

# Gluteal, abdominal, and thoracic multiple impalement injuries

## A case report on management of a complex polytrauma

Lara Ugoletti, MD<sup>a</sup>, Maurizio Zizzo, MD<sup>b,c,\*</sup>, Carolina Castro Ruiz, MD<sup>a</sup>, Erica Pavesi, MD<sup>a</sup>, Federico Biolchini, MD<sup>a</sup>, Valerio Annessi, MD<sup>a</sup>

### Abstract

**Rationale:** Historically, traumatic injuries include penetrating and blunt lesions. Impalement injury represents one of the rarest and potentially dramatic forms of penetrating trauma. If patient reaches hospital alive and is hemodynamically stable, there is a good chance that patient overcomes the traumatic event. However, non-removal of foreign body represents the cornerstone in initial treatment of this type of patients.

**Patient concerns:** A stable 55-year-old woman was admitted to the Emergency Department after falling out of a tree onto a wooden fence. One fence pole transfixated left gluteus, left abdominal wall, left abdominal cavity, and left thoracic wall by transdiaphragmatic way.

**Diagnosis:** Due to patient stability, a chest-abdomen CT scan with contrast medium was performed. It showed multiple parietal and visceral traumatic penetrating injuries from a foreign object.

**Interventions:** After primary and secondary advanced trauma life support (ATLS) assessment, patient underwent successful surgery.

**Outcomes:** Patient was discharged on 9th postoperative day in good general clinical condition.

**Lessons:** Impalement injury represents a rare and potentially lethal traumatic event. Unstable patients rarely reach Emergency Department alive. On the contrary, stable patients have a good chance of successful treatment, if they are quickly taken to tertiary Trauma Center. In this case, chest X-ray and Focused Assessment with Sonography for Trauma (FAST) represent useful diagnosing investigations, although CT scan remains gold standard. Conservative treatment is not possible, while thoracoscopy/laparoscopy/laparotomy is/are mandatory.

**Abbreviations:** AAST = American Association for the Surgery of Trauma, ATLS = advanced trauma life support, CT = computed tomography, DPL = diagnostic peritoneal lavage, FAST = Focused Assessment with Sonography for Trauma.

**Keywords:** abdomen, chest, emergency, impalement, injury, surgery, trauma

## 1. Introduction

In the United States, traumatic injuries represent the fourth leading cause of death overall for all ages. They are first cause of death among children, adolescents, and young adults between 1st and 34th year of life.<sup>[1]</sup> In 2009, almost 150,000 people died

because of traumatic injury in the USA. Global death rate recorded 54.4 per 100,000 people, that is, 400 deaths from traumatic injuries per day.<sup>[1]</sup> Historically, traumatic injuries are divided into penetrating and blunt lesions. In turn, penetrating lesions are classified into stab (SWs) and gunshot (GSWs) wounds.

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Local ethics committee (Comitato Etico dell'Area Vasta Emilia Nord, Italy) ruled out any formal ethics approval for this particular case.

Written informed consent was obtained from patient for publication of this case report and all related images. A copy of the written consent is available at Editor-in-Chief of this journal.

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LU and MZ contributed equally to this work.

<sup>a</sup> General Surgery Unit, Azienda Unità Sanitaria Locale/IRCCS di Reggio Emilia, Ospedale Civile di Guastalla, Guastalla, <sup>b</sup> Surgical Oncology Unit, Azienda Unità Sanitaria Locale/IRCCS di Reggio Emilia, Arcispedale Santa Maria Nuova di Reggio Emilia, Reggio Emilia, <sup>c</sup> Clinical and Experimental Medicine PhD Program, University of Modena and Reggio Emilia, Modena, Italy.

\* Correspondence: Maurizio Zizzo, Surgical Oncology Unit, Azienda Unità Sanitaria Locale/IRCCS di Reggio Emilia, Arcispedale Santa Maria Nuova di Reggio Emilia, Viale Risorgimento, 80, 42123 Reggio Emilia, Italy (e-mail: zizzomaurizio@gmail.com).

