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Case Series

Radiology Section

Hepatic Artery Embolisation in Polytrauma Patients: A Case Series

SAURABH KUMAR[1], SIDDHARTH MISHRA[2], NITIN ARUN DIKSHIT[3], ANIL RAWAT[4]

ABSTRACT

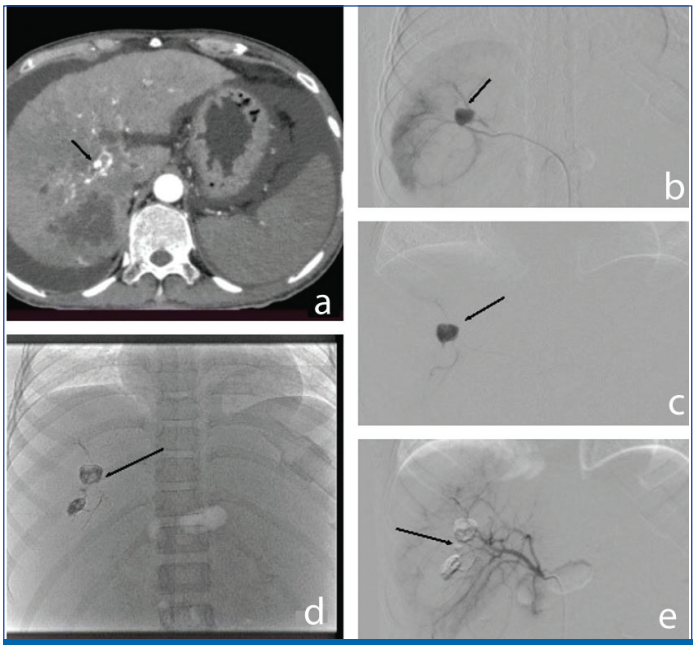
Blunt hepatic injury is quite common in polytrauma cases. In this high-speed era, polytrauma cases are increasing, with serious mortality and morbidity. Authors hereby, described cases of three male patients presenting with blunt abdominal injuries and hepatic lacerations managed successfully with transarterial embolisation with minimal risk. The goal of the present case series was to demonstrate how hepatic artery embolisation can be used to treat blunt hepatic injuries in haemodynamically unstable patients when open surgery is not an option. All patients presenting with blunt trauma to the abdomen were initially screened by Focused Assessment with Sonography for Trauma (FAST), followed by Computed Tomography (CT) angiography of the abdomen where needed, and planned for embolisation of active bleeders or pseudoaneurysms. Transarterial hepatic artery embolisation is used for the management of high-grade liver injuries. Acute post-injury phases with definite evidence of bleeders in CT angiography, and situations where the diagnostic laparotomy is negative but the patient is unstable with low haemoglobin and requires a blood transfusion, are common indications for hepatic artery embolisation. Successful management of high-grade liver injuries often involves a combined angiographic and surgical approach. However, in situations where surgical intervention is not possible, Interventional Radiology (IR) might be the only saviour.

Keywords: Computed tomography angiography, Intervention radiology, Liver injuries, Pseudoaneurysm

