

# Impalement Injury to The Heart

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## INTRODUCTION

In impalement injuries, a large elongated foreign body penetrates a body cavity or extremity in a through and through fashion and transfixes the structures it traverses. These combine aspects of both, blunt and penetrating trauma and have a substantial operative mortality. Penetrating injuries to the heart have been described as early as 3000 BC in the Edwin Smith papyrus.<sup>1, 2, 3</sup> The first successful repair of a penetrating cardiac injury was documented in 1897 when Rehn sutured a bleeding right ventricle in a young man after he was stabbed in the chest.<sup>4</sup> Unlike cuts to the heart, impaling injuries are almost always fatal, and seldom reach a place of care. The management of such patients is challenging despite the advances in cardiac surgery and emergency care. We report a successful management of a patient with an impalement injury to the heart.

## ABSTRACT

Cardiac impalement injury is rare and one of the most severe penetrating chest injuries, often fatal. The management of penetrating cardiac injuries is a challenging one. The success in management of impaling cardiac trauma requires stabilization of the impaling object, expeditious transfer to a facility for open heart surgery, rapid imaging, access to blood and blood products and a ready surgical team. We report a case of impalement injury to the heart by a stick, transfixing the right ventricle and its successful treatment.

## KEY WORDS

*Impalement injury, Penetrating cardiac injury, Cardiac injury, Cardiac impalement*

## CASE REPORT

A 56 year lady presented to the emergency room after 8 hours of sustaining a fall injury. The patient was sitting by the side of a narrow hilly trail when she slipped and fell a few feet down the slope to land on an upright wooden stick. The stick penetrated her left upper chest in the front. She had bled little from the injury site, and had not sustained any other injury. The wound had been dressed at a local health center and she had been promptly transferred to our hospital in an ambulance.

At presentation, she was alert, hemodynamically stable and only complained of mild pain at the entry site. The external end of the stick, protruding from the chest, was secured with adhesive dressing (Fig. 1) in the emergency room. The location, direction and the 'pulsatile' movement of the stick indicated that the stick traversed the mediastinum, possibly even the heart. Thus the patient was quickly taken for a Contrast-enhanced CT scan of chest and upper abdomen (Fig. 2). The CT scan revealed that she had left hemothorax, contused left lung and a radiolucent round shadow within



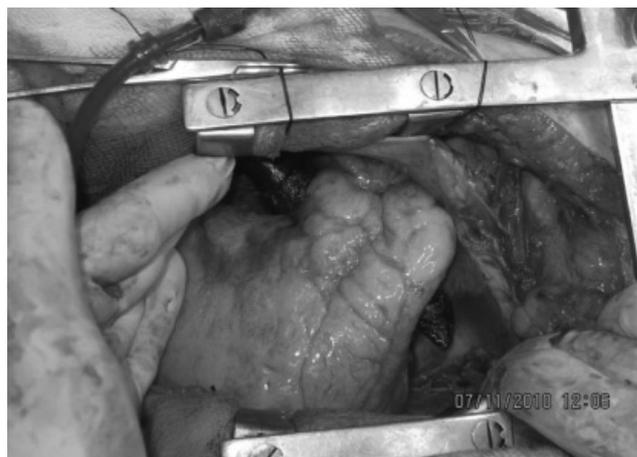
**Figure 1.** Impaling stick secured by bulky bandage

the right ventricle just adjacent to the interventricular septum. The stick that traversed the left anterior chest had impaled the right ventricle and caused a small contusion at the diaphragmatic surface of the right liver. The patient was shifted to operation theatre from the CT, with preparations for cardiopulmonary bypass (CPB). A central venous catheter; wide bore peripheral venous access and a left radial arterial pressure monitoring lines were placed. She received tetanus toxoid, ceftriaxone, metronidazole and amikacin preoperatively.

She was intubated with a single lumen endotracheal tube. Femoral artery and vein were cannulated after heparinization and she was put on cardio-pulmonary bypass, as a sternotomy could displace the wooden stick and destabilize the patient. The chest was opened via median sternotomy and antegrade cardioplegic cardiac arrest was done. A liter of blood was drained from the left pleural cavity. The stick was seen entering the chest at the second left intercostal space, at the midclavicular line, piercing the pleura and passing between the upper and lower lobes of the lung, penetrating the left side of the pericardium. It then passed through the anterior wall of the right ventricle (RV) just right of the left anterior descending artery (LAD) at its mid-segment, then through the RV cavity to exit at its diaphragmatic surface. The tip of the stick had made a rent in the diaphragmatic pericardium to finally abut on the superior surface of liver. (Fig. 3) There was no gross injury to the liver.



**Figure 2.** Contrast CT of chest. Hemothorax, contused lung, radiolucent round shadow within the right ventricle. Note the pneumopericardium.

