

Severe thoracic impalement injury: Survival in a case with delayed surgical definitive care

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ABSTRACT

Impalement injuries are rare and among the most spectacular and dramatic traumatic lesions. The survival of a patient with a thoracic impalement injury is an extremely rare event. The objective of this study was to present the case of a 24-year-old male patient with a severe thoracic impalement injury successfully treated despite his late arrival in our hospital. A log in 12 cm diameter penetrated his right thorax producing injuries of the right main bronchus, right pulmonary lobe, right subclavian artery as well as extensive parietal lesions. Definitive surgical repair of these lesions was performed more than seven hours after trauma. The management principles contributing to the successful outcome that we would like to emphasize are: rapid transportation and reaction of the trauma team, minimal manipulation of the impaling object, removal of the log as one piece under direct vision in the operating room, ventilatory support, extensive debridement, and lavage associated with appropriate antibiotherapy.

Key words: Foreign body; impalement injury; thoracic injury; thoracotomy.

INTRODUCTION

Impalement injury is an uncommon form of trauma encountered rarely in a surgeon's career. These injuries are spectacular and dramatic, and due to the multiple lesions they may associate, they represent a challenge even for an experienced surgeon. The literature presents only few survival cases, the vast majority being unfortunately fatal.^[1-8] One important issue for patient survival is rapid transportation of the victim to the appropriate hospital. A rapid and prompt reaction of the trauma team and adherence to a structured management protocol are also essential. In this report, we presented the case of a young male with severe thoracic impalement injury successfully treated despite his late arrival. Management principles were also discussed.

CASE REPORT

A 24-year-old male patient was involved in a car accident. He

was on the backseat of the car when the vehicle was engaged in collision with a cart full of very long logs. One log penetrated the windshield of the car, and the patient sustained an impalement injury of the right thorax. The ambulance arrived in about 15 minutes. The log, measuring about 12 centimeters in diameter and 7 meters in length, was cut with a chain saw in the proximity of the thoracic wall and the patient was transported to a regional hospital, 40 km away, where he arrived 2 hours after trauma. During transportation, the patient was hemodynamically stable, with a respiratory rate of 29 breaths per minute and fully aware. This small hospital was not able to deal with such a complicated case and immediately the patient was transported to the county hospital, 20 km away. He became dyspnoeic and a nonselective orotracheal intubation had to be performed. A central venous catheter was also inserted. At this moment, the surgeon decided that the county hospital did not have the experience and the facilities to treat such a case, and sent the patient to the university hospital, 140 km away. During transportation, cardiac arrest occurred which was successfully managed. He arrived in our hospital more than 7 hours after the accident. Upon arrival, the patient was intubated and hemodynamically stable (blood pressure, 70/40 mmHg; heart rate, 90 beats per minute; and urine output of 1 litre for a 3-hour period). Physical examination revealed a right thoracic impalement wound with foreign body retention (log), edema and cyanosis of the right arm and the right hemi-face (Fig. 1).

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Figure 1. Right thoracic impalement injury: anterior, posterior and lateral aspect.

The patient was immediately transported in the operating room. A generous right lateral thoracotomy was performed in the 4th intercostal, joining the entry and exit places of the impaled log. The log was carefully extracted as one piece (Fig. 2). The extraction raised difficulties due to the numerous small wood branches present on the surface of the log. No massive hemorrhage was noted. An inventory of intrathoracic lesions revealed an incomplete right main bronchus rupture, extensive pulmonary dilaceration and partial (adventitial) rupture of the right subclavian artery (Fig. 3). The opening in the right main bronchus was immediately occluded, allowing the arterial oxygen saturation to rise from 50% to 95%, followed by suture of the bronchus. An atypical partial superior right pulmonary lobe resection was performed in order to address the pulmonary dilacerations and to achieve correct hemostasis and aerostasis. Right brachiocephalic and right subclavian veins appeared compressed but without dilacerations of the vessels. The small adventitial arterial subclavian lesion was sutured. Multiple multifocal rib fractures (rib 1 to 8) and a fracture of the internal third of the right clavicle were also present. All devitalized tissue, foreign bodies (large and numerous fragments of leather and textile material) and bone fragments were removed. The log entry and exit sites were extensively irrigated. The thoracic wall was then reconstructed using autologous structures and two drains were positioned in the pleural cavity (Fig. 4a).

