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Case Report

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Spontaneous Pneumopericardium in a Previously Healthy Adult: A Case Report and Literature Review

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ABSTRACT

Pneumopericardium-defined as the presence of free air within the pericardial sac — is an uncommon and potentially serious condition. While it is most often encountered in the setting of chest trauma, barotrauma, or thoracic intervention, truly spontaneous cases in otherwise healthy adults are rare and diagnostically challenging. We describe a 35-year-old man with no relevant medical history who arrived at the emergency department complaining of acute retrosternal chest pain and mild breathlessness. There was no history of injury, recent procedures, or identifiable precipitating events. Computed tomography (CT) of the chest confirmed air localized within the pericardial cavity, with no concurrent pneumothorax or pneumomediastinum. Transthoracic echocardiography showed preserved biventricular function and no evidence of tamponade physiology. The patient responded well to conservative treatment — supplemental high-flow oxygen, analgesics, and watchful monitoring — with complete radiological and symptomatic resolution documented on follow-up imaging at day five. This case reinforces the importance of including spontaneous pneumopericardium in the differential diagnosis of acute chest pain and highlights the pivotal role of cross-sectional imaging in confirming the diagnosis and guiding management.

Keywords: Pneumopericardium, Pericardial Air, Cardiac Tamponade, Chest Pain, Macklin Effect, Conservative Management

Introduction

The term pneumopericardium describes the abnormal accumulation of gas within the pericardial space. Although uncommon in general clinical practice, the condition commands attention because even modest amounts of intrapericardial air can precipitate tension pneumopericardium and cardiac tamponade — life-threatening emergencies that demand immediate recognition and intervention [1]. In the neonatal period, pneumopericardium is well recognised as a complication of severe pulmonary disease, vigorous cardiopulmonary resuscitation, and mechanical ventilation. Among adults, the aetiology is predominantly iatrogenic or traumatic: blunt and penetrating chest injuries, positive-pressure ventilation with high airway pressures, thoracic surgical procedures, and invasive cardiac interventions collectively account for the overwhelming majority of reported cases [2].

By contrast, spontaneous pneumopericardium - occurring without any trauma, instrumentation, or discernible precipitating cause - is exceedingly rare [3]. Its clinical presentation is nonspecific and frequently mimics other cardiopulmonary emergencies, creating a diagnostic challenge that can delay appropriate management. Early identification is paramount, given the potential for rapid haemodynamic deterioration if intrapericardial pressure rises unchecked. We present the case of a previously healthy young man who developed spontaneous pneumopericardium and was successfully treated without surgical intervention, alongside a focused review of the relevant literature.

Case Presentation

A 35-year-old male with no prior medical or surgical history presented to the emergency department with sudden-onset, sharp retrosternal chest pain accompanied by mild exertional dyspnoea. The pain had begun several hours before arrival and was not relieved by rest or positional change. On direct questioning, the patient denied any recent blunt or penetrating thoracic trauma, thoracic or cardiac procedures, severe or

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protracted coughing, forceful vomiting, recreational or illicit drug inhalation, or recent respiratory tract infection. There was no history of connective tissue disease, asthma, or any condition predisposing to alveolar fragility.

On arrival, the patient was alert, oriented, and haemodynamically stable: blood pressure 118/76 mmHg, heart rate 88 beats per minute, respiratory rate 18 breaths per minute, and oxygen saturation 97% on room air. Cardiovascular examination was notable for distant heart sounds and a rhythmic, low-pitched churning murmur audible over the precordium — a classic 'Bruit de Moulin,' or mill-wheel murmur — consistent with simultaneous air and fluid within the pericardial cavity. Routine blood tests were sent which was within normal limits, including white cell count, C reactive protein, and troponin I. The ECG showed a sinus rhythm with normal axis deviation. Respiratory examination was unremarkable; breath sounds were equal bilaterally, and no subcutaneous emphysema was palpable over the chest wall or neck.

