The Successful Management of a Penetrating Cardiac Injury in a Regional Hospital: A Case Report

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Stabbing injuries of the heart are uncommon but have a high mortality rate. Most patients with cardiothoracic stabbing injuries die on admission to the emergency department. The management of cardiac stabbing injuries is dependent on rapid diagnosis and prompt surgical repair. We report our successful management of a patient with left ventricle penetrating injury. A 36-year-old female suffered from a stabbing injury to the left chest with hypovolemic shock. She underwent emergency anterolateral thoracotomy with repair of left ventricle without cardiopulmonary bypass. The postoperative course was uneventful except for acute tubular necrosis and the patient recovered gradually over the next two weeks. The patient was discharged on the 17th days after the operation without any follow-up problems.

Key words: heart, stabbing injury

Introduction

Cardiac stabbing injuries are not frequent, but when they occur they are a life-threatening emergency. These injuries require prompt and specific treatment in order to decrease mortality and morbidity. The wounded heart is likely to follow one of two courses: tamponade or exsanguination. About 90% patients will present with classic signs of pericardial tamponade, including hypotension, elevated jugular veins and muffled heart sounds (Beck’s triad). A few patients may bleed freely into the thoracic cavity and exsanguination then occurs. Most victims die at the scene or in the emergency room. If they survive to reach hospital, they will be showing signs of hemorrhagic shock. The key to successful management of penetrating cardiothoracic injuries is based on a high level of suspicion, the physical findings, immediate cardiopulmonary resuscitation, prompt diagnosis, surgical intervention, excellent surgical technique and the ability to provide excellent surgical critical care to these patients postoperatively. Herein, we discuss the clinical features, diagnosis, treatment and prognosis of such cases.

Case Report

A 36-year-old female was healthy before until she suffered from a stabbing injury to the left chest during an assault with a knife by her husband. She arrived at our emergency department by ambulance about 30 minutes later. The heart rate and respiratory rate were 94 per minute and 20 per minute, respectively, on the ambulance. During the journey she was conscious and alert. Unfortunately, on arrival in our emergency room, she entered severe shock with unconsciousness and in the ab-
ence of the knife in the left chest, active bleeding via the left chest was occurring. Her heart rate and respiratory rate were measured as 119 per minute and 25 per minute, respectively. Her blood pressure was undetectable and her jugular veins were distended. We performed endotracheal intubation immediately and cardiopulmonary resuscitation. An electrocardiogram showed tachycardia and ST segment elevation in V3-V5. An arterial blood gas test showed metabolic acidosis (pH: 7.004, HCO₃⁻: 10.8, BE: -20.2). An echocardiogram resulted in suspected pericardial effusion. She was transferred to the operating room after a short period of hemodynamic improvement. An anterolateral thoracotomy via the fourth intercostal space was made at once.

On exploration, a laceration wound over the left upper lobe of lung about 1 cm in length with active bleeding and an air leak were noted. Pericardial tamponade was also noted and we open the pericardium. A penetrating wound of the left ventricle (LV) about 1 cm in length was found. A large amount of blood was evacuated from the pericardium. Next, a 16-French Foley’s urine catheter was inserted and the balloon was filled with saline to obstruct the penetrating wound of the LV by gentle traction (Fig. 1). Direct LV repair was made using 3 O prolene with five interrupt stitches that were reinforced with a plaget (Fig. 2). The laceration wound of the left upper lobe of lung was repaired with 3 O catgut. During the operation, we did not use a cardiopulmonary bypass to facilitate the cardiac repair.

Postoperatively, acute tubular necrosis was noted and was treated with hydration and a low dose diuretic agent, which resulted in recovery. Elevated serum levels of amylase and lipase (amylase: 222 U/L, lipase: 175 U/L) were also noted, but they returned to normal spontaneously several days later. An echocardiogram was performed on the sixth day after the operation and showed normal LV and right ventricle (RV) wall motion as well as adequate LV systolic function. The patient was discharged on the 17th day after the injury with fully mobility and without complications.

