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Case Report

Managing post-traumatic gunshot thoraco-abdominal bleeding by intervention embolisation: A case report

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الملخص

يصف هذا التقرير حالة مثيرة للاهتمام ومهددة لحياة المصاب؛ ناتجة عن الإصابة بطلق ناري أدى إلى نزيف شديد في منطقة البطن والصدر. حيث خضعت لانصمام شرياني انتقائي لوقف النزيف بعد عمليتين جراحتين لم يتمكنا من السيطرة على النزيف في الحجاب الحاجز وما تحت الحجاب الحاجز، مع نزيف شديد في الكبد وتجمع لورم دموي تحت الحجاب الحاجز. عرضنا صور الأشعة المقطعية التي توضح مكان حدوث النزيف وصور الشرايين المغذية للكبد التي تظهر النزيف النشط قبل الانصمام وتوقف النزيف بعد الانصمام بواسطة تصوير الأوعية الدموية بالطرح الرقمي. تم شرح التاريخ المرضي وتقدم حالة المريض وكتابة مناقشة الحالة والاستنتاج.

الكلمات المفتاحية: الإصابة بطلق ناري؛ نزيف كبدي؛ تصوير الأوعية الدموية؛ الانصمام الشرياني؛ البطن

Abstract

We report an interesting life-threating case of post-traumatic severe bleeding in the thoraco-abdominal region. The patient was initially treated by open surgery, which failed to control bleeding in the intrahepatic and sub-diaphragmatic regions of the liver with associated haematoma collection. As bleeding continued, on the 2nd post-operative day, the patient underwent super-selective embolisation of the bleeding vessels to cease serious bleeding. The pre-embolisation arterial feeders with active bleeding and post-embolisation images by computed tomography subtraction angiography showed complete cessation of haemorrhage. Torrential haemorrhage in the thoraco-abdominal regions can be successfully managed by trained interventional radiologists in highly specialised centres.

Keywords: Abdomen; Angiography; Embolisation; Hepatic bleeding; Traumatic-gunshot

Introduction

Selective arterial embolisation was developed early in November 1970 when an actively bleeding gastroepiploic artery was successfully occluded using a vasoconstrictor agent in a 43-year-old patient with hepatic failure who had a severe coagulation defect.[1] Arterial embolisation has been evolving since then, and it has become a key element in the control of massive haemorrhage and management of various high-grade organ injuries, such as blunt hepatic trauma,[2,3] pelvic trauma,[4] acute gastrointestinal haemorrhage,[5] renal lesions,[6] and post-partum haemorrhage.[7] Arterial embolisation is indicated in two principal occasions after traumatic injury: primary control of bleeding in haemodynamically stable patients with computed tomography (CT) imaging evidence of active arterial bleeding and adjunctive haemostatic control in haemodynamically unstable patients with potential arterial bleeding, despite various trials of resuscitation including emergency laparotomy. Successful management of grade III and higher injuries often encompass a combined angiographic

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and surgical approach. Awareness of the ischaemic complications due to angioembolisation is important.[2]

Case report

A 29-year-old male patient presented to the emergency department of a private hospital in Almadinah Almunawarah after he sustained a gunshot that traversed the right upper quadrant of the abdomen passing through the right side of the chest and exiting through the back. On examination, the patient was in shock with low blood pressure (80/35 mmHg), suspected massive right haemothorax noted on chest X-ray images with opacified right hemithorax, and massive haemoperitoneum noted on ultrasound examination with abdominal and subhepatic free fluid with internal echoes. Emergency laparotomy was performed, which showed a liver laceration with a diaphragmatic injury. Repair of the liver laceration and diaphragmatic injury and right-sided insertion of an intercostal tube (ICT) were performed. After surgery, about 2000 mL of blood was drained from the ICT. The patient was then transferred to the intensive care unit (ICU) on mechanical ventilation and was evaluated by the thoracic surgery team; their advice was to stabilise the haemodynamic status of the patient and then shift him to the King Fahad Hospital Almadinah Almunawwarah (KFHM) ICU. After stabilisation, the patient was transferred, and upon admission to KFHM, he remained unstable despite various trials of resuscitation. His blood pressure was 103/60 mmHg, pulse was 150 bpm, and haemoglobin level was 8 g/dL. CT of the chest and abdomen was performed, which showed right moderate haemothorax with contrast extravasation, right lung contusion, and basal segment collapse. Liver laceration with contrast extravasation and perihepatic fluid collection extending down to the right paracolic gutter were also detected, along with a D11–D12 right transverse process fracture (see Figure 1).

