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Bicycle Handlebar Injury in a Child Resulting in Complex Liver Laceration with Massive Bleeding and Bile Leakage: A Case Report

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Abstract

Background: Bicycle accidents are a significant cause of traumatic morbidity in the paediatric population. The handlebar injuries are usually isolated and remain a major source of bicycle related morbidity. We present a case of severe liver laceration with left hepatic duct transection caused by handlebar trauma in a 13-year-old boy.

Case presentation: An otherwise healthy 13-year-old Caucasian male patient was rushed to the hospital following a blunt abdominal trauma from a bicycle handlebar. An ultrasound finding of extensive free intraperitoneal fluid with accompanying features of hemodynamic instability necessitated a decision to perform an emergency exploratory laparotomy. Operative findings included massive haemoperitoneum, a deep laceration almost separating left and right liver lobes, and a near-complete interruption of the left hepatic duct. Interestingly, the vascular anatomy of the left liver lobe was preserved. Surgical haemostasis was successfully accomplished, and a duct-to-duct anastomosis of the ruptured left hepatic duct was performed. A T-tube biliary drainage was inserted, and intraoperative cholangiography showed no extraluminal spillage of contrast. During the recovery phase, cholangiography was performed several times revealing leakage from left hepatic duct. The leakage was managed conservatively and finally stopped. The boy was eventually discharged home in stable clinical condition.

Conclusion: Management of blunt hepatic injuries has remarkably changed from mandatory operation to mostly non-operative interventions with selective operative management. Hemodynamic instability remains the main reason for exploratory laparotomy. Near-isolated laceration of main hepatic ducts is an extremely rare surgical finding, and immediate reconstruction is the best option if an experienced surgeon is available. Additionally, even though biliary leakage was observed after the operation, conservative treatment with T-tube left in place for a considerably long period was successful.

Keywords: Bicycle accidents; Handlebar injury; Liver laceration; Pediatric trauma; Case report

Abbreviations: HBI: Handlebar Injury; HPB: Hepato-Pancreato-Biliary; ICU: Intensive Care Unit; MAP: Mean Arterial Pressure; US: Ultrasound; FAST: Focused Assessment with Sonography for Trauma; PDS: Polydioxanone Suture; AAST: American Association for the Surgery of Trauma; AST: Aspartate Aminotransferase; ALT: Alanine Aminotransferase

Core Tip

Bicycle injuries are related to significant morbidity among the paediatric population. The handlebar injuries are usually isolated and remain a major source of bicycle-related traumatic morbidity. Despite minimal or absent visible external signs on the abdominal wall, which is the most frequent site of impact, bicycle handlebar injuries should be treated with great care. We present a case of severe liver laceration with rupture of the left hepatic duct caused by handlebar trauma in 13-year-old boy. The injury was managed operatively.

Introduction

Bicycle injuries represent a significant cause of traumatic morbidity among the paediatric population [1-4]. Besides high-speed bicycle traumas causing multiorgan injuries, isolated handlebar injuries (HBI) remain a major source of bicycle-related morbidity, with nearly one third of cases requiring surgical intervention [1-5]. The spectrum of injuries varies widely from solid organ injury to traumatic abdominal wall hernias and bowel injuries [6]. Despite minimal or absent visible external signs on the abdominal wall, which is the most frequent site of impact, bicycle HBI should be treated with great care [2,7-9]. In the present report, we describe the clinical presentation, management and outcome of HBI causing severe liver laceration with haemorrhage and left hepatic duct injury in a young boy. The left hepatic duct was interrupted almost completely with only less than 10% of the duct circumference preserved. However, the portal and arterial vessels for the left lobe were mainly preserved. We reviewed relevant literature and discussed the best practice management approach in such case.

Case Presentation

Chief complaints

A 13-year-old Caucasian male patient presented to our surgical emergency department with complaints of severe diffuse abdominal pain and distension.

History of present illness

The patient was brought to the hospital by helicopter about 2 hours after sustaining a direct blow to the upper right quadrant of his abdomen from a bicycle handlebar. At the scene of the accident, all resuscitation measures were given in line with the recommendations of advanced trauma life support.

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History of past illness

The patient's prior medical history was unremarkable.

Physical examination upon admission and laboratory investigations

The patient was conscious and well-oriented. During the helicopter transportation, he was noted to be pale with blood pressure around 90/60 mmHg, a heart rate of 110-120 beats/min and haemoglobin 85 g/L. Despite a slightly higher blood pressure (115/80 mmHg) following fluid resuscitation upon admission, he remained pale and tachycardic (120 beats/min). Abdominal examination was remarkable for significant distension and diffuses tenderness, but no visible external injuries on the abdominal wall.

