



Case Report on Stab Injury to the Heart by Knife

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Significance:

Penetrating cardiac injury (PCI) is of importance due to potentially life-threatening consequences associated with it. Such injuries become even more important in children, due to higher risk involved. In this case report, management of PCI on a beating heart in a child is presented.

Abstract

We present a rare case of a child with penetrating cardiac injury (PCI) with a knife and its successful repair. A 10-year-old boy was brought to the emergency department with penetrating injury under the nipple on the left side of the chest, with entrance sized 1x0.5 cm, in a hemodynamically unstable condition. Physical examination showed findings suggestive of cardiac tamponade and shock. Focused Assessment with Sonography in Trauma (FAST) and echocardiography visualized pericardial effusion, and chest X-ray showed left pleural effusion. Needle thoracostomy was performed, followed by urgent sternotomy. Right ventricular tear of size 1x1cm visualized and repaired. The left pleura was drained blood up to 800 milliliters. The pericardium was closed with sutures. We then placed retrosternal and pericardial drains and sealed the chest with wire sutures at the sternum. During the induction of anesthesia, the patient underwent cardiac arrest, immediate cardiopulmonary resuscitation revived the patient and surgery was performed. Here, expertise lies in performing the procedure on a pumping heart without cardiac bypass. In addition, the most common cause of PCI is an intentional gunshot injury in adults. In contrast, our case presents the accidental nature of injury in children by knife, which makes this interesting. Therefore, we documented our experience of this rare finding. In addition, we present a literature review about penetrating injury to the heart, focused on the pediatric population and survival, morbidity, and mortality of the condition with and without access to the hospital.

Introduction

Penetrating cardiac injuries (PCIs) are life-threatening, with stab wounds and gunshot as predominant causes (1). These surgeries are challenging because of the limited therapeutic window unusual causes of trauma and the patient's hemodynamics. There are links

between mortality and the patient's hemodynamic condition at admission, the type of weapon used, wound characteristics, surgical outcomes, and the complexity of the repair. The complications linked to PCI include cardiac tamponade, hemorrhage and cardiac failure. Regardless of the benefits of early management of cardiac tamponade, the mortality rate is still very high. Even though there have been advancements in therapeutic and diagnostic approaches, the mortality rate associated with PCIs is significant. The survival rates from many studies range from 3 to 84 per cent regardless of intensive care (2-6). The cause of injury and clinical presentation on admission to the hospital are the most critical factors in determining the fate of these patients. However, few studies have suggested that other factors, such as the incidence of numerous lesions in the cardiac chambers, are also significant (1, 6). Although PCI caused by firearms is the most prevalent, other causes of stab wounds cannot be overlooked. According to reports, cardiac tamponade occurs in around 2 per cent of penetrating injuries and 10 per cent of blunt trauma injuries (7). Ventricle injuries, when combined, account for up to 87 per cent of all penetrating heart injuries, considering the right ventricle (RV) as the most often damaged chamber of the heart (8). RV injuries have the best "to discharge" survival rate, at around 60%, but right atrium injuries are roughly half as likely (9). Although the data shows a difference in the frequency of right atrial and ventricular traumas, there is no change in mortality rate (10). Moreover, heart valves, conduction fibers, and major coronary arteries are also injured by PCI in rare cases.

Pericardiocentesis could treat tamponade in small pericardial and myocardial lesions. Contrary to this, surgeons should treat larger wounds inflicted by bullets with an urgent thoracotomy and cardiography. We present a case of a young boy who underwent reparative surgery for cardiac tamponade due to a stab wound injury in the right ventricle.

Case Summary

A 10-year-old boy was escorted to the emergency department three hours after an accidental penetrating injury to the left side of the chest from a household paring knife. According to the patient's attendants, he was in his usual health 3 hours ago when a knife stabbed into his chest inadvertently. They immediately removed

the knife and took the patient to a local hospital, but hospitalists referred him to the tertiary hospital.

