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CASE REPORT

Surgical Resolution of Penetrating Cardiac Injury: A Case Report of a Serrated Knife Blade Blow

Jaísse Valente Cruz,[1] Adnaldo da Silveira Maia,[2,3] Giovana dos Santos Couto,[1] Giselle Macedo de Souza[4]

Universidade Federal do Amazonas,[1] Manaus, AM – Brazil
Dante Pazzanese Cardiological,[2] São Paulo, SP – Brazil
Universidade de São Paulo,[3] São Paulo, SP – Brazil
Hospital Universitário Getulio Vargas,[4] Manaus, AM – Brazil

Abstract

Severe cardiac injuries, such as blunt or penetrating injuries caused by bladed weapons, require early diagnosis, usually by electrocardiography, tomography, and Focused Assessment With Sonography in Trauma (FAST). This study describes a case of penetrating cardiac trauma successfully treated by surgical intervention. During surgery, the medical team identified a serrated knife blade in the anterior chest wall, associated with a rib fracture and pericardial injury, without compromising the diaphragm. The patient had a positive outcome after the intervention. Effective management of these injuries depends on understanding the trauma mechanism and the patient's characteristics, allowing for a rapid response and potentially life-saving therapies.

Introduction

Cardiac injuries are considered lethal and severe when compared to other types of trauma, surpassed only by central nervous system injuries. Cardiac trauma is classified according to the mechanism of injury, which can be blunt and penetrating. The most common heart injury is blunt trauma, often caused by an abrupt deceleration in car accidents, followed by vehicle impacts, motorcycle accidents, and falls from heights. Regarding penetrating heart injuries, white weapon injuries are the most common, followed by firearm injuries.[1]

Keywords

Thoracic Injuries; Penetrating injuries; Myocardial Contusions

Determining hemodynamic status is essential for estimating the patient's outcome, as patients admitted to the hospital in shock have a poor prognosis. The main risk factors for mortality include time spent at the scene and in transit exceeding ten minutes, the need for cardiopulmonary resuscitation, exsanguination, a low Glasgow scale score, massive hemothorax, hypotension, and bradycardia, and the need for a thoracotomy.[1]

When a cardiac trauma patient is admitted to the hospital, it's the general or trauma surgeon's responsibility to promptly diagnose the injury to lower mortality rates and minimize the waiting time for thoracotomy. The diagnostic methods include electrocardiography, chest tomography, and Focused Assessment with Sonography in Trauma (FAST). FAST is widely used in hospital settings and, despite being operator-dependent, has a sensitivity of 92-100% and specificity of 99-100% for detecting pericardial effusion and fluids in other cavities. In hemodynamically stable patients, a chest Computerized tomography (CT) scan can be performed, as it presents a sensitivity of 100% and specificity of 96% for the diagnosis of hemopericardium.[2]

Based on the information reported above, this study aims to present a case report of penetrating cardiac trauma caused by a white weapon, which resulted in a positive outcome and was managed by the general surgery team, along with a review of the related literature.

Case report

A 41-year-old patient, female, was admitted to the tertiary unit after being referred from the Emergency Care Unit following a physical attack involving a

Mailing Address: Adnaldo da Silveira Maia
Dante Pazzanese Cardiological Institute. Av. Dr. Dante Pazzanese. Postal code: 04012-909. São Paulo, SP – Brazil
E-mail: adsm.ccv@gmail.com
Editor responsible for the review: Glaucia Maria Moraes de Oliveira

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white weapon. During her initial assessment at the Emergency Care Unit, a penetrating wound was identified in the 3rd intercostal space in the right middle axillary line. Despite the wound, the patient was hemodynamically stable. A chest X-ray was performed, but due to the severity of the case, the patient was transferred to a tertiary unit (Figure 1). During a secondary assessment at the tertiary unit, the patient was found wearing a three-pointed patch over the area of the penetrating injury, along with cut and bruise lesions on the right forearm and abrasions on the right arm. Vital signs upon admission were SBP: 160, DBP: 100, HR: 113, SAT with 3L/min O_2 catheter: 97%, RR: 23, Glasgow score 15. A FAST ultrasound was performed, revealing no pericardial fluid content. The patient remained hemodynamically stable, and a chest CT scan showed a blade in a cavity transfixing the right lung and pleural cavity (Figure 2-3).

