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Case Report

Management of an abdominal penetration injury due to a car accident

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Introduction

Penetrating injuries are caused by heterogenous trauma mechanisms and are much rarer than blunt injuries. Suicide- or violent crime-associated gunshot and stabbing wounds are the most common causes. Other origins are for example trauma caused by accidents. Penetrating injuries are rare challenges for physicians in Germany and Western Europe. A retrospective analysis of the trauma registry of the German Trauma Society (*TraumaRegister DGU®*) between 2009 and 2018, by Bieler et al. demonstrated penetrating injuries with an incidence of 4.1% among severely injured patients (AIS >1) [1]. Compared to the United States where the incidence of penetrating injuries is 20% [2], penetration wounds are a considerable rare entity in Germany. According to the aforementioned registry, gunshot and stab wounds account for 57% of penetrating injuries. The most frequent injuries other than those are road traffic accidents by car (15.5%) or motorcycles (14.2%), and falls (23%). Lower (41.3%) and upper extremities (35.6%), head (34.3%) and chest (33.6%) are the most frequently affected regions. Among penetrating injuries other than gunshot and stab wounds, the abdominal region is involved in 13.0% [1]. Consequently, abdominal penetration due to car accident is a rare entity. Because of the low incidence of traumatic abdominal penetration injuries due to road traffic accidents by car, the management of this type of penetrating injury is challenging for medical professionals at all levels of health care.

Case presentation

A 41-year-old male patient was admitted to our emergency department after a car accident. He lost control of his car and went off road with approximately 65 mph. The crash barrier impaled the vehicle and severely injured the patient who was wearing a seat belt. Due to the abdominal penetration injury, the patient was intubated at the scene. The paramedic service estimated an initial blood loss of 2000 ml.

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A multislice computed tomography scan (MSCT) was performed after cardiopulmonal stabilization at the resuscitation room. The MSCT showed (1) an open abdominal wall injury with rupture of the straight abdominal muscles, (2) dislocation of almost the entire small bowel, the descendosigmoid junction and the cecum, (3) diffuse, free intra- and retroperitoneal air, and (4) multi-fragment fracture of the left os ilium (Fig. 1). The patient was immediately transferred to the operating room. Because of advanced wound contamination a calculated antibiotic therapy with Piperacillin/Tazobactam (Hexal AG, Holzkirchen, Germany) was started preoperatively.

The intraoperative inspection of the abdominal wall and cavity revealed the following findings: Extensive penetrating abdominal injury with multiple ileum perforations, elongated avulsion and ischemia of the attached ileum segments, open fracture of the left pelvic crest, complete disruption of the left abdominal wall and severe decollement of the cutis.

According to the applied damage control surgery (DCS) approach 130 cm ischemic ileum were resected and blind closure of both ends was performed. Since the os ilium fragments penetrated the peritoneum and caused perforation, it was decided to remove the displaced and significantly contaminated fragments. After removal of the left os ilium fragments out of the abdominal cavity, debridement of the abdominal wall defect, and lavage, the abdomen was temporally closed by an abdominal vacuum assisted closure (VAC) with minus 40 mmHg (Fig. 2). The total operation time was 60 min. Due to hemorrhage the patient required transfusion of six packed cells, four fresh frozen plasma units, 8 mg of fibrinogen and 3000 units prothrombin complex concentrate. Afterwards the patient was transferred to the intensive care unit (ICU). Between post-operative day 2 and 8 the patient received parenteral nutritional support. A scheduled second-look surgery was performed after 36 h. The intestinal continuity could be restored by a side-to-side ileo-ileostomy. Furthermore, it was possible to partially adapt the straight and oblique abdominal muscles. Following radical decontamination we opted for a planned hernia approach.

Two days later, the patient was again transferred to the operating room to change the abdominal vacuum dressing. Because of a leakage at the ileo-ileostomy, an ileocecal resection and with primary anastomosis was carried out. The calculated antibiotic therapy was administered until post-operative day 12 and no further antibiotics were needed.

