

Case Report**Penetrating Chest Trauma due to High-Velocity Projectile at Workplace****Dr Sarah Al Hinnawi¹, Dr. Ganesh A. Patil²**¹Assistant Professor, ²Registrar Department of Forensic Medicine, H. B. T. Medical College, Juhu, Mumbai,
Corresponding Author: Dr Sarah Al Hinnawi (email: hannawi50@gmail.com)**Abstract:****Background**

Penetrating trauma is that which is caused by a foreign object piercing the skin and damaging the underlying tissues and leading to an open wound. In addition to gunshot wounds (GSWs) and stab wounds, these injuries include other types of impalements as well and can range in severity from superficial punctures to penetration of major body systems including vital organs that may lead to the death of the person. Thoracic lesions are a major aggravating factor in patients with multisystem trauma, accounting for nearly 20% of all deaths of penetrating traumatic origin. However, occupational deaths due to such penetrating trauma are rare.

Case History

We report a case where a part of machinery acted like an unusual projectile leading to devastating chest injuries leading to death. Crime scene examination lead to the reconstruction of the circumstances of death.

Conclusion

This case brings forth the already understood penetrating trauma aspects of wound ballistics that can be used to explain the response of all tissue to penetrating trauma of all types, thereby helping to predict and explain the severity or lack of severity of tissue injury in trauma in general. While there are several cases about penetrating injuries due to unusual projectile foreign bodies, no cases have been discussed in recent literature, to the best of our knowledge. Proper evaluation requires crime scene correlation and comparison of metallic fragment or projectile retrieved at autopsy and machinery and tools from the scene.

Keywords: - penetrating trauma, thoracic injuries, projectile, occupational injuries.**INTRODUCTION:**

Occupational injuries from projectiles are quite common. However, they do not usually cause death as they usually injure the eyes or subcutaneous tissue.¹ There are very few reports of deaths due to penetrating projectile. And among these, penetrating injuries over the chest is even less common. For example, a case was reported of a work-related death due to penetrating chest injury from a piece of metal that broke off from a hydraulic drill press.² Some wounds from projectiles pose a difficulty in diagnosis as such injuries often resemble an atypical gunshot or stab wound. An injury that is caused by a foreign object piercing the skin and damages the underlying tissues, therefore, resulting in an open wound is known as penetrating trauma. The severity of the injury depends on the speed of

penetration.³ A high-velocity projectile can puncture human flesh upon contact and can cause the cavitation injury.

CASE REPORT:

A 29-year-old male construction worker was handling a concrete diamond wire saw to cut the concrete ledge of an under-construction building at a height of about 6 feet. It was not known if it was his first time using the machine or if any protective gear was given to the worker. He collapsed and fell from that height and was brought to the emergency room (casualty) of our hospital. A small size wound was noted on the right side of the abdomen, just below the costal margin of the 8th rib. Resuscitation measures were immediately started but were unsuccessful and he was declared brought dead by the doctor on duty.

Owing to the presence of only a single injury over the chest, his co-workers gave a misleading statement that he first collapsed and then fell on a projecting wooden piece that was present at the construction site. As the death was suspicious and in the course of employment, police were informed, and the body was sent for medicolegal autopsy. A post-mortem was then performed.

Autopsy Findings

The deceased was averagely built and averagely nourished lying in the supine position on the autopsy table. Both eyes and mouth were closed. Post-mortem lividity was present over-dependent parts except for pressure areas. On external examination, there was a single oval penetrating wound present over the epigastric region. It measured 3 cm x 2 cm in size (Fig 1).



Figure 1: External surface of the deceased body showing the penetrating injury in the epigastrium.

The wound track was directed upwards, inwards, and laterally into the chest cavity causing a penetrating injury in underlying subcutaneous and muscular tissue. On dissection, a linear displaced fracture at costal margins of 8th and 9th ribs and then entered the pericardial cavity causing a perforating injury to the apex of the left ventricle and exiting at the left border of the heart involving the epicardium and myocardium of left ventricle (Fig 2).

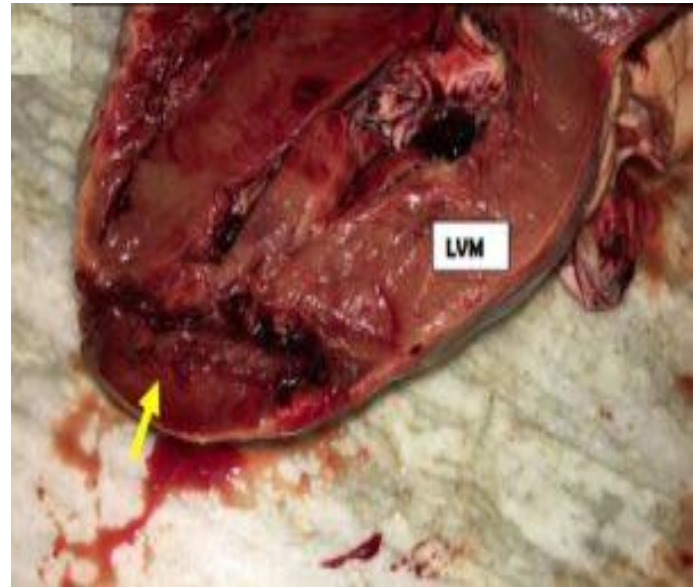


Figure 2. Cavitation injury of the heart involving the left ventricular musculature (single arrow).