Emergency coeliac angiography was performed under general and local anaesthesia, which demonstrated bleeding from a branch of the left hepatic artery. A 6F Simon II catheter was first passed from the coeliac trunk to the common hepatic artery; super-selective coaxial catheterisation of

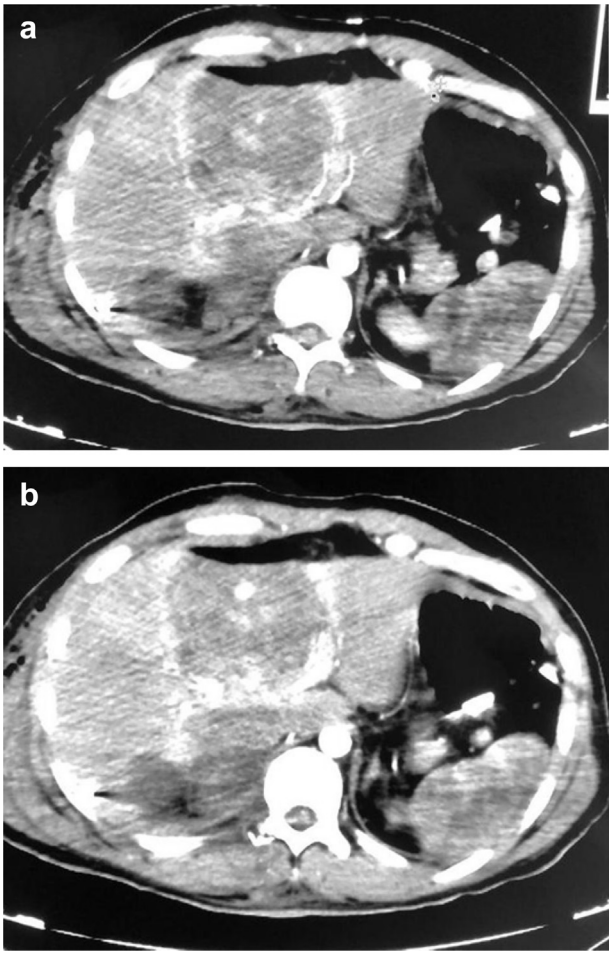

Figure 1: (a and b) CT image showing liver laceration with contrast extravasation denoting active bleeding and perihepatic fluid collection. CT, computed tomography.

