

CASE REPORTS

IMPALEMENT INJURIES OF THE CHEST

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SUMMARY

Impalement injuries of the chest are uncommon in civilian practice with few reports in the literature. We report three cases of thoracic impalement seen over a 5 year period with unusual underlying mechanisms. In two of the cases, the impalement was obvious; in the third, the impalement was concealed having occurred 5 months earlier. In Case 1, the underlying mechanism was a high-speed road traffic accident. The patient was impaled by a metallic square pipe piled by the roadside. In Case 2, the gun-housing of a locally-made rifle gave way as it was fired and allowed a reverse ejection of the barrel during recoil that impaled the hunter's chest. In Case 3, a domestic assault with an old umbrella caused an impalement injury as one of the umbrella spokes broke off, penetrated and lodged in the left chest going unnoticed for 5 months. Persistent chest pain and haemoptysis led to a request for chest radiographic examination upon which the foreign body was discovered. Massive haemoptysis brought the patient to emergency thoracotomy. All three patients underwent thoracotomy with a successful outcome.

Keywords: Impalement injuries, thoracic, mechanisms, debridement, management.

CASE REPORTS

Case 1

A 22 year-old lady was referred to the National Cardiothoracic Centre (NCTC) with an impalement injury of the left upper chest following a road-traffic accident that morning as a passenger. When the van in which she was travelling skidded off the road, she got impaled on a metallic pipe piled by the roadside. She had chest pain and dyspnoea on admission. Examination showed a metallic square pipe lodged in the left chest in through-and-through fashion antero-posteriorly (Figure 1). She was conscious, alert and haemodynamically stable with a blood pressure of 110/80mmHg

and a pulse of 104/minute. Respiratory examination showed signs of a left haemopneumothorax and left lung collapse. Apart from a laceration of the right arm and forearm the rest of the physical examination was normal. A left chest tube was inserted and preparations were made for thoracotomy. Broad-spectrum antibiotic prophylaxis (1 gram ceftriazone and 500mg metronidazole) and tetanus immunoglobulin were administered prior to surgery.



Figure 1 Case 1 with impaled metallic object

At surgery, the foreign body was extracted carefully without sequelae. There was a laceration of the left upper lobe; no major vessel or cardiac injury was found. The injured part of the left lung was debrided and the resulting defect repaired. Debridement of the chest wall at the entry and exit wounds was carried out. The pleural cavity and chest wall wounds were copiously lavaged with saline, a chest tube was passed and the incisions closed primarily. The patient was returned to the Intensive Care Unit. She made an uneventful recovery and was discharged on the 14th post-operative day.

Case 2

An 18 year old male farmer was referred to the NCTC with a day's history of a metal lodged in the right chest, chest pain and breathlessness. He suffered the injury a day prior to presentation whilst hunting with a locally manufactured rifle. As he fired at a bird perched on a tree, the recoiling barrel was ejected retrograde and penetrated his chest. He was seen at a nearby clinic, given tetanus prophylaxis and referred to our centre. On examination, he was conscious and alert with mild pallor of the mucous membranes. The breech end of the barrel could be seen adjacent to the inferior angle of the right scapula while the bore end was seen jutting out just beside the jugular notch (Figure 2).



Figure 2 Case 2: The gun barrel protruding from the suprasternal notch.

He had a pulse of 92 beats per minute and a blood pressure of 105/55 mmHg. He was breathing at 32 cycles per minute with features of a right haemopneumothorax and complete collapse of the right lung. The rest of the systemic examination was normal. The chest X-ray confirmed the clinical findings. Additionally, there were fractures of the right fifth to seventh ribs posteriorly.

