



ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

Major penetrating thoracic trauma – The importance of collaboration between different specialties

Amalie Lambert Kristensen^{a,*}, Ole Brink^{b,c}, Ivy Susanne Modrau^{a,c}, Nikolaj Eldrup^d, Anette Højsgaard^a, Thomas Decker Christensen^{a,c}^a Department of Cardiothoracic and Vascular Surgery, Aarhus University Hospital, DK - 8200 Aarhus N, Denmark^b Department of Orthopedic Surgery, Aarhus University Hospital, DK - 8200 Aarhus N, Denmark^c Department of Clinical Medicine, Aarhus University, DK - 8200 Aarhus N, Denmark^d Department of Vascular Surgery, Rigshospitalet, DK - 2100 Copenhagen East, Denmark

ARTICLE INFO

Keywords:

Thoracic trauma
 Penetrating trauma
 Subclavian vessel injury
 Costa fractures
 Multidisciplinary approach

ABSTRACT

Introduction: Penetrating thoracic trauma presents a rare and serious condition with great diversity in impalement mechanisms and following injuries, resulting in a high mortality. This case reports successful management of a severe thoracic trauma and need for collaboration between surgical specialties.

Presentation of case: An 18-year-old, otherwise healthy, Caucasian female had penetration of the chest with a wooden post due to a solo car accident and was admitted to a Level 1 trauma center at a university hospital. Trauma computed tomography scan showed costa fractures and fracture of the left clavicular bone. Damage to the subclavian artery, the brachial plexus and pulmonary artery were suspected. Extracorporeal circulation was on standby at surgery. However, removal of the foreign object did not result in any major bleeding. The patient was discharged from hospital on the 19th day after surgery. Fifteen months after the trauma, surgery was performed to remove the first two costae on the left side, as a disfiguring prominence on the neck was the patients' only complaint.

Discussion: Initial management of the patient should follow ATLS® principles with stabilization of airways, breathing and circulation. Multidisciplinary approach resulted in reconstruction of vessels, debridement and wound closure. The importance of follow-up after trauma and surgery are underlined by the current case, as the patient required additional surgery at follow up.

Conclusion: Multidisciplinary approach to the current penetrating trauma resulted in rapid assessment of injuries and management with excellent outcome.

Introduction

Penetrating thoracic trauma presents a rare and serious condition with significant diversity in impalement mechanisms and following injuries, resulting in a high mortality [1]. Typically, these lesions may require multidisciplinary action [2,3], and hereby the need for visitation to a hospital with relevant resources [4]. Penetrating thoracic trauma can influence both airways, breathing and circulation, and the need for a structured and rapid patient assessment according to guidelines are of utmost importance [1,5]. In stable

* Corresponding author at: Department of Cardiothoracic and Vascular Surgery, Aarhus University Hospital, DK - 8200 Aarhus N, Denmark.
 E-mail address: akr@clin.au.dk (A.L. Kristensen).

<https://doi.org/10.1016/j.tcr.2020.100376>

Accepted 1 November 2020

Available online 3 November 2020

2352-6440/© 2020 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

patients a thorough and detailed evaluation can be performed, while a more rapid identification of the reason for hypotension should be a priority in hemodynamically unstable patients, as the obvious suspicion for shock in trauma patients is hemorrhagic [5].

This case reports the successful management of a severe penetrating trauma to the chest and need for collaboration between surgical specialties.

Case report

We present a case of an 18-year-old, otherwise healthy, Caucasian female with penetration of the chest with a wooden post due to a solo car accident, where the car hit a brick wall anchored with wooden posts (Fig. 1A). One of the wooden posts penetrated the left hemithorax of the patient underneath the clavicular bone. At the site of the accident, the patient was cut loose by division of the wooden post, and an approximately 45 cm long solid part was left *in situ* (Fig. 2). Intubation and left mini thoracotomy for chest drain insertion were performed before transportation by helicopter to a Level 1 trauma center at a university hospital. Two red blood transfusions were given during transport. The patient was hemodynamic stable at admission. The trauma team was led by an orthopedic surgeon who performed initial examination, and treatment followed ATLS® principles of ABC management. Extended trauma call was made, and thoracic surgeons were present upon admission. The left arm showed reduced muscle tone and suspicion of damage to the brachial plexus was raised. Hemodynamic stability allowed performance of trauma computed tomography scan (CT) including angiography prior to treatment, with the patient in lateral position. The CT scan revealed fracture of the first three costae and the clavicular bone on the left side (Fig. 1B). The scapula was displaced laterally and posterior by the foreign object. The patient was then taken immediately to theatre. The multidisciplinary team consisted of cardiac-, thoracic-, vascular- and orthopedic trauma surgeons in addition to anesthesia and a perfusionist, the latter to handle extracorporeal circulation. The surgical team was assembled and present in theatre, in order to provide correct and quick surgery when the foreign object was removed.