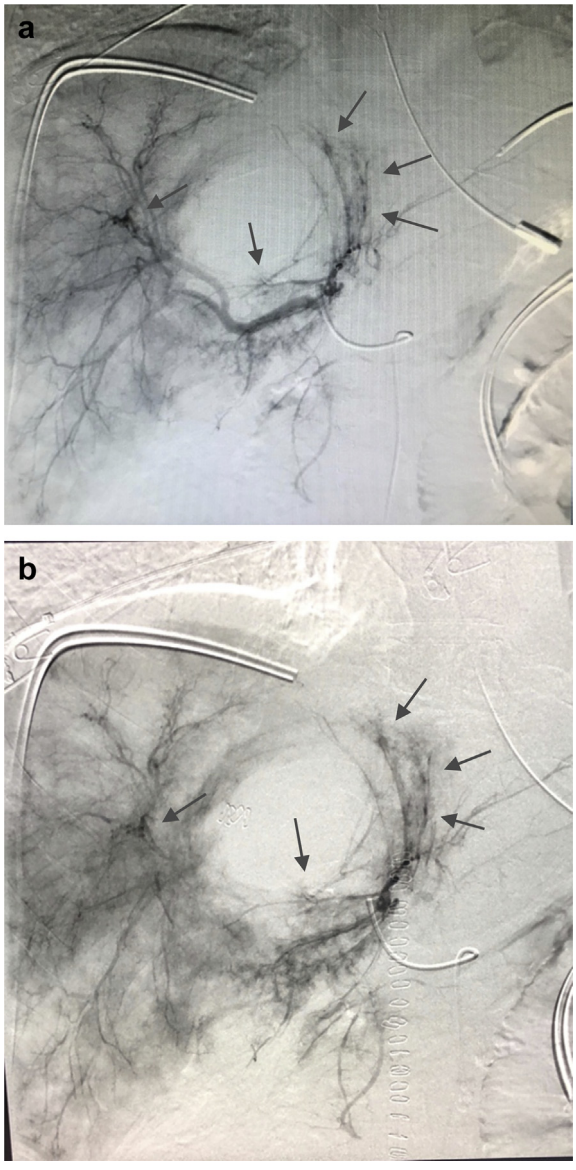

Figure 2: (a and b) Angiographic study showed contrast extravasation from the branches of the left hepatic artery denoting active bleeding, with vessel displacement by a large haematoma.

the left hepatic artery branch was then performed using a 3F microcatheter. Diagnostic angiography showed contrast extravasation from the left hepatic artery branches [Figure 2, (a) arterial phase and (b) capillary phase].

There was also marked vascular arterial displacement surrounding an area of a filling defect, which showed absent normal hepatic capillary blush, denoting an area of haematoma. The main bleeder was embolised using Gelfoam, used as an embolising material, which immediately ceased bleeding into the haematoma cavity. Post-embolisation angiography revealed no further bleeding [Figure 3, (a) arterial phase and (b) capillary phase].

A second-look laparotomy was performed. The abdomen was opened through the site of the previous incision. The drain was removed, and 200 mL of blood was withdrawn. There were many blood clots, which were removed from the subhepatic, pelvic, and both para-colic gutter regions. No active bleeding was found. The previously repaired liver injury was well covered by the stitched omentum. After that, video-assisted thoracoscopic surgery (VATS) was performed through a 2-cm incision at the level of the 5th intercostal space. Thoracoscopy showed an expanded lung with small clots, which were extracted, and no lung tear or air leak was found. The diaphragm was intact. Drainage of 200 mL of old clotted blood and irrigation was performed. An ICT size 32 Fr was inserted.

Post-VATS third-look laparotomy was performed. The previous midline incision was reopened (skin clips removed), and the previously applied packs and drains were removed. No active bleeding or blood clots were observed. The previously sutured liver laceration was still intact with the omental patch over it undistorted. Lastly, mapping, irrigation, and suction were performed with no active bleeding noted. The abdominal wall was closed, and the skin was widely clipped using skin clips. The subsequent recovery was complicated by paraplegia (contusion of conus medullaris, fracture of D11 transverse process), bilateral deep vein thrombosis (large clot in the inferior vena cava), and liver biloma. The patient's condition improved, he was discharged on the 80th day of admission, and he is undergoing regular follow-up with general surgery and physical rehabilitation teams.

Figure 3: (a and b) Post-embolisation angiographic study showed no more contrast extravasation surrounding the haematoma after indicating successful embolisation of the left hepatic artery branches.

