

CASE REPORT

Pathology/Biology

Fatal penetrating abdominal injury by a metallic projectile

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Abstract

Penetrating abdominal injury is often a life-threatening condition, which is mainly associated with inflicted injuries. Fatal self-inflicted sharp force abdominal injuries too have been reported in the literature. Inadvertent penetrating abdominal injuries are a rarity and are caused by sharp objects of low-velocity and often nonmissile-type. A 27-year-old male factory worker was brought dead to the emergency department with an alleged history of sustaining abdominal injury by a sharp metal projectile while working on a metal cutting grinder. Autopsy observations were consistent with the history of inadvertent penetrating injury. Our case reports a fatal missile-type inadvertent sharp force trauma over the abdomen with intestinal perforation, a relatively uncommon scenario in occupational/workplace settings. The present case report describes the significance of the death scene visit and corroborating the medical findings with investigating agencies. This case further emphasizes on the need for adopting proper safety measures at the workplace.

KEYWORDS

abdominal injury, autopsy, forensic pathology, intestinal perforation, penetrating injury, sharp metal injury

Highlights

- The case reports a rare fatal missile-type inadvertent sharp force trauma to the abdomen at the workplace.
- The case shows the significance of the death scene visit and supporting the medical findings with that of the investigating team.
- The case accentuates the need to take adequate professional training and follow safety protocols to avoid such untoward incidents.

1 | INTRODUCTION

A penetrating wound is an injury caused by direct application of a mechanical force by any foreign object that enters the skin, damages the underlying structures in the penetration path, and results in an open wound [1]. Penetrating abdominal trauma is one of the common causes of mortality and morbidity [2]. The severity of the injury to the organ or tissue depends upon the density of the organ, physical characteristics of the weapon, such as its velocity, size, and

shape [1]. Penetrating abdominal injury is mostly associated with inflicted injury, while inadvertent sharp force trauma to the abdomen is a rarity [3].

Industrial workers are more prone to occupational hazards, which may be due to fire accidents, explosions, fall from a height, high voltage electrocution, slipping, and inadvertent fall of heavy objects [4]. According to the national health profile 2019, nearly 9866 deaths occurred in India due to factory or machine accidents during the period from 2005 to 2015 [5]. We present an unusual

case of missile-type penetrating abdominal injury that occurred inadvertently at the workplace while cutting the stainless steel plates used for making utensils, which lead to the individual's death. Workplace accidents involving penetrating injuries may raise suspicion of assaults. The present case report describes the death scene investigation's significance and corroborates the medical findings with investigating agencies in solving such cases.

2 | CASE REPORT

A 27-year-old male was admitted to the Emergency Department of a tertiary care hospital with an alleged history of penetrating abdominal injury at his workplace while cutting steel plates during early morning hours. The patient was working as a machine operator in a steel factory where stainless steel sheets are cut in different sizes and processed, which are used for making utensils & vessels. The victim at the time of incident was wearing hand rubber gloves, and a protective suit made up of rubber sheet and cloth, weighing about 1.5 kg, with dimensions of about 70 × 44 cm. This suite is vernacularly called "Afreeen." This protective suit was worn by him over the chest and abdomen while cutting the steel sheets. The victim was using a metal cutter machine (4HI SS Rolling mill™) to cut the steel sheets, and as per the information provided by the coworkers, the victim had sustained the injury at around 04:45 am, after which he collapsed and became semiconscious later. The patient was brought to the hospital at around 05:30 am. On clinical examination, the patient was unconscious, unresponsive, asystolic/pulseless; pupils were fixed and dilated. Coils of intestines were seen protruding out from a horizontal wound measuring 1.5 inches & 0.5 inches in length and width, respectively, in the right lower quadrant of the abdomen (Figure 1A). Cardiopulmonary resuscitation was done, but the team was unable to revive the patient. The patient was declared dead and the body was shifted to the mortuary. The

overall interval of time between the injury and the death was about one to two hours.

The autopsy was conducted on the same day. The half-sleeve vest (an undergarment worn underneath the shirt) present over the body had a defect measuring 3.5 × 1.5 cm; 10 cm above the lower border and 43 cm below the neck collar; margins were clean and had bloodstains surrounding it (Figure 1B). On removal of the vest, we observed a penetrating wound of size 2.9 × 1.1 cm × cavity deep present on the right iliac region; 6.5 cm right lateral to the midline, 2 cm above right anterior superior iliac spine with clean cut margins and part of small intestine protruding out from the wound. The wound had acute angles at both ends (Figure 1C). On internal examination, there was a clean cut wound of size 0.6 × 0.2 cm, lumen deep was present on the superior mesenteric artery. There was a collection of 2.6 L of blood in the peritoneal cavity. A triangular metal piece of size 4.6 × 4.3 × 2.2 cm was found in situ in the lower abdominal cavity. The thickness of the foreign body/projectile was 1 mm. The metal piece/projectile was recovered just right lateral to the midline of the body and medially backward and left side to the wound. The projectile was about 10 cm depth from the surface of the skin. The orientation of the projectile was medially backward (Figure 1D). Two perforations measuring 2 and 1.5 cm in diameter were present on the ileum, 118 and 108 cm proximal to the ileocaecal junction, respectively, with clean-cut margins (Figure 2A,B). Another perforation of size 2.5 cm in diameter was present on the ileum, 25 cm proximal to the ileocaecal junction with clean-cut contused margins, and clean cut wound of size 1 × 0.5 cm over surrounding mesentery (Figure 2C).