Imaging investigations

Chest x-ray showed no signs for rib injury, pneumothorax or any other expected pathology. Focused Assessment with Sonography for Trauma (FAST) scan was performed, showing diffuse echogenic free fluid intraperitoneally with the most probable cause being hemoperitoneum. There were some radiologic signs of contusion of the upper part of left liver lobe, but no signs of splenic injury. Due to the extensive intraperitoneal free fluid seen on FAST and the persisting features of haemodynamic instability (tachycardia, pallor), a decision for immediate exploratory laparotomy was made.

Final diagnosis

Bicycle handlebar injury, abdominal wall contusion, haemorrhagic shock, major liver laceration with bleeding and left hepatic duct injury. The exact diagnoses of liver injuries were established intraoperatively.

Treatment

An emergency upper median laparotomy was performed under general anaesthesia to determine the exact nature of the abdominal injury. Due to the hematoperitoneum, our operative procedure was in conformity with damage control surgery and tamponade of all four abdominal quadrants was performed. During the exploration, a deep laceration almost separating left and right liver lobes was found with evident bleeding from the laceration (grade II-III according to AAST liver injury scale). Firstly, with the intention to stop the bleeding, the Pringle manoeuvre was performed, and venous bleeding was stopped with several sutures. Thereafter, a meticulous examination of the laceration was done, and an injury of the left hepatic duct was observed. The left hepatic duct was interrupted almost completely, with less than 10% of the circumference preserved. However, the portal and arterial vessels for the left lobe were mainly preserved. A duct-to-duct anastomosis of the injured left hepatic duct was performed with 6.0 PDS intermittent sutures. Subsequently, cholecystectomy, insertion of biliary T-tube and intraoperative cholangiography were performed (Figure 1). Intraoperative cholangiography showed no extraluminal spillage of contrast. At the end of the operation, hemostatic absorbable wraps Surgicel were inserted into the liver laceration. Intraoperatively, the patient received 3 units each of fresh frozen plasma and concentrated erythrocytes, as well as crystalloid fluids and tranexamic acid.

After operation he was admitted to the paediatric ICU under analgosedation and endotracheal intubation. Immediate post-op laboratory data were as follows: AST 7.02 μkat/L, ALT 7.81 μkat/L, total bilirubin 22 μmol/L, direct bilirubin 10 μmol/L, haemoglobin 107 g/L, erythrocytes 3.76 × 1012, leukocytes 10.4 × 109 and CRP below 5 mg/L. Sedation and vasoactive support were discontinued within the first postoperative day. On the second postoperative day, an US scan was performed, showing minimal free fluid in the peritoneal cavity under the liver. The bile ducts diameters were within normal range. At the location of the liver segment 3, a heterogenous parenchyma with surgical echogenic material used for tamponade was noted. No other pathologic findings were described. A decision was made to prolong the antibiotic treatment with cefazoline due to elevated inflammation markers. On the fifth postoperative day, an US scan was repeated, revealing biliary ducts of normal diameter; however, there was an intrahepatic fluid collection described at the point of liver laceration measuring approximately 6 × 2 × 3 cm in size. Exact determination of whether the fluid was hematoma, biliary fluid or other was impossible on US, so we decided to perform cholangiography imaging through the T-tube to exclude biliary leakage. The cholangiography revealed evident leakage from the left hepatic duct, with the size and location of the extravasated contrast corresponding to the previously described fluid collection on US. Furthermore, a small leakage of contrast was seen in the right biliary tree with small collection of contrast with diameter around 5 mm. The common hepatic duct and common bile duct were otherwise intact and draining of contrast media to the duodenum was observed (Figure 2).

A decision was made to manage the leakage of bile from left and right biliary tree conservatively. The T-tube was consequently left open. On the eighteenth postoperative day and 13 days after the first cholangiography, a follow-up cholangiography was performed, which showed no signs of leakage from both the left and right biliary trees (Figure 3). In response to the cessation of leakage, we decided to commence intermittent closure of the T-tube. A series of follow-up abdominal US scans were performed, and the size of the intrahepatic collection was initially noted to be increasing, with the largest diameter being 8.6 × 7.1 × 7.6 cm (approximately 300 ml) on the twenty-first postoperative day-3 days after initiation of the intermittent T-tube closing. Afterwards, the intrahepatic fluid collection began to decrease in size and finally stabilized. The last US follow-up during hospital stay was performed on the 38th postoperative day and showed a collection measuring 10.6 × 7.4 × 5.9 cm (220-250 ml), indicating that the size of the collection did not change and there were no signs of biliary obstruction. The patient was asymptomatic and feeling well, and we noted a decline of the previously elevated liver enzymes (ALT and ALT) (Figure 4). Consequently, he was discharged from the hospital with a closed T-tube in place.

