



## Case Report

## Thoracic impalement injury: A survivor with large metallic object in-situ

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## ARTICLE INFO

## Article history:

Received 13 March 2018

Received in revised form

12 May 2018

Accepted 11 June 2018

Available online 20 September 2018

## Keywords:

Impalement

Injury

Thoracic

Metallic object

Traffic accident

Sequela

## ABSTRACT

Impalement injuries, is a severe form of trauma, which are not common in civilian life. These injuries rarely occurs in major accidents. Abdomen, chest, limbs and perineum are often involved due to their large surface area. Thoracic impalement injury is usually a fatal injury, due to location of major vessels and heart in the thoracic cavity. These injuries are horrifying to site, but the patients who are lucky enough to make it to hospital, usually survive. Chances of survival are larger in right sided impalement injuries while central injuries are always died at the scene.

Our patient, 25 years old male, was brought to the emergency room (ER) with large impaled metallic bar (about 2.5 feet long) in situ, in right sided chest. The patient was immediately shifted to operation room (OR) and was operated, his recovery was uneventful without any sequelae.

Such patients should be treated and resuscitated according to advanced trauma life support (ATLS) protocols and operated without any delay for further investigations. Such operations are carried out by the most experienced surgeon team available. The impaled objects should not be processed if not necessary to avoid major hemorrhage and damage to vital structures, until the patient is in operation room. Large size and unusual position of impaled objects, makes the job difficult for surgeons/anesthetists.

Although horrifying at scene, patients with thoracic impalement injuries are mostly young and healthy, and those who survive the pre-hospital phase are potentially manageable with proper resuscitation. Usually these patients make recovery without any further complications.

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## Introduction

Road traffic accidents (RTAs) cause 1.3 million deaths and 20 to 50 million non-fatal injuries each year all over the world, which exacerbated the global disability and aggravated the burden of health costs.<sup>1</sup> The incidence of penetrating thoracic trauma varies geographically with as low as 4% in Europe<sup>2</sup> due to better awareness of traffic laws.

Patients suffering RTAs usually present with a spectrum of injuries, including impalements, rib fractures, sternal fractures and thoracic wall lacerations.

Impalement injuries are defined as large objects or foreign bodies, commonly steel bar or wooden object, piercing through in a body cavity or extremity and still in place.<sup>3</sup> These are a form of severe injury and can be fatal mostly. These injuries often occur in

road traffic accidents, aircraft crashes and other accidents happened at concrete construction sites, which lead to tissue destruction by both blunt and penetrating trauma.

Many patients sustaining major intra-thoracic injuries died at the scene, while those survivors need to transfer rapidly to a major hospital with appropriate facilities and team effort to save their lives. Impalement injuries make rare, but horrifying, appearances at trauma centers. There are only few cases reported that the patients with impalement injuries recovered without any sequelae.<sup>4</sup> In this article, we report a case that a patient with a right-sided thoracic impalement injury caused by a large metallic object in a road traffic accident successfully managed by team effort.

The study was performed in accordance with the Helsinki Declaration and Good Clinical Practice.

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Peer review under responsibility of Daping Hospital and the Research Institute of Surgery of the Third Military Medical University.

## Case report

A 25-year-old male send to emergency department (ED) due to thoracic impalement injury caused by a metallic bar. He crashed into a lorry from behind in high speed when he was driving a motor car. As a result, his car wind screen was broken, a blunt iron bar from the lorry pierced through his upper sternum and came out from posterior aspect of right thorax, below and lateral to tip of right scapula. The patient was stuck at the accident scene for almost an hour with severe pain and mild continuous bleeding. He was separated from damaged vehicle by rescue workers after cutting the metallic bar off the lorry and was brought to hospital with in-situ foreign body. During pre-hospital phase, he received IV fluids resuscitation with 18 g cannula and analgesics.

The patient was conscious when he arrived at emergency room (ER), was having mild tachypnea and agonizing with pain. His pulse was 125 beats per minute, blood pressure (BP) was 100/60 mm Hg, respiratory rate (RR) was 35/min, Glasgow coma scale (GCS) was 15/15 and SpO<sub>2</sub> of 92%. Patient was in grade-II hypovolemic shock. There was no past significant medical history. Immediate resuscitation according to advanced trauma life support (ATLS) protocols was conducted. Broad spectrum antibiotics and tetanus immunization was given and right sided tube thoracostomy was done, which caused around 1800 ml fresh blood loss.

When an urgent thoracotomy was planned, regional blood bank was informed that a massive blood transfusion was needed. Without any radiological investigation, the patient was transferred to operating room immediately.

With general anesthesia and double lumen endotracheal tube, patient was put in supine position, slightly towards right edge of operating table to adjust the in-situ rod (Figs. 1,2). Complete aseptic



Fig. 2. Metallic bar in-situ, also chest tube in place.

measures were applied to the front and back of the patient as well as the metallic rod in order to prevent from any further contamination. Limited right anterolateral thoracotomy was carried out by a team consisted of 2 general surgeons and a cardiothoracic surgeon, also a senior anesthetist who responsible for anesthesia.

We found this rusted metallic rod pierced the chest wall, fractured the adjacent ribs and pierced the right lung parenchyma lead to continuous bleeding. No major bronchial vessel or bronchus was damaged. The bar was removed under vision after separated from lung parenchyma with the help of linear cutting staplers (Figs. 3,4). Hemostasis was secured and lung parenchyma damage was repaired.