Discussion

We did not identify cases of such serious gunshot liver injuries caused by a bullet in the literature. However, sharp traumas of the abdomen are often encountered in road accidents with exposure to or falling on a sharp object. Several publications have accumulated significant evidence on the safety and success of embolisation over the past three decades.[8–17] This is understandable because to carry it out safely, the environment must be properly prepared; have the necessary infrastructure; and be qualified with a readied, united, and cohesive medical team. Clinical examinations and detailed studies of imaging (CT) of the projectiles' paths, to identify or exclude the presence of abdominal injuries, are indispensable to perform non-operative management (NOM). CT of the abdomen, besides being one of the protocol items, has a number of advantages and is essential for this kind of approach, there being evidence level II recommendations.[18] With advancements in technology, multidetector CT has a sensitivity of 91%–97%, a specificity of 96%–98%, and an accuracy of 96%–98% in detecting intra-abdominal injuries in patients with gunshot wound (GSW) abdominal injuries.[19–21] Among the benefits of NOM are the decreases in the frequency of unnecessary laparotomies and their complications, length of hospital stays, and overall treatment costs. Several publications showed that 20%–30% of patients with abdominal GSWs who underwent laparotomies also underwent unnecessary surgeries, strengthening the importance of approaches such as NOM.[8,9,22,23] In recent review articles and guidelines about NOM of penetrating abdominal trauma, the method was considered effective with success rates ranging from 69% to 100%.[18,24,25] In an analytic review of 6072 patients, it was found that only 15.5% required laparotomies for the treatment of complications or failure of NOM.[24] In another review of 6468 patients, only 14.8% required laparotomies due to NOM failure; of those, 28.2% were unnecessary.[25] The recommendations of these reviews and guidelines based on the level of evidence were a) patients with abdominal GSWs who are haemodynamically stable and without signs of peritonitis may be good candidates for NOM (level II) and b) patients with isolated injuries of

solid viscera due to abdominal GSWs in the presence of haemodynamic stability and no worsening of the clinical condition or the abdominal examination may be candidates for NOM (level III).[18,24,25] Liver injuries have certain important features that allow NOM to be performed with high success rates. Currently, it is the first choice of treatment adopted in institutions that have the essential conditions for its use. Most of the time, the bleeding that originates from liver damage ceases spontaneously, a fact often noted by trauma surgeons during surgical approaches to liver damage in haemodynamically stable patients.[26]