On examination sick looking child lying on the bed in distress and altered sensorium. There is an entrance wound at the third intercostal space on the left, medial to the midclavicular line of about 1x0.5 cm. Vitals signs were as afebrile patient with blood pressure 79/40 mm Hg, heart rate 135 beats/minute, and respiratory rate was 30 breaths/minute. Signs of cardiac tamponade, including raised jugular venous pressure, muffled heart sounds, and Kussmaul sign, were present. There was a decreased chest expansion with absent air entry of breath sounds on the left side. On mental status, examination the patient was confused but arousable with a GCS of 15/15. The further systemic review was insignificant.

Chest X-ray showed cardiomegaly and left-sided pleural effusion, and FAST showed pericardial effusion. The emergency medical team performed Needle thoracentesis. Electrocardiogram (EKG) revealed low QRS complexes in all leads and PR segment depression. The Pediatric Cardiac Surgery Department received an interdisciplinary emergency call, and the on-call doctor responded immediately. Echocardiography (Figure.1) found a large pericardial collection with underfilling of the left ventricle and right ventricle collapse. He received a shot of tetanus toxoid immunoglobulin injection. Cross matched blood transfusion was started and shifted the patient to Operation Room. Baseline investigations of the patient are reported in Table 1.

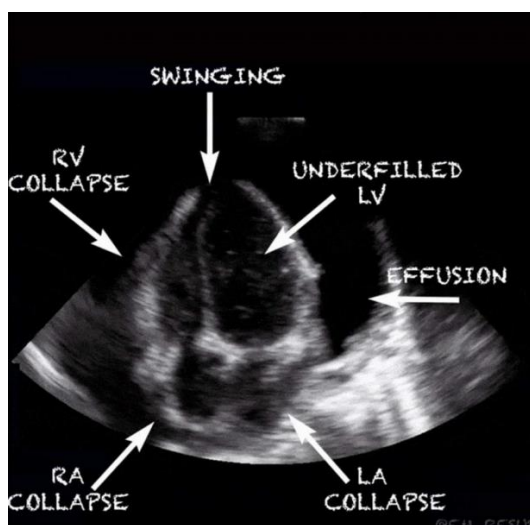


Figure.1 Echocardiography showing a large pericardial collection with under filling of left ventricle and right ventricle collapse.

Table 1: Baseline investigations of the patient.

Laboratory investigations	Normal Value (unit)	Patient's value	Comments
Hematological Profile			
Hb	11-15.5 (g/dL)	9.0 (g/dL)	Low
MCV	71.3-84.0 (fL)	82.0 (fL)	Normal
TLC	4-11 ($\times 10^3/\mu\text{L}$)	7.8 ($\times 10^3/\mu\text{L}$)	Normal
PLT	202-403 ($\times 10^3/\mu\text{L}$)	250 ($\times 10^3/\mu\text{L}$)	Normal
BUN	7-20 (mg/dl)	8 (mg/dl)	Normal
Cr	0.5-1.0 (mg/dl)	0.8 (mg/dl)	Normal
Coagulation Profile			
PT	10.5 (seconds)	10 (seconds)	Normal
APTT	26-36 (seconds)	25 (seconds)	Normal
INR	≤ 1.10	1.0	Normal
Hb, hemoglobin; MCV, mean corpuscular volume; TLC, total leukocyte count; PLT, platelets; BUN, blood urea; Cr, creatinine; PT, prothrombin time; APTT, activated partial thromboplastin time; INR, international normalized ratio.			

During induction of anesthesia, the patient experienced hypotension leading to cardiac arrest. The medical team started Cardiopulmonary resuscitation (CPR), and the patient revived successfully. Using the sterile technique, we made a sternotomy incision. We found a tear in the pericardium, incised it, and opened the pericardium. Thus, the heart was visualized with a right ventricular tear of 1x1 cm with blood oozing from it. The defect was repaired with Plogel prolene suture 4.0 and interpose could be felt. We performed this surgery on the beating heart without bypass. The right atrium, left atrium, and the left ventricle was found intact. Transesophageal echocardiography (TEE) was performed to assess any intracardiac injury but found no abnormalities. We opened the left pleura and drained 800 milliliters of blood. The pericardium was closed with interrupted sutures and restored the patient's hemodynamics. Finally, we placed a retrosternal and a pericardial chest tube and closed the sternum with wire sutures.