The patient was transferred to the operating room for an emergency exploratory thoracotomy, performed by the trauma surgery team. A right posterolateral thoracotomy was performed at the 6th intercostal space, showing the presence of a serrated knife blade attached to the anterior chest wall, with a fracture of the costal arch, transfixing the upper lung lobe and causing a pericardial injury, but without diaphragmatic injury. A large volume of clot was observed near the pericardium and at the lung base, but there was no active bleeding. The foreign body was extracted using clamp forceps, and the pericardial lesion was enlarged, identifying a lesion in the right atrium, which was plugged. The atrium was clamped with Satinsky forceps, and cardiorrhaphy was performed with a single U-stitch, followed by approximation of the pericardium using 3-0 polypropylene. A tractotomy was performed in the upper lobe, and a U-stitch suture was made at the air leak sites with pneumorrhaphy using a double-layer continuous suture with 3-0 polyglactin. Hemostasis was performed with electrocautery on the chest wall. The pleural cavities were irrigated and cleaned. Two No. 36 thoracic drains were placed: the first was posteriorly exteriorized by a counter-opening in the posterior axillary line at the 9th intercostal space, and the second was anteriorly exteriorized by a counter-opening in the anterior axillary line. After the surgical procedure, the patient was transferred to the Intensive Care Unit, where she remained for two days without any complications. During her stay in the general ward, the patient was monitored by the general surgery/thorax team, the chest tube was removed on the 5th postoperative (PO) day, and she was discharged on the 6th PO day.

The patient provided informed consent for the publication of the case report and accompanying images.

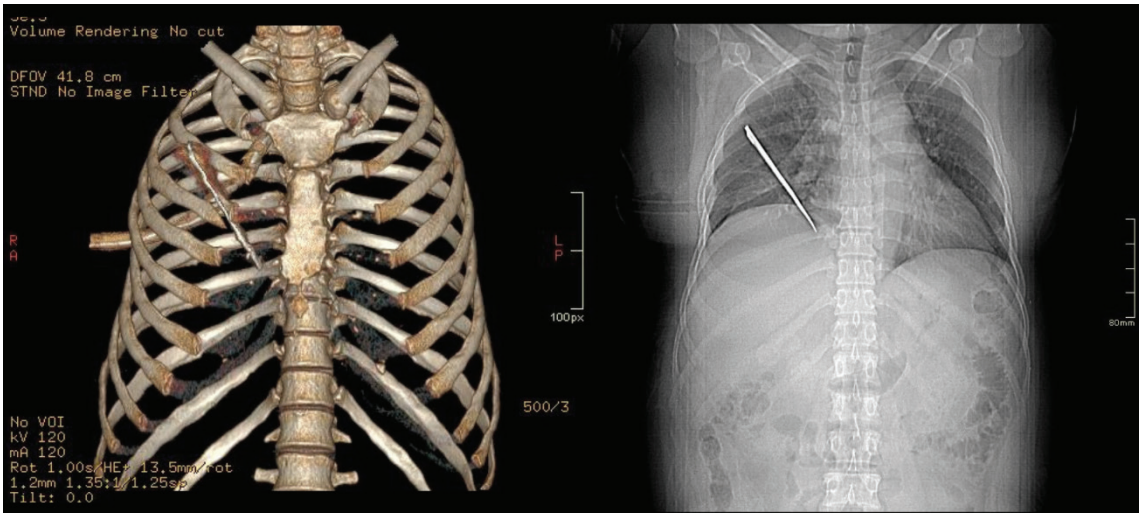

Figure 1 – Chest X-ray and 3D CT reconstruction showing the course of the knife trauma.

Figure 2 – CT scan showing the proximity of lung and heart structures.