With the patient still in lateral position, the back of the wooden post was cut with an oscillating saw, and the patient was then rearranged to supine position. In case of hemodynamic instability due to bleeding after removal of the wooden post, the femoral artery and vein were exposed by the cardiac- and vascular surgeons, and extracorporeal circulation was on standby. Removal did not result in any major bleeding. The subclavian artery and vein were identified and found to be torn over and thrombosed in both ends (Fig. 3). The subclavian vein was ligated, whereas the subclavian artery was reconstructed by the vascular surgeon with reversed greater saphenous vein bypass end-to-end. The orthopedic surgeon performed debridement of the wound, and a 32 French chest tube was inserted by the thoracic surgeon. Osteosynthesis of the clavicular bone was omitted to reduce risk of infection from a foreign body (plate). Direct skin closure was feasible at the entry wound, while the exit wound was treated with vacuum-assisted closure therapy and an orthopedic surgeon performed delayed split skin graft due to inadequate skin coverage.

On the 5th postoperative day, CT scan showed a complex pleural effusion with septae on the left side. Thoracic surgeons performed debridement of the pleural cavity via Video Assisted Thoracoscopic Surgery. During the hospital stay, intravenous antibiotics were administered due to increased risk of contamination from the wooden post, especially with spores of fungus. The patient received piperacillin/tazobactam for 11 days, metronidazole for 8 days, and amphotericin B for 11 days as well as a prophylactic tetanus vaccine upon admission. The patient was discharged from the intensive care unit on the 7th day and discharged from the hospital on the 19th day after admission.

At the six months' orthopedic outpatient control, the patient had regained normal range of motion, strength and sensibility of the

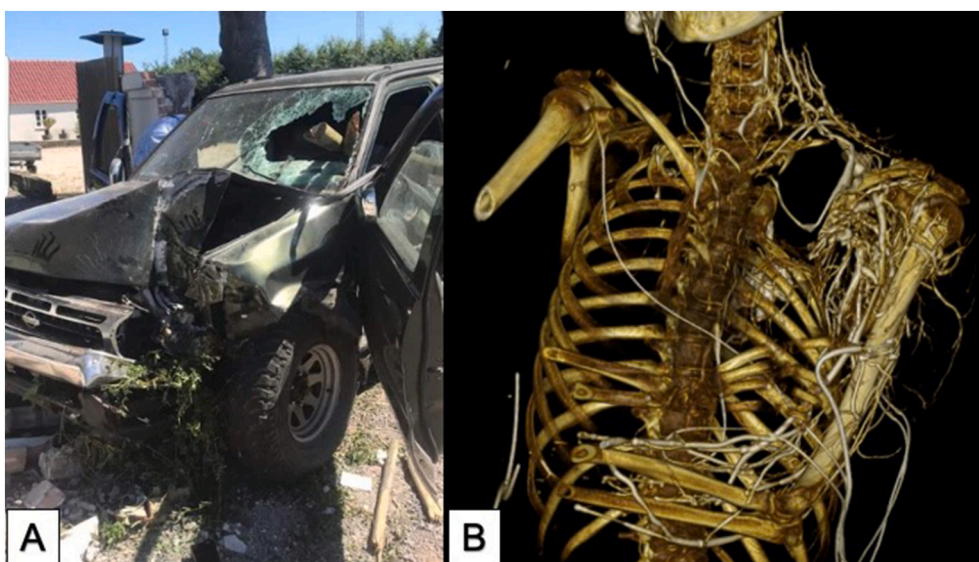


Fig. 1. A: Accident site with a wooden post through the windshield of the car. B: 3D reconstruction of trauma CT scan.



Fig. 2. Different angles of the patient upon admission with the foreign object *in situ*. Head up, feet down. Notice that the patient is in lateral position because of the foreign object.