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Impalement injury is one of the most spectacular and potentially dramatic rare forms of penetrating trauma.<sup>[2,3]</sup> In many cases, impaled patient dies at the scene.<sup>[3]</sup> Patient who manages to reach hospital alive and is hemodynamically stable has a good chance of overcoming traumatic event. However, non-removal of foreign object represents the cornerstone of initial treatment, as possible vascular lesions remain compressed by object in situ, thus avoiding irrepressible hemorrhages.<sup>[2,3]</sup>

We present the case of an adult woman with multiple polydistrictual lesions, secondary to impalement injury by wooden fence pole after a fall from tree. We also introduce diagnostic-therapeutic pathway related to management of this complex polytrauma.

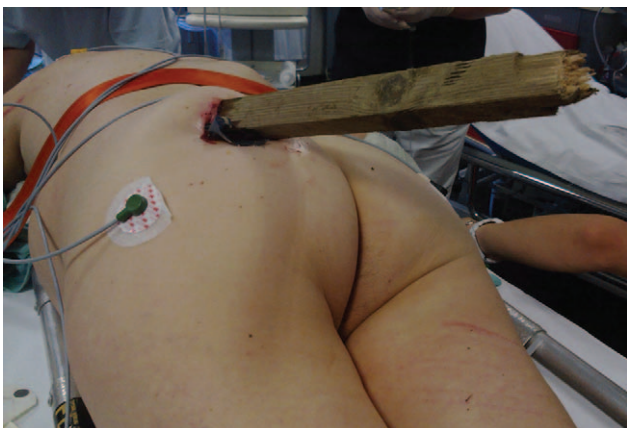
## 2. Case presentation

A 55-year-old woman was admitted to the Emergency Department 45 minutes after falling from a 5-meter tree onto a country wooden fence made up of multiple poles. One 90 cm × 6 cm × 5 cm parallelepiped shaped pole entered left gluteus. We assumed it reached and transfixated left abdominal wall, left abdominal cavity and left thoracic wall by transdiaphragmatic way. On trauma scene, patient lay supine on the floor, while fence pole exited left gluteus.

At Emergency Department, she was vigilant, oriented and hemodynamically stable. Her blood pressure was 139/88 mmHg, while heart rate 85 bpm. Laboratory tests showed following abnormalities: 14.16 × 1000/μL (4–10 × 1000/μL) white blood cells, 10.1 g/dL (12.5–15.5 g/dL) hemoglobin, 189 mg/dL (60–110 mg/dL) blood sugar, 270 mg/dL (<50 mg/dL) blood alcohol. All other examined parameters were normal.

Clinical examination showed a single penetration site at super-external quadrant of left gluteus, with no exit site. A 35 cm-long wooden pole tract emerged by entry site, with no active bleeding from entry site (Fig. 1).

Following Advanced Trauma Life Support (ATLS) protocol concerning initial assessment in trauma patient, multidisciplinary team ruled out both chest X-ray and Focused Assessment with Sonography for Trauma (FAST). Due to patient stability, a chest-abdomen computed tomography (CT) scan with contrast medium was performed on prone patient, showing multiple traumatic penetrating injuries from a foreign object (Fig. 2A-D), as below described in caudo-cranial order:



**Figure 1.** Patient in a prone position with the impaled object emerging from left gluteus.

- i) approximately 6 cm diameter penetrating lesion in upper third of left gluteus maximus muscle (entry site);
- ii) soft tissue tear from gluteus penetration site up to abdominal wall penetration site;
- iii) penetrating lesion of abdominal wall at left latissimus dorsi muscle, along posterior axillary line;
- iv) XI and X left rib fractures;
- v) splenic laceration with extensive parenchymal and subcapsular hematoma (American Association for the Surgery of Trauma (AAST) Grade III-IV);
- vi) perisplenic fluid;
- vii) penetrating lesion of left diaphragm at costal insertions;
- viii) VI and V left rib fractures, along middle axillary line;
- ix) soft tissue tearing of left thoracic wall;
- x) left pleural effusion.

Path by foreign object was about 50 cm long. No further lesions in thoracoabdominal viscera were recorded.

