Trauma Case Reports 48 (2023) 100962

Contents lists available at ScienceDirect

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

A rare case of perforating chest wall including pericardial sac with penetrating trivial injury: A case report and literature review

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ARTICLE INFO

Keywords:
Perforating chest wall
Pericardial sac
Chest trauma
Pediatric chest injury
Penetrating trauma

ABSTRACT

Perforating chest wall injuries involving the pericardial sac in pediatric patients are exceedingly rare and pose a unique clinical challenge. Thoracic trauma in the pediatric population remains a significant cause of morbidity and mortality. We present a case of an 8-year-old boy with an acute history of a sharp injection needle embedded in his chest wall presented with severe chest pain and diaphoresis. Diagnostic evaluations included computed tomography revealed a hyperdense focus with a metallic artefact seen impacted in the interventricular septa and perforating the heart. He underwent a thoracotomy and cardioplegic arrest for needle retrieval and subsequent cardiac repair. Our case underscores the importance of a multidisciplinary approach, meticulous monitoring, and a profound understanding of the unique anatomical considerations in pediatric chest injuries.

Summary: This article presents a rare and challenging case of an 8-year-old male who arrived at the emergency department with a sharp injection needle embedded in his chest wall. Despite being relatively rare in children, thoracic injuries can be severe and potentially life-threatening. A fast and accurate diagnostic approach is crucial to prevent fatal complications. Thoracic trauma in the pediatric population remains a significant cause of morbidity and mortality. Timely diagnosis and appropriate interventions are critical in improving patient outcomes. The presented case highlights the need for caution and a well-planned approach in managing such rare and complex injuries in children.

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https://doi.org/10.1016/j.tcr.2023.100962
Accepted 18 October 2023
Available online 19 October 2023

Introduction

Chest injury is the second leading cause of trauma-related mortality in children under the age of one. Since the underlying thoracic injuries are frequently disproportionate to the surface injury and those symptoms may not manifest for several hours, a fast diagnosis is challenging and is commonly underestimated, delayed, or overlooked. Six fatal injuries must be left out of the first trauma survey, and six hidden injuries must be considered in the secondary survey [1]. Chest wall injuries range from relatively mild to fatal flail chest or huge defects. In patients admitted after severe trauma, one-third present with significant chest wall injuries [2].

In children, significant morbidity and mortality occur in major chest trauma. Their anatomic-physiological makeup is such that the pattern of injuries differs from their adult counterparts. The injuries from primary contusions, pneumothorax, hemothorax, and rib fractures to clinically more serious and potentially life-threatening complications like tracheobronchial tear, aortic rupture, and cardiac injuries though seen rarely. Chest radiography is the first and most crucial imaging technique in pediatric chest trauma, and it should be complemented by an ultrasound and computed tomography (CT) scan. However, the methodology is specific to each child and is determined by the type of traumatic event as well as clinical characteristics. In the case of a CT scan, to minimize the radiation dose to the patient, the appropriate modification should be incorporated while preserving the diagnostic integrity at the same time [3].

The most frequent cause of injury in the United States is motor vehicle accidents, and chest trauma is in third place after extremities trauma and brain trauma in large accidents. The frequency and severity of chest injuries should decrease because of increased vehicle safety, moderate speed, and ongoing education [4].

Case presentation

An 8-year-old male was brought to the emergency department with a sharp injection needle penetrating a chest wall. The patient was anxious, diaphoretic, and in pain. The child's parents informed that the kids were playing with syringes and needles when a needle accidentally pierced the chest wall of the boy. Past medical history was insignificant and immunization history is up to date. Conservative management along with failed attempts to retrieve the needle was done by a local practitioner surgeon and he referred the patient to the higher medical system.

On general physical examination, vitals were stable, and the patient was anxious and oriented to time, place, and person. His trans axial helical, spiral CT scan of the chest has been done which revealed a hyperdense focus with a metallic artefact (likely a foreign body) seen impacted in the interventricular septa as shown in Fig. 1, perforating the heart, and sitting inside the heart chambers moving with each beat. No significant lung injuries were observed as shown in Fig. 2.