He was prepared for thoracotomy that afternoon. Antibiotic prophylaxis (as in case 1 above) was administered at induction of anaesthesia and a double-lumen endotracheal tube was passed to facilitate isolation of the right lung. Intra-operatively, no major blood vessel was injured; the oesophagus and the trachea were intact. The metal had gone through the upper lobe of the right lung through to the posterior chest wall. The right lung showed significant contusion and the endotracheal tube returned frothy bloody secretions from the right bronchial lumen which was repeatedly sucked out by the anaesthetists. The foreign body was removed with no significant bleeding. After debridement of all devi-

talised tissue, the defects in the lung and chest wall were repaired. Satisfactory re-expansion of the right lung was achieved intra-operatively. Copious saline lavage of the pleural cavity and chest wall wounds was carried out and the incision closed. Post-operatively, the patient required mechanical ventilation on account of hypoxic respiratory failure. He was successfully weaned after six days of mechanical ventilation. He was discharged from hospital on the fifteenth post-operative day with a superficial infection of the exit wound. This healed with daily dressings on out-patient basis.

Case 3

A 17 year-old female was referred to the emergency room with a three month history of recurrent haemoptysis, left-sided chest pain and fever. Five months prior to presentation, she was assaulted in the interscapular area from behind with an old umbrella. She had been unwell since with intermittent fever, left-sided chest pain and later haemoptysis. On examination, she was ill, pale and febrile (38°C). She was in respiratory distress with signs of a massive left pleural effusion. The effusion proved bloody on aspiration. She had a weak pulse of 122 beats per minute and a blood pressure of 100/60mmHg.



Figure 3 Case 3: Chest X-ray showing left pleural effusion (haemorrhagic). The umbrella spoke is seen in the left upper hemithorax.

Chest x-rays in frontal and lateral projections confirmed the clinical findings and also demonstrated a rod-like metallic foreign body in the upper posterior left hemithorax (Figure 3, lateral view not shown). A left chest tube was inserted and returned 950cc of bloody fluid. She was transfused with 2 units of whole blood. Systemic antibiotics, analgesics and chest physiotherapy were begun. She improved remarkably on these measures. Exploratory thoracotomy was

planned electively. However, on the tenth day of admission, the patient developed massive haemoptysis (approximately 800cc) with impending cardiovascular collapse. Emergency thoracotomy had to be undertaken. At operation, a double-lumen left-sided endotracheal tube was inserted after induction of anaesthesia and the chest entered through a left postero-lateral fourth inter-costal space thoracotomy. In the course of mobilising the left lung, torrential bleeding with near-total exsanguination of the patient resulted. After securing haemostasis and appropriate volume resuscitation, the source of the bleeding was found to be a 2cm defect in the aortic isthmus.

This turned out to be the avulsed wall of a pseudoaneurysm that had apparently resulted from the injury. A fistula had formed between the pseudoaneurysm and the left lung with a contained rupture into the left pleural space. The aortic defect was closed primarily, the connection to the left upper lobe was repaired by direct suture and the foreign body (an umbrella spoke) retrieved from the vicinity of the aneurysm. The rest of the procedure was completed successfully. The patient was returned to the Intensive Care Unit and made an uneventful convalescence. She was discharged on the fourteenth post-operative day.

DISCUSSION

Impalement injuries result from the penetration of fixed elongated objects through the body. Projectile missile injuries resulting from firearms are generally excluded from the definition but stab wounds where the knife or sword is left in the victim are considered to be impalement injuries. Thoracic impalement injuries are rare in civilian practice probably because many of the patients who sustain these types of injuries die prior to presentation in a hospital. Our experiences as well as that of others indicate these injuries may present overtly or in a concealed fashion.^{1,2,3} In overt impalement injuries, the impaling object is seen protruding from the victim's body. Consequently, the clinical problems are usually obvious and clinical decision-making usually uncomplicated. In concealed impalement injuries, the impaling object typically lodges within the body in its entirety and may not attract attention until the development of life-threatening complications.¹ Clinical decision-making is often confounded by a tortuous path to diagnosis.