After shortening of emerging wooden pole at level of gluteal entry site, patient was transferred to operating room and placed in supine position. Xipho-umbilical laparotomy was performed. Following findings were recorded:

- i) approximately 500 mL hemoperitoneum;
- ii) AAST grade III-IV splenic lacerations;
- iii) micronodular hepatic cirrhosis;
- iv) wooden pole crossing left abdomen cavity with entry and exit sites at left lateral abdominal wall and left diaphragm, respectively;
- v) penetrating laceration of left diaphragm.

During exploratory time and under strict supervision of surgeon and assistant surgeon, a third operator slowly extracted wooden pole from gluteal entry site (Fig. 3). No vascular lesions were identified. Furthermore, at exploration of thoracic cavity through diaphragmatic laceration, no pulmonary lesions were detected. Surgical operation was completed by performing:

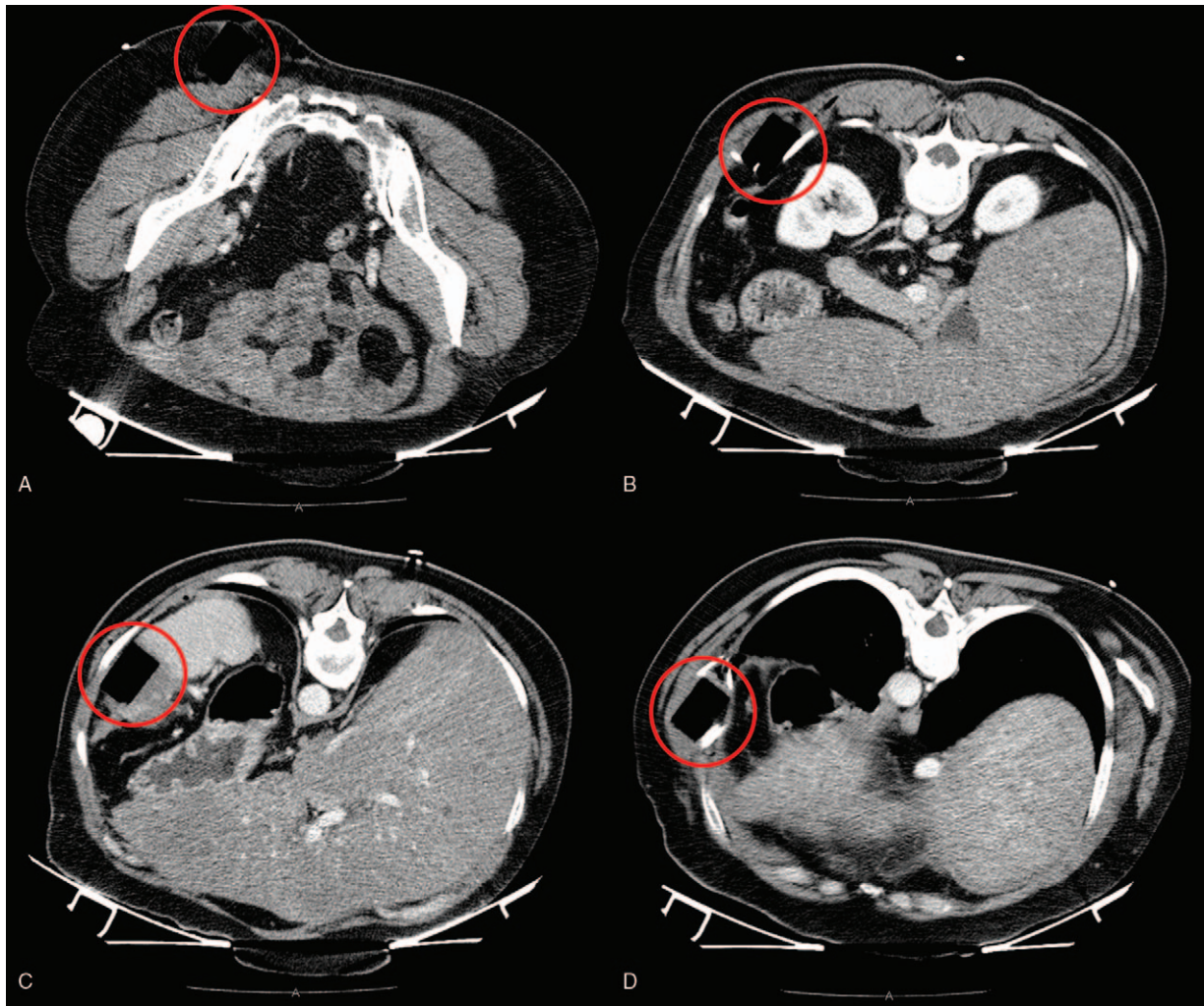
- i) splenectomy;
- ii) placement of a left chest tube;
- iii) diaphragmatic suture with interrupted polypropylene 0 stitches;
- iv) abdominal cavity toilet;
- v) placement of 2 abdominal drainages, toilet and closure of gluteal wound.

