

A case report of a polytrauma patient with penetrating iron rods in thorax and head

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Abstract

Introduction: Impalement injury is an uncommon presentation, and penetrating chest injuries account for 1% to 13% of thoracic trauma hospital admissions. The vast majority of patients with penetrating thoracic trauma who survive to reach the hospital alive can be managed nonoperatively. Nevertheless, in 10% to 15% of cases, emergency operation is necessary due to the associated hemorrhagic shock and visceral injury.

Case presentation: Here, we report on a 39-year-old male, a construction worker, who fell down from a height of a construction site, landing ventrally on a clump of iron rods with 4 projecting heavy metallic rods penetrating into his thorax and head (scalp pierced only). Emergency surgery was taken, and the patient had an uneventful successful outcome.

Conclusions: After massive thoracic impalement, rapid transportation to a tertiary trauma center with the impaled objects in situ can improve the outcome. Video-assisted thoracic surgery (VATS) is recommended to remove the foreign body under direct vision and to reduce the incidence of missed, potentially fatal vascular or visceral injuries.

Abbreviations: BP = blood pressure, CT = computed tomography, CTA = CT angiography, ECMO = extracorporeal membrane oxygenation, ED = emergency department, ICU = intensive care unit, VATS = video-assisted thoracic surgery.

Keywords: iron bar, penetrating trauma, thorax

1. Introduction

Polytrauma patients impaled by hard and pointed objects with foreign bodies in situ are rare, and penetrating chest injuries account for 1% to 13% of thoracic trauma hospital admissions.^[1,2]

Many patients die at the trauma scene, and for the vast majority of patients with penetrating thoracic trauma who survive to reach the hospital alive can be managed nonoperatively. Nevertheless, in 10% to 15% of cases, emergency operation is necessary because these injuries are potentially life-threatening due to the associated hemorrhagic shock and visceral injury.^[2]

Some of them may not manifest its seriousness, but physicians must have a high degree of suspicion for shock in patients with

penetrating trauma.^[3] For those patients who appear stable in vital signs, it is of great significance not to remove the impaled objects, so that possible vascular lesions remain compressed by the objects in situ, avoiding unstoppable hemorrhage.^[4,5]

Severely impaled patients should be transferred to a tertiary hospital or trauma center as early as possible, as these lesions typically require a combination treatment from a multidisciplinary team.

Here, we report on a rare case with 4 projecting heavy metallic rods jabbed into the patient's thorax and head (scalp pierced only). We also present a literature review on thoracic impalement injuries and discuss the general management of these injuries.

2. Case report

A 39-year-old male construction worker was admitted to the emergency department of West China Hospital of Sichuan University 3 hours after falling from a second floor and landing ventrally on a clump of iron rods. Four metallic bars (1.5 cm in diameter) jabbed into his body at right anterior chest wall, left supraclavicular region, right temporoparietal region, and left temporal site, respectively. In addition to the impalement injuries, the patient also suffered from a left-hand dyskinesia, which was proved to be a distal radius comminuted fracture by X-rays. Bystanders cut the iron rods from the ground as gently as possible to prevent movement of the metallic bars within his body as instructed by a local health worker on scene.

On admission to the emergency department, the patient was fully conscious, oriented, and stable hemodynamically. His pulse rate was 157 bpm, regular, full volume with a blood pressure (BP) of 150/95 mm Hg. Routine blood test showed increased white blood cell count and no excessive loss of blood. Clinical examination found 2 metallic bars with entry sites at bilateral anterior upper chest wall and no exit site on backside. One iron rod penetrated the patient's right temporoparietal scalp through and through. Another iron rod was found traversing from the

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The patient signed the necessary documents to consent to the use of his data for teaching and publication.

This case report does not include any experimental research on animals or human patients, and ethical approval is not necessary.

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Figure 1. The patient in emergency operation room.

patient's left cheek to the region above the tragus with nearly 15 cm of the metallic bar under skin (Fig. 1). No active bleeding was found at anyone of the entry or exit sites.

A chest computed tomography (CT) (Figs. 2 and 3) showed parenchymal lesions in both bilateral apical segments of lung and the presence of 2 foreign bodies with high density, 1.5 cm in diameter, extending in a ventridorsal direction from the bilateral anterior upper chest wall deepest to the left-side posterior paravertebral muscle. Fracture of several ribs and transverse process of vertebrae was also detected in chest CT. Thanks to the protection of the skull, no intracranial injury was found except for penetrating wounds of the scalp.