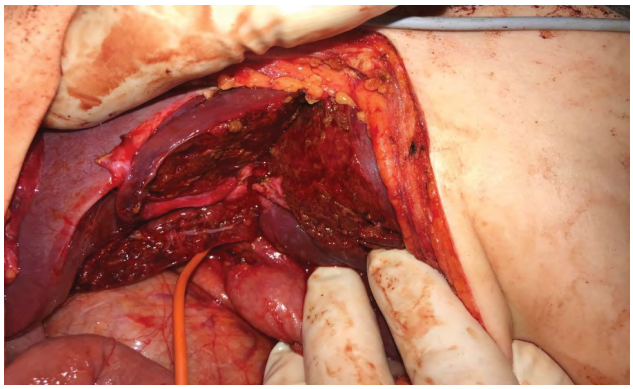

Figure 1: Liver laceration with T-tube inserted into the common bile duct.

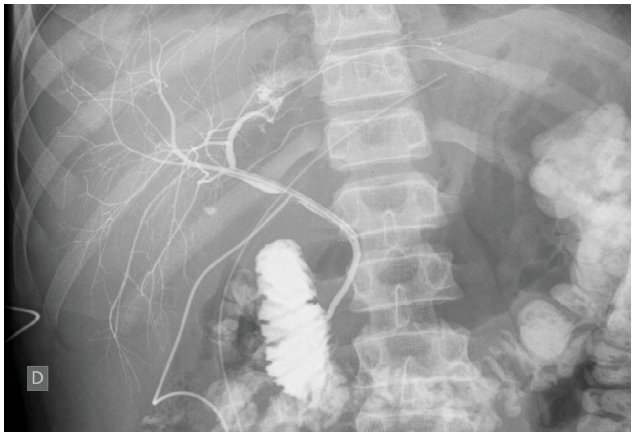

Figure 2: The cholangiography through the T-drain on the 5th postoperative day. Leakage from left hepatic duct is seen. There is a small collection of contrast in the right biliary tree. Normal opacification of the common hepatic duct and common bile duct is noted.

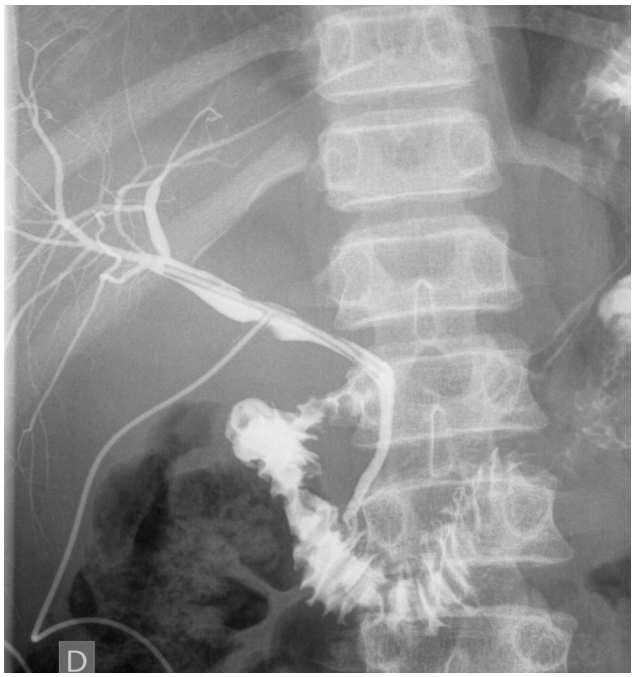

Figure 3: The cholangiography performed on 18th postoperative day. Normal opacification of the intra and extra-hepatic biliary channels are noted without signs of biliary leakage. Normal opacification of the duodenum is seen as well.

Outcome and follow-up

The first follow-up in the outpatient clinic was on the 46th postoperative day. The patient was still asymptomatic and feeling well. A check abdominal US scan showed no significant dynamics of the intrahepatic fluid collection (size: 10.6 × 7.2 × 5.1 cm, 200-220 ml), and no signs of biliary obstruction. We, therefore, decided to remove the T-tube. Due to the normal laboratory results and absence of subjective complaints from the patient, we did not deem it necessary to perform percutaneous drainage of the collection. Almost one year after the operation, the size of the collection is decreasing, measuring 9.7 × 8.1 × 2.7 cm (approximately 80 ml) and the patient remains asymptomatic.