Patient was treated with broad-spectrum antibiotics for 7 days, while thoracic drainage and abdominal ones were removed on the 5th and 7th postoperative days, respectively. She was discharged on 9th postoperative day in good general clinical condition.

## 3. Discussion

Impalement is the penetration of an organism by an object such as pole, hook, stake or spear, by complete perforation of the central body mass.<sup>[3]</sup> Transfixion and immobilization are also important components.<sup>[3]</sup> Clinical definitions have ranged from transfixing a body cavity or extremities by a rigid object of variable size to have a foreign body penetrate and embed in a body part with the object still remaining in the wound, to being suspended by the impaling object.<sup>[3]</sup>

Impalement injury is a rare form of penetrating trauma which cannot be included into a strict protocol for injury management,



**Figure 2.** Chest-abdomen CT scan with contrast medium (patient in prone position): A) 6 cm maximum diameter penetrating lesion in upper third of left gluteus maximus muscle (entry site); B) penetrating wound of abdominal wall at the level of the left latissimus dorsi muscle, along the posterior axillary line, and fractures of left XI and X ribs; C) splenic laceration with extensive parenchymal and subcapsular hematoma, and perisplenic fluid; D) penetrating lesion of left diaphragm at its costal insertions, and fractures of VI and V ribs, along middle axillary line.

due to different variables related to impalement mechanism: nature of impaled object; kinetics of injurious mechanism; body areas affected by trauma; number of injured viscera for each body region; type of parietal and/or visceral injuries.<sup>[1,2]</sup> The resulting lesions may include features of both blunt and penetrating

trauma with considerable tissue destruction and organ penetration.<sup>[3]</sup> Thus, we must pay close attention how patient, whose performance strictly relies on age and comorbidity, might respond to trauma.

Most impalement injuries take place in car crashes or accidents at construction sites.<sup>[3]</sup> Three general groups of impalement injuries are associated with

- i) vehicle collisions,
- ii) sexually motivated activities in anogenital region,
- iii) falls.<sup>[3]</sup>

A different classification suggests type 1 injuries, when a body impacts stationary objects (e.g., in falls at a construction site or ejection from a vehicle), and type 2 injuries when a moving object penetrates a stationary body (e.g., object enters a vehicle cabin).<sup>[3]</sup>

Penetrating trauma of both thorax and abdomen is described as a “double-jeopardy”, because of difficult management of both cavities wounds.<sup>[4]</sup> Optimal patient management suffering from penetrating thoracoabdominal trauma is a well-known clinical challenge, as injury patterns, management strategies, and clinical



**Figure 3.** Impaled foreign body after extraction.



outcomes remain unexplained across a large population.<sup>[4]</sup> Therefore, to date, a proper patient management is still under discussion.

In hemodynamically stable and asymptomatic patient, best applicable therapeutic approach is widely discussed.<sup>[5]</sup> Retrospective and prospective studies recorded a 10% to 15% rate requiring surgical intervention in patients affected by penetrating thoracic trauma, while a 32% to 46% one in patients with penetrating abdominal trauma.<sup>[4]</sup> Negative or non-therapeutic cavitory surgical exploration is a well-known pitfall associated to “double jeopardy” of thoracoabdominal trauma.<sup>[4]</sup> Non-therapeutic laparotomies recorded a 70% overall rate with up to 20% complication rates, longer hospitalization times and increased costs.<sup>[4,5]</sup> On the contrary, in case of haemodynamic instability, peritonitis, evisceration, or impalement injury, surgical exploration is considered mandatory by the main experts in Emergency Surgery.<sup>[5,6]</sup> Correct sequencing of cavitory intervention is paramount in managing unstable patients and 23% to 44% missequencing rates were reported.<sup>[4]</sup>