Postoperatively, the patient maintained intubated and mechanically ventilated. Cardiac arrest occurred five hours postoperatively, with successful resuscitation. For the next five days, the patient maintained intubated with internal pneumatic stabilization of the thoracic wall. On the 6th postopera-

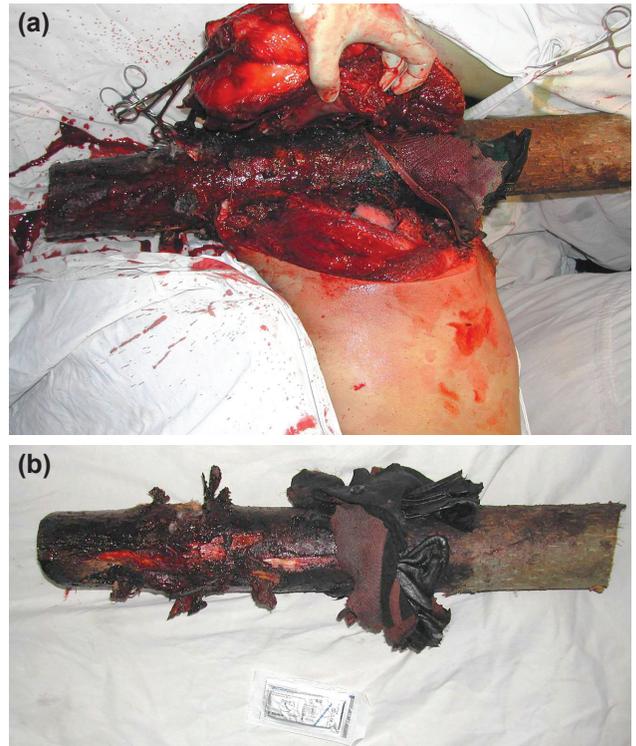


Figure 2. (a) Extensive thoracotomy joining the entrance and exit sites, the impaling object is fully exposed and extracted as one piece; (b) the log, 12 cm in diameter, with a large fragment of patients leather jacket.

tive day, the patient was extubated, and followed next day by oral feeding and ambulation. During hospitalization, the patient developed bronchopneumonia which responded well to broad spectrum antibiotics. Entry and exit orifices became infected and required a series of local excisions, dressing and secondary suture. We also noted osteitis associated with the open fractures of the 3rd, 4th and 5th ribs that required partial resections. The patient was discharged on the 40th postoperative day. Two months after the operation, the patient presented limitation of abduction and rotation of the right upper

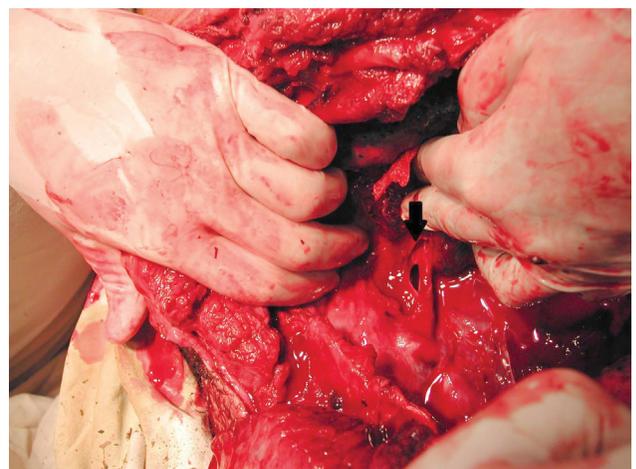


Figure 3. Intraoperative aspect - 1.5 cm in diameter dilacerations is present in the right main bronchus (black arrow).

