

# Patient with severe blunt hepatic trauma involving vascular and common bile duct injuries treated in the hybrid emergency room system (HERS) by a multidisciplinary team

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## CASE PRESENTATION

A teenager who was involved in a motorcycle crash was brought to our hybrid emergency room system (HERS), which was a novel trauma resuscitation room equipped with fluoroscopy, a CT scanner, and an operating room set-up. The patient's vital signs at admission were: Glasgow Coma Scale score, 15 (E4V5M6); heart rate, 100 beats per minute; blood pressure, 100/70 mm Hg; respiratory rate, 22 breaths per minute; SpO<sub>2</sub>, 95% (on face mask oxygen at 6L/min); and body temperature, 37.0°C. The abdomen was distended and firm. Ultrasonography revealed free fluid around the liver and spleen. Laboratory tests revealed lactic acidosis (3.40 mmol/L), anemia (hemoglobin 82 g/L), coagulopathy (fibrinogen 146 mg/mL), and elevated transaminases. A whole-body CT scan showed a huge laceration in the S4 region of the left hepatic lobe, with vascular injuries (American Association for the Surgery of Trauma grade IV) and a large amount of hemoperitoneum (figure 1).

The acute care surgery team performed a trauma laparotomy in the HERS. On opening the abdomen, approximately 2000 mL of blood was evacuated. S4 of the left hepatic lobe including the portal triad was lacerated in a craniocaudal direction. Blood was pouring from the laceration. Furthermore, the distal part of the common bile duct (CBD) was completely torn off.

## WHAT WOULD YOU DO?

1. Left hepatic lobectomy, intraoperative cholangiogram (IOC), choledochojejunostomy with Roux-en-Y reconstruction, then close the abdomen.
2. Suture closure of the hepatic laceration, ligation of the CBD, then close the abdomen. Percutaneous transcatheter cholangial drainage later.
3. Perihepatic packing, ligation of the CBD, then temporary abdominal closure. Close the abdomen at second-look surgery. Percutaneous transcatheter cholangial drainage later.
4. Perihepatic packing, temporary abdominal closure, then transcatheter arterial embolization (TAE) of the liver. IOC and choledochojejunostomy with Roux-en-Y reconstruction at second-look surgery.

## WHAT WE DID AND WHY

We manually compressed the ruptured liver while searching for other bleeding sites. The hepatoduodenal ligament was partially torn, and there was a small laceration on the anterior surface of the main portal vein (PV), which was sutured. No other source of bleeding was found. Perihepatic packing slowed the bleeding but did not achieve complete hemostasis. Immediately after the temporary abdominal wall closure dressing was applied, the interventional radiology (IR) team started the TAE on the same table in the HERS. Angiography showed active extravasation of a large amount of contrast medium from the left hepatic artery (LHA), which was embolized (figure 2A,B). The patient was moved from the HERS to the intensive care unit for further resuscitation.

The second-look laparotomy was performed 48 hours after admission once the patient was stabilized. There was no more bleeding. Bile was leaking from the lacerated CBD (figure 3A). IOC was performed through the lacerated CBD and confirmed the complete avulsion (figure 3B). The hepatopancreatic biliary (HPB) surgery team performed a choledochojejunostomy with Roux-en-Y reconstruction.

The patient tolerated the procedures very well. The postoperative course was complicated by episodes of PV thrombosis that required anticoagulation therapy and by the formation of a hepatic abscess that was treated by percutaneous drainage. The patient was discharged home on postoperative day 53 in good condition.