During 1947–1963, the surgical findings of 205 liver injuries from stab wounds and 428 from GSWs were documented. In this sample, 86% of stab wounds and 72% of GSWs did not require any treatment, except for drainage at the time of surgery.[27] This highlights the ease with which these injuries can be sealed. However, during surgery or manipulation of the injury, massive bleeding may occur due to loss of the clot. This bleeding is often difficult to control, requires complex surgical manoeuvres, and is associated with high morbidity.[28] In some circumstances of heavy bleeding in critical injuries, it is not possible to achieve satisfactory haemostatic results using conventional surgical techniques, so damage control surgical manoeuvres are required instead. All this can occur in patients that are haemodynamically stable with no active bleeding. Furthermore, it is known that the hepatic parenchyma has a great capacity for healing and regeneration following either traumatic or surgical injury, maintaining the organ architecture. Work in experimental models has shown that 3–6 weeks after the occurrence of an injury, the force required to tear a scar formed is equal to that which would damage normal parenchyma, whether a liver injury was sutured or not.[29] This healing ability is one of the most important factors in the indication, use, and success of NOM for liver injuries, even for those considered complex. The patients followed in this study showed healed injuries in subsequent CT scans. They also maintained adequate coagulation and did not show signs of liver failure, regardless of the extent of the injuries. As previously mentioned, NOM for liver GSWs is not routinely performed, the main reason of which is the high incidence of associated injuries of other visceral and abdominal structures that require surgical treatment. Laparotomy, in most cases, is still the safest approach. However, in a highly selective group of patients, NOM may be a feasible option for liver GSWs, being safe and demonstrating high success rates.[10,28,30–32] Undoubtedly, the most difficult and important aspect is the selection and appropriate monitoring of patients. The use of CT, in this situation, principally aims to understand the trajectory of the projectile and therefore avoid any concomitant surgical injury; it is an essential condition to perform NOM. Recent studies, including the present one, specifically addressed NOM for liver GSW injuries, showing its safety and efficacy in selected patients. These studies showed that NOM was possible for between 26.6% and 32.3% of patients with liver GSWs.[30–32] They showed an incidence of complications that varied from 3.8% to 50%, the less frequent being directly related to liver injuries. The success rates varied from 68.5% to 100%.[28,30–32] Although severe injuries are associated with increased complication rates, the grades of injury, per se, are not shown to be an independent factor for NOM failure, justifying its performance even for injuries considered complex, i.e. for grade IV and V injuries.[28,32] The presence of contrast blush on a CT image, which indicates the presence of vascular injury, a pseudoaneurysm, or arteriovenous fistula, is a factor that predisposes NOM failure. This finding justifies performing angiography and embolisation, increasing the possibilities of NOM success. The increase in abdominal pain or the onset of jaundice, fever, or gastrointestinal bleeding suggest complications related to the actual liver injury and must be studied by performing another CT scan. Most of these complications (e.g. biloma, biliary fistula, infected haematoma, bilaemia) can be treated with minimally invasive methods, such as endoscopic retrograde cholangiopancreatography (for papillotomy and the insertion of stents), involving the puncture and drainage of collections guided by ultrasound or video laparoscopy. However, the most frequent complications are related to associated injuries, particularly thoracic (retained haemothorax, empyema, and infected pulmonary contusion) and sometimes renal injuries.[10,28,30–32] This higher frequency of subsequent complications related to associated injuries at least partially explains the low rate of complications found (3.8%) in this study. In the English-language literature, we did not identify a specific study that assessed NOM for liver GSWs as the only abdominal injury and with no associated chest injury that required treatment. The results of this study showed that the incidence of isolated liver injuries that fulfil the NOM criteria was low (16.6%) and that morbidity and failure rates were lower when compared to those in studies wherein liver injuries were associated with other abdominal or thoracic injuries. NOM for liver GSWs is safe for a well-selected group of patients, presents low morbidity, and in principle, can be performed for all grades of liver injury. However, even for isolated liver injuries, this approach should only be carried out in an environment with adequate infrastructure, where an experienced and cohesive team can follow the specific protocol under strict periodic evaluation of their results. Otherwise, it would be an adventure into the unknown which, of course, is not recommended.

Conclusion

Isolated liver injury post gunshot abdominal trauma is uncommon. However, the NOM protocol for these kinds of injuries is safe and confers low morbidity rates. This approach should only be followed in institutions with appropriate infrastructure, where an experienced and cohesive team can follow a specific protocol with rigorous periodic assessment of its results. NOM of liver injury is considered the gold standard of care for haemodynamically stable patients. Angiography has important diagnostic and therapeutic roles in the management of active bleeding secondary to liver injury. It should be considered in localising the site of bleeding and in providing an opportunity for the interventionalist to proceed to transcatheter embolisation of the bleeding sites. The successful application of

the method requires teamwork in a multidisciplinary hospital and the services of an interventionalist who has good expertise in angiography and embolisation to achieve satisfactory results within the applicable time.

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This case report did not require funding.

Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

This is to certify that departure research committee King Fahad Hospital – Almadinah Almunawwarah al Munawarh has reviewed all submitted updated and amended documents from the ethical point of view for the study. The committee is full complaint with the conditions and principles of good clinical practice. The committee is constituted with the WHO and ICH – GOP guidelines and works according to written standard operating procedures.

Authors' contribution

Dr Anas Elshaer is the corresponding author and the main contributer of this work, also Dr Anas Elshaer has attended the interventional arterial embolization procedure, reviewed literature, wrote and revised the manuscript. Dr Abdelsalam Abdelaziz performed the interventional arterial embolization procedure, illustrated the figures, wrote the discussion, and reviewed the manuscript. Dr. Abdullah Allam performed video assisted thoracoscopic surgery procedure. Dr Fathi Abdelsalam performed the Exploratory laparotomy procedures. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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