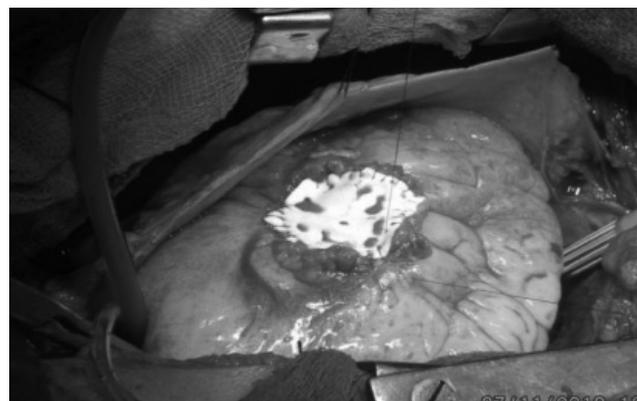


**Figure 3.** Per-operative picture of the stick transfixing the heart. Note the sharpened end over the contused diaphragmatic pericardium.

After cardiac arrest, the 32 cm wooden stick was removed. RV cavity was thoroughly washed and margins freshened. The anterior injury was repaired with Gore-Tex patch, using horizontal mattress sutures to pass beneath the left anterior descending artery. (Fig. 4) The posterior exit injury was closed primarily with stitches buttressed with Gore-Tex strips. The laceration in the diaphragm was repaired primarily after refreshing the edges. After hemostasis and thorough irrigation, she was weaned off the cardiopulmonary bypass and decannulated uneventfully in standard fashion. Temporary ventricular epicardial pacing wire, Mediastinal and pleural drains were placed. Sternotomy and femoral vessel access site were closed in the usual fashion. The entry wound was loosely closed after debridement.

The immediate post-operative course was uneventful, with overnight ventilatory support. She was on dopamine infusion in the immediate post-operative period and was weaned down due to her stable vital signs. After 4 days of recovery in the ICU, she was transferred to the surgical ward. The entrance wound got infected and was debrided and closed secondarily on the 12<sup>th</sup> postoperative day with no sequelae. The patient was finally discharged home on the 15<sup>th</sup> postoperative day.

She is leading a normal life now and on a regular follow up.



**Figure 4.** Repair of the anterior wall defect with PTFE patch

## DISCUSSION

A vast majority of penetrating cardiac injuries are caused by stabs or firearms, with only a few caused by road traffic accidents and impalement. Impalement injuries to chest are uncommon with few reports in the literature. Mediastinal impalement injuries are quite rare and often fatal, as it is very improbable that such injuries would have avoided a major structure. Survival from impalement injuries to the heart is even rarer. Among all penetrating cardiac injuries, right ventricle alone is involved in 35% of the patients reaching the hospital. Left ventricle alone is involved in 25% of them. In 30% of the patients, more than one cardiac chamber is injured.<sup>5</sup> These injuries can occur alone or in combination with other injuries to pleura, lung, mediastinal structures or abdominal organs.<sup>6</sup> Cardiac injuries are called complex when they involve coronary arteries, valves, septum or multiple chambers.

When a patient presents with a penetrating wound to the chest in a location and direction that could involve the heart, it must be assumed that a penetrating wound of the heart exists. Most of the penetrating cardiac injuries result in cardiac tamponade, exsanguinating hemorrhage or malignant arrhythmias, all potentially fatal. Most patients present in shock, and require urgent resuscitation and access to surgery. Stable patients allow time for investigations. Probably the most important point in impalement injuries is that the impaling object must not be manipulated or removed (not until the pericardium is opened); rather well padded and stabilized.<sup>7</sup> We attribute this “masterly inactivity” on part of the initial attendant that played a vital role in saving this patient's life. The analysis of Rhee P.M. showed a lower hospital survival rate for areas with well structured pre-hospital care and is probably related to more grievously injured patients being transported in.<sup>8</sup> Despite the review, amongst patients with suspected cardiac injury, the aphorism of “scoop and go” still holds the best chance of survival.<sup>9</sup>

Chest X-ray, ECG, trans-thoracic echo (preferably trans-esophageal) or CT scan (as in our patient) are the usual modes of investigation in stable patients, although impalement is in itself a clinical diagnosis. In the future, evaluation of stable mediastinal penetrating trauma victims may be reduced to a solitary evaluation with a rapid multidetector CT scan, cutting short the evaluation time.<sup>10</sup>

The present case is a unique one, in that such a grievous injury left the patient hemodynamically stable. We think following factors contributed to the successful management of this patient: natural selection, proper handling by the primary attendants, prompt transfer to appropriate center, rapid work-up, prompt surgery with use of femoral vessels for CPB and intensive postoperative care.

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