19 days after the accident, and after repeated debridement of the abdominal wall and continued abdominal vacuum assisted-therapy for decontamination, a mesh implantation with *Phasix® ST* Mesh (C. R. Bard GmbH, Karlsruhe, Germany) of approx. 20 × 35 cm size as an open intraperitoneal onlay mesh (IPOM) repair was performed. To ensure granulation matrix and later graft meshing of the defect, the mesh was covered again with vacuum dressing. After 20 days more of continues vacuum assisted-therapy and after another four changes, the defect could be covered by skin grafted meshing (Fig. 3).

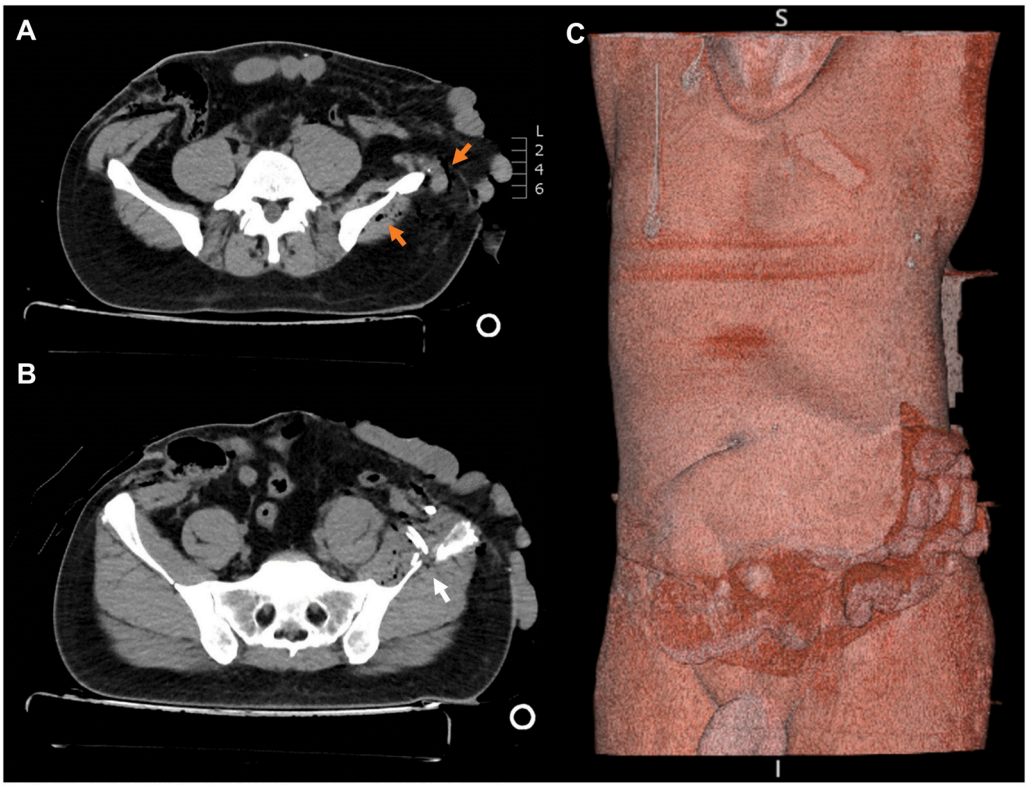

Fig. 1. MSCT (A, B) showing evisceration of the small bowel; diffuse free intra- and retroperitoneal air (orange arrow): multi fragment fracture of the left os ilium (white arrow); and (C) 3D-reconstruction of MSCT imaging demonstrating an advanced open abdominal wall injury with rupture of the abdominal muscles. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