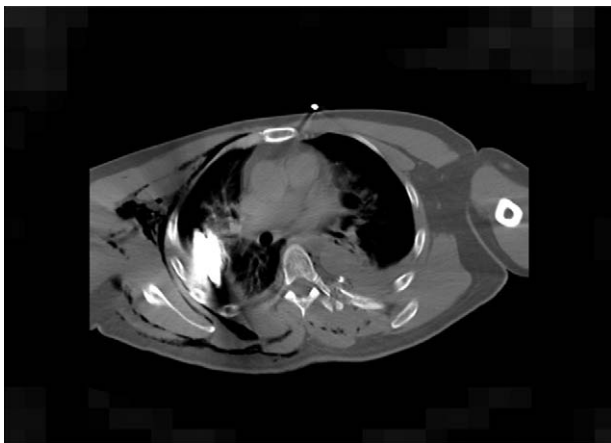


Figure 2. Chest CT scan findings on ED presentation. Chest CT scan revealed parenchymal lesion in the right-side apical segment of lung and the presence of a foreign body with high density, 1.5 cm in diameter, extending in a ventridorsal direction. ED=emergency department.

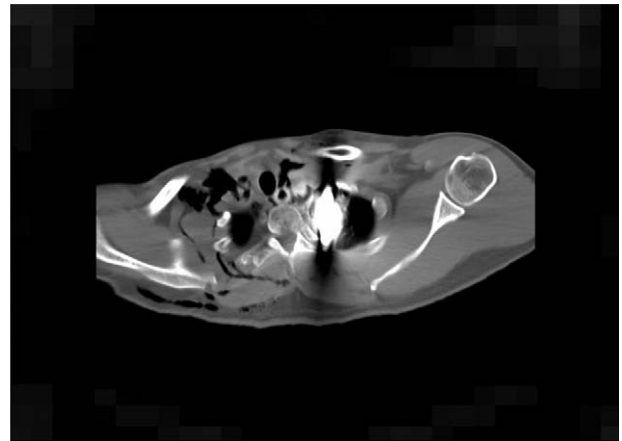


Figure 3. Contralateral apical segment of lung was impaled by the iron rod. The foreign body extended from the anterior upper chest wall deepest to the left-side posterior paravertebral muscle.

In order to inspect suspicious vascular lesions, CT angiography (computed tomography angiography [CTA]) was also performed, which found a blurring boundary between the left-side subclavian vessels and the foreign body.

The patient was immediately transferred to the emergency operating room for removal of the impaled objects and injury control. Bilateral closed chest tube drainage was promptly performed as soon as the patient was inside. In cases of severe acute respiratory distress syndrome (ARDS), extracorporeal membrane oxygenation (ECMO) was used as a temporary substitute for the injured lung to increase lung rest time, giving it time to recover from trauma.^[4]

Head injury was first managed. Two iron rods were removed by a neurosurgeon and scalp lacerations were sutured after debridement. An orthopedist handled the left upper limb fracture by manipulative reduction maneuver and plaster external fixation.

During the surgical removal of the foreign body, plugging effect of the foreign body on the injured blood vessels wall might be relieved; anticipation of sudden gushing out of blood from an injured major vessel was essential.^[1] Therefore, as instructed by the CTA done before the operation, 2 vascular surgeons were summoned to explore the adjacent relationship between the foreign body and the left-side subclavian vessels.

Video-assisted thoracic surgery (VATS) was performed to take a thorough exploration of the thoracic cavities and to remove the foreign bodies under direct vision. Surprisingly, except for some avulsion injuries of the arteriovenous adventitia, our patient did not subject to any fatal injury to the major vessels, as the iron rod had just passed through the narrow rift between the left side subclavian artery and vein. Bilateral apical segments of lung were transected by the iron bars and the pleural cavity was found to be filled with 200 mL of blood and clots. No active bleeding point was found. Two iron bars were removed under direct vision by using VATS and a bilateral upper lobectomy was also performed by 3 thoracic surgeons (Fig. 4). A conversion to thoracotomy was taken due to hemostasis of an intercostal artery. Inflated lung promotes effect of compression on the bleeding vessels and reduces dead space, which is a good protection against empyema.^[4] After extensive rinsing of the bilateral thoracic cavities, lung was fully insufflated to prevent atelectasis. Bilateral pleural drainage was a must, considering residual clotted blood as



Figure 4. Impaled lung lobe was excised.

the major risk factor for the development of fibrothorax and empyema.

Total operative time was 12 hours. Surgeons involved in the operation include 3 senior thoracic surgeons, a neurosurgeon, 2 vascular surgeons, an orthopedist, and 5 surgery residents. Two thousand milliliter of blood was lost during the operation time associated with transfusion of 4 packed red blood cells and 600 mL fresh frozen plasma.

The patient was treated by broad-spectrum antibiotics and weaned from mechanical ventilation after 2 days stay in intensive care unit (ICU). He was then discharged from the ICU and admitted to an ordinary ward to receive a left upper limb fracture repair surgery, after which he had an uneventful recovery and was discharged from the hospital with a good general condition.