A plain chest radiograph demonstrated a thin radiolucent halo outlining the cardiac silhouette, raising the clinical suspicion of pneumopericardium. To confirm the diagnosis and delineate the extent of air, a CT scan of the thorax was performed with intravenous contrast. This definitively confirmed the presence of free air confined entirely within the pericardial sac, without evidence of pneumomediastinum, pneumothorax, or any parenchymal lung pathology. Transthoracic echocardiography was performed to assess haemodynamic consequence; it revealed normal chamber dimensions, preserved left and right ventricular systolic function, no pericardial effusion, and no echocardiographic features of cardiac tamponade.

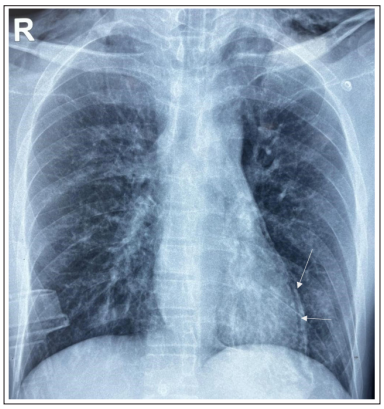

Figure 1: Admission Chest Radiograph Demonstrating a Radiolucent Halo Surrounding the Cardiac Silhouette (Halo Sign), Consistent with Pneumopericardium.

The patient was admitted to a monitored ward setting and managed conservatively. High-flow supplemental oxygen was administered via a non-rebreather mask to accelerate nitrogen washout and promote reabsorption of the pericardial air. Analgesia was provided with oral non-steroidal anti-inflammatory agents. Serial clinical assessments and repeat vital signs were documented every four hours. His symptoms improved progressively over the subsequent 48 hours, and followup CT imaging performed on day five demonstrated complete resolution of the intrapericardial air. He was discharged home in a clinically stable condition and remained entirely asymptomatic at outpatient review two weeks later.

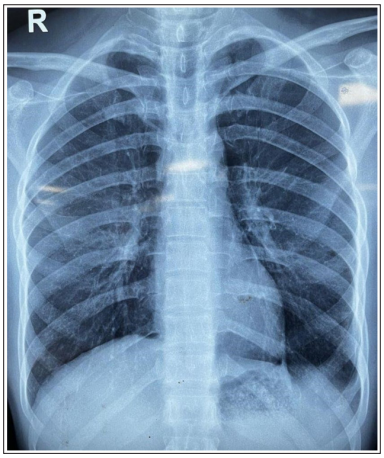

Figure 2: Follow-up Chest Radiograph at Day Five Demonstrating Complete Resolution of Pericardial Air with a Normal Cardiac Silhouette.

Discussion

Spontaneous pneumopericardium is a rare clinical entity that disproportionately affects young, otherwise healthy adults. It may come to medical attention incidentally — discovered on imaging performed for other indications — or, as in the present case, during the evaluation of acute chest discomfort and breathlessness. The clinical spectrum is wide: patients may report nothing more than mild, pleuritic chest pain or throat tightness, yet at the other extreme, rapidly accumulating intrapericardial air can precipitate haemodynamic collapse [4].

The most frequently reported symptoms include substernal or pleuritic chest pain, dyspnoea, dysphagia, neck discomfort, and dysphonia [4,5]. On physical examination, several signs may be elicited. Hamman's sign - a crunching or crackling sound synchronised with each cardiac systole - is perhaps the most recognisable, though not invariably present. Auscultation may also reveal the mill-wheel murmur (Bruit de Moulin), which arises when gas and fluid coexist within the pericardial space and produces a characteristic churning quality [6]. When intrapericardial pressure escalates sufficiently to impair ventricular filling, the clinical triad of Beck's - muffled heart sounds, hypotension, and raised jugular venous pressure - may supervene, accompanied by pulsus paradoxus and progressive haemodynamic compromise. Our patient exhibited the millwheel murmur in isolation, without any features of haemodynamic instability.

The leading mechanistic explanation for spontaneous pneumopericardium invokes the Macklin effect. A sudden or sustained rise in intra-alveolar pressure - whether from coughing, retching, physical exertion, or even no identifiable trigger - causes alveolar rupture at the bronchovascular sheath attachments. Liberated air then dissects centripetally along the perivascular connective tissue planes toward the mediastinum. From the mediastinum, gas may gain entry to the pericardial cavity through microscopic pleuropericardial communications or focal areas of congenital pericardial weakness, producing pneumopericardium in the absence of any obvious precipitant. The present case is notable in that no trigger whatsoever could be identified, placing it among the most truly spontaneous examples in the published literature.