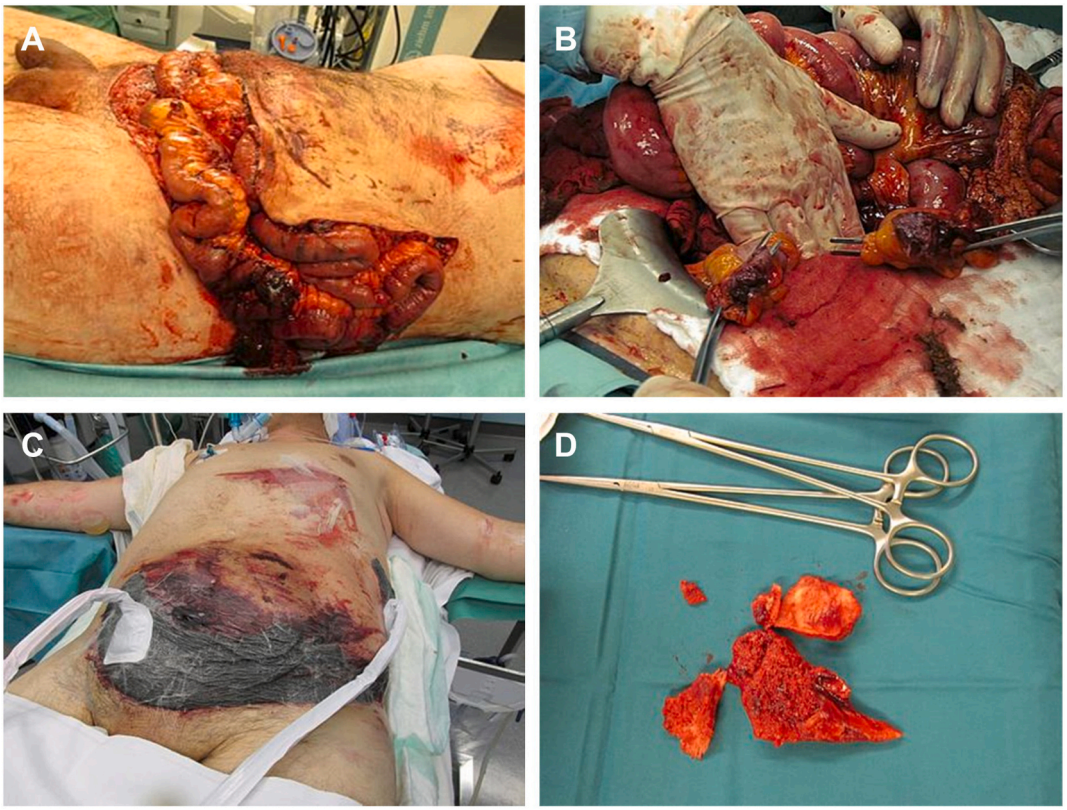

Fig. 2. (A) Photography showing the abdominal wall defect with evisceration and ischemic small bowel; (B) status after resection of 130 cm ischemic ileum; (C) temporally closure with abdominal VAC after debridement; and (D) os ilium fragments.

The patient was treated at the ICU for 6 days, at the intermediate care unit for additional 5 days. The total hospital stay was 55 days.

Discussion

Abdominal penetration due to car accidents is a rare entity in Germany. Especially advanced abdominal wall defects due to penetration need highly specialized therapy regimes to ensure functional satisfying results.

A MSCT of the hemodynamic stable or stabilized patient at the resuscitation room is the gold standard for initial diagnosis [3]. According to Clarke et al. the probability of death increases approx. 1% for each 3 min in the emergency department [4]. Thus, rapid transfer to the operating room is essential in case of severely injured patients with abdominal bleeding from trauma. Abdominal evisceration remains an indication for emergency laparotomy as well [5]. For selected critically injured patients with the 'lethal triad' of hypothermia (<34 °C), acidosis (pH < 7.2), and coagulopathy (INR > 1.6 or intraoperative transfusion >4 l) DCS is indicated [6]. Initially, DCS includes rapid hemostasis, intraabdominal packing, avoidance of further contamination, debridement and temporary closure of the abdomen. Reconstruction of organ injuries and definitive abdominal wall closure needs a planned second-look surgery [7]. In case of contamination, the primary reconstruction or implantation of a biological mesh is theoretically possible [8]. In practice, however, experience has shown that a cosmetically and functionally good result is more likely to be achieved with a multi-stage procedure.

Conclusion

While initially there is no time to lose in treating a severe penetrating abdominal trauma, functional reconstruction of the abdominal wall is a long-term treatment goal. In the presented case we used a slowly absorbable mesh which was implanted as abdominal wall replacement to cover the otherwise exposed small bowel. The mesh was implanted for abdominal wall remodeling. Due to the destruction of the abdominal wall with an extensive defect in the left hemiabdomen with almost complete infraumbilical loss of the straight abdominal muscles, the abdominal wall of the patient could not be reconstructed (Fig. 4). Initially, a planned hernia approach was chosen. Subsequently, there was the indication for a component separation technique, for example by a transversus abdominis release according to Novitsky/Rosen [9], combined with mesh augmentation and a myocutaneous free tissue flap [10].