Discussion

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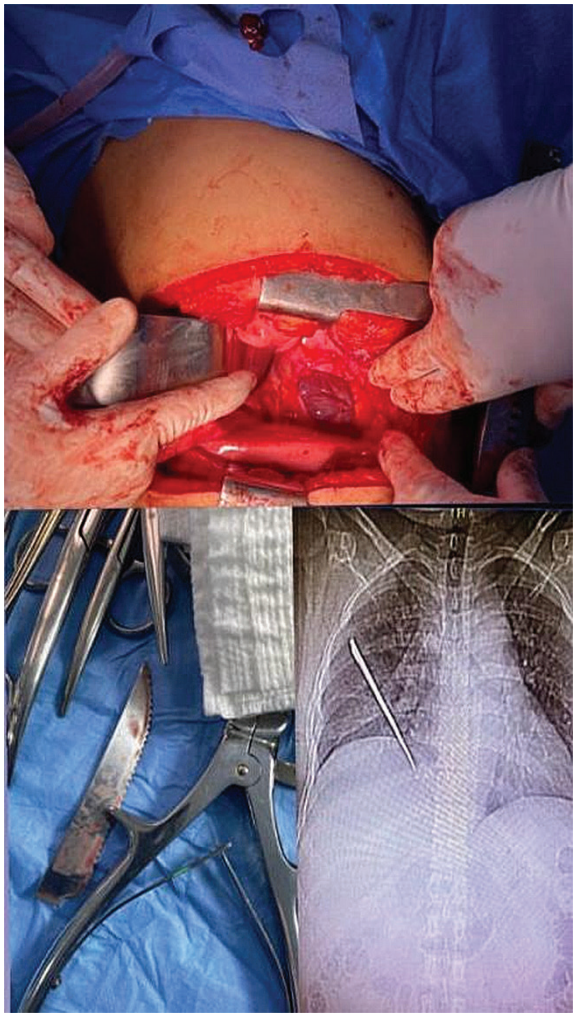

Figure 3 – Injury identified during intraoperative thoracotomy along with the serrated knife blade.

Penetrating heart injuries are the result in most cases of two types of artifacts, such as white weapons and firearms. The extent of the penetrating heart injury depends on the type of weapon used, the speed of the projectile, and the missile's trajectory. Chest X-rays can be used for both firearm and white weapon injuries; for instance, in shotgun wounds, the path of the projectile and its location in the thoracic region can be determined. Chest X-rays can also show costal arches and sternum fractures, as well as an enlarged mediastinum. Initial cardiac imaging can be performed using a FAST ultrasound, which, if possible, can identify pericardial fluid. Penetrating injuries may result in a negative FAST when blood leaks directly into the chest cavity through a pericardial defect.[3]

There has been an improvement in imaging tests that enable the diagnosis of cardiac injuries using non-invasive techniques, one of which is FAST. This complementary test can be used in the emergency room and during serial assessments. Still, it requires the operator to be well-prepared, experienced, and sensitive in detecting non-specific signs of cardiac trauma. Alterations in imaging methods can also be observed on chest CT scans, although these represent non-specific findings such as pneumomediastinum, pneumopericardium, mediastinal hematoma, hemopericardium, pericardial effusion, and mediastinal hemorrhage.[4]

Any penetrating injury to the cardiac box should be considered indicative of potential cardiac injury. A thorough physical examination should be carried out to identify classic findings of cardiac tamponade, such as muffled heart sounds, hypotension, jugular venous distension, and paradoxical pulse. The importance of FAST ultrasound should be emphasized, as it aims to detect pericardial fluid and can also be complemented with findings of inferior vena cava distension.[5]

The term "cardiac box" is used to anatomically delimit a critical area, in trauma, where there is a greater possibility of cardiac injury. The upper limit of the area is marked by the clavicles, laterally by the hemiclavicular lines, and inferiorly by the costal margins. Until proven otherwise, penetrating injuries to the cardiac box should suggest previous cardiac injuries that can guide surgical access.[5]

If the injury is distant from the cardiac box, it may suggest non-cardiac thoracic injuries that can be more effectively managed through surgical access via anterolateral thoracotomy. The most frequently injured chamber of the heart is the right ventricle, accounting for over 50% of penetrating injuries. The right border of the heart consists of the right atrium and the vena cava, which are located parasternally between the 3rd and 6th costal cartilages.[5]

A retrospective study by Lone et al.,[6] examined 40 patients who underwent surgery due to cardiac injuries caused by firearm projectiles. The finding indicated that 35 (87.5%) of these patients had a single injury to one of the cardiac chambers, leading to a survival rate of 62.8% (22 out of 35). Furthermore, 12.5% of patients with multiple cardiac chamber injuries did not survive. The patient described in this report presented with a tamponade lesion in the right atrium and experienced a very favorable postoperative evolution.

Author Contributions

Conception and design of the research, acquisition of data: Cruz JV, Couto GS, Souza GM; analysis and interpretation of the data: Cruz JV, Maia AS, Couto GS; statistical analysis: Cruz JV; writing of the manuscript and critical revision of the manuscript for intellectual content: Cruz JV, Maia AS, Couto GS, Souza GM.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval And Consent To Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

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