CASE SERIES

Case 1

A 32-year-old male presented to the Trauma Surgery Department six hours after an injury from a road traffic accident, with bruises on his face, head and limbs. Initial haemodynamic parameters showed a blood pressure of 80/60 mm Hg, a Pulse Rate (PR) of 125 beats/minute and Saturation of Peripheral Oxygen (SpO_2) of 99%. After initial resuscitation, a Focused Assessment with Sonography for Trauma (FAST) was performed, revealing a right lobe hepatic laceration (measuring approximately 7×8 cm) with gross haemoperitoneum. No other solid visceral injury or obvious hepatic aneurysm could be identified during FAST. The patient's haemoglobin was 9 mg/dL, and no active surgical exploration was performed. The patient was kept under close observation. A repeat haemogram performed after four hours showed a significant drop in Hb (5 mg/dL). CT angiography of the abdomen revealed a Right Hepatic Artery (RHA) pseudoaneurysm [Table/Fig-1a]. The patient was transferred to the IR suite for endovascular embolisation. After obtaining consent for the procedure, the right femoral artery was accessed under Ultrasonography (USG) guidance, and a 5 Fr femoral vascular sheath was secured in the right femoral artery. A total of 1500 IU of intra-arterial heparin at 70-100 IU/kg body weight was administered through the sheath. Using the Terumo J tip hydrophilic guide wire and C2 Cobra catheter, the celiac trunk was cannulated, and an angiogram was performed. Under the Digital Subtraction Angiography (DSA) roadmap, the guide wire was advanced into the Common Hepatic Artery (CHA), followed by the advancement of the catheter over the wire. A repeat angiogram of the CHA was conducted, revealing a pseudoaneurysm arising from the RHA [Table/Fig-1b]. In this case, it was decided to perform N-butyl cyanoacrylate {(NBCA)(glue)}+lipiodol (1:2 ratio) embolisation of the aneurysm because the aneurysm sac exhibited a small bleb at the inferior aspect [Table/Fig-1c]. A Progreat microcatheter was further advanced to reach the culprit branch of the pseudoaneurysm, and a slow injection of contrast was conducted to ensure the catheter's location in the appropriate branch and to calculate the amount of glue and lipiodol needed for embolisation. Before injecting the glue, the microcatheter was primed with 5% dextrose to prevent intracatheter glue polymerisation. A glue cast was observed opacifying the pseudoaneurysm sac [Table/Fig-1d]. The check angio was performed, and no obvious pseudoaneurysm was identified post-angiography embolisation [Table/Fig-1e]. The procedure took around 50 minutes, and approximately 80-100 mL of contrast was used during the process. Following the completion of the

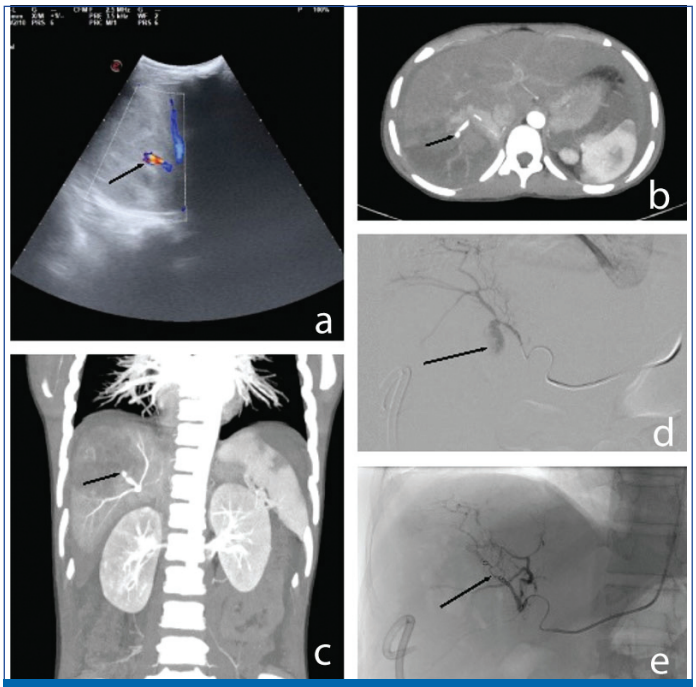


[Table/Fig-1]: a) CT angiography axial section shows a sac-like hyper-enhancing lesion in the right lobe suggestive of pseudoaneurysm (arrow); b) Right Hepatic Artery (RHA) angiography shows sac with pooling of contrast suggestive of pseudoaneurysm (arrow); c) Super selective angiogram of RHA branch shows pseudoaneurysm sac with small bleb at the inferior aspect of the sac (arrow); d) Spot fluoro image shows glue cast filling the sac with inferior migration suggestive of probable rupture of the sac (arrow); e) Post-embolisation angiography does not show any opacification of pseudoaneurysm of the sac (arrow).

procedure, the patient was transferred to the ward and kept under observation for three days. A percutaneous catheter drainage was placed under USG guidance to drain the haemoperitoneum. The patient was ultimately discharged after 10 days with an improved status. On follow-up, no residual haemoperitoneum or hepatic artery pseudoaneurysm was observed in the USG.