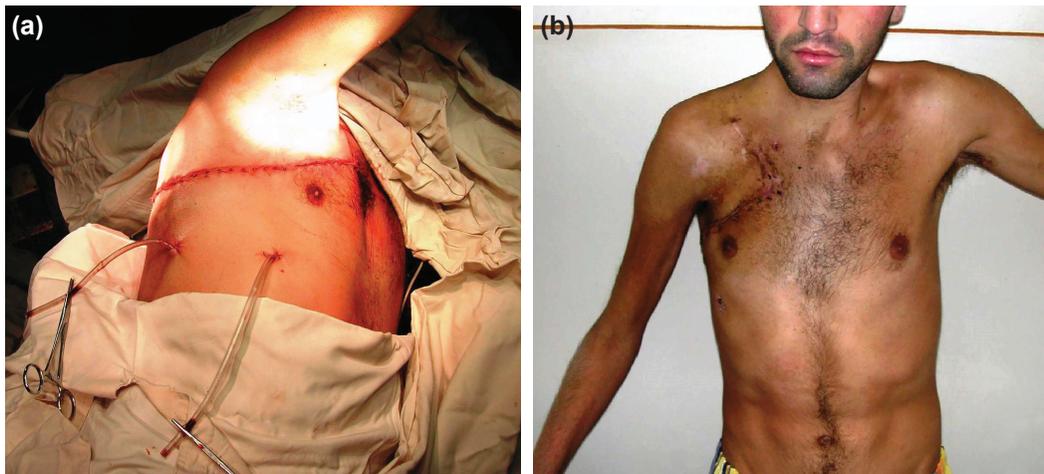


Figure 4. (a) Final aspect of the operation (b) and patient 2 months post-operatively.

limb and thoracic scoliosis but without impact on his quality of daily life (Fig. 4b).

DISCUSSION

Impalement injuries are fortunately rare nowadays, and few surgeons have the “privilege” to treat such an injury. Impalement injuries usually occur in motor vehicle and labor accidents.^[1,2,5-8] Eachempati et al. have divided impalement injuries into two types:^[6] type I injuries result from impalement of the body with an immobile object as it happens in collisions with protruding objects or in case of falls; type II injuries involve a mobile object intentionally manipulated that is lodged in a stationary body and are frequently encountered in children, in the pelvic, anorectal and vaginal regions as a result of sexual perversion or rape.^[9]

Virtually, any region of the body may be subject to an impalement injury.^[6,9-11] Impalement injuries of the thoracic cavity are uncommon, but dramatic when they occur.^[12] Thoracic impalement accidents on the right side are more frequently encountered because on the left side the presence of the heart makes survival exceptional, with few survivals cases reported in the literature.^[1,4,5,7,8,13-15] If the patient survives, this is because the foreign object missed vital internal structures, especially the great vessels or heart.^[4,15] This was also the case of our patient in whom vital structures were spared by the injury.

Critical decisions and actions during prehospital and operative stages are essential in improving survival rate. Unfortunately, impalement injuries are frequently fatal, few patients arriving alive at the hospital. Therefore, transportation of the patient must be as expeditious as possible. However, first aid on-site must be extremely qualified and rapid. On-site, paramedics and physicians must regard patient situation as a major trauma and adhere to the trauma protocol recommended by the American Association for the Surgery of Trauma.^[16]

Special attention must be paid to the injured region, and by all means the impalement object must not be mobilized or removed.^[1,3-16] All authors recognize the tamponade effect of the impaling object. Any dislodgement of the impaling object in the field may result in cataclysmic hemorrhage impossible to control. Kelly et al. have reported the case of a 15-year-old boy impaled upon a gate through the anterior abdominal region, who was lifted off the gate by a friend.^[17] When the ambulance arrived, he was profoundly shocked due to abdominal life-threatening hemorrhage. The patient should be mobilized, shifted and examined as gently as possible, avoiding any mobilization of the impaled object. Reduction of the impaling object to a manageable size is recommended so that the patient can be transported easier but without the risk of losing the tamponade effect.^[18,19]

A level I trauma or teaching hospital is probably the best solution for these patients. Unfortunately for our patient, he initially reached two regional hospitals without medical experience and facilities to treat such injuries, including lack of a thoracic and vascular surgeon, lack of a blood bank, and absence of cardiopulmonary bypass. This was the reason why the patient arrived to our hospital more than 7 hours after the accident. This delay, which resulted in the alteration of the general status of the patient, caused the patient to require intubation and ventilation, put the patient in cardiac arrest during transportation, and led to hypotension at arrival. This is probably one of the weaknesses of our medical system. In our hospital, the case was operated by a general surgeon qualified in trauma emergencies, thoracic and vascular surgery. These types of injuries remain a general surgical problem, because the general surgeon is the person on the spot. Moreover, we consider that every general surgeon should be qualified and able to deal with such complex cases.

We consider that in the very moment the patient arrives at the hospital, he should be immediately transported in the operating room. Preoperative imaging is rarely possible, es-

pecially in thoracic involvement. Chui et al.^[13] have reported a 24-year-old man surviving impalement injury of the left thorax with a steel rod, in whom the precise nature and extent of the injury were determined by computer tomography and aortography. In the case described above, there were no attempts for complex exploration due to his severe condition on arrival.