On further consultation with a cardiothoracic vascular surgeon (CTVS) team, the boy was immediately taken to operation theatre (OT) to prevent a further fatal injury. The patient underwent a thoracotomy and cardioplegic arrest for needle retrieval and subsequent cardiac repair. On initial resuscitation, he was hemodynamically stable and underwent a chest x-ray and electrocardiogram (ECG), which was normal. He was immediately transferred to the operating room with blood products for thoracotomy under general anesthesia. He was positioned supine with his right chest slightly up, and a central venous catheter (CV) line was inserted. The

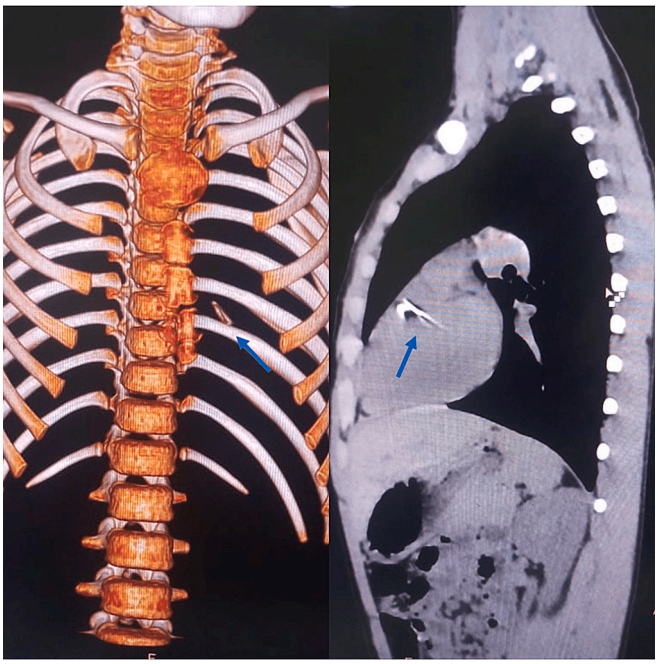

Fig. 1. Hyperdense focuses with a metallic foreign body in the interventricular septa (arrows).

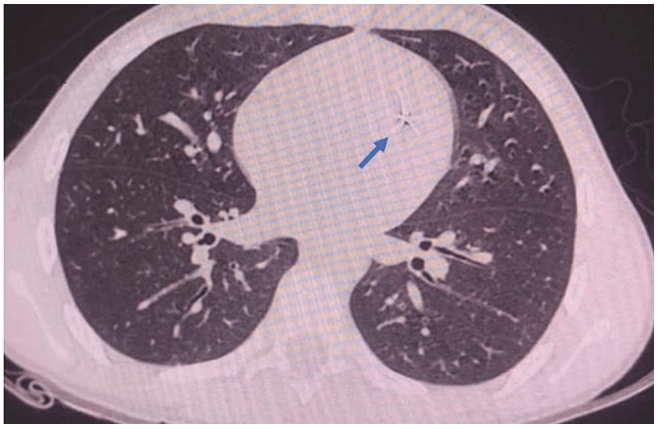

Fig. 2. CT axial section showing metallic foreign body with no significant lung injuries (arrow).

penetrating needle was examined, and his chest was exposed up to the pericardium along the penetrating needle. The underlying pleura and lungs were examined. A pericardial tear of 1 cm × 1.5 cm with a clot and hemopericardium. While repairing the wall, his blood pressure increased to 110/60 mmHg, and his heart rate dropped to 100/min. The double arm propylene suture was applied in double layers till the hemostasis was achieved. His thoracic cavity was inspected again, the needle was removed, and hemostasis was secured. The thoracic cavity was washed with normal saline and closed in layers after the insertion of two chest drains. The patient was then shifted to the intensive care unit for further evaluation, monitoring, and management. The patient was extubated on the second postoperative day. A repeat chest X-ray showed moderate right-sided pleural effusion and pleural tapping was done. He was discharged after twelve days and demonstrated satisfactory recovery and he was doing well on his follow-up visit.

