Cardiac Penetrating Injury with Complete Heart Block: A Case Report

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Keywords
Complete heart block · Penetrating trauma · Heart injuries · Cardiac injury

Abstract
The development of heart block following cardiac penetrating injury is rare, and only few cases can be found in the literature. This uncommon healthcare emergency has shown to be a medical challenge for healthcare personnel, and it manifests very high mortality rates of 80–90% among its victims. The pre-hospital management and transport time for these cases are vital and can dictate the possible outcome for the victim. In this article, we present the first case ever reported in the Gulf Region about complete heart block as a consequence of penetrating chest injury. Our patient was a 35-year-old male who had a stab wound on the right side of the chest wall and who developed complete heart block in the Emergency Department (ED) as a result of the injury. Patient was rapidly diagnosed and managed in ED and then was shifted to the operating theater for immediate surgical repair. However, despite anatomical correction during the surgery he remained hypotensive and bradycardic. When hemodynamic stability was achieved, he was then placed on a temporary pacemaker and later on a permanent pacemaker by the cardiology team.

Introduction
Cardiac penetrating injuries remain a healthcare challenge, and an estimated 80–90% of victims do not survive initial medical care due to immediate exsanguination [1, 2]. Any penetrating trauma to torso and without any other cause of shock should be investigated for the possibility of occult cardiac injury [3].

It is rare to have impaired cardiac function following penetrating trauma and is mostly seen in unusual event of direct trauma to the conduction bundle [2]. We describe the first presentation and management of complete heart block because of penetrating injury. After reviewing the literature in English and Portuguese, this is the first case ever reported in the Gulf Region with such a complication. We report a victim of stab wound injury with stable vital signs after penetrating chest injury, who suddenly developed a complete heart block and became unstable.

Case Report/Case Presentation
A 35-year-old male presented to the Emergency Department (ED) with a stab wound to the right side of the chest. He was brought by ambulance with limited history and was stabbed at around 90 min before arrival. Upon arrival, he was conscious and agitated, complaining of chest and back pain. Patient was imme-
Immediately shifted to the resuscitation room. Primary assessment and investigations are shown in Table 1.

Patient was classified with possible grade I hypovolemic shock. He was managed immediately by emergency team and was kept on monitor with defibrillator pads. Intravenous fluids, analgesia, and tetanus toxoid booster dose were administered.

As the vital signs were stable, he was sent for an urgent CT of the chest and abdomen. On route, the heart rate and blood pressure dropped to 54 and 71/33 mm Hg and became confused. He was shifted back to resuscitation room with activated full polytrauma CODE, which meant anesthesia, orthopedic, and general surgery teams to be available at the patient bedside.

Table 1. Primary assessment and investigations

| Primary assessment | Investigations |
|--------------------|---------------|
| Airway – patent     | Venous blood gas |
| Breathing – clear and equal bilaterally, SpO₂ 99% in room air | Decreased pH of 7.21 |
| Circulation – pulses were present and equal in all limbs, blood pressure was 146/110 mm Hg, and heart rate was 116 bpm. No clinical signs of pericardial tamponade | Normal pCO₂ of 44 mm Hg |
| Disability – Glasgow Coma Scale as 15/15, without focal neurologic deficits | High pO₂ of 116 mm Hg |
| Exposure – single incised wound, located on the right upper parasternal chest wall, at the level of the 3rd rib. The wound appeared deep and had approximate length of 2 cm with a width of 1.5 cm, with minimal blood oozing. No signs of other penetrating or blunt injuries were found on the patient | Low HCO₃ of 16.4 mmol/L |
| Extended focus assessment with sonography for trauma (E-fast) showed no signs of pneumothorax or hemothorax and no free intraperitoneal fluid. Equivocal for minimal fluid in the pericardium | Acceptable SpO₂ values of 96% |
| Venous blood gas | High glucose of 445 mg/dL |
| Normal pCO₂ of 44 mm Hg | High lactic acid of 11.0 mmol/L |
| High pO₂ of 116 mm Hg | Hemoglobin value on ABG showed 12.4 g/dL |
| Low HCO₃ of 16.4 mmol/L | Full blood count |
| Acceptable SpO₂ values of 96% | Hemoglobin of 14.6 g/dL |
| High glucose of 445 mg/dL | Hematocrit of 43.5% |
| High lactic acid of 11.0 mmol/L | White blood count of 12.2 × 10³/μL, platelets of 178 × 10³/μL |
| Hemoglobin value on ABG showed 12.4 g/dL | High troponin of 101 ng/L |
| Full blood count | High CKMB of 83 U/L |
| Venous blood gas | Coagulation profile |
| Normal pCO₂ of 44 mm Hg | Slightly elevated INR of 1.24 |
| High pO₂ of 116 mm Hg | Elevated PT of 15.9 s |
| Low HCO₃ of 16.4 mmol/L | Elevated APTT of 43.7 s |

Fig. 1. ECG showed complete heart block.
Primary survey reassessment shows airway and breathing intact, hypotension, and bradycardia with signs of altered mental status as stated above. Repeated E-FAST was positive for a rim of pericardial effusion only. ECG of patient prior to surgical repair is shown in Figure 1.

The ECG of the patient was analyzed by the cardiology specialist which stated in spite of the slightly narrow QRS complex noted, the ECG is still classified as complete heart block as the impulse depolarizing the His bundle is likely to be originated from the upper-mid AV node consequently depolarizing the left ventricle before crossing to the right ventricle portion of the bundle. Medical therapy and transcutaneous pacing were started with electrical and mechanical capture achieved. Despite optimized resuscitation efforts, he remained unstable without improvement of clinical and vital parameters. The decision was made to intubate and start on dopamine and noradrenaline infusion.

