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CASE REPORT

# Spontaneous pneumomediastinum in a male adolescent using e-cigarettes

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## ABSTRACT

**Background:** Spontaneous pneumomediastinum (PM) is a rare benign disease entity in children with several predisposing factors. This study reports a case of spontaneous PM related to the use of electronic cigarettes (e-cigarettes) in a 17-year-old adolescent.

**Case Presentation:** A 17-year-old male, user of e-cigarettes, with no underlying pulmonary disease presented to the emergency department with acute chest pain, without any preceding events including trauma. His physical examination was unremarkable apart from positive Hamman's crunch. A plain chest X-ray showed PM and left-sided apical pneumothorax. Chest computed tomography confirmed the presence of PM, accompanied by pneumopericardium and bilateral apical pneumothoraces. The patient reported the use of e-cigarettes, and he was admitted and conservatively managed in the hospital and discharged after three uneventful days. In this case, smoking e-cigarettes was the only predisposing factor found to be associated with the development of spontaneous PM.

**Conclusion:** Emergency physicians should consider the diagnosis of spontaneous PM in adolescents who are presenting with acute chest pain, and e-cigarette smoking could be a precipitating factor.

**Keywords:** Pneumomediastinum, emergency department, electronic cigarettes, pediatric, chest pain.

## Introduction

Pneumomediastinum (PM) is the presence of air or gas in the mediastinal cavity and can be classified as spontaneous with no underlying pathology or secondary to blunt and penetrating injuries, or iatrogenic intervention such as endoscopic procedures, intubation, and central line insertion [1]. Spontaneous PM also known as mediastinal emphysema or Hamman's syndrome [2]. In children, spontaneous PM is related to many trigger factors including bronchospasm, cough, vomiting, foreign body aspiration, and physical exercise or underlying pulmonary pathologies such as asthma, upper respiratory tract infections, and pneumonia [3-5]. Additionally, smoking tobacco and the use of recreational drugs are considered predisposing factors for developing spontaneous PM [6,7]. In the absence of those trigger factors and underlying pathology, the condition is categorized as primary or idiopathic spontaneous PM [3-5]. Spontaneous PM is caused by the rise in intrathoracic pressure resulting in alveolar rupture with air leak into the peribronchovascular sheath till it reaches the mediastinum, and air leakage can extend further causing subcutaneous emphysema, pneumopericardium, pneumothorax, or pneumoperitoneum [8]. This case report reviewed a case of spontaneous PM associated with electronic cigarette (e-cigarette) smoking, referred to also as "Vaping."

## Case Presentation

This is a case of a previously healthy 17-year-old adolescent male, who presented to the emergency department (ED) with the complaint of sudden acute chest pain for 4 hours. The pain started suddenly as neck pain, then extended to the upper central chest area. It was pleuritic in character, associated with dyspnea, and started 10 hours prior to attending the ED. There was no cough, fever, vomiting, or palpitation. There were no other associated symptoms and the systems review was non-contributary. The patient denied any history of trauma or recreational activities. He had no previous

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medical problems or surgical procedures. He reported smoking e-cigarettes with nicotine and flavoring additives and denied any use of illicit drugs or alcohol intake. During the physical examination, the patient was fully conscious and oriented, but anxious and in pain. His vital signs were heart rate of 91 beats per minute, blood pressure of 134/92 mmHg, oxygen saturation of 100% on room air, respiratory rate of 20 breaths per minute, body temperature of 36.9°C, pain score = 5/10, and was triaged as level 3 on the Manchester Triage System. The head and neck examination revealed a centralized trachea, and the chest auscultation had normal vesicular breathing sounds with equal air entry bilateral. Pericardial auscultation was significant for crunching/crepitation sound which changes with the heartbeat (Hamman's crunch).

An electrocardiogram was obtained and showed a normal sinus rhythm. Complete blood count showed leukocytosis of 15.3 × 10′/l. COVID-19 polymerase chain reaction test for nasopharyngeal swab was negative. Other laboratory investigations (serum electrolytes, renal function, and coagulation profile) were within normal ranges. A chest X-ray (anterior view) was done, which showed PM with a minimal rim of apical left-sided pneumothorax (Figure 1). A chest computed tomography (CT) confirmed the presence of PM, with the presence of pneumopericardium and bilateral rim of apical pneumothoraxes, without any underlying lung pathology (Figure 2). The patient received symptomatic treatment for his pain. He was referred and evaluated by the thoracic surgical team on-call and admitted under their care for conservative management. His 3-days hospital stay was uneventful, his repeated chest X-rays showed marked improvement, and then he was discharged with clinic follow-up.

## Discussion

Spontaneous PM is an uncommon condition and is less investigated in children as compared to the adult population, and in pediatrics (excluding the neonates) spontaneous PM carries an incidence of 1/8,000 to 1/15,000 in patients seen at the ED and it occurs mainly in two age groups: 6 months to 4 years and 15-18 years [3]. Chest pain is the commonest presenting symptom in spontaneous PM, with Hamman's crunch being the pathognomonic sign of the condition [1-8]. Smoking tobacco and the use of recreational drugs are considered among the commonest predisposing factors for developing spontaneous PM [6,7]. The diagnosis is usually confirmed by performing an anterior chest X-ray view and chest CT; and several radiographic signs indicating the presence of spontaneous PM can be detected on the anterior view of the chest X-ray including Spinnaker sail sign, vertical lucent streak sign, continuous diaphragm sign, and the *V* sign [3]. In pediatrics, chest X-rays were diagnostic for spontaneous PM in 99.5% [3] and 90% [4] of all cases. Chest CT is becoming a routine imaging modality to assess the degree of the PM, confirming the diagnosis with an undetermined chest X-ray, and detecting other pathologies [6], as the condition can be complicated with pneumothorax and pneumopericardium [5]. Clinically stable children with spontaneous PM can be managed in the ED with observation and symptomatic treatment as indicated and arranging a close follow-up, without the need for extra imaging and invasive procedures [4].

