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Complete Dissection of a Hepatic Segment after Blunt Abdominal Injury Successfully Treated by Anatomical Hepatic Lobectomy: Report of a Case

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Key Words

Liver laceration · Dissected liver tissue · Surgical resection

Abstract

A 21-year-old male patient was transferred to the emergency room of our hospital after suffering seat belt abdominal injury in a traffic accident. Abdominal computed tomography revealed a massive hematoma in the abdominal cavity associated with deep hepatic lacerations in the right lobe. The presence of a solid tissue possibly containing pneumobilia was observed above the greater omentum. These findings were consistent with a tentative diagnosis of hepatic laceration due to blunt trauma; therefore, this prompted us to perform emergency laparotomy. The operative findings revealed a massive hematoma and pulsatile bleeding from the lacerated liver and a retroperitoneal hepatoma, which was most likely due to subcapsular injury of the right kidney. In accordance with the preoperative imaging studies, a pale liver fragment on the greater omentum was observed, which was morphologically consistent with the defect in the posterior segment of the liver. Since the damaged area of the liver broadly followed the course of the middle hepatic vein, we carefully inspected and isolated the inflow vessels and eventually performed a right hepatic lobectomy. The patient's postoperative course was uneventful, and he was doing well at 10 months after surgery.

Introduction

With the advancements of interventional radiology (IVR), the majority of traumatic liver injuries can be conservatively treated. However, severe type traumatic liver injury is still a major cause of mortality after blunt abdominal trauma. Therefore, the best way to proceed with any kind of medical intervention should be carefully considered in each case. A variety of liver lacerations have so far been reported. However, to our knowledge, no reports of a complete dissection of the hepatic segment exist in the literature. In the present report, we describe this rare type of liver injury and also discuss the management options.

Case Report

A 21-year-old male patient was transferred to hospital after receiving a blunt abdominal injury in a traffic accident. At the time of the patient's admission, his blood pressure was 81/62 mm Hg with a heart rate of 100 beats/min. Intravenous fluids were immediately administered, and abdominal computed tomography (CT) revealed a massive hematoma along with a deep liver laceration and a retroperitoneal hematoma likely due to the right renal injury. The patient was transferred to our emergency department.

At the time of admission, his blood pressure was 140/89 mm Hg, and his heart rate was 89 beats/min following continuous fluid administration. At physical examination, a seat belt bruise was observed on the right upper side of the abdomen. There was also marked abdominal tenderness and muscular defense. Laboratory tests revealed a WBC count of 32,770 cells/ml and a Hb level of 14.2 g/dl. Liver enzymes analyses revealed an AST level of 787 IU/l, an ALT level of 644 IU/l, and an ALP level of 351 IU/l; CRP level was normal with 0.01 mg/dl. In the coagulation test, the prothrombin time level was 75.4% (INR: 1.17). In the blood gas test, mild acidosis with a pH level of 7.32 and a BE level of –3.0 was recognized. At the initial CT, there was a low concentration in the anterior segment, and no obvious extravasation of the contrast agent was recognized around the liver. The right kidney appeared to be slightly ruptured with localized retroperitoneal hematoma. Moreover, hemorrhagic ascites were observed at a high concentration. The severity of liver injury was considered to be grade V. Abdominal CT revealed a massive hematoma in the abdominal cavity that was associated with deep hepatic lacerations in the right lobe. Significantly, some solid tissue possibly containing pneumobilia was observed above the greater omentum ([fig. 1](#)). These findings prompted us to perform emergency laparotomy.

The operative findings revealed a massive hematoma and pulsatile bleeding from the lacerated liver and retroperitoneal hepatoma, possibly due to a subcapsular injury of the right kidney. In accordance with the preoperative imaging studies, a pale liver fragment on the greater omentum was observed, which was morphologically consistent with the defect in the posterior segment of the liver. Since the damaged area of the liver broadly followed the course of the middle hepatic vein, we carefully inspected and isolated the inflow vessels and eventually performed a right hepatic lobectomy. Surgical time was 265 min, blood loss was 1,160 ml, and the required blood transfusion was 560 ml ([fig. 2](#), [fig. 3](#)).

The postoperative course was uneventful, and the patient was discharged on postoperative day 17 ([fig. 4](#)). He is currently undergoing follow-up on an outpatient basis, and the status of liver regeneration is favorable.

Discussion

The liver is largely protected by the rib cage and the spinal column, but it can sometimes suffer fatal injuries [1]. The reasons why the liver is susceptible to severe bleeding include (1) the low level of coating and compression of the surrounding tissue, (2) respiratory movement inhibiting hemostasis, (3) absence of a venous valve, (4) low

contractility of the hepatic veins, and (5) the leaked bile juice decreasing blood coagulability [1]. More than 60% of fatalities due to liver injury occur due to massive uncontrollable bleeding [2]. However, recent advancements in IVR have made the number of non-surgical treatments increase and led to completion rates as high as 85% [3]. The mortality rate among severe cases remains >50% [2, 3], and it is important to rapidly determine whether laparotomy is necessary for evaluating the extent of the liver injury.