The position of the patient on the surgery table may be difficult, especially when a posterior impaling object is present. For thoracic impalement, a decubitus lateralis position is the rule, but this position may prove difficult for the anesthetist for selective intubation of the selected lung. Our patient arrived already intubated, but not selectively, and no attempt was made to switch to a selective intubation due to its position on the table. As a principle, the incision must join the entrance and exit sites. The surgeon may use conventional or unconventional incisions, the aim being to gain the best possible access in order to remove the object and to control any possible hemorrhage. One or more incisions may be used to remove the impaling object. In a thoracoabdominal impalement case, Thomson et al.^[1] have performed a left thoracoabdominal incision followed by a right anterolateral thoracotomy. The impaling object must be removed as one piece and under direct vision. A vascular control should be achieved whenever possible. In the thoracic cavity, vascular control is often not possible in advance so the surgeon must be prepared to perform rapid hemostasis after the impaling object is removed. When a major vascular lesion is suspected, cardiopulmonary bypass should be considered.^[20,21] Shimokawa et al.^[20] have reported the successful removal of a thoracic impaling bolt 7 mm in diameter involving the right ventricle and the esophagus under cardiopulmonary bypass.

Generally, impaling objects are wooden materials (logs, planks, branches) or metal bars and are less than 5 cm in diameter. Objects of greater dimension impaled in the thorax produce major visceral destructions, but also important parietal lesions. In the situation we described, the log was 12 cm in diameter and produced major damages to the chest wall. Reconstruction of the thoracic wall is sometimes very challenging when a large amount of thoracic wall is lost. Internal pneumatic stabilization should be considered in patients with loss of parietal tissue, flail chest, and extensive thoracotomy.

Pathogen contamination of the region must be regarded as a very serious problem. Wooden fragments, soil particles, clothes, and bone fragments are usually present in the wound. Extensive debridement and lavage is mandatory. Postoperative care should control infection at any level. Patients are at risk for bronchopneumonia, soft tissue infection, and osteitis as was the case of our patient. Broad spectrum antibiotics should be administrated.^[7,14]

Impalement injuries must be regarded as major trauma, and Advanced Trauma Life Support principle should be applied.

The impaling object must not be removed in the field. The rapid transport of the patient to a qualified hospital is critical, and emergency operation is mandatory. The impaling object must be removed under direct vision and as one piece, thus, an incision joining the entry and exit sites is advisable. Hemorrhage represents a major risk after removing the object so all means should be employed in order to achieve hemostasis, and cardiopulmonary bypass should be considered. Extensive debridement and lavage are mandatory and broad spectrum antibiotics are advisable. Reconstruction of the thoracic wall may prove difficult, and internal pneumatic stabilization may be considered to stabilize parietal lesions.

Conflict of interest: None declared.

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OLGU SUNUMU - ÖZET

Ağır toraks penetran yaralanması: Kesin cerrahi tedavisi gecikmiş olguda sağkalım

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Kazık şeklindeki cisimlerin batmalarına bağlı penetran yaralanmalar seyrek görülen, en dikkat çekici ve dramatik travmatik lezyonlardan biridir. Toraksın penetran yaralanması sonucu hastanın sağkalması son derece nadir görülen bir olaydır. Yirmi dört yaşında, göğüs kafesine kazık batması sonucu ağır derecede yaralanmış, hastanemize geç dönemde başvurmasına rağmen başarıyla tedavi edilmiş bir olguyu sunmaktayız. On iki santimetre çapında bir kütük göğüs kafesinin sağ tarafına saplanmış, sağ ana bronş, sağ akciğer lobu, sağ subklavyen arteri yaralanmış, yaygın pariyetal lezyonlara neden olmuştu. Bu lezyonların kesin cerrahi onarımı travmadan yedi saat sonra yapılmıştı. Vurgulamak isteyeceğimiz, başarılı sonuçlara katkıda bulunan tedavi ilkeleri: travma ekibinin hızlı olay yerine ulaşımı ve olaya müdahalesi, batan cismin minimal manipülasyonu, ameliyathanede doğrudan görüş altında batan cismin tek parça halinde çıkartılması, solunum desteği, yaygın debridman ve lavajla birlikte uygun antibiyoterapi.

Anahtar sözcükler: penetran yaralanmalar; torakotomi; toraks yaralanması; yabancı cisim.

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