In this case, we described an unusual case of spontaneous PM in a male adolescent after smoking e-cigarette. e-cigarettes use also well-known as vaping become a public health alarm in the adolescent population in the United States (US), and its usage by high school students had increased from about 12% to 21% over just 2 years (2017-2018) [9]. Looking at the type of injuries caused by vaping, respiratory illnesses were the commonest and

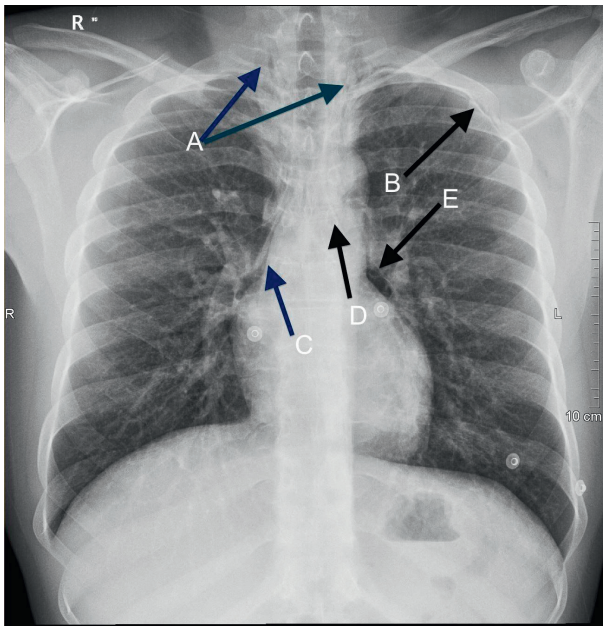


***Figure 1.*** *P-A chest X-ray. (A) Subcutaneous emphysema along soft tissue of the neck. (B) Pneumothorax. (C) Streaks of air along mediastinum. (D) Peribronchial air along left lung hilum. (E) Pneumopericardium.*

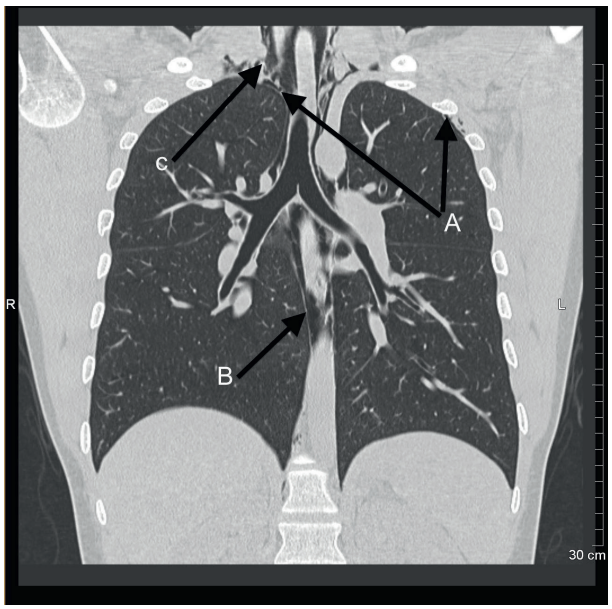


***Figure 2.*** *Coronal reconstruction image-CT scan of the chest. (A) Pneumothorax. (B) Pneumomediastinum extent inferiorly along esophagus and descending aorta. (C) Subcutaneous emphysema extent along the neck.*

***Table 1.*** *Case reports of spontaneous PM linked to smoking e-cigarettes.*

| Age (years) | Sex | Symptoms | Time from last vaping to symptoms | Treatment | Country | References |
|---|---|---|---|---|---|---|
| 17 | Male | Dyspnea and dysphagia | Immediately | Admitted | Italy | [10] |
| 20 | Male | Chest pain and cough | 2 hours | Admitted | Iceland | [11] |
| 25 | Male | Chest pain and neck stiffness | 1 day | Admitted | US | [12] |
| 22 | Male | Cough and dyspnea (tested positive for influenza B) | 4 days | Admitted, oxygen supplied, and given antibiotic | US | [13] |
| 18 | Male | Chest pain and cough | Not mentioned | Admitted, oxygen supplied, and given steroid | US | [14] |
| 20 | Female | Chest pain and dyspnea | 1 day | Admitted | US | [15] |

they included e-vaping acute lung injury, pneumonia, bronchiolitis, pneumothorax, asthma exacerbation, pneumonitis, diffuse alveolar hemorrhage, acute respiratory distress syndrome, and epiglottitis [9]. In the literature, an increased number of cases were reported in which spontaneous PM was related to e-cigarette use [10-15] as per Table 1. e-cigarette smoking could be underestimated as a predisposing factor for the development of spontaneous PM in adolescents and young adults.

## List of Abbreviations

| | |
|---|---|
| PM | Pneumomediastinum |
| CT | Computed tomography |
| E-cigarettes | Electronic cigarettes |
| ED | Emergency department |
| PCR | Polymerase chain reaction |

## Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this article.


## Funding

None.


## Consent for publication

Consent was obtained from the patient to publish this case report and accompanying images.

## Ethical approval

Ethical approval is not required at our institution to publish an anonymous case report.


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