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UTILITY OF MEDIAN STERNOTOMY IN PENETRATING CHEST TRAUMA

Surgery

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ABSTRACT

Penetrating injuries to the "cardiac box" are amongst the most lethal traumatic injuries with an estimated 6% of the patients arriving to the hospital alive[1]. We report the benign presentation of a 79 year-old female with penetrating injury to the cardiac box. Post-operative course was unremarkable. In this report, we discuss the surgical implications of penetrating injury to the cardiac box.

KEYWORDS

Cardiac box, Penetrating Chest Trauma (PCT)

INTRODUCTION

Penetrating thoracic injuries to the cardiac box represent a group of high mortality and high-morbidity traumatic injuries, with most patients dying before making it to a trauma center[2, 3]. Cardiac box is defined anatomically as the area within the borders described as: cephalad borders are the clavicles, lateral border is the mid clavicular line on either side and the caudal border is the costal margin. Most injuries to the "cardiac box" are associated with injuries to vital organs, with damage to the heart accounting for 80%[4], which carries a mortality rate of 80%[5].Clinical presentation is variable, ranging from hemodynamic stable patients, to patients in cardiac arrest. Hemodynamically stable patients with penetrating injury to "cardiac box" are rare, thus representing a small select group with favorable post-operative outcome[6, 7]. We discuss a rare case of a hemodynamically stable patient with penetrating trauma to "cardiac box".

A 79 year-old female with a history of bipolar disorder and schizophreniais brought in by emergency medical services after stabbing herself in the left chest with a 20cm kitchen knife. The knife handle was visible at the 4th rib inter-space in the left para-sternal line. The patient's sole complaint was chest pain and denied additional symptoms. On examination, the patient was agitated, but awake, alert, and hemodynamically stable throughout her pre-surgical course. Initial vital signs were: Heart rate 101, Blood pressure 175/89, Respiratory Rate 18, Temperature97 F, O_2 saturation 94%. Primary survey revealed bilateral breath sounds. The knife handle oscillated in sync to the patient's heart rate. Secondary survey was negative for additional injuries. FAST exam revealed small pericardial effusion. Chest X-Ray was remarkable for theknife overlying the left lower hemithorax in the region of the heart, without a pleural effusion or pneumothorax (Fig 1).

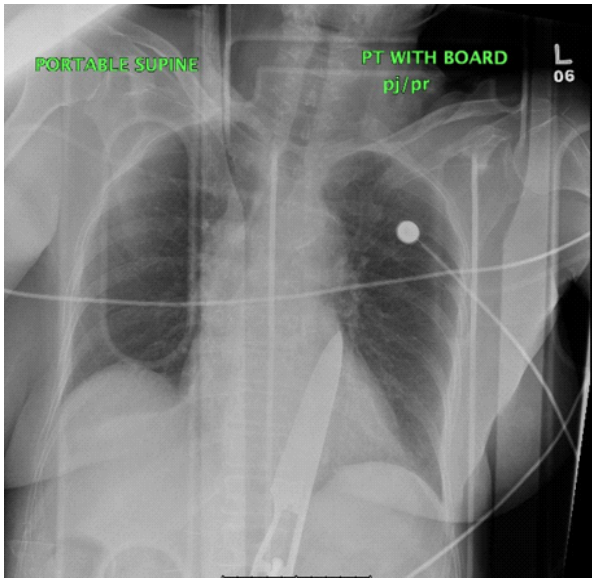

Fig. 1 Chest X-ray showing stab wound with a knife overlying the left lower hemithorax in the region of the heart

The patient was taken to the operating room, where she was urgently explored via a median sternotomy (Figure 2). The sternum was carefully retracted manually to avoid manipulation of the knife. The left pleura was opened revealing the course of the knife through the pericardial space, with the knife tip seen anterior to pulmonary artery and posterior to aorta. The knife was carefully withdrawn and further inspection revealed a small left hemo-thorax, which was evacuated. The mediastinum was again inspected, revealing no injuries other than the laceration to the pericardium. The pericardium was partially re-approximated. Three chest tubes were placed in the left pleural space, pericardial space, and anterior mediastinum. The sternum was re-approximated using sternal wires. The entrance of the stab wound was packed with iodoform gauze. The patient was then transported to the surgical intensive care unit in stable condition.