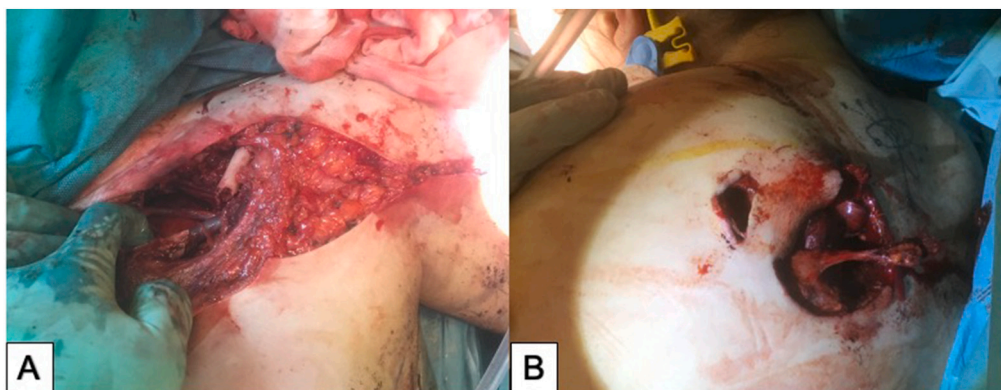


Fig. 3. Intraoperative findings after removal of the foreign object. Head up, feet down. A: Entry wound. Notice the clavicular bone. B: Exit wound.

left arm (Fig. 4A–B). The wounds were healed, and the patient did not wish to be assessed regarding cosmetic wound revision (Fig. 4C). She had no complaints from the former multiple costa fractures or the non-surgical treated clavicular fracture. One year after the accident, she had resumed all daily activities and started studying. The only complaint remained discomfort from a disfiguring prominence on the left side of the neck. A CT scan revealed posterior parts of the fractured costa one and two on the left side as the cause (Fig. 4D). Fifteen months after the trauma, surgery as a joined venture between thoracic and orthopedic surgeons, with resection of costae one and two was performed, leaving *caput costae in situ*. Further resection was omitted because of scar tissue and fear of damage to the brachial plexus. The patient was discharged the day after.

Discussion

The presented case is an example of successful collaboration between different surgical specialties with extraordinary good patient outcome. Correct prehospital management is of utmost importance. Minimal manipulation of the foreign object both prehospitally and upon arrival at the trauma center is critical, as the impaling object may provide a tamponade effect and compress serious vascular lesions [2,4,6]. It is advisable to leave the penetrating object *in situ* and delay removal until proper precautions are in place, as demonstrated by this case. Patients with severe penetrating trauma should always be admitted to a Level 1 trauma center where all surgical specialties are present. A multidisciplinary trauma team ensures minimal delay in diagnosis and adequate treatment to severely injured patients [7]. Initial management of the patient should follow Advanced Trauma Life Support® (ATLS®) principles with stabilization of airways, breathing and circulation [1]. Ambition should be devoted on performing CT scan including angiography to prepare and optimize surgery [8]. In this case, the extent of the trauma, the location of the foreign object and concern of injury to the subclavian artery, the pulmonary artery and the brachial plexus revealed the need for different surgical specialties. With the femoral artery and vein exposed and extracorporeal circulation on standby, no larger incision was made prior to removal, e.g. thoracotomy or sternotomy. The multidisciplinary approach led to each surgeon performing relevant parts of the surgery, thus resulting in primary reconstruction of vessels, fracture treatment, debridement and wound closure. Use of foreign objects for osteosynthesis should be considered omitted in trauma patients with risk of contamination from the penetrating object [9]. Despite malalignment of the clavicular bone, fibrous healing of the fracture occurred, and today the patient has no functional limitations in movement of the left shoulder. Additionally, the importance of follow up after trauma and surgery are underlined by the current case, as the patient was in need of additional surgery.