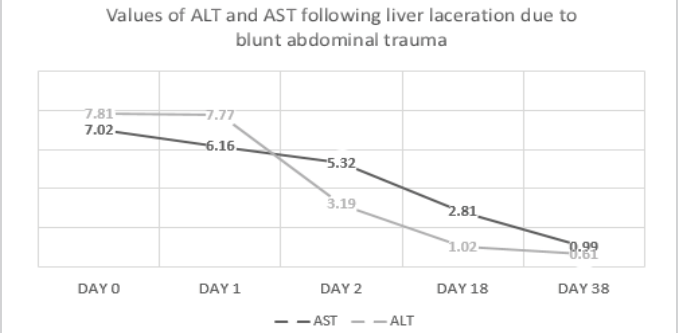

Figure 4: ALT and ALS levels following liver laceration. In the course of the inpatient hospital treatments, the values of liver enzymes ALT and ALS decreased to normal levels.

Discussion

The bicycle handlebar injury is somewhat unique regarding its location and the need for intervention, compared to other bicycle injuries [3]. An analysis of HBI sites noted that the abdomen is the most frequently injured body region (64.0%), followed by other sites including the face (13.6%), chest (12.3%) and the thigh (11.4%) [8]. Despite minimal or absent visible external signs on the abdominal wall, bicycle handlebar injuries should be treated with great care [2,7-9]. Best practice guidelines recommend that the vast majority of blunt liver trauma in children should be managed conservatively [10,11]. Nevertheless, the guidelines also affirm that hemodynamic status, rather than the grade of the injury, should determine the primary treatment strategy [10,12]. If there is no response after initial fluid resuscitation or there is a great amount of free intraperitoneal fluid with signs of active bleeding on FAST, other imaging techniques should be omitted and an emergency operative protocol activated [10,13]. Compared to other bicycle trauma cases, HBI patients are much more likely to require a major operation [8]. Published case series report a 20-40% operative intervention rate in paediatric HBI patients [5].

In the present report, we describe a case of HBI causing severe liver laceration with haemorrhage and left hepatic duct injury. Treatment of liver injuries in children can represent an arduous challenge to the paediatric surgeon. Control of haemorrhage is critical but can be difficult to achieve. Several measures to achieve surgical haemostasis have been described in the literature: perihepatic packing and manual compression, hepatic mobilisation, topical haemostatic agents, sutures and Pringle manoeuvre. In exceptional cases of active retrohepatic vena cava bleeding, atriocaval shunt may also be performed, but only by an experienced surgeon [12-14]. Management of injury to the intrahepatic biliary tract should follow the control of associated haemorrhage [15,16]. In adults, biliary injuries are commonly iatrogenic (laparoscopic cholecystectomy being the most frequent cause) and there is a large volume of published studies describing the management of such injuries [17-20]. In contrast, there is a limited literature on the management of paediatric biliary tract injury following trauma [11-22].

Conclusion

Traditionally, laparotomy and hepaticojejunostomy has been the gold standard for treatment of biliary injuries. Nevertheless, we believe that in a case of a major transection of the intrahepatic biliary duct, primary suture and duct-to-duct anastomosis is feasible if an immediate laparotomy is mandatory due to hemodynamic reasons. It

is of vital importance to arrest haemorrhage and attain haemodynamic stability prior to attempting ductal anastomosis. The T-tube drain is useful for biliary drainage and also for later radiographic evaluation if necessary. Peritoneal drainage is also advisable in cases of biliary leakage. Additionally, conservative measures such as placement of endoscopic stents to facilitate healing can be carried out if there is no reduction of biliary secretion through the abdominal drain. However, we are aware the bile duct strictures are possible complication after primary suture, but the exact incidence remains unknow duo to the lack of scientific data regarding such injuries. Due to limited evidence, we recommend consultation with an experienced HPB surgeon on a case-by-case basis for every paediatric biliary injury.

Declarations

Ethical approval and consent to participate

Our institution does not require ethical approval for publishing a case report. Written informed consent was obtained from the parents of the young patient for publication of this case report and accompanying images.

Consent for publication

Written informed consent was obtained from the patient's parents for publication of this article and any accompanying images. A copy of the written consent is available for review by the Editor of this journal.

Availability of data and materials

All data are included in the section of Case Presentation and are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflict of interests with regard to this case report.

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There is no relevant external funding in respect of this case report.

Author contributions

Grosek J participated in the operation and drafted the manuscript; Čebron Ž collected the data and was involved in editing the manuscript; Janež J participated in the operation and was involved in editing the manuscript; Tomažič A operated the patient and contributed to critical revision. All authors issued final approval for the version to be submitted.

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