To determine the severity of the liver injury, the Liver Injury Scale of the American Association for the Surgery of Trauma has frequently been utilized so far as shown in [table 1](#) [4]. The present patient presented with a complete dissection of the liver tissue accompanied by the injury to the middle hepatic vein and was therefore diagnosed with grade V injury. To the best of our knowledge, there have been no reports describing complete hepatic dissection in the literature.

The mechanisms of liver damage can be explained as follows: Trauma to the right side of the abdomen often leads to damage of the right hepatic lobe or the right kidney, whereas trauma to the left side of the abdomen often leads to damage in the spleen and the left kidney, such as in cases of liver trauma caused by vertical movements such as a fall, and can damage the hepatic round ligament and the triangular ligament. In cases of anteroposterior movements, such as in a head-on collision, the liver moves forward with the triangular ligament as a fulcrum, and the right lobe is susceptible to damage [4]. In the present case, it is assumed that a blunt abdominal injury caused by the seat belt compression in a traffic accident may have created severe liver lacerations with complete liver dissection.

In terms of therapeutic strategies, trauma patients should initially be categorized as either responders, transient responders, or non-responders based on their response to initial fluid therapy to select the subsequent treatment [5–7]. However, no specific criteria for classification have been developed [8–10]. As shown in the algorithms, initial treatment is broadly divided into three types, including IVR, surgery, and conservative therapy. Findings that proceed with IVR include (1) extravasations, arterial blushing, and A-P shunts found in abdominal contrast CT scans, and (2) blood pressure above 90 mm Hg which can be maintained with a rapid administration of intravenous fluids. To reduce the extent of bleeding from the injured liver, IVR has often been performed [11, 12]. Surgery is suitable in the following cases: (1) blood pressure above 90 mm Hg cannot be maintained even with rapid administration of intravenous fluids, (2) intestinal damage or damage of any other solid organ is suspected, and (3) cases in whom bleeding is persistent and blood pressure is unstable even after IVR. Cases in whom conservative therapy is suitable are those who do not apply to any of the above factors.

Perihepatic packing is an effective technique for achieving hemostasis after severe liver trauma in a hemodynamically unstable case [13, 14]. Other options such as hepatotomy, selective artery ligation, resectional debridement, and anatomical resection are also effective for achieving hemostasis, but they invariably result in a loss of functioning liver tissue.

In the present case, the patient responded well to the rapid administration of intravenous fluids and there was no damage to any other internal organs. Abdominal CT revealed no extravasation, and therefore IVR was not performed. Delayed surgery should be considered in cases of biloma, hepatic necrosis, abdominal compartment syndrome,

intraperitoneal abscess, and peritonitis due to delayed intestinal damage. In the present case, we performed emergency laparotomy based on the findings that included progressive anemia, completely disrupted liver tissue on CT conducted 6 h after the injury, and the fact that hepatic necrosis of the affected region could not be ruled out. In reports from other institutions, the incidence of intraperitoneal abscesses in grade IV or V cases was as high as 68.2%, and delayed complications after IVR occurred in 28.9% of cases [15].

In summary, we performed hepatic lobectomy in a patient with severe liver injury accompanied by a complete dissection of a hepatic segment, and the patient had a favorable clinical outcome. Currently, IVR is an indispensable option for therapeutic consideration of the liver. However, there are still cases that require surgical procedures. Based on our experience, we advocate that surgical intervention should be proactively considered when encountering such patients. When a patient's condition allows it, anatomical resections can therefore be safely performed.

Table 1. Liver Injury Scale

Grade	Type of injury	Description of injury
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10–50% surface area Intraparenchymal, <10 cm in diameter
	Laceration	Capsular tear 1–3 parenchymal depth, <10 cm in length
III	Hematoma	Subcapsular, >50% surface area ruptured Subcapsular or parenchymal hematoma Intraparenchymal hematoma >10 cm or expanding
	Laceration	3 cm parenchymal depth
IV	Laceration	Parenchymal disruption involving 25–75% Hepatic lobe or 1–3 Couinaud's segments
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud's segments within a single lobe
	Vascular	Juxtahepatic venous injuries, i.e. retrohepatic vena cava/central major hepatic veins
	Vascular	Hepatic avulsion

Fig. 1. Abdominal CT scans 6 h after injury. **a** As found at the time of injury, the concentration in the area with a poorly defined border in the anterior segment had decreased slightly and the area was becoming distinct. **b** Below the kidney, a flat parenchymal structure was present, the interior of which contained vasculature with a low concentration and vasiform gases, and the structure was believed to be a torn liver parenchyma. **c** Magnification of the area believed to be a torn liver parenchyma.

Operation method: right hepatic lobectomy

Fig. 2. Surgical findings. **a** A deep liver injury was observed from the posterior to the anterior segment, and as in the CT findings, there was a deficit in a portion of the posterior segment. **b** The vascular channel was treated anatomically. **c** Resection stump after right hepatic lobectomy.

Fig. 3. Resected specimen. The defective liver tissue was drained of blood and was pale. Moreover, the extracted defective portion and the resected liver were combined and were consistent with part of the posterior segment.

Fig. 4. Postoperative course. The circulatory dynamics were stabilized through the rapid administration of intravenous fluids at the time of hospitalization, and emergency surgery was performed based on the results of the examinations. The clinical course was good, and the patient was discharged from the intensive care unit on postoperative day 4. There were no particular complications, and the patient was discharged from the hospital on postoperative day 17.

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