Then entering the left pleural causing a penetrating injury to the lower lobe of the left lung at the mediastinal surface. On dissection of the lung, a silver color cylindrical metallic body of length 2 cm and a diameter of 1 cm was recovered from the lung parenchyma (Fig 3).

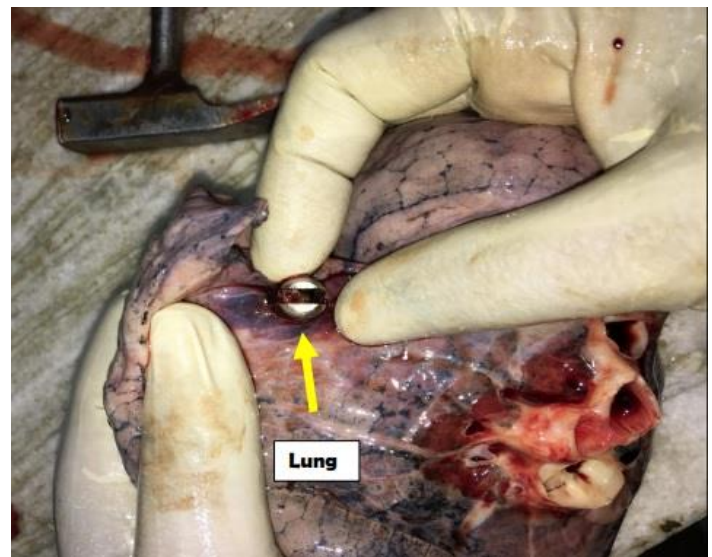


Figure 3. The left lung parenchyma show the foreign body projectile in situ (single arrow).

Hence, it was found that the small metallic projectile had fractured the ribs, lacerated the heart, and got embedded in the left lung (Fig 4).

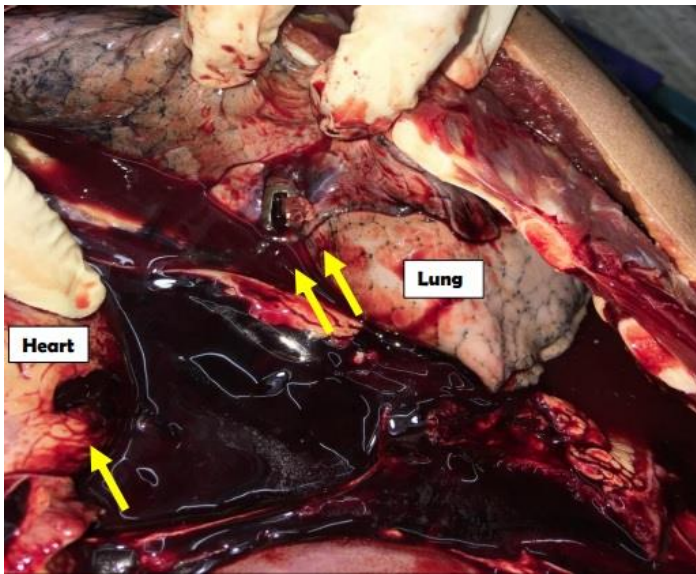


Figure 4. The path of the projectile showing perforating injury to heart (single arrow) and penetrating injury to lung with presence of foreign body embedded in lung (double arrow).

As a result, the left pleural cavity contained 800 cc blood and blood clots and the pericardial cavity was torn and the cavity was filled with 400 ccs of blood and blood clots.

There was no presence of any other external surface injuries. All other organs were pale. Viscera was preserved which is routine in such cases. Blood was preserved for blood grouping and cross-matching. The silver-colored metallic piece was preserved for examination and comparative analysis. Thus, the cause of death based on crime scene visit and post-mortem findings was given as “Shock and hemorrhage due to injury to vital organs”

The autopsy findings were similar to those seen in penetrating gunshot wounds of the chest causing massive soft tissue damage and internal bleeding leading to the death of the person.