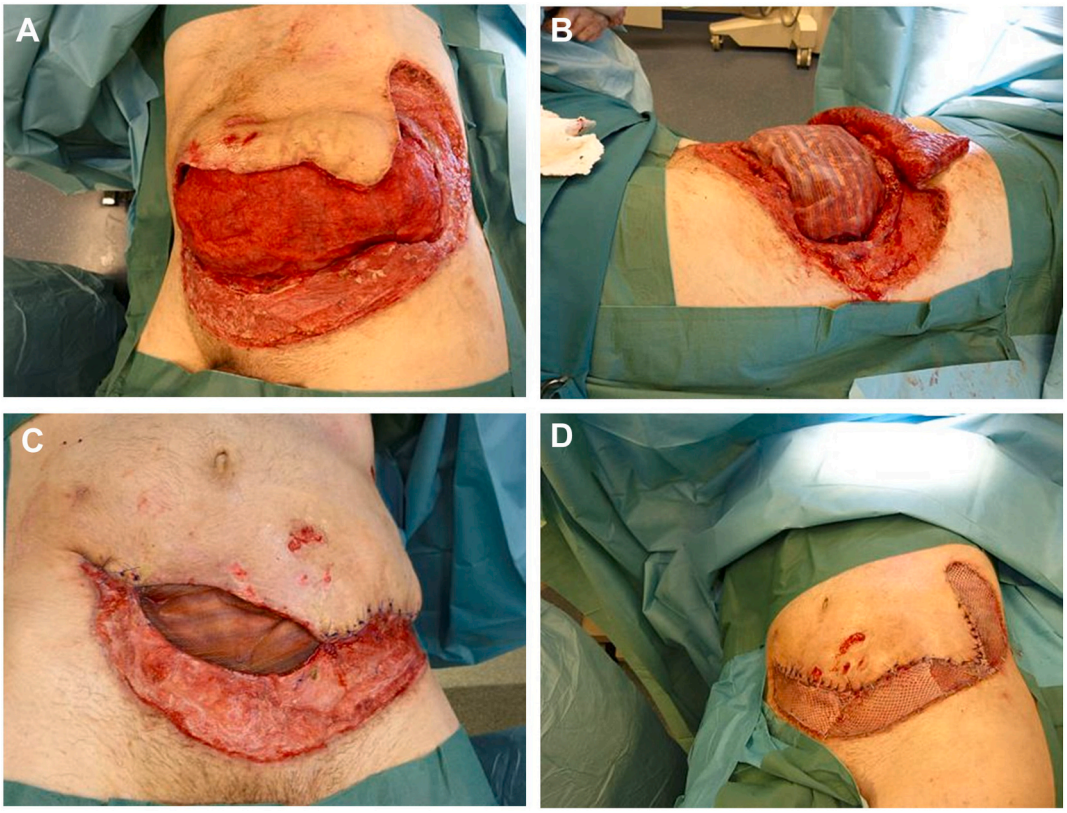

Fig. 3. (A) Decontaminated abdominal wall defect with omentum majus and exposed small bowel; (B, C) abdominal wall reconstruction using an open IPOM repair with Phasix® ST Mesh implantation; (D) defect covered by skin graft mesh.