Several conditions must be considered in any patient presenting with acute chest pain and radiological evidence of mediastinal or pericardial air. Pneumomediastinum shares much of the same pathophysiology but is distinguished by the distribution of gas - tracking along mediastinal planes rather than conforming to the pericardial contour. Pneumothorax produces a pleural-based lucency and is readily differentiated on CT. Acute pericarditis, pericardial effusion, acute coronary syndrome, pulmonary thromboembolism, and oesophageal perforation all demand consideration and exclusion, as the therapeutic implications of each diverge substantially. CT thorax reliably distinguishes all of these entities and remains indispensable in the acute diagnostic work-up.

Plain chest radiography is usually the first investigation obtained and may reveal a radiolucent band partially or completely encircling the cardiac silhouette - the so-called 'halo sign' or, when gas bridges the two hemidiaphragms, the 'continuous diaphragm sign' [1]. These findings, however, may be subtle and are not sufficiently specific in isolation. CT of the thorax remains the goldstandard modality: it precisely localises intrapericardial air, differentiates pneumopericardium from both pneumomediastinum and pericardial effusion, and simultaneously evaluates the lungs and mediastinum for any underlying or co-existing pathology [7]. Transthoracic echocardiography is an equally critical component of the initial assessment, providing real-time evaluation of cardiac function and enabling prompt identification of tamponade physiology. Although electrocardiographic changes are non-specific and not pathognomonic, low QRS voltage and electrical axis shifts have been described in the context of intrapericardial gas interfering with myocardial electrical conduction [8].

Published experience with spontaneous pneumopericardium remains limited to case reports and small series. Brander and colleagues (2002) described a young adult with spontaneous pneumopericardium in the absence of trauma, drawing attention to the continuous left hemidiaphragm sign on plain radiography as an early diagnostic clue and demonstrating favourable outcomes with conservative therapy alone [2]. More recently, Karmaus, Liddle and Cummings (2022) reported a comparable presentation in an otherwise healthy adult, further reinforcing the diagnostic challenges inherent to this entity and the adequacy of non-operative management in haemodynamically stable patients [9]. The present case aligns closely with these precedents: an isolated finding of pericardial air on CT without co-existing pneumomediastinum or pneumothorax, a stable haemodynamic profile throughout, and complete resolution with conservative measures.

The cornerstone of management in pneumopericardium is an accurate and timely assessment of haemodynamic stability. Patients who remain stable - as in the present case - can almost always be treated conservatively. Administration of high-concentration supplemental oxygen is central to this strategy: by displacing nitrogen in the alveolar and blood compartments, high-flow oxygen creates a diffusion gradient that accelerates reabsorption of the pericardial air. Adjunctive measures include adequate analgesia, physical rest, and serial clinical and radiological reassessment. Where there is any deterioration in haemodynamic status - falling blood pressure, rising heart rate, worsening pulsus paradoxus, or echocardiographic evidence of diastolic collapse-urgent pericardial decompression via pericardiocentesis or surgical pericardial drain placement is mandatory and must not be delayed.

Conclusion

Spontaneous pneumopericardium, though rare, is a diagnostically important cause of acute chest pain that should feature in the differential diagnosis of any young adult presenting with acute-onset retrosternal pain and dyspnoea - even when trauma and iatrogenic causes are conspicuously absent. The mill-wheel murmur, when present, is a valuable clinical pointer. CT of the thorax is the most reliable imaging modality for confirming intrapericardial air and excluding other serious cardiothoracic pathologies. Echocardiography is indispensable for ruling out tamponade. The majority of haemodynamically stable patients can be managed conservatively with high-flow oxygen, analgesia, and close observation, with an expectation of full radiological and symptomatic resolution. Nonetheless, vigilant monitoring remains essential throughout, as progression to tension pneumopericardium - though uncommon - can occur rapidly and is potentially fatal without prompt intervention.

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