Fig. 1 The left ventricle penetrating wound was obstructed by insertion of a Foley’s urine catheter insertion and balloon, which was filled with enough fluid such that with gentle traction blood loss was limited
Discussion

Penetrating cardiothoracic injury includes both stab and gunshot wounds. Stabbing wounds generally occur more frequently than gunshot wounds\(^2\). Cardiac rupture is a common cause of death after a stabbing cardiothoracic injury. The most common site of a stabbing cardiac injury is the RV because it has the greatest anterior exposure; this is followed by the LV, right atrium (RA), left atrium (LA) and the intrapericardial great vessels. The highest mortality rate is found for LV injury because this reflects pump failure and this is followed by RV and superior vena cava injuries\(^3,4\).

The clinical presentations of penetrating cardiac injuries range from complete hemodynamic stability to acute cardiovascular collapse. Beck’s triad, consisting of distended neck veins, muffled heart sounds and hypotension, represents the classical presentation of the patient arriving in the emergency department with pericardial tamponade. However, hypotension may be absent with a smaller injury if the pre-hospital time is short or, if present, it may be attributed mistakenly to other injuries. Furthermore, the neck veins may be flat if there has been massive blood loss. Pericardial tamponade is the unique manifestation of cardiac injury. This decreases the ability of heart to fill, resulting in a subsequent decrease in LV filling and a lower ejection fraction; thus there is an effective decrease in cardiac output and stroke volume. Pericardial tamponade also provides a protective effect as it can limit extrapericardial bleeding into the left hemithoracic cavity, thus preventing exsanguinating hemorrhage. In our case, the patient presented with distend jugular veins, hypotension after resuscitation without massive fluid transfusion and no dullness sound from the left chest wall. Pericardial tamponade was immediately suspected.

Penetrating cardiac injuries are generally suspected from the physical examination. Some patients presenting with a penetrating cardiac injury may be completely stable and the diagnosis can be missed. A chest X-ray may show an enlarged globular heart shadow or the pneumopericardium may be visible. These findings are present in ap-
proximately half of all cases but are non-specific\(^1\). EKG findings can include low voltages, S-T changes or inverted T waves. The most important tool in the rapid evaluation of cardiac injury is echocardiography. It can detect the pericardial effusions and suggest, if the results are positive, that the surgeon has the option of performing a thoracotomy, depending on the hemodynamic stability of the patient. Echocardiography can decrease the time needed to establish a diagnosis and thus it increases the survival rate. Furthermore, it also is useful in diagnosing abnormal pericardial fluid in doubtful cases\(^5\).

Pericardiocentesis was not suggested because penetrating into a cardiac chamber may yield a false-positive result, while clotting of the blood in the pericardial cavity may yield a false-negative result. Furthermore, drainage of the pericardial blood is often incomplete and tamponade may persistent or recur. Nonetheless, pericardiocentesis may have a role when no surgeon or operating room is available because the procedure can be carried out in the emergency room and pericardial decompression by pericardiocentesis might create the time to allow transfer of the patient to an operating room or trauma center. Pericardiocentesis was not performed in our case after pericardial tamponade was clearly impressed via echocardiography. We immediate perform a thoracotomy to control bleeding and repair the heart injury.

In contrast to abdominal injuries, which can be easily accessed via celiotomy, the management of penetrating cardiothoracic injuries requires accurate judgment when selecting the best approach to the injury. A median sternotomy is the incision of choice in patients admitted with penetrating cardiac wounds that may harbor an occult or non-hemodynamically compromising cardiac injuries\(^6\). This provides better exposure to all parts of the heart and is convenient if a cardiopulmonary bypass is needed. This incision also causes less postoperative pain and respiratory dysfunction than a thoracotomy. However, it gives poor access to the back of the heart. A left anterolateral thoracotomy is the incision of choice for the management of patients with penetrating cardiac injuries that arrive in extremis\(^6\). This incision is most often used in the emergency department for resuscitative purposes. It is also the incision of choice in patients undergoing celiotomy who deteriorate secondary to unsuspected cardiac injuries. The left anterolateral thoracotomy can be extended across the sternum as a bilateral anterolateral thoracotomy if the patient’s injuries extend into the right hemithoracic cavity\(^7\). This approach is the incision of choice in a patient who is hemodynamically unstable or suffering from injuries that have traversed the mediastinum. This incision allows full exposure of the anterior mediastinum and both hemithoracic cavities.