3. Discussion

Polytrauma patients impaled by hard and pointed objects with foreign bodies in situ are rare and hold a high mortality rate because of the complexity of trauma and associated injuries. Reported protocols for managing impalement injuries could hardly reach a consensus due to the great diversity in impalement mechanisms with which unique and individualized care based on injury severity and affected organs is required. The existing literatures and our experience, however, acknowledge a few conclusions and recommendations to minimize mortality and maximize outcome.

When the penetrating objects at the scene of primary accident and transport patient to hospital are cut down, it is crucial not to remove the foreign bodies within patient to avoid further injuries and maintain the plugging effect on the breach in injured blood vessel wall. Removal of the impaling objects should be performed only in a tertiary trauma center under direct vision, using a multimodality surgical approach, under the guidance of surgeons experienced in particular anatomical regions and systems affected by the objects. Anticipation of sudden gushing out of blood from an injured major vessel is essential, for which rapid warm fluid and blood products should be prepared before operation. Besides CT scan of particular systems, CTA is a helpful diagnostic means to inspect suspicious vascular lesions. In addition to finding intraluminal filling defects or pseudo-aneurysms, CTA can also detect vessel disruption by showing extravasation of contrast distal to normal vessel location.^[6]

Generally speaking, most patients with chest trauma can be managed with simple procedures; however, 10% to 15% of patients who present with thoracic trauma require operative repair and the vast majority have sustained a penetrating injury.^[7,8] In order to reduce the number of missed, potentially fatal vascular or visceral injuries, VATS is safe and reliable, and is an effective alternative to thoracotomy in the management of penetrating chest injuries. Although exploration in our case was negative for vascular injuries, it did reveal the relationship between the injuries and the subclavian vessels. We thus believe that surgical exploration must be performed whenever there is a suspicion that a penetrating chest injury has penetrated the chest cavity in order to thoroughly examine the pleural cavity, identify the source of bleeding and possible injuries to the pulmonary parenchyma, the diaphragm, and to remove foreign bodies.

For unsalvageable necrotic tissue, lung lobectomy should be performed, but care must be taken to preserve viable lung, because an expanded lung can reduce dead space, which is a good protection against empyema.^[9] We stress the significance of decontamination of the pleural cavity to manage infection, for which dirt and organic/inorganic debris leased by the mechanism of chest trauma must be rinsed out.^[4] Extensive rinsing of the thoracic cavity associated with the debridement of the lesion would therefore be considered to be a set of standard process leading to a better prognosis. For the nature of the low pressure of the pulmonary vessels and high thromboplastin concentration in their tissues, pulmonary bleeding tends to be self-limited. Lung expansion in the pleural cavity can also promote effect of compression on the bleeding vessels.^[10] Lung parenchyma, therefore, should be fully insufflated to prevent atelectasis, soon after surgical repair.^[10] Traditionally, pleural drainage has been advocated when it comes to suspecting or diagnosing hemothorax. Residual or unhandled hemothorax is a common risk factor for the development of fibrothorax and empyema. Nevertheless, the primary risk factor for empyema is the need for a chest tube. Thus, we would not recommend applying this to the residual small untapped or drained hemothorax.^[11] In cases of severe ARDS, ECMO, if available, could be applied as a temporary substitute for the injured lung to increase lung rest time, giving it time to recover from trauma. According to the Cesar trial, the ECMO group showed a remarkably survival improvement in the comparison with the use of traditional treatment for severe ARDS.^[12,13]

Empirically, posttraumatic empyema is usually associated with gram-positive bacteria, but whether “prophylactic” antibiotics can independently reduce the infection risk or not remains to be proved. Nevertheless, at least 1 dose of antibiotics that covers gram-positive organisms sometimes associated with tetanus vaccination are still traditional strategies for most of center administrators to manage infection.^[11]

4. Conclusion

As for the lessons learnt from our case, we cannot overemphasize the importance of the management of the major vessels surrounding the injury and whether damaged or not proper assessment (CAT) and enough blood products preparation done before operation are essential. Except for providing field of vision for surgeons to remove the foreign bodies under direct vision, surgical indications of VATS should be extended so as to reduce the incidence of missed, potentially fatal injuries and to manage the source of hemothorax and persistent air leaks, whose dilation over time increases morbidity and the incidence of chronic sequelae.

Severe impalement injuries require immediate life-saving endeavor, rapid transportation to a tertiary trauma center with the impaled objects in situ, appropriate intensive care, targeted, succinct examination and serial reassessments in the emergency department, readily diagnosis, and surgical intervention by a multidisciplinary team. With these requirements provided, outcome is maximized, mortality is minimized, and permanent/long-term damage may be avoided.

Author contributions

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