Postoperative echocardiography performed in the ICU showed mild Right ventricular dysfunction. The right and left atrium and the left ventricle were normal with an ejection fraction of 70 per cent, without abnormal pericardial collection. The patient had an uneventful

postoperative course before discharge from the hospital.

Discussion

The occurrence of PCIs in children is a rare finding. In an 11-year retrospective study (11), 32 out of 4569 (0.7%) children hospitalized for trauma suffered penetrating cardiac injuries, of which 81% of the cases were of a stab wound. The most frequent weapon for stab injuries is a knife, followed by screwdrivers, ice picks, chopsticks, and pneumatic nail gun nails. Boys are more likely to be affected by penetrating chest trauma than girls, and the average age is between 7 and 11 years old (12).

Many physiological indicators and trauma mechanisms are a predictor of death. The type of weapon used, the magnitude of the myocardial damage, the cardiac wounded chamber, coronary artery impairment, initial hemodynamic condition, concomitant lesions, and the time passed until reaching the hospital impact the survival rate following a PCI. The pre-hospital transfer is critical with PCIs since only a tiny percentage of patients survive. Studies show this percentage is between 0.05 and 10 per cent (3). The time between injury and operation is crucial, since presenting after 30 minutes results in higher mortality (3). The subject of our case was brought three hours after the injury, contributing to criticality.

Three typical symptoms of cardiac tamponade include a weakened apical heartbeat, muffled heart sounds, and low pulse pressures were present in our patient. The case of cardiac tamponade also commonly presents with jugular venous distention or the Kussmaul sign. There was documentation of this sign in our patient indicating the occurrence of cardiac tamponade following PCI. In our case, we also observed Beck's triad (defined as hypotension, JVD and muffled cardiac sounds), which usually present in 10% to 40% of tamponade patients.

Echocardiography is superior to traditional radiography in identifying pericardial effusion and cardiac tamponade because it is noninvasive, conclusive, and sensitive to as little as 20-50 milliliters of pericardial fluid (13). It has a sensitivity of 90 per cent and specificity of 97 per cent in identifying cardiac trauma (14). We found pericardial effusion on the echocardiography of our patient, causing the collapse of the right atrium and ventricle and under filling of the left ventricle.

Cardiac tamponade is treated with pericardiocentesis, performed under local anesthesia in hemodynamically unstable patients (7). Cardiac tamponade could also be treated with percutaneous balloon pericardiotomy

procedures (7). Depending on the patient's hemodynamics, various techniques can be used to treat PCIs, including emergency department thoracotomy to in-theatre thoracotomy or median sternotomy (15). We performed median sternotomy to get the best possible view of the heart. Compared to left-sided thoracotomy, it provides good exposure, and entrance is relatively rapid in skilled hands.

Cardiopulmonary bypass (CPB) is the most common approach used to repair cardiac cavities (16), indicated for treating severe or numerous lesions. Although coronary artery transection is rare, it can happen occasionally and can be fatal. But there was no injury to a coronary artery or any other major artery in our case that resulted in a favorable outcome. A ventricular septal defect is known to occur in 1.5-5.0 per cent of all penetrating cardiac injuries (17). However, echocardiography, which is the gold standard in diagnosing patients with cardiac trauma, did not show a septal defect in our patient.

Despite removing the stab knife in the first place, which could act as a plug and delay in reaching the hospital, our patient survived and made an uneventful recovery.

In conclusion, we have presented a case of cardiac tamponade occurring due to penetrating cardiac injury. Despite the complexity of the case and the patient's young age, we performed a successful repair on a pumping heart without cardiac bypass. Such interesting cases should be added to the literature pool for helping other physicians and trainees learn from their colleagues' expertise and apply knowledge for the best interest of the patient.

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