Patient deteriorated into cardiac arrest, with a pulseless electrical activity rhythm. Cardiopulmonary resuscitation was initiated according to advanced trauma life support protocol and bilateral chest tube inserted. ROSC was achieved after 2 cycles and transfused 1st unit of O negative packed red blood cell. Patient was admitted by cardiothoracic team for emergency operating theater thoracotomy.

Thoracotomy revealed a hematoma in the pericardium, a right ventricle tear that was repaired, a right internal mammary artery torn and actively bleeding that was ligated and clipped, a large hematoma in the right upper parasternal area compressing the heart that was drained, and active bleeding from intercostal artery that was ligated. Hemostasis was insured and 2 drains kept one in the pericardium and one in the right pleural cavity.

Patient had persistent bradycardia during surgery even after cardiac injury repair, cardiology team was consulted, and temporary transvenous pacemaker was inserted. Post-surgery CT polytrauma was done which showed moderate amount of intraperitoneal free fluid but no evidence of obvious solid organ.

For 1 month, patient heart rhythm remained pacemaker dependent despite multiple attempts to reduce the pacemaker settings that resulted in episodes of severe bradycardia with unstable vital signs, ECG shown in Figure 2. Cardiology team concluded that patient was a candidate for permanent pacemaker. As patient general condition and laboratory parameters improved, after multidisciplinary discussion with cardiology, surgical intensive care, and cardiothoracic teams, a dual-chamber pacemaker PPM Biotronik was inserted, and he was discharged in stable condition.

Discussion

One of the main causes of cardiac injuries is penetrating traumas to the chest wall, mainly caused by gunshot and stab injuries [4]. These kinds of injuries have very low survival rate and are primarily dependent on rapid management [5]. Recent studies highlighted that these patients’ general condition and physiologic status upon ED arrival have improved due to better pre-hospital management and transport time, increasing the chances for cardiac repair [4–6].

Nevertheless, the mortality rate of penetrating cardiac injuries is still highly linked to pre-hospital exsanguination and cardiac tamponade [2, 7]. Most victims benefit from rapid assessment in ED, immediate control of hemorrhage, and alleviation of tamponade [7]. Rapid surgical intervention may result in improved survival chances of those who arrive with signs of life [4–6].

In a study on 1,701 patients with penetrating chest trauma, 260 were identified with wound trajectories that included the cardiac box. From them, 76 patients (29%) suffered a cardiac injury [5]. Most post-traumatic arrhythmias are consequence of blunt thoracic trauma [8].

Cardiac conduction system injuries secondary to pene-
trating traumas are a rare but equally life-threatening condition, and their rapid recognition and management are critical to improve chances of survival [7].

The presence of arrhythmias after traumatic heart injury is significantly responsible for higher mortality levels [3–9]. In a series of 46 patients with penetrating heart injuries, 6 of the 11 intraoperative deaths were caused by refractory arrhythmias. From the 29 cases that survived the cardiac injury, only one patient reported heart block as a complication post-repair [9].

The most common types of arrhythmias in the settings of cardiac trauma are premature ventricular contractions and supraventricular tachycardia [8]. This could be linked to the fact that the right ventricle is most frequently injured [1, 3, 9]. Brady-arrhythmia is uncommon in both blunt and penetrating traumas [7–9]. Although a rare entity, complete heart block can occur and be persistent, requiring temporary or even permanent pacemaker [8–10].

A study at Grady Memorial Hospital identified 71 penetrating cardiac injury patients. Of these, 3 (4%) patients had multi-chamber and atrioventricular node injuries. After cardiography, all 3 patients presented with persistent hypotension and bradycardia from complete heart block, requiring temporary epicardial pacing placement, with resolution of the arrhythmia after 72 h post-procedure [7].

Eckart et al. [10] reviewed a case of a 30-year-old US army soldier who had penetrating chest trauma with focal cardiac injury. Patient had penetration of his right atrium and subsequent traumatic membranous ventricular septal defect. At the time of surgery, the patient developed progressive heart block and eventual complete heart block requiring manual cardiac stimulation. Despite pharmacologic management and surgical correction of the defect, the patient’s heart block was persistent and required implantation of a pacemaker [10].

In our case, patient presented tachycardia, maintaining blood pressure. Then, he developed bradycardia and complete heart block in the ED, requiring transcutaneous pacemaker and vasopressors. Then, he was shifted for urgent thoracotomy and surgical repair. His bradycardia persisted, and transvenous pacemaker was inserted. Furthermore, permanent pacemaker had to be inserted for the persistent complete heart block.

**Conclusion**

Complete heart block in the settings of penetrating traumas is a rare presentation. The literature is based on few case reports. Almost all victims of penetrating chest trauma reported to develop heart block post-injury needed further temporary or permanent pacemakers. This article described the first case reported in the Gulf Region of penetrating chest injury who presented stable and developed complete heart block needing transvenous and later permanent pacemaker. Patients with penetrating cardiac injuries need rapid identification and management, with close monitoring for the risk of developing arrhythmias and heart blocks.

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**Statement of Ethics**

The research was conducted ethically and in accordance with the Declaration of Helsinki. The research committee policies of Dubai Health Authority do not require ethical approval. We have taken a written and signed consent from the patient to publish the case and images accompanied by it.

**Conflict of Interest Statement**

The authors have no conflicts of interest to declare.

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**Author Contributions**

Lamiz Tannouri: case presentation, manuscript preparation, and literature search. Salwa Younis Aljanaahi: case presentation, manuscript preparation, and review. Omar Qais Muhammed Noori: case presentation, manuscript preparation, and review. Khalifa Muhammed: manuscript review and ECG analysis and report.

**Data Availability Statement**

All the information generated or analyzed during this study is included in the report. The corresponding author can be contacted for further information.
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