One perforation of size 5 cm in diameter, mucosal deep was present over caecum near the ileocaecal junction with clean-cut contused margins. One perforation of size 1 cm in diameter was present on the ascending colon, 20 cm distal to the ileocaecal junction with clean-cut contused margins (Figure 2D). The path of penetration of metal projectile was found to be medially and downward.

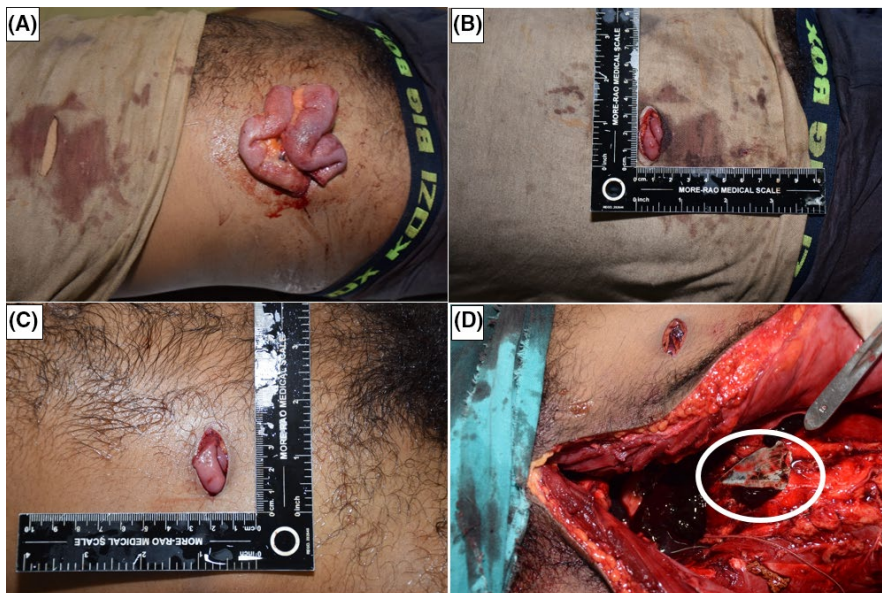


FIGURE 1 (A) A horizontal wound present over the right-side of the lower abdomen with coils of intestines protruded out; (B) Defect over the blood-stained vest corresponding to the injury; (C) Penetrating wound of size 2.9 × 1.1 cm × cavity deep present on right iliac region exposing intestines; and (D) A triangular metal piece in-situ in the lower abdominal cavity (encircled) along with blood clots

FIGURE 2 (A,B) Two perforations of ileum, measuring 2 and 1.5 cm in diameter, 118 and 108 cm proximal to the ileocaecal junction respectively with clean-cut margins; (C) Perforation of ileum of size 2.5 cm in diameter, 25 cm proximal to the ileocaecal junction with clean-cut contused margins; slit of size 1 × 0.5 cm over surrounding mesentery associated with it; and (D) A perforation of ascending colon of size 1 cm in diameter, 20 cm distal to the ileocaecal junction with clean-cut contused margins

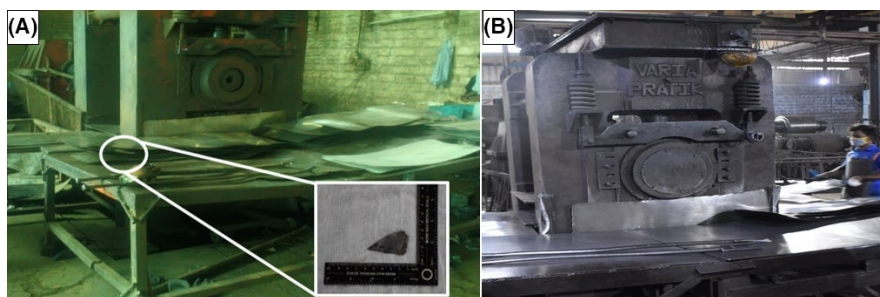
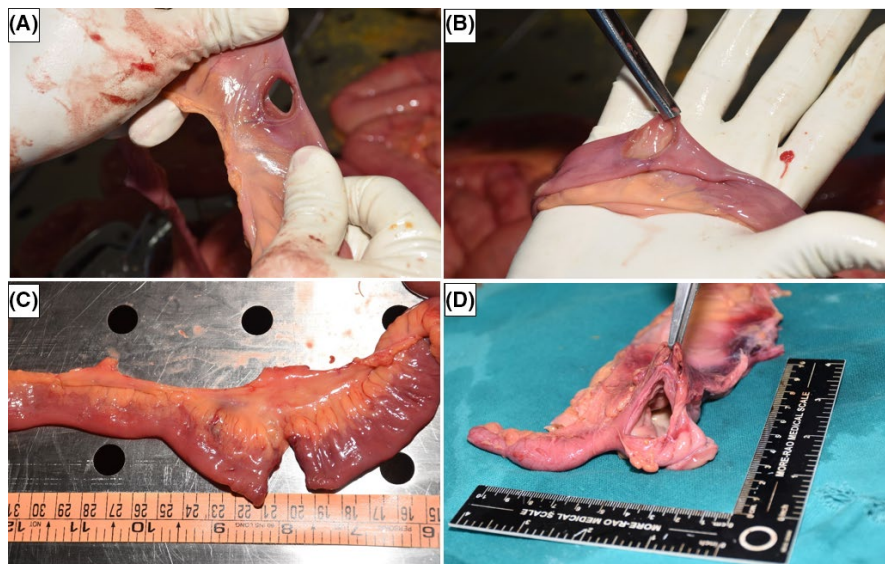