Case 2

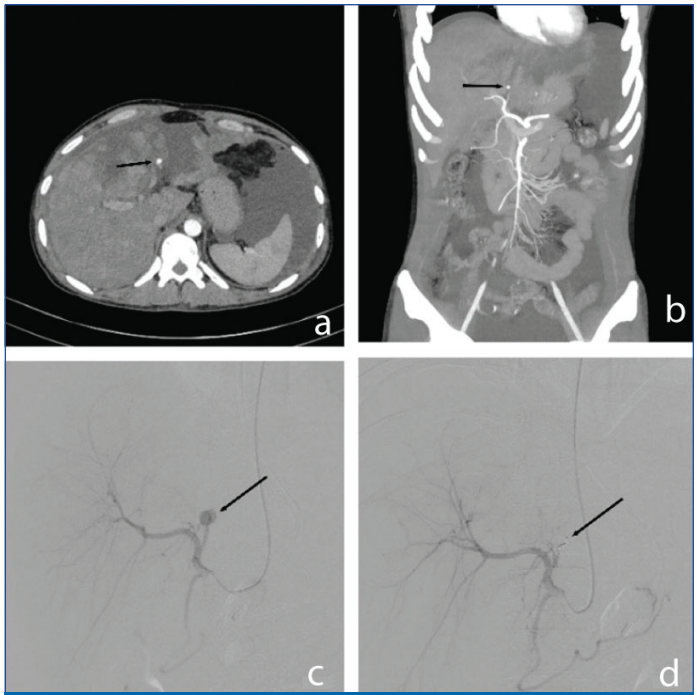
A 25-year-old male presented approximately four hours after sustaining a firearm injury to the Trauma Surgery Department. Initial haemodynamic parameters were blood pressure of 90/50 mm Hg, PR of 112 beats/minute and SpO_2 of 98%. Initial resuscitation was performed in the emergency room. Clinical examination revealed an entry wound in the right subcostal region, but no exit wound was found. FAST was conducted, showing right and left lobe hepatic lacerations (measuring 4×6 cm in the right lobe and 3×5 cm in the left lobe) with a small perihepatic and pelvic haemorrhagic collection. No other solid visceral organ injuries were noted. The haemoglobin level was 11 mg/dL on the day of admission, and the patient was kept in the ward under close observation. On the second day, the patient developed severe abdominal distention with tachycardia and tachypnoea. There was a significant drop in haemoglobin (7 mg/dL), and USG revealed gross haemoperitoneum with a focal area of color aliasing in the right lobe, suspicious of a pseudoaneurysm [Table/Fig-2a]. CT angiography confirmed a pseudoaneurysm arising from the RHA branch [Table/Fig-2b,c]. After the CT angiography, endovascular embolisation of the pseudoaneurysm was decided, and the patient was transferred to the IR suite. Following consent for the procedure, the right radial artery was accessed under USG guidance, and a 5 Fr radial access sheath was inserted into the right radial artery. An angiogram of the CHA revealed a pseudoaneurysm arising from the RHA [Table/Fig-2d]. A Progreat microcatheter was utilised to reach the culprit branch, and a slow injection of contrast was performed to confirm the catheter's location in the appropriate branch. Since there was no arterioportal fistula, Nester-fibred microcoils (18-2-4 and 18-3-3) were used to embolise the vessel. A check angiogram was conducted, and no obvious pseudoaneurysm was identified post-embolisation with a coil across the pseudoaneurysm [Table/Fig-2e]. Following the procedure's completion, the patient was transferred to the ward and monitored closely for four days. The patient was discharged on day 15. On follow-up USG, no hepatic artery pseudoaneurysm or peritoneal collection was observed.



[Table/Fig-2]: a) USG abdomen shows laceration in the right lobe of liver with sac-like lesion showing colour aliasing within suggestive of pseudoaneurysm (arrow); b,c) CT angiography axial and coronal section shows a sac-like hyper-enhancing lesion in the right lobe suggestive of pseudoaneurysm (arrow); d) Right Hepatic Artery (RHA) angiogram shows sac with pooling of contrast suggestive of pseudoaneurysm (arrow); e) Post-embolisation angiography does not show any pseudoaneurysm. Coil seen in-situ (arrow).