## DISCUSSION

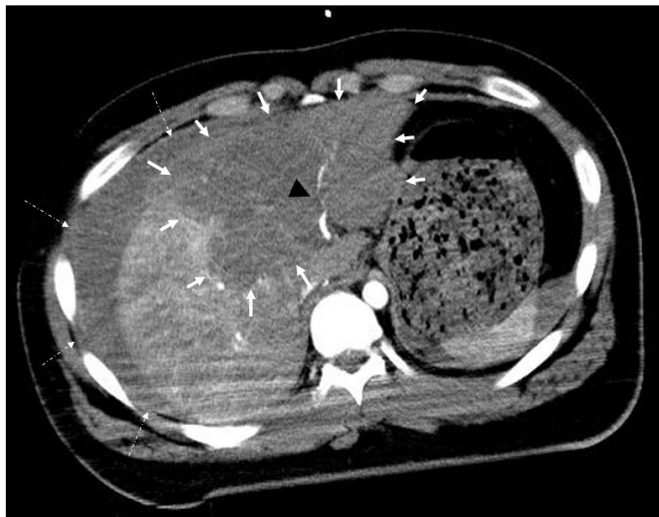
We presented a case of severe hepatic trauma complicated by injuries of the LHA, main PV, and CBD in which the initial resuscitation, damage control surgery, and IR procedures were performed simultaneously in the HERS. Definitive biliary reconstruction was performed in collaboration with the HPB surgery team during second-look surgery.

The HERS allowed the trauma team to perform damage control surgery and endovascular procedures simultaneously. An analysis of our practice has shown that protocolized multidisciplinary trauma patient care in the HERS improves the outcomes of severely injured patients.

The mortality rate is reportedly 99% if both the hepatic artery and PV are injured in patients with

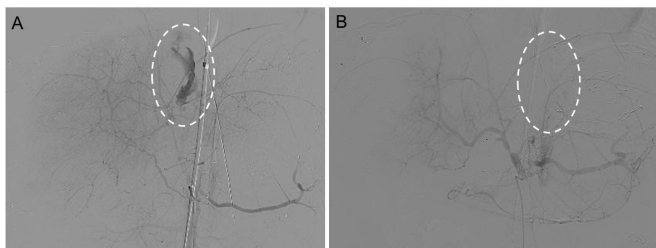
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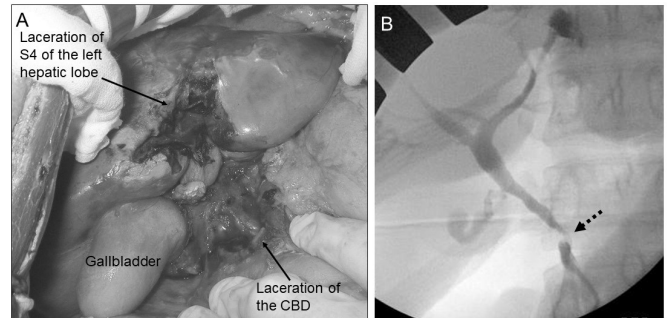


**Figure 1** Enhanced CT reveals a huge laceration in the S4 region of the left hepatic lobe (white arrows), with suspected damage to the left portal vein and left hepatic artery (black arrowhead) and a large amount of hemoperitoneum (white dashed arrows).

hepatic trauma. In our patient, the LHA and PV injuries caused severe bleeding that could not be controlled by perihepatic packing alone. The characteristics of the HERS made it possible for the IR team to perform TAE of the LHA almost simultaneously with the damage control surgery. Embolization of the LHA probably led to partial necrosis and abscess formation in the left



**Figure 2** Angiography performed immediately after the damage control laparotomy reveals active extravasation of a large amount of contrast medium from the left hepatic artery (A), which was successfully embolized (B).



**Figure 3** Intraoperative photograph reveals a large laceration of the left liver lobe and complete avulsion of the distal common bile duct (CBD) (A). Intraoperative cholangiography reveals complete avulsion of the CBD (dashed arrow) (B).

liver lobe postoperatively, which was salvaged with percutaneous drainage.

In this case, bleeding control and resuscitation were prioritized in the initial surgery. Therefore, the evaluation and treatment of the CBD injury were carried over to the second-look surgery. During second-look surgery, the HPB surgery team also intervened to successfully perform a complex biliary reconstruction.

For the treatment of severe hepatic trauma with biliary and vascular injuries, it is crucial to implement multidisciplinary treatment involving multiple specialties such as acute care surgery, IR, and HPB surgery. This multidisciplinary approach was made possible by the HERS.

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