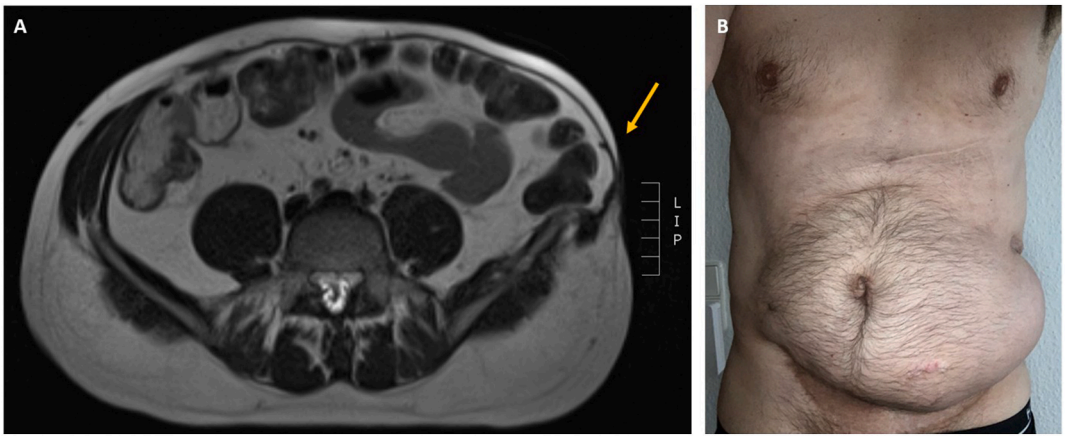

Fig. 4. (A) MRI at 10 month follow-up showing herniation (→) due to loss of ilium bone and abdominal muscle; (B) photography of the abdomen at 18 month follow up. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Abbreviations

MSCT	multislice computed tomography
TraumaRegister DGU®	trauma registry of the German Trauma Society
AIS	abbreviated injury scale
DCS	damage control surgery
ICU	Intensive care unit

VAC vacuum assisted closure
INR international normalized ratio
MRI magnetic resonance imaging

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References

[1] D. Bieler, E. Kollig, L. Hackenberg, et al., Penetrating injuries in Germany – epidemiology, management and outcome an analysis based on the TraumaRegister DGU®, Scand. J. Trauma Resusc. Emerg. Med. 29 (80) (2021) 1–14, https://doi.org/10.1186/s13049-021-00895-1.
[2] D.S. Kauvar, C.E. Wade, The epidemiology and modern management of traumatic hemorrhage: US and international perspectives, Crit. Care 5 (9 Suppl) (2005) 1–9, https://doi.org/10.1186/cc3779.
[3] R.A. Novelline, J.T. Rhea, P.M. Rao, J.L. Stuk, Helical CT in emergency radiology, Radiology 213 (2) (1999) 321–339, https://doi.org/10.1148/radiology.213.2.r99nv01321.
[4] J.R. Clarke, S.Z. Trooskin, P.J. Doshi, L. Greenwald, C.J. Mode, Time to laparotomy for intra-abdominal bleeding from trauma does affect survival for delays up to 90 minutes, J. Trauma 52 (3) (2002) 420–425, https://doi.org/10.1097/00005373-200203000-00002.
[5] M. da Silva, P.H. Navsaria, S. Edu, A.J. Nicol, Evisceration following abdominal stab wounds: analysis of 66 cases, World J. Surg. 33 (2) (2009) 215–219, https://doi.org/10.1007/s00268-008-9819-y.
[6] S. Germanos, S. Gourgiotis, C. Villias, M. Bertucci, N. Dimopoulos, N. Salemis, Damage control surgery in the abdomen: an approach for the management of severe injured patients, Int. J. Surg. 6 (3) (2008) 246–252, https://doi.org/10.1016/j.ijsu.2007.05.003.
[7] J.A. Loveland, K.D. Boffard, Damage control in the abdomen and beyond, Br. J. Surg. 91 (9) (2004) 1095–1101, https://doi.org/10.1002/bjs.4641.
[8] A. Hamidian Jahromi, J. Skweres, G. Sangster, et al., What we know about management of traumatic abdominal wall hernia: review of the literature and case report, Int. Surg. 100 (2) (2015) 233–239, https://doi.org/10.9738/INTSURG-D-13-00239.1.
[9] Y.W. Novitsky, H.L. Elliott, S.B. Orenstein, M.J. Rosen, Transversus abdominis muscle release: a novel approach to posterior component separation during complex abdominal wall reconstruction, Am. J. Surg. 204 (5) (2012) 709–716, https://doi.org/10.1016/j.amjsurg.2012.02.008.
[10] A. Leppäniemi, E. Tukiainen, Reconstruction of complex abdominal wall defects, Scand. J. Surg. 102 (1) (2013) 14–19, https://doi.org/10.1177/145749691310200104.