First assessment of any traumatized patient must be fast and systematic.<sup>[6]</sup> All patients presenting at Emergency Department after thoracoabdominal trauma should be screened for lesions according to ATLS protocol.<sup>[6,7]</sup> As thoracic lesions can impact each ABCs (Airway, Breathing, Circulation), quick chest assessment is performed during the primary patient’s survey to detect potentially lethal injuries.<sup>[6,7]</sup> In case of unstable patients, cardiac ultrasonography should be part of primary survey in addition to chest radiography which allows to identify patients who might experience decompression of tamponade in the pleural space.<sup>[4]</sup> Just negative FAST does not always ruled out cardiac trauma and may turn out misleading in a small percentage of patients, as sensitivity can be compromised both by tamponade decompression in pleural spaces or mediastinum and by a concomitant pathology such as a pneumothorax.<sup>[4,6]</sup> According to Berg et al, urgent laparotomy is the most effective approach for an unstable patient who is still alive and shows no clinical or ultrasound evidence of cardiac injury, followed by a rapid transdiaphragmatic pericardial window, in case causal lesion is not immediately evident.<sup>[4]</sup>

In stable patients, management of thoracoabdominal trauma is marked by possible more in-depth and rapid case study. As suggested by Biffi and Leppaniemi, chest X-rays and FAST should be performed. If both tests appear normal but there is a clinical suspicion of a penetration capable of causing diaphragmatic lesions, diagnostic peritoneal lavage (DPL) is carried out with a 5000/mm<sup>3</sup> red blood count (RBC) threshold. In most patients, this rules out laparoscopy/laparotomy, as only a (+) DPL would require laparoscopy/laparotomy. If there is an emothorax or pneumothorax with (–) FAST, thoracoscopy is performed first. In case of a diaphragmatic lesion (as in approximately 24% patients), laparoscopy/laparotomy is performed to rule out lesions below diaphragm. In case of a (+) FAST, laparoscopy/laparotomy is mandatory.

In our case, emergency team ruled out chest X-rays and FAST and carried out a chest-abdomen CT scan. That choice was grounded on 3 important reasons:

- i) patient hemodynamic stability;
- ii) mandatory prone position;
- iii)

excellent diagnostic capability of CT scan in thoracic and abdominal trauma, which represents gold standard for stable patients.<sup>[4–8]</sup>

Following cross-sectional imaging identification of visceral and parietal wounds, patient underwent surgery when careful and progressive removal of the foreign object and subsequent repair of multiple lesions were performed.

#### 4. Conclusion

Impalement injury represents a rare and potentially lethal traumatic situation. Unstable patients hardly get to Emergency Department alive. Nevertheless, stable patients have a good chance of surviving if they quickly get to tertiary Trauma Center and are promptly treated. It is of paramount importance not to remove the impaled foreign object. After a primary survey, chest X-ray and FAST are useful diagnostic investigations for those patients, although CT scan remains gold standard. Conservative treatment is not possible, while thoracoscopy/laparoscopy/laparotomy is/are mandatory.

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#### Author contributions

**Conceptualization:** Lara Ugoletti, Maurizio Zizzo, Valerio Annessi.

**Data curation:** Lara Ugoletti, Maurizio Zizzo, Carolina Castro Ruiz, Erica Pavesi, Federico Biolchini.

**Formal analysis:** Lara Ugoletti, Maurizio Zizzo.

**Investigation:** Lara Ugoletti, Maurizio Zizzo, Carolina Castro Ruiz, Erica Pavesi, Federico Biolchini, Valerio Annessi.

**Methodology:** Lara Ugoletti, Maurizio Zizzo.

**Supervision:** Lara Ugoletti, Maurizio Zizzo, Valerio Annessi.

**Validation:** Lara Ugoletti, Maurizio Zizzo, Valerio Annessi.

**Writing – original draft:** Lara Ugoletti, Maurizio Zizzo.

**Writing – review & editing:** Lara Ugoletti, Maurizio Zizzo.

Maurizio Zizzo orcid: 0000-0001-9841-7856.

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