CASE REPORT

PENETRATING CARDIAC INJURY

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ABSTRACT

Management of penetrating cardiac injuries continues to be a challenge despite considerable improvement in healthcare facilities. The patient who reaches the hospital alive is usually in agony. The key to good outcome is prompt recognition of injuries, urgent surgical intervention and intensely monitored post-operative care. In patients with recent or impending cardiac arrest, resuscitative thoracotomy in emergency room is the only hope for survival. The poor outcome generally ascribed to the procedure is related to the cardiac injury itself. We report the management of a patient whose heart was lacerated by a motorized saw. This patient went into cardiac arrest upon arrival in emergency room. Resuscitative thoracotomy was performed in emergency room and his right ventricle was repaired successfully. The patient survived but suffered from ischaemic cerebral encephalopathy. The purpose of reporting this case is to highlight the role of early resuscitative thoracotomy in patients with impending or recent cardiac arrest due to penetrating cardiac trauma. The reported low survival should not deter the surgeon from attempting this procedure which can be life saving in a selected group of patients.

Key words: Penetrating cardiac injury, Cardiac tamponade, Thoracotomy.

INTRODUCTION

Penetrating injuries to the heart have been described in manuscripts as old as three thousand BC.[1,2,3] These injuries were considered universally fatal till about a century back when first successful repair of the right ventricle was performed in 1896 by Rehen in Frankfurt, Germany.[4] Considerable improvement in the management has been made since then, however these injuries are still challenging and demand prompt recognition and urgent surgical intervention.[5, 6] Cardiopulmonary bypass is not required in most of these patients and management can be conducted in emergency room (ER) by any experienced General or Trauma surgeon with usual instruments.[7] We report the management of a patient who sustained extensive laceration of anterior chest wall and right ventricle with a motorized stone cutting saw at work.

CASE HISTORY

A thirty years old man was brought to ER of Najran General Hospital on 23/9/1426 approximately 20 minutes after sustaining severe injury to the anterior chest wall by a stone cutting saw. On arrival he was combative with vigorous body movements. The blood pressure was not recordable. Soon after arrival he went into cardiac arrest. A large transverse laceration was found on the anterior chest wall just below the left nipple dividing the sternum and left costal cartilages along with soft tissues. Trauma resuscitation protocol was instituted immediately and external cardiac massage was started along with endotracheal intubation and controlled ventilation. Location and depth of the wound suggested a very high probability of cardiac injury so decision to perform thoracotomy in ER was taken. Chest was opened through left anterolateral incision, which was extended across the midline incorporating the trauma wound. Exploration revealed bluish and tense pericardium with a laceration occluded by a clot. This opening in the pericardium was enlarged vertically and about 200 ml of clotted blood was removed and internal cardiac massage started. As the heart began to contract a jet of blood was seen coming through a hole in the right ventricle (RV). Left index finger was introduced into this hole. After this a purse-string suture was applied to the RV muscle around the introduced finger which was withdrawn gradually while tightening the suture. Internal cardiac massage was continued along with digital compression of descending thoracic aorta with the right hand. This maneuver resulted in regular contractions of the heart and the rhythm became normal. Three horizontal mattress sutures were then applied in this wound and purse string suture was removed. Injury to proximal coronary arteries, other chambers, major vessels and other intrathoracic structures were excluded. The pericardial rent was

closed over a soft drain with two interrupted sutures leaving a window towards the pleura. Both left and right internal mammary arteries were ligated. Large bore tubes were put in both pleural cavities and chest was closed in layers. The patient was shifted to ICU. For initial 48 hours he required inotropic support for hemodynamic stability but cardiac rhythm remained normal. Postoperative echocardiography did not reveal any valvular and septal injuries or pericardial collection. Hepatic and renal functions were also normal. Attempts to wean him off the ventilator were unsuccessful for two weeks and required tracheostomy. The EEG and CT scan of brain suggested cerebral anoxic injury. After being weaned off, he was shifted to Medical ward for nursing care. He remained in vegetative state with vital organs functioning normally.

DISCUSSION

Penetrating injuries to the heart are usually caused by stabs or firearms. Less common causes are road traffic accidents, impalements and iatrogenic injuries.[5,8] Industrial and occupational causes are rare and to our knowledge this is the first reported case reaching the hospital alive after saw injury to the heart. Right ventricle is the most commonly affected chamber followed by the right atrium because of the anterior location. Injuries to the left sided chambers are less common.[3,8-10] In our patient, there was a large laceration at the level of 5th costal cartilage, damaging the anterior chest wall, sternum and right ventricle. Penetrating cardiac injuries may be isolated or associated with other injuries to the chest or other parts of the body. Rarely some penetrating injuries to the heart are complex when coronaries, valves, septum or multiple chambers are injured. These complex injuries are difficult to manage and require cardiopulmonary bypass.[7]