FIGURE 3 (A) Scene of incident where the victim was working on a machine to cut stainless steel sheets. Missing part of the sheet is encircled, and metal piece recovered during autopsy found to be a perfect match as shown in inset; and (B) Shows the metal cutter machine (4HI SS Rolling mill™) on which the victim was working at the time of incident

Abdominal organs appeared pale. The cause of death was opined to be exsanguination due to superior mesenteric artery injury from penetrating sharp force projectile. Further, the metal piece which had pierced the victim was examined at autopsy and was found to be a perfect match with the missing corner part of the steel sheet on which the victim was working at the time of incident. These steel sheets are usually of size 10 feet in length and two feet in width (Figure 3A). The machine on which the victim was working at the time of incident is shown in Figure 3B.

3 | DISCUSSION

Body-penetrating objects cause penetrating wounds, piercing the skin and disrupting, destroying, or adjacent contusing tissue, creating an open wound [6]. Firearms and sharp objects are most frequently associated with penetrating injuries [6,7]. Tissue damage depends on the part of the human body affected, the features of the penetrating object, and the amount of energy transferred to the tissues. The transferred energy from the moving object to the body tissues causes a change in rest or motion. This mechanical force causes deformation or traction strains causing rupture of tissues. Another critical factor is

the kinetic energy of the moving object [8–10]. In penetrating trauma, wounds are either clean-edged or uneven and abraded depending on the type of weapon and movements of the victim [11].

Penetrating wounds are frequently associated with homicides. These missile injuries predominantly occur by explosive devices and firearms. Accidental injuries due to missile objects are rarely reported at the workplace in the literature. At times, these may be caused by other objects such as metal spikes, arrows, wooden stakes, stones, garden or farm forks, and various vehicular and industrial instruments [8,12]. Penetrating abdominal injuries at the workplace are mostly nonmissile-type, low-velocity civilian injuries caused by sharp objects. However, in industries to cut metals, stones, etc., grinders are dangerous and can cause penetrating injuries due to shattered or detached pieces acting as high-velocity projectiles [13]. These open or penetrating wounds may sometimes mimic stab-like injuries [12]. In the reported case, the victim had sustained a catastrophic accidental injury by the metal projectile. The force of impact of the ejected metal piece was such that it pierced the protective suite and the abdominal wall, causing fatal intestinal injuries.

Penetrating trauma to the abdomen can be life-threatening as it causes damage to the vital organs, which can bleed profusely [8].

The right lower abdominal region supplied by the superior mesenteric artery arises from the aorta's anterior surface (L1), just inferior to the celiac trunk's origin. It supplies the second half of the duodenum, jejunum, ileum, caecum, appendix, ascending colon, and proximal two-thirds of the transverse colon. Injury to this region causes severe blood loss due to damage of the superior mesenteric artery and its branches [14]. Abdominal vascular injuries are linked with a high mortality and morbidity rate [3,13,15]. In penetrating abdominal injury, the most commonly involved organ is the small intestine accounting for 49–60% of all injuries [13,16]. The overlapping nature of the coils and their mesentery can result in multiple internal wounds [12]. In the reported case, superior mesenteric artery injury and multiple intestinal perforations were present, which corresponded with the external injuries and were indicative of the direction of the projectile metal piece. Inadequate protection by the protective suite (*Afreen*) attributed to the fatal injuries caused to the victim.

Due to the relative shortage of trained and skilled staff, lack of proper infrastructure, and more working hours, the industrial workers are more prone to accidental injuries. The reported case describes a rare unintentional injury caused by an atypical missile object that led to the death of the victim. This case highlights the need to take adequate professional training and safety measures to avoid such untoward incidents. This case also emphasizes that in cases of penetrating injuries to the abdomen, inadvertent causes should also be ruled out, other than the self-inflicted and homicidal etiologies. This becomes more pertinent when the incident has occurred in an industrial setting. The crime scene visit, correlating the autopsy findings, and interdepartmental collaboration becomes pivotal in such isolated scenarios.

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