Discussion

Penetrating chest trauma remains a significant challenge for emergency physicians and attending surgeons. Surgical emergencies, such as traumatic cardiac chamber rupture, often pose complex diagnostic dilemmas. Nevertheless, achieving an accurate diagnosis and promptly initiating surgical intervention can yield substantial therapeutic benefits. The initial primary assessment, resuscitation efforts, and maintaining a vigilant awareness of potential underlying injuries are crucial elements in enhancing survival following traumatic incidents. In terms of therapeutic and surgical approaches, the treatment of traumatic penetrating thoracic injuries in children and adults is identical. For adolescents and adults, the utilization of emergency department thoracotomy and admission physiology can predict death from penetrating thoracic trauma based on the severity of the damage. Children may have a higher risk of poor outcomes regardless of the degree of the injury [6].

In both penetrating and blunt injuries, post-traumatic empyema (PTE) is a significant problem, and its incidence is reported 2–25 % in patients who have sustained chest injuries. Potential causes of PTE include infection of the pleural space during chest tube placement, direct infection from penetrating injuries of the thoracic cavity, secondary infection of the pleural cavity from associated intra-abdominal organ injuries with the diaphragmatic disruption, secondary infection of an undrained or insufficiently drained hemothorax and parapneumonic empyema [7].

In thoracic trauma, 1–13 % of the hospital admissions are due to penetrating chest injuries and are mostly managed conservatively [8]. There is residual clotted blood in 18 to 30 % of cases handled only with tube thoracostomy, which is a major risk factor for the development of empyema and fibrothorax. Furthermore, 4 % to 23 % of patients with a chest injury have chronic pneumothorax, and 15 % to 59 % of patients have a diaphragmatic injury, which is undetected in 30 % of instances. All patients with a pleural cavity penetrating injury should have surgical investigation to lower the incidence of undetected injuries, and late mortality [9]. Thoracoscopic surgery using video assistance can correctly identify and treat penetrating chest wounds while minimizing the risk of overlooked possibly deadly lesions and long-term complications [9].

Common life-threatening chest injuries include tension pneumothorax, open pneumothorax, massive hemothorax, or cardiac tamponade [10]. Most of these patients do not survive until they reach the hospital, but some deaths can be prevented, especially in cases involving cardiac tamponade or uncontrolled bleeding. Therefore, it is crucial to minimize rescue time, emphasizing the importance of early diagnosis and immediate appropriate treatment. Time is of the essence in such situations [11].

The primary objective is to reduce morbidity and mortality by promptly identifying life-threatening injuries through a comprehensive clinical examination, diagnostic imaging (such as chest x-rays, focused sonography, and computed tomography), and tailored patient-centered treatment. One safe approach is following the “ABCDE” Advanced Trauma Life Support (ATLS) protocol, which involves a standardized rapid initial assessment and management of the injured patient [12]. Airway obstruction issues (A) are rare in penetrating chest trauma, being more commonly associated with penetrating neck injuries. Life-threatening problems in penetrating chest trauma mainly revolve around breathing (B) and circulation (C), including tension pneumothorax, open pneumothorax, massive hemothorax, cardiac tamponade, and hemorrhagic shock, all of which necessitate immediate surgical interventions. Encountering a

penetrating chest trauma should trigger suspicion of potential cardiac, great vessel, hilar, pulmonary, and abdominal injuries, and these possibilities must be thoroughly investigated without hesitation [13].

In children, ribs being flexible, less mineralized causes them to bend but not break. The soft chest wall in children confers less protection to the underlying lung parenchyma and allows direct transfer of energy to underlying lungs which causes more pulmonary contusions and pneumothorax. In children, mechanical ventilation is generally of short duration as chest injury seems to produce a mild compromise of respiratory function which is usually well tolerated by children. Flail chest, transection and aortic transactions are uncommon in children but are frequently encountered in adults due to which thoracotomy is also generally not required in children [14]. For needle retrieval and subsequent heart repair, our patient underwent a cardioplegic arrest as well as a thoracostomy. He was discharged twelve days after surgery after demonstrating acceptable healing.

Conclusion

In the pediatric population, thoracic trauma continues to be a substantial source of morbidity and mortality. To solve this conundrum, governments, civil societies, and the medical profession must collaborate. A strong index of suspicion, adequate diagnostic tests, and a multidisciplinary approach are essential for early detection and treatment. A simple tube thoracostomy can successfully treat most blunt chest injuries, with only a few cases requiring an open thoracotomy.

Patient consent statement

Signed consent for a case report was obtained from the patient's legally authorized representative (LAR). The IRB approval was taken from Regency Hospital Ethics Committee.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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