	1(6)
Illicit drug use	2(12)	Defecation	0
Interstitial lung disease	0	Giving birth	0
		Sneezing	0



**Fig. 2 – Admission specialties for spontaneous pneumomediastinum.**



**Fig. 3 – CT chest showing the Macklin effect, gas along the central lung vascular sheaths (white arrows).**

party balloons.<sup>5,8</sup> Alveolocapillary membrane abnormalities can also favour the development of an alveolar rupture. Asthma has been identified in the literature as a predisposing factor in 8–39% of patients.<sup>5,8,7</sup> The most common presenting symptoms in both our study and in the literature are chest pain, dyspnoea and neck pain with the most common sign being surgical emphysema.<sup>3,5</sup> Pneumomediastinum can be detected radiologically on chest x-ray, as was the situation with all of the patients in our study. CT is considered the gold standard for detecting mediastinal air, as it can detect small amounts that cannot be seen on chest x-ray. (Fig. 3)

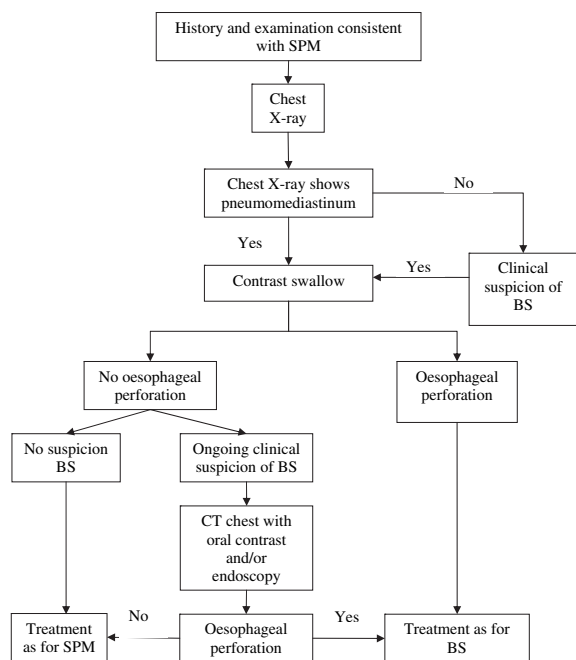
**Table 2 – Symptoms and Signs of spontaneous pneumomediastinum.**

Symptoms	No. of patients (%)	Signs	No. of patients (%)
Chest pain	13(77)	Subcutaneous emphysema	14(82)
Neck pain	4(24)	Hamman's sign	3(18)
Dyspnoea	5(29)		
Dysphagia	0		
Odynophagia	0		

The most serious differential diagnosis that mimics spontaneous pneumomediastinum is Boerrhaave's syndrome. Both conditions are commonly precipitated by the same factors, (i.e. coughing, straining or vomiting). They both commonly present with chest pain, dyspnoea, neck pain, pneumomediastinum and surgical emphysema. The factors that would suggest a diagnosis of Boerhaave's syndrome would include an unwell patient with tachycardia, tachypnoea, fever, hypotension or hydropneumothorax. Other differential diagnoses include acute coronary syndrome, pulmonary embolus, pericarditis, pneumothorax and tracheobronchial tree rupture.<sup>8</sup>

We suggest a new management algorithm for spontaneous pneumomediastinum as depicted in Fig. 4. All patients with pneumomediastinum should have a radiographic contrast swallow to exclude oesophageal rupture, as spontaneous pneumomediastinum and Boerrhaave's syndrome can so closely mimic each other. More importantly the management and the severity of the two diagnoses are very different. If Boerrhaave's syndrome is still suspected despite a normal radiographic contrast swallow then the patient should have a CT chest with oral contrast and upper gastrointestinal endoscopy. Suspected tracheobronchial perforation should be further investigated by bronchoscopy.

In our study there was no mortality or morbidity, corresponding with the literature where there have been no reports of mortality following spontaneous pneumomediastinum and morbidity is uncommon.<sup>3</sup> Two recent studies have reported two cases of co-existing pneumothorax that required treatment with chest drainage out of a total of 36 patients with pneumomediastinum.<sup>5,6</sup> There were no episodes of recurrence in our study and in the literature recurrence is uncommon and usually responds to conservative treatment.<sup>3</sup> Management of spontaneous pneumomediastinum should consist of an early accurate diagnosis. Treatment is with analgesia and rest. Patients can then be safely discharged home if they are well and do not have a significant pneumothorax. No routine follow-up is necessary.



**Fig. 4 – Management algorithm for suspected cases of spontaneous pneumomediastinum Key: SPM – Spontaneous pneumomediastinum, BS – Boerrhaave's syndrome.**

## Conclusion

Spontaneous pneumomediastinum is an uncommon condition that predominantly affects young males. It occurs because of a rupture to an alveolus, usually due to vomiting or coughing. Making an accurate early diagnosis of spontaneous pneumomediastinum is important because the presentation can be similar to Boerrhaave's syndrome. All patients should

therefore be investigated with a radiographic contrast swallow examination to exclude a perforation to the oesophagus. Patients can then be discharged early if they are well and do not have a significant pneumothorax. No follow-up is required. Given the frequency of spontaneous pneumomediastinum all doctors who managed patients with suspected rupture of the oesophagus should know about this condition and be able to differentiate it from Boerrhaave's syndrome [Table 2](#).

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#### REFERENCES

1. Hamman L. Spontaneous mediastinal emphysema. 1939. *Bull Johns Hopkins Hosp* 1939;64:1-21.
2. Macklin M, Macklin C. Malignant interstitial emphysema of the lungs and mediastinum as an important occult complication in many respiratory diseases and other conditions: interpretation of the clinical literature in the light of laboratory experiment. *Medicine* 1944;23:281-358.
3. Newcombe AE, Clarke PC. *Chest* 2005;128:3298-302.
4. Mondello B, Pavia R, Ruggeri P, Barone M, Barresi P, Monaco M. Spontaneous pneumomediastinum: experience in 18 adult patients. *Lung* 2007;185:9-14.
5. Mc Mahon DJ. Spontaneous pneumomediastinum. *Am J Surg* 1976;131:550-1.
6. Sakai M, Murayama S, Gibo M, Akamine T, Nagata O. Frequent cause of the Macklin effect in spontaneous pneumomediastinum: Demonstration by multidetector-row CT. *J Comput Assist Tomogr* 2006;30:92-4.
7. Jougon JB, Ballester M, Delcambre F, Macbride T, Dromer CE, Velly JF. Assessment of spontaneous pneumomediastinum: experience with 12 patients. *Ann Thorac Surg* 2003;75:1711-4.
8. Koulias G, Karkolis D, Wang X, Hammond G. Current assessment and management of spontaneous pneumomediastinum: experience in 24 adult patients. *Eur J Cardiothorac Surg* 2004;25: 852-5.