Cardiac injury should be suspected in any patient with a wound on the anterior chest wall between the nipples. These patients may be hemodynamically stable but more often present with shock or in agony with impending cardiac arrest.[5,11,12] After initial resuscitation further management is according to the clinical status. Stable patients allow time for investigations and exact documentation of injuries. Urgent Chest radiograph, ECG and echocardiography should be performed in all these cases.[13] These patients should be operated through median sternotomy in well-equipped operating room preferably with the availability of cardiopulmonary bypass.[5] In equivocal cases there is a role for pericardial window.[14] A point of note is the impalement injuries with foreign bodies still stuck in the chest. These foreign bodies should never be removed in ER.[15] These patients should be shifted to operating room and chest opened through any suitable incision which must not cause any movement of the foreign body. After complete exposure of the heart the foreign body should be removed under direct vision.[16,17]

Priorities are different in patients presenting with shock.[11] This shock may be hypovolumic when bleeding from the heart is free into the pleural cavity, however these patients exsanguinate at the scene and rarely reach the hospital alive. More often the shock is of obstructive type due to cardiac tamponade when wound in the pericardium is smaller than the cardiac wound and becomes occluded with clotted blood. This raises the intrapericardial pressure, compresses the right atrium and right ventricle thus interfering with cardiac filling and cardiac output leading to cardiac arrest.[18] Beck's triad of hypotension, distended neck veins and muffled heart sounds may be found in some of these cases. Cardiac tamponade has advantages and disadvantages.[19,20] Initially it prevents exsanguination from free bleeding into the pleural cavity thus providing chance for the patient to reach the hospital alive. Later on, it interferes with venous return causing subsequent cardiac arrest. Echocardiography may be performed in ER if the patient condition permits.[21] The patient should preferably be shifted to operating room. Median sternotomy is the incision of choice for exploration but left anterolateral thoracotomy can be employed if speedy exposure is required.[22] In deteriorating patients with high suspicion of cardiac tamponade pericardiocentesis is a time gap procedure.[23]

In patients with impending cardiac arrest and strong suspicion of cardiac injury that does not improve with pericardiocentesis or patients already in arrest with warm body and reactive pupils, ER thoracotomy should be urgently performed. Left anterolateral incision which can be extended to the right by dividing the sternum is the incision of choice.[24-26] We employed the same incision which gave adequate exposure without rib retractors. Pericardium should be evacuated of the clot followed by initiation of internal cardiac massage. Arrest of hemorrhage is the next immediate step when cardiac activity starts. Atrial wounds are controlled by special Satinsky clamps and repair can be performed with through and through continuous sutures. If the clamp is not available a Foley's catheter can be introduced and balloon inflated to plug the hole.[4] Ventricular wounds are controlled digitally and repaired with horizontal mattress sutures avoiding the coronary arteries. We employed the same method. Control at base of the heart as described by Sauerbruch is difficult and not tolerated for more than three minutes.[4]

When injury to the coronary arteries is identified proximally, cardiopulmonary bypass is mandatory to repair the vessel urgently.[27] Valvular and septal injuries also require cardiopulmonary bypass.[4] If cardiopulmonary bypass is not available, wound in the heart should be closed to prevent exsanguination and the patient should be transported to a cardiac surgery centre. Distal injury of the coronary vessels can be ligated.[27]

Cross clamping of thoracic aorta in resuscitative thoracotomy is beneficial and delivers more blood to the coronaries and cerebral arteries.[24- 26] If cross clamp is not available, digital pressure can be helpful.[29] In our patient digital compression was maintained over thoracic aorta for 6-8 minutes after cardiac activity started. After repair of the cardiac wound other injuries in the vicinity should be excluded. In bilateral anterolateral thoracotomy both internal mammary arteries need ligature.

These patients require intensely monitored postoperative care. Low cardiac output and hypotension are usual and often require inotropic support for variable duration.[5] Cerebral anoxic encephalopathy is the common complication after ER thoracotomy.[24-26] Our patient developed this tragic complication. We attribute it to cerebral hypo-perfusion due to cardiac tamponade and subsequent arrest. Anoxic brain damage can occur in up to 85% of patients after otherwise successful cardiopulmonary resuscitation for in-hospital arrest.[30] Pre-arrest hypotension is among the important determinants of the outcome. Re-perfusion cerebral injury after resuscitation has recently been described as the contributing cause of this complication.[31]

Although considerable improvement in survival has been reported in recent years, penetrating injuries to the heart continue to be a great challenge for trauma and cardiac surgeons. The key to good outcome is rapid transport to the appropriate health care facility, prompt recognition, urgent intervention and optimum post-operative management.[18] The concept of ER thoracotomy in recent years has contributed much to the salvage of these critically injured patients. It is a useful procedure and can save 10-15% of the patients with recent cardiac arrest and reactive pupils.[4] This relatively poor outcome should not deter the surgeon to perform the procedure. In a vertical health care system the surgeon on call cannot reach the ER in less than ten minutes. These ten minutes are vital determinants of the outcome in such patients. Round the clock availability of persons trained in handling such situations in ER is desirable.

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