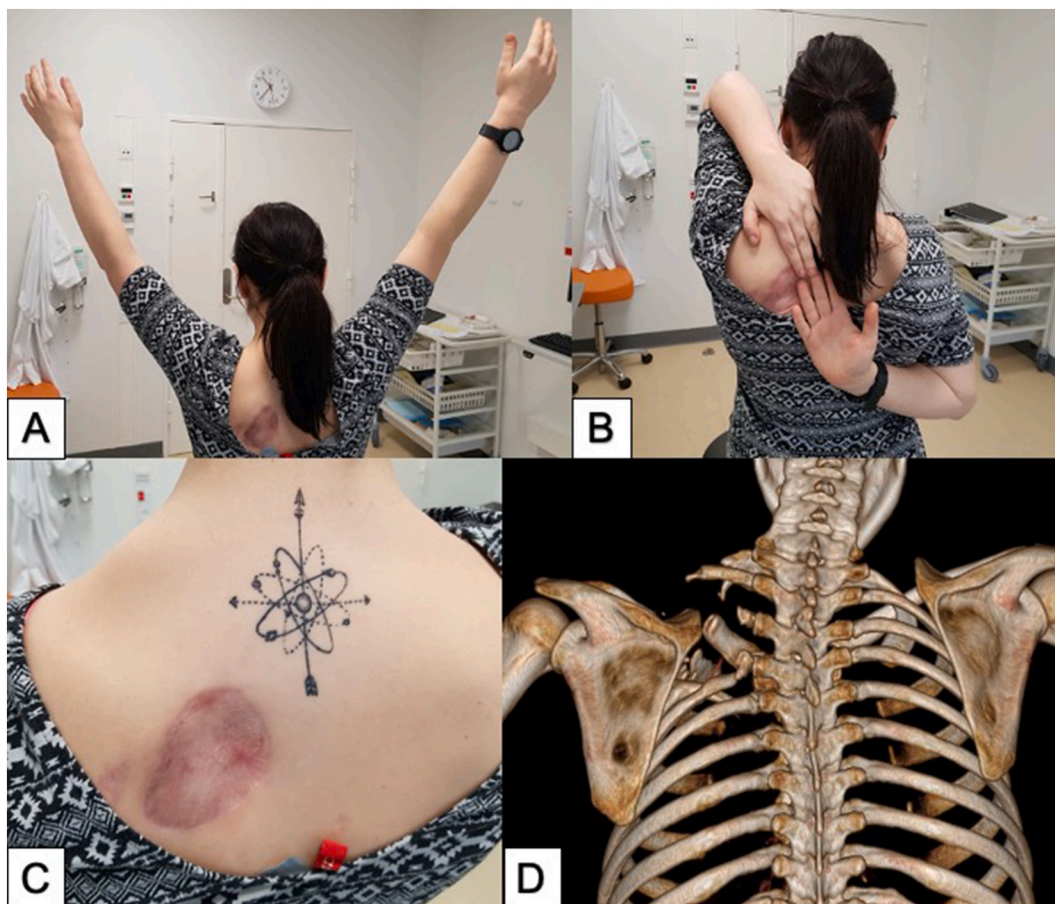


Fig. 4. A–B: Six months' outpatient control showing normal range of motion. C: Exit wound at six months' outpatient control. Notice the disfiguring prominence on the left side of the neck. D: 3D reconstruction CT scan prior to removal of the posterior part of costae one and two.

Informed consent

The patient gave informed consent prior to publication of this case report.

Declaration of competing interest

Thomas Decker Christensen: has been on the speaker bureaus for AstraZeneca, Boehringer-Ingelheim, Pfizer, Roche Diagnostics, Takeda, Merck Sharp & Dohme (MSD) and Bristol-Myers Squibb and has been in an Advisory Board for Bayer and Merck Sharp & Dohme (MSD).

Nikolaj Eldrup: has been on the speaker bureaus for Bayer, Pfizer and Amgen and has been in advisory board for Bayer and AstraZeneca.

References

- [1] American College of Surgeons, 10th Edition of the Advanced Trauma Life Support (ATLS) Student Course Manual, Chicago (IL), 2018.
- [2] I.P. Kelly, S.E.A. Attwood, W. Quilan, M.J. Fox, The management of impalement injury, *Injury* 26 (1995) 191–193.
- [3] R.M. Ruano, B.M. Pereira, G. Biazoto, J.B. Bortoto, G.P. Fraga, Management of severe thoracic impalement trauma against two-wheeled horse carriage: a case report and literature review, *Indian J Surg* 76 (2014) 297–302.
- [4] S. Lunca, O. Alexa, M. Pertea, Severe thoracic impalement injury: survival in a case with delayed surgical definitive care, *Ulus Travma Acil Cerrahi Derg* 21 (2015) 152–156.
- [5] M. Schellenberg, K. Inaba, Critical decisions in the management of thoracic trauma, *Emerg Med Clin N Am* 36 (2018) 135–147.
- [6] J. Ha, R.A. Sikorski, J. v O'Connor, Thoracic impalement by a steel reinforcing bar, *Am Surg* 84 (2018) 6–8.
- [7] A. Georgiou, D.J. Lockey, The performance and assessment of hospital trauma teams, *Scand J Trauma Resusc Emerg Med* 18 (2010) 66.
- [8] X. Tang, H. Chen, C. Chen, J. Xu, A case report of a polytrauma patient with penetrating iron rods in thorax and head, *Medicine* 97 (2018) 1–4.
- [9] S.D. Elek, Experimental staphylococcal infections in the skin of man, *Ann N Y Acad Sci* 65 (1956) 85–90.