Case 3

A 10-year-old semiconscious boy was brought to the Trauma Surgery Department by his parents, approximately six hours after falling from a height of approximately 20 feet, complaining of severe abdominal pain. Initial haemodynamic parameters were blood pressure of 80/40 mmHg, PR of 130 beats/minute and SpO_2 of 100%. Due to tachycardia and hypotension, initial resuscitation was performed in the emergency room. Clinical examination did not reveal any external injuries. A FAST USG was conducted, showing a left lobe hepatic laceration (measuring 3×2.5 cm) with small perihepatic and pelvic collections. The spleen and kidneys were normal. A small suspicious pseudoaneurysm was identified during the USG arising from the Left Hepatic Artery (LHA) with a possible fistula between the LHA and the left portal vein branch. The initial haemoglobin level was 9 mg/dL. A CT angiogram revealed a pseudoaneurysm originating from the LHA branch [Table/Fig-3a,b] without any obvious arterioportal fistula. Following the CT angiography, the patient was transferred to the IR suite. After obtaining consent for the procedure, an angiogram of the CHA was performed using a transradial approach, revealing a sac-like pseudoaneurysm arising from the LHA [Table/Fig-3c]. A Progreat microcatheter was utilised to reach the neck of the pseudoaneurysm, and Nester-fibred microcoils (18-5-4 and 18-3-3) were used to embolise the LHA [Table/Fig-3d]. A check angiogram was conducted, and no obvious pseudoaneurysm was identified post-embolisation [Table/Fig-3d]. The procedure was completed within an hour, and approximately 80-100 mL of contrast was used. The patient was closely monitored for three days and discharged after seven days. On follow-up, no residual haemoperitoneum or hepatic artery pseudoaneurysm was observed in the repeated USG.



[Table/Fig-3]: a, b) CT angiography axial and coronal section shows sac-like hyper-enhancing lesion in the left lobe of liver suggestive of pseudoaneurysm (arrow); c) Left Hepatic Artery (LHA) angiography shows sac with pooling of contrast suggestive of pseudoaneurysm (arrow); d) Post-embolisation angiography does not show any pseudoaneurysm (arrow).

DISCUSSION

Traumatic low-grade liver injury is very common in the young population of any country [1]. There is a high rate of mortality and morbidity associated with blunt trauma due to Road Traffic

Injuries (RTI) cases in the economically productive period of 15-49 years of age, which requires costly trauma care, leading to a financial burden on affected families [2]. Bleeding could be both arterial and venous. Hepatic artery injury is the cause of clinically substantial bleeding in most of these cases. On the other hand, venous injury (portal or central hepatic vein) is significantly more dangerous and requires surgical repair regardless of haemodynamic status [3]. Patients with American Association for the Surgery of Trauma (AAST) grade 4 or 5 hepatic injuries and haemodynamically unstable patients need urgent intervention most of the time. On the other hand, patients who are haemodynamically stable or have sustained a grade 1 or 2 hepatic injury could be continuously monitored. A drop in haemoglobin in patients with grade 4/5 hepatic injury may likely be caused by post-traumatic arterioportal fistulas with active extravasation from associated pseudoaneurysms [4]. Patients unable to tolerate Non operative Management (NOM) due to haemodynamic instability should undergo open surgery either alone or in conjunction with embolisation. A lower risk of complications, fewer blood transfusions, and deaths have been linked to intraoperative embolisation [5]. With advancements in imaging and image-guided interventions, there has been an improvement in the outcome of cases of hepatic injury. The addition of CT angiography in blunt trauma patients as a protocol has proved to be very helpful in assessing the degree of hepatic injury, diagnosing the source of bleeding, and providing the best possible course of management. Optimal patient care still revolves around a multidisciplinary approach in managing the traumatically injured patient [6]. In addition to providing a precise diagnosis, IR has significantly reduced the total hospital stay, financial burden, and hospital-acquired infections. Transarterial embolisation of the hepatic artery can be used as an adjunct to operative management after the patient continues to haemorrhage following initial surgery [7].

