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Tension pneumopericardium in blunt thoracic trauma

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ABSTRACT

INTRODUCTION: Pneumopericardium, defined as the presence of gas in the pericardial sac, is a rare condition caused mostly by trauma. Tension pneumopericardium is a cause of hemodynamic instability; hence, it consists in a life-threatening situation and should be regarded in blunt chest trauma.
CASE REPORT: A 51-year-old male was victim of a 4 m fall and burial. He was stable upon admission and presented a simple pneumopericardium and pneumomediastinum on CT. While being submitted to an upper digestive endoscopy he presented respiratory failure and had to be intubated, suddenly evolving to shock. He was promptly referred to the operating room; a pericardial window confirmed tension pneumopericardium and immediately hemodynamic stability was restored. A pericardial drain was placed and kept for 15 days. He was discharged at the 18th day post-trauma after a satisfactory recovery at the trauma ICU.
DISCUSSION: Blunt thoracic trauma causes pneumopericardium by various mechanisms. Tension pneumopericardium is a possible outcome, probably related to positive-pressure ventilation. It leads to hemodynamic instability and requires immediate decompression and placement of a pericardial drain.

1. Introduction

Pneumopericardium is the presence of gas in the pericardial sac. The major etiology is trauma, most of which blunt chest trauma [1,2]. It is a rare condition, associated with a high mortality rate (up to 57%) due to its severity *per se*, when causing cardiac tamponade, or to associated trauma, considering it is generally found in high-energy accidents [1].

According to Capizzi et al.'s review of pneumopericardium following blunt trauma reports from 1931 to 1995, comprising 32 patients, 37% developed tension pneumopericardium, most of them associated with mechanical ventilation [3]. The same percentage of hemodynamic instability was found in Cummings et al.'s 252-patient series of pneumopericardium of various etiologies [1].

Tension pneumopericardium presents clinically with increasing respiratory distress, increased central venous pressure and hypotension. Heart sounds may become attenuated. In most cases, chest X-ray exhibits air surrounding the heart, outlined by a thin stripe consisting of the pericardium and its associated structures. Though, a normal X-ray does not exclude pneumopericardium [1,4].

Although being a relevant cause of shock in trauma, pneumopericardium is rarely regarded during initial trauma assessment, which delays life-saving immediate measures and proper treatment. Moreover, its management is not largely known by practitioners, since this condition is often neglected in emergency protocols due to its rareness. This article brings pneumopericardium to light, reinforcing the importance of considering it within the differential diagnosis of shock in blunt trauma, remarking its management and adding up our experience to this subject's scarce literature. This report complies with the CARE guidelines, firming its transparency and accuracy [5].

2. Case report

The patient was a 51-year-old male, mason, who suffered a work accident in the building site–a 4 m high fall followed by burial. Hemodynamically stable and conscious at the scene, he was brought to our tertiary hospital by rescue helicopter. On admission, he presented decreased breath sounds bilaterally, thoracic subcutaneous emphysema, chest pain, breathing rate of 22, peripheral saturation of 87%, which increased to 93% with supplementary oxy-

Abbreviations: BP, blood pressure; BPM, beats per minute; FAST, Focused Assessment with Sonography for Trauma; ICU, Intensive Care Unit; PO, post-operative day; UDE, Upper Digestive Endoscopy.

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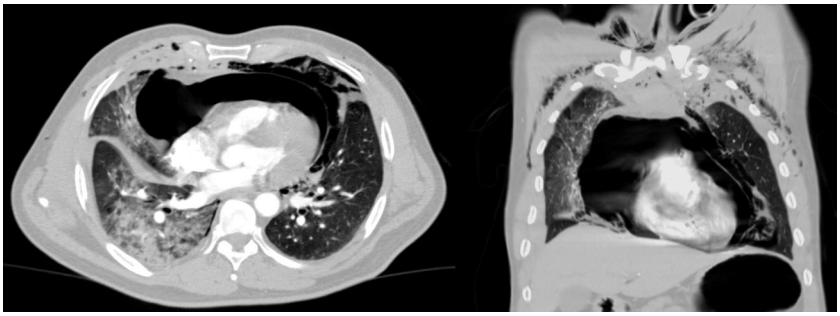

Fig. 1. Computed tomography scans on arrival, axial and coronal planes. An expressive non-tension pneumopericardium is present. Pneumomediastinum, subcutaneous emphysema and right lung contusion can also be noticed.

gen, heart rate of 92 bpm, blood pressure (BP) of 97 × 70 mmHg and a negative FAST (Focused Assessment with Sonography for Trauma).

A computer tomography showed bilateral lung contusion; minor pneumomediastinum; an expressive pneumopericardium; pubic symphysis disjunction; and fractures of the sternum, left clavicle, right scapula, left ischiopubic and iliopubic rami. Pneumothorax and abdominal injuries were excluded. The fractures were assessed by the orthopedic team, which considered them stable and oriented a conservative management.

In the emergency department, 15 h after admission, the patient presented tachypnea during upper digestive endoscopy (UDE), requiring orotracheal intubation, followed by hypotension, increase of the subcutaneous emphysema and clinical suspicion of right pneumothorax, immediately drained, though no air escape was found during the procedure. Hemodynamic instability persisted (BP 80 × 50 mmHg) and he was promptly referred to the operating room, where a pericardial window was performed, in which the escape of a large amount of air was verified, followed by immediate restoration of hemodynamic stability (BP 130 × 80 mmHg). A tubular drain was placed in the pericardial sac and the patient was submitted to a fiber bronchoscopy. UDE and fiber bronchoscopy showed no abnormalities (Fig. 1).