Crime Scene Visit

Due to the circumstances surrounding the death and lack of any other external injuries, a crime scene visit was done to review the circumstances of the death. The scene was a typical construction site in the Indian scenario with haphazardly placed construction material and machines. The co-workers present at the construction site lacked any sort of protective equipment and scaffolding was made of bamboo. The

site from which the worker had been working at the time of incidence was examined. The ledge was present at a height of 6 feet. The site where he had fallen was inspected for any projecting tools or equipment and bloodstains. There was none. The alleged wooden projecting piece was present at least 2 feet away from the site on where he had fallen & without any bloodstains, thus ruling it out as an object of offense.

On further scrutiny of the machine with which the worker was working, it was learned that it was a concrete diamond wire cutter. It consisted of two revolving pulleys through which rotated a diamond wire which was joint by 2 connector pieces or mechanical joiners. On examination, the connector piece of the said wire was similar to the foreign object found in the body of the deceased (Fig 5). Also, the corresponding connector piece was missing at the other end of the wire (Fig 5).

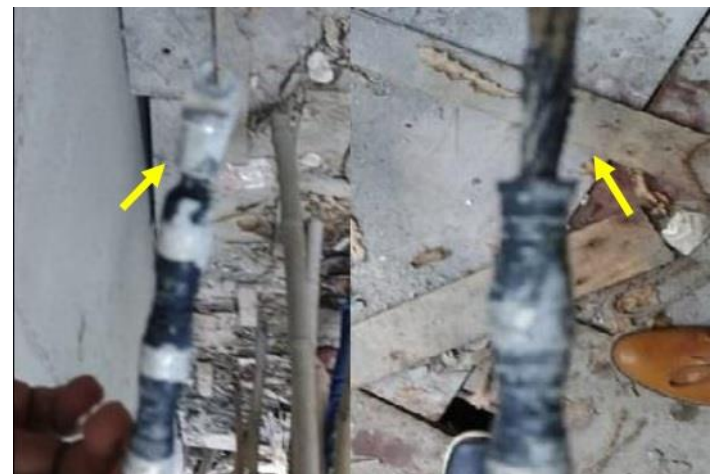


Figure 5. Diamond wire end showing connector piece (Left) and Diamond wire with missing connector piece (Right).

The investigation officer was instructed to send the connector piece from the end of the wire cutter present at the scene for comparative analysis with the foreign object (projectile) recovered from the body of the deceased.

DISCUSSION:

In the present case, we have reported an incidence wherein death was due to a connector piece or mechanical joiner acting like a high-velocity ballistic projectile. The case described here will be

particularly useful to forensic experts while dealing with the autopsy of similar cases. The case highlights unexpected injury and death in the workplace. A diamond wire saw consists of a tension element made from a loop of high tensile wire impregnated with diamond dust joined with a mechanical joiner or connector piece rotating at speed of up to 1300 m/s.⁴ In this case, maintenance of the machine was not done properly, and the joiner or connector was not attached properly, causing the cable to snap and the connector piece to behave like a projectile.

The extent of an injury caused by a projectile causing penetrating trauma is directly proportional to the amount of kinetic energy. A projectile that is passing through the body can wound by only two mechanisms which are crush and stretch. Tissue crush is defined as the crushing of the tissue which is struck by the high-velocity projectile thus, forming the permanent cavity. The tissue is crushed throughout the length of the track of the projectile in penetrating trauma. No matter the wounding potential of the projectile is used, the severity of the wound is also dependent on the tissue or organ struck. Stretching of the tissues will be tolerated variably by different tissues. Therefore, a bullet which is heavier and slower may cause crushing of more tissue but will produce less temporary cavitation. In contrast, a lighter, faster bullet uses up most of its wounding potential to form a larger temporary cavity resulting in a smaller permanent cavity.⁵

Penetrating heart injuries have a high mortality rate. The main causes of death are hypovolemic shock and cardiac tamponade. Survival largely depends on multiple factors like projectile velocity and range, location of the injury, and the structures primarily affected.

Other factors that contributed to the fatal accident are, firstly, that there was no compliance concerning the tools used for joining and attaching the mechanical joiner. Secondly, the operator was not wearing any protective goggle or any safety equipment like jackets, shields, etc. However, we do accept that in such circumstances there may have been

extraordinarily little any safety equipment over the chest to offer any protection.

CONCLUSION

Our case demonstrated that fragments, especially from tools may attain enough velocity and kinetic energy to penetrate the body, causing lethal injury. These wounds are confusing to the autopsy surgeon as they resemble atypical gunshot wounds or may mimic stab wounds. Any foreign body should be recovered from the body along with metallic projectile from the crime scene for comparison which is of paramount importance for determining the proper manner and circumstances of death

Conflict of Interest: none

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CITE THIS ARTICLE:

Sarah Al Hinnawi, Ganesh A. Patil Penetrating Chest Trauma due to High-Velocity Projectile at Workplace. *Int J Med Case Reports.* 2020 Jul 3 (3) 21-24