Interventional Radiology (IR) had a significant impact on the management of blunt injuries to the abdomen with active intra-abdominal bleeding. With advancements in imaging and the proven results of IR, there has been a marked change in the management of abdominal trauma from operative to non operative or minimally invasive surgery over the past few decades [8]. This global change in the management plan of blunt trauma cases occurred due to certain inherent advantages in IR, such as being minimally invasive, lower-risk, not requiring anaesthesia or only mild sedation, and not necessitating post-procedure ventilator support, resulting in a decline in mortality. Hepatic Arterial Embolisation (HAE) has shown excellent outcomes in saving patient lives in cases of hepatic injury with definitive evidence of bleeding arteries and even in cases where CT angiography results are negative [8]. In the case series presented here, HAE was found to be an excellent treatment for patients who had continued haemorrhage following trauma and were unfit for surgery (case no. 1 and 2 were deemed unfit for open surgery due to unstable vitals; however, parents refused open surgery in case no. 3).

Hepatic arterial embolisation can also be useful when used in cases of delayed intraperitoneal bleeds that were otherwise stable in the acute post-traumatic phase but suddenly deteriorate due to delayed haemorrhage. The initial assessment and resuscitation of patients with blunt abdominal trauma follow an organised approach and protocol as outlined in the Advanced Trauma Life Support program [9]. All cases of blunt injury to the abdomen must be screened by FAST in unstable patients, followed by abdominal pelvic CT angiography in more stable patients. The indications for abdominal exploration in the setting of blunt hepatic trauma are peritonitis and haemorrhagic shock. In a patient with blunt hepatic trauma who is haemodynamically unstable, operative intervention is indicated. The initial surgical manoeuvres usually involve manual compression and packing of hepatic injuries. Active arterial bleeding after perihepatic packing is as high as 60% in some series [10,11]. Though minimally invasive, HAE can be associated with complications like major hepatic necrosis (including bile leaks and abscesses) and non target embolisation, especially gall bladder necrosis [12,13]. Fortunately, none of the cases in the present case series encountered such complications. The more distal or selective the embolisation is done, the less likely the chance of hepatic ischaemic injury occurring. Coils and/or glue, gelatin-based material, or Polyvinyl Alcohol (PVA) are common embolic agents used at the present study institution, depending on the etiology. In cases where no active bleeder could be seen in catheter and CT angiography, bland gel foam embolisation could be done of highly suspicious arteries in cases with dropping haemoglobin. The most common complications of HAE are non target embolisation and catheter-related vascular injury like dissection or perforation of the artery, if done with inexperienced hands. It is always recommended to avoid cystic artery embolisation while dealing with pseudoaneurysms from RHA to avoid gall bladder necrosis [14]. A post-traumatic pseudoaneurysm, as well as, arteriovenous and arterioportal fistulas, could be the cause of delayed haemorrhage in the setting of blunt hepatic trauma and should be kept in mind, if the patients had sudden haemodynamic instability post-injury.

CONCLUSION(S)

Hepatic artery embolisation in a blunt hepatic injury case is minimally invasive, has low risk, and yields good outcomes in a selected group of cases. The ability to rapidly control potentially fatal bleeding through embolisation and access the site of vascular injury without compromising the normal tissue barrier is what makes endovascular techniques unique.

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PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Radiodiagnosis, King George's Medical University, Lucknow, Uttar Pradesh, India.
2. Assistant Professor, Department of Radiodiagnosis, King George's Medical University, Lucknow, Uttar Pradesh, India.
3. Assistant Professor, Department of Radiodiagnosis, King George's Medical University, Lucknow, Uttar Pradesh, India.
4. Associate Professor, Department of Radiodiagnosis, King George's Medical University, Lucknow, Uttar Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Anil Rawat,
Associate Professor, Department of Radiodiagnosis, King George's Medical University, Lucknow-226003, Uttar Pradesh, India.
E-mail: anilrawat@kgmcindia.edu

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