Commonly, the mechanism involved in the causation of impalement is one in which there is an impact between the human body and an immobile object. Accidental falls and road-traffic-accidents involving collisions with a protruding object or patients ejected from automobiles who fall onto protruding objects typify this mechanism. Case 1 in this report exemplifies this

mechanism of impalement. Cases 2 and 3 are rather unusual in this regard – the impaling object was the mobile one. The mechanism in Case 2 is even more unusual: the retrograde ejection of the barrel from the gun housing during recoil and the impalement of the shooter as a consequence. In nature, every action has an equal and opposite reaction. This principle is responsible for the recoil effect in guns. When a bullet is propelled down the gun's barrel, the forward force of the bullet has an opposite force that pushes the barrel backward. This recoil force normally just pushes the gun back at the shooter. In this case, the gun housing was defective and allowed unrestrained motion of the barrel to impale the shooter's chest beginning with the breech end which came to a halt just outside the skin between the scapula and vertebral column. Case 3 demonstrates the problems with diagnosis and management of concealed impalement injuries. The symptoms were not ascribed to the impalement until the development of life-threatening complications. The unusual mechanism and the fact that no definite external sign of penetration was seen after the impact contributed to the diagnostic uncertainty.

General principles of trauma care apply in the management of thoracic impalement injuries. Attention to the airway, breathing and circulation are paramount. The pre-hospital phase of care is even more crucial. With rare exception, the impaling object should be left in-situ during transport.⁴ Efforts at removal are best carried out under direct vision in a controlled environment as obtains in an operating theatre.⁵ Premature removal may result in exsanguinating haemorrhage.

Generally, thoracic impalement injuries require surgical attention and preparations should be made in this regard keeping radiographic and laboratory investigations to a minimum. Adequate amounts of blood should be made available as well as facilities for cardiopulmonary bypass as profuse haemorrhage may attend the surgical procedure. We experienced this in the management of Case 3. Tetanus and antibiotic prophylaxis should be administered as the impaling objects often have high infective potential. The operative approach may be a thoracotomy or a sternotomy based on the suspicion of involved organs; thoracotomy was satisfactory in all our patients as there was no mediastinal involvement. A chest tube must be placed before mechanical ventilation is begun to prevent the possible development of tension pneumothorax. The use of a double-lumen endotracheal tube allows selective bronchial isolation and prevents soiling of the uninvolved lung with attendant complications. This was particularly helpful in the management of Case 2. The foreign body is removed under direct vision bearing in mind the possible loss of any tamponade effect and subse-

quent haemorrhage that may attend the removal. All devitalized tissue must be removed and copious saline lavage carried out. The wounds may be closed primarily or otherwise based on assessment of the possibility of infection.

From our experience and that reported by others, patients with thoracic impalement injuries reaching hospital have a good chance of survival if general principles of trauma care are followed by a multi-disciplinary team experienced in trauma care.^{3,4,7} Other factors that have been reported to contribute to a good outcome are the absence of mediastinal involvement, young age, and right-sided chest impalement.⁵

REFERENCES

1. Chalmers JA, Graham TR, Magee PG. A concealed impalement injury of the chest - an unusual intrathoracic foreign body. *Eur J Cardiothorac Surg.* 1989; 3(3): 267-269.
2. Shikata H, Tsuchishima S, Sakamoto S, Nagayoshi Y, Shono S, Nishizawa H, Watanabe Y, Matsubara J. Recovery of an impalement and transfixion chest injury by a reinforced steel bar. *Ann Thorac Cardiovasc Surg* 2001; 7: (5) 304-306.
3. Hyde MR, Schmidt CA, Jacobson JG, Vyhmeister EE, Laughlin LL. Impalement injuries to the thorax. *Ann Thorac Surg* 1987; 43: 189-190.
4. Carole LF, Naidoo P. Breaking the rules: a thoracic impalement injury. *MJA* 1999; 171: 676-77.
5. Darbari A, Tandon S, Singh AK. Thoracic impalement injuries. *IJTCVS* 2005; 21: 229-231.
6. Chui WH, Cheung DL, Chiu SW, Lee WT, He GW. A non-fatal impalement injury of the thorax. *JR Coll Surg Edinb.* 1998 Dec; 43(6): 419-21.
7. Robicsek F, Daugherty HK and Stansfield AV. Massive chest trauma due to impalement. *J Thorac Cardiovasc Surg.* 1984 Apr; 87(4): 634-636