Fig 2. Median Sternotomy illustrating opening of the pericardial sac with the knife in situ.

DISCUSSION

Management of penetrating injury the "cardiac box" include both conservative as well as surgical management (Fig 3). A large number of penetrating chest trauma can safely be managed non-operatively, however, injuries to the "cardiac box" should raise concern for damage to vitals structures. Thus, evaluation and management depends on the clinical presentation of the patient. Immediate thoracotomy is indicated for all patients in imminent cardiac arrest or cardiac arrest. The hemodynamically unstable patient should undergo immediate chest radiography for localization of the object and FAST (focused abdominal sonogram for trauma) examination for evaluation of pericardial effusion, if time permits, prior to surgical intervention.

Assessment of the hemodynamically stable patient with penetrating injury to the cardiac box, especially in the setting of negative imaging, can be difficult and warrants a high index of suspicion for rapid diagnosis and appropriate intervention. Because delay in recognizing injury to vital structures within the "cardiac box" is associated with higher morbidity and mortality, the patient needs high-quality imaging

to investigate the extent of injury.8 Thus, appropriate management depends on the findings of a contrast material–enhanced chest CT9 whose findings may prompt further evaluation (e.g. angiography or endoscopy) or conservative management or immediate surgery (Fig 3). Of note with objects being impaled in this area, especially if they are metallic the yield of CT may be limited due to scatter and the risk of dislodging the impaled object inadvertently. With immediate surgery, median sternotomy affords the best functional approach to the heart. While it does take more time as compared to the thoracotomy, the enhanced visualization of the heart in a hemodynamically stable patient makes the median sternotomy the approach of choice.

Despite the benign presentation, our patient required surgical intervention for safe removal of the impaled knife, as well as further assessment of the surrounding vital structure such as the bronchial trees and the great vessels. Fortunately, the knife missed all vital structures and our patient's post-operative course was uneventful. This is the first case, to our knowledge, where penetrating injury to the "cardiac box" resulted in no injury to vital structures. There, irrespective of clinical presentation, time and keen clinical judgement are crucial in the diagnosis and intervention of penetrating injury to the "cardiac box" for improved patient outcome.

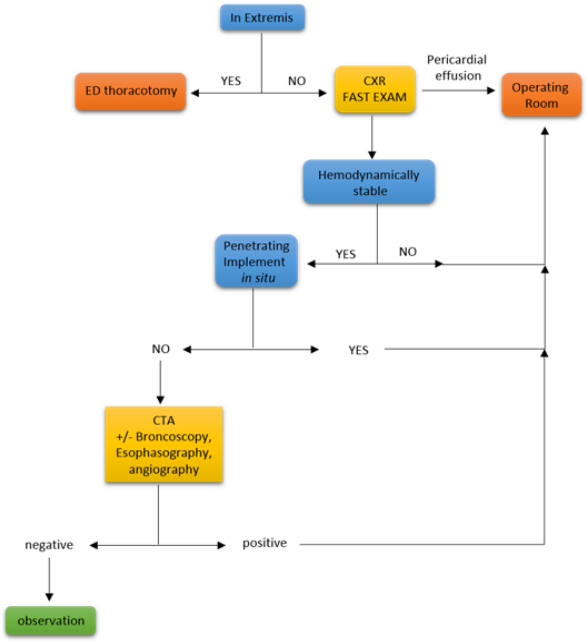

Fig 3. Chart illustrates an algorithm for the initial evaluation of patients with penetrating injury to the cardiac box. Abbreviations: ED= emergency department, CXR= chest x-ray, FAST = focused abdominal sonogram for trauma, CTA= computed tomographic angiogram]

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