Following the procedure, the patient was admitted to the Trauma Intensive Care Unit (ICU) maintaining hemodynamic stability and functioning drains in underwater seal. The pericardial sac drain presenting air bubbling was connected to a suction system. The patient was extubated on the fourth postoperative day (PO), when the suction system was disconnected. A radiographic relapse of the pneumopericardium was verified four days later, demanding additional 48 h under suction. On the 13th postoperative day, the right chest tube was removed. The pericardial sac drain was removed on the 15th PO. Two days later the patient was dismissed from the ICU to the Trauma Ward, and was discharged the next day. He then recovered well and his follow up at the clinics was finished on the 28th day post-trauma (Fig. 2).

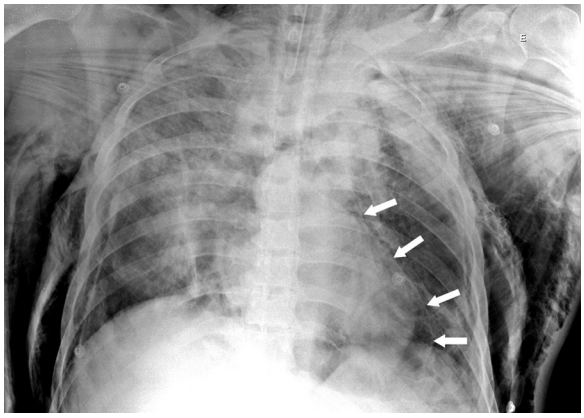

Fig. 2. Portable X-ray film obtained in the Emergency Room, after intubation. White arrows indicate pericardium stripe and its underlying pneumopericardium.

3. Discussion

According to most authors, pneumopericardium in blunt trauma is caused by alveoli rupture due to sudden rise in intrathoracic pressure, leading to air leak to the pericardium via pleural cavity in the presence of a pleuropericardial tear, if the visceral pleura is disrupted causing pneumothorax, or via lung interstitium, tracking along the perivascular planes of pulmonary vessels into the mediastinum, neck, retroperitoneum and pericardium – what is known as "Macklin effect". Another mechanism would consist in direct apposition of tracheobronchial and pericardial tears [3,6,7]. Since our patient did not present pneumothorax upon arrival, and tracheal and main bronchi lesions were excluded by fiber bronchoscopy, his pneumopericardium probably resulted from the Macklin effect or from the rupture of a non-primary bronchus.

If a valve mechanism occurs within the air passage to the pericardium, the increasing pressure may lead to cardiac tamponade [2]. Adcock measured pneumopericardium hemodynamic impact and found significant changes in pulse rate, arterial and venous pressure when the intrapericardial pressure exceeded 145 mm of water [8]. Capizzi et al.'s review of 32 cases of pneumopericardium following blunt injury, 12 of which with tension pneumopericardium, suggests a correlation between mechanical ventilation and tamponade – 83% became unstable under positive-pressure ventilation [3].

Tension pneumopericardium is a cause of hemodynamic instability and the acute shock may be managed by pericardial decompression either by needle pericardiocentesis or percutaneous drain placement. These emergency maneuvers should only be temporary, and followed by the placement of a soft tubular drain in the operating room, by subxiphoid approach, as in our case, or by open thoracotomy, or by video assisted thoracoscopic window [3,9]. Gould and Schurr reported the recurrence of tension pneumopericardium one day after percutaneous drainage, while under mechanical ventilation, what they attributed to a possible plug, solved after forceful aspiration followed by the placement of a tubular drain under video assisted thoracoscopy [9]. Our patient was already extubated when presented the relapse of a non-tension pneumopericardium whilst maintaining a functional tubular pericardial drain, after disconnection of the suction system. It was solved by connecting it back for another 48 h. Thus, the maintenance of a low negative pressure in the drain system may be necessary in some cases, particularly when a persistent air leak is present.

This case has brought us experience in such a rare condition. We now have a higher suspicion of pneumopericardium when assessing blunt trauma patients, considering it in the differential diagnosis of shock. We have also revised and grounded our management of this condition. In a similar scenario we would now probably diagnose it sooner and, perhaps, we would avoid hemodynamic decompensation by early accomplishing pericardiocentesis and pericardial drainage, before performing an UDE or intubation. We should also be aware of the potential recurrence of pneumopericardium while maintaining a pericardial drain, by its obstruction or by the presence of a persistent air leak, even if the patient is not under positive-pressure ventilation – which reinforces the importance of intensive care support until the resolution of this condition.

Conflict of interest

The authors declare no conflict of interest.

Funding

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Ethical approval

No ethical approval is necessary for this case report.

Consent

The patient has provided written consent for the publication of this case report.

Author contribution

Antonio Fernando Rolim Marques: author; Lizianne Hermogenes Lopes, Marcela dos Santos Martins: co-authors; Cesar Vanderlei Carmona, Gustavo Pereira Fraga, Elcio Shiyoiti Hirano: supervisors.

Guarantor

Elcio Shiyoiti Hirano.

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