After thoracotomy or sternotomy, the pericardium should be opened and the heart should be made visible. This should relieve tamponade, if present and allows digital control of the ventricle wound. If the injury is quite large, a urinary catheter can be inserted through the defect and the balloon filled with enough fluid to control most of the bleeding. However, if the balloon is overfilled, the chamber volume and cardiac output may be compromised. In atrial and caval injuries, a side-biting vascular clamp can be used to control bleeding during repair. It is very important that direct repair of ventricle wounds is not carried out. Ventricular wounds are best sutured with interrupted pledgeded mattres. Fortunately, there were no coronary artery, valve or large vessel injuries in our case. After opening the pericardium, a urinary catheter was inserted via the LV penetrating wound and fill with adequate fluid. The patient’s vital signs began to improve after the bleeding was controlled and we were able to repair the heart without any problems.
Dr. Karmy-Jones suggested that vein grafting with a cardiopulmonary bypass should be performed in cases where the injuries are associated with the proximal major coronary arteries or if there is evidence of significant myocardial ischemia. Cardiopulmonary bypass is extremely helpful when used for rewarming and for reversing acute metabolic deficits. Although the urgency of the situation did not permit the use of the heart-lung machine, he reports that mortality ought to be reduced if a cardiopulmonary bypass was employed.

*Volume restoration should proceed simultaneously with surgical intervention, preferably using whole blood or packed red blood cells. Internal cardiac compressions should be performed if the heart is not beating and arrhythmia should be treated with internal defibrillation and medication.*

Complications are common and may occur immediately. The most common immediate complications are respiratory in nature, such as atelectasis, residual pneumothorax, pneumonia, empyema, residual hemothorax and lung abscess. Multiple organ dysfunction related to hemorrhagic shock may also occur. In the present case, the patient developed acute tubular necrosis with polyuria and transient hyperamylasemia. These were reversed by adequate supportive treatment. Cardiac function complications may also occur and usually present late with the most delayed complication reported being a ventricular septal defect (VSD) by Dr. Tesinsky.

The mortality rate for penetrating cardiac injuries varies widely and values from 19% to 65% have been reported. Factors that are predictive of a poor outcome in terms of pre-hospital factors were reported by Dr. Asensio. They include the absence of vital signs, fixed and dilated pupils, the absence of cardiac rhythm, the absence of a palpable pulse and the absence of any motion in the extremities. Dr. Tyburski reported that patients with intrapericardial great vessel injuries or multiple chamber wounds have a lower survival rate than those with a single-chamber wound. In patients with stab wounds, those with cardiac tamponade have a better outcome than those without tamponade.

**Conclusions**

Penetrating cardiac injuries are relatively rare but have a very high mortality rate. The key to successful management of a penetrating cardiac injury is early diagnosis and emergency surgical intervention. Echocardiography can decrease the time needed to establish a diagnosis of penetrating cardiac injury, which is very useful. It has high accuracy, specificity and sensitivity when detecting a penetrating cardiac injury; furthermore it is also an easy and noninvasive method. A left anterolateral thoracotomy should always be performed on patients who are hemodynamically unstable. This incision is most often used in emergency departments for resuscitative purposes. A median sternotomy is the incision of choice in patients with some degree of hemodynamic stability. Penetrating cardiac injuries are often lethal and have a poor prognosis; therefore doctors need to have a high level of suspicion with such injuries, which need to be treated aggressively with resuscitation, early diagnosis and early surgical repair.

**References**


區域醫院成功治療心臟穿刺傷—病例報告

張文演  許正義  張一方  趙家聲  張光瑞

心臟穿刺傷是個少見但死亡率極高的疾病，受到心胸穿刺傷的病人大部份於到急診室前已死亡，治療心臟穿刺傷需要快速的診斷及立即的手術治療。我們報告一個成功治療左心穿刺傷的個案。一位36歲女性受到左胸穿刺傷合併低血容量休克，她接受了立即的左前胸開胸手術修補心臓穿刺傷且未經體外循環，術後除了短暫的急性腎衰竭且於兩週恢復正常外，其他情況恢復良好且於住院第17天出院。

關鍵詞：心臓，尖刺傷