Fig. 1. Patient with in-situ object and tube thoracostomy of right chest.



Fig. 3. Removed metallic bar.



Fig. 4. Intraoperative view of foreign body.

In addition, antibiotics was used in operation. Hemostasis of chest wall was obtained. Thoracic cavity was lavaged with 2 L of warm normal saline. Chest wall closed with non-absorbable prolene-1 sutures and muscles repaired with absorbable Vicryl-1 sutures. Skin closed with skin staplers. With a chest drain left in place, the patient was transferred to ICU, where he had kept for 3 days.

Post-operative chest X-ray showed fully expanded lung with no collection. Chest tube was removed at 4th day after operation. Patient was discharged at 5th day after operation. His follow-up visits were unremarkable and no significant sequelae of the injury were seen.

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

## Discussion

The history of impalement can date back to the Middle Ages, when impalement was used as a punishment against criminals, slaves, political or racial heretics, as a revenge to personal enemies, which caused by different methods such as using long thin sharp poles, bars or ragged objects through different parts of body even through anus.<sup>5</sup> These injuries were common in wars and proved to be fatal, but they are not common these days. Nowadays, these injuries present as a result of falling from height on sharp objects, penetrating low/high velocity object wounds, sexual abuse and torture.<sup>5</sup> Impalement injuries are associated with multiple mechanism like crushing, penetration, tissue loss, wound contamination, major fractures, massive blood loss, which brought great challenge

to surgeons.<sup>6</sup> patients of impalement injuries either die on the spot or they reach hospital with stable vitals.

Impalement injuries have two broad types<sup>7</sup>:

Type I injuries: these injuries are more common, result from impact between moving human body and an immobile object, such as falling on sharp objects, motor vehicle collisions.

Type II injuries: these injuries are opposite to type 1 injuries, occurred as a result of a moving object pierces into immobile human body. Such injuries can be found in assaults, spear and some motor vehicle collisions.

In such cases, in-situ foreign bodies should never be removed at the scene because moving these objects can change the tempo-nading effect of these objects on major vessels or body cavities underlying, which will lead to massive or fatal hemorrhage. It can also make the injury worse by damaging surrounding tissue. In certain cases, sometimes it is unavoidable to cut down the metallic objects in order to remove patients from scene. Most of the patients who have right sided thoracic impalement injuries survived to hospital, because a lower risk of injury to heart and great vessels on that side.<sup>8</sup> There is inadequate data shows a patient who suffered left side impalements only had lung injury.<sup>9</sup> However our patient sustained a right side injury. The suggested protocols for management of impalement injuries are based on limited number case reports that the patients who survived the scene. In view of the unpredictable mechanism and extent of injury, management of such injuries presents a major challenge. Patients who reached the hospital should be considered for immediate surgical exploration by a team of specialists, usually including a cardiothoracic surgeon, anesthetist, gastrointestinal surgeon, orthopedic surgeon and plastic surgeon.<sup>10</sup>

Emergency department staff should always be informed pre-hand by rescuers for special arrangements. Precious time should not be wasted for radiological investigations as it may not be possible due to odd positions of the patients, and movement of the object during these proceedings may cause further damage.<sup>3,4</sup> Keeping in view this vital point, no radiological investigations were done in this patient.

Involved vital structures such as the heart chambers, aorta, pulmonary artery and pulmonary vein may need cardiopulmonary bypass (CPB); hence, the patient should be operated in a cardiac operating room with standby femoro-femoral CPB if available.<sup>11</sup>

This patient was shifted directly from the emergency room to the operating room, where informed team was fully prepared for further management. Anesthesia in such cases is often challenging due to the abnormal position of the patient, need for strict immobilization, requirement of single lung ventilation is other issue.<sup>4,9,10</sup> Our patient however could lie supine but required a change of endotracheal tube to double lumen at later stage after exploration, for repair of lung injury. Although the intraoperative change of the endotracheal tube is potentially a hazardous procedure and should be avoided unless, as in the present case, intubation was easy and so further conversion into double lumen tube was not expected to be difficult. No attempt should be made to remove the impaled object blindly and removal should only be done under direct vision after seeing the object and the structures injured in the thorax.<sup>3,9,10,12–14</sup> In this patient, after anterolateral thoracotomy, the right pleural cavity was opened and the bar was clearly identified and its path and injured structures visualized.

The site of incision for thoracotomy should be decided with considering the path of the object, necessity for extending incision. In this patient, a right anterolateral thoracotomy was chosen.

A multi-discipline team work is essential as the patient may need a gastrointestinal surgeon for gastrointestinal injuries, an orthopedic surgeon for managing bony injuries, and the

cardiothoracic surgeon playing the pivotal leading role. Most of the patients are young, in good health and have fast recovery from the injury as this patient did –full recovery. Often, these wounds associated with a risk of infection and require thorough debridement, broad spectrum antibiotics, special dressings and tetanus prophylaxis.

Though horrifying at scene, most of the patients with thoracic impalement injuries are young and healthy, those who survive the pre-hospital phase are potentially manageable and surgery to remove foreign bodies under vision should not be delayed in a well-equipped operating room.

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