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Case Report

Hepatic compartment syndrome treated with damage control surgery and transarterial embolization: A case report

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ABSTRACT

Background: Hepatic compartment syndrome (HCS) is a complication of nonoperative management in patients with blunt hepatic injury. Although decompression of elevated intrahepatic pressure through surgical exploration or drainage and hemorrhage control are required to manage this condition, evidence for such a management for this complication is insufficient. Herein, we report a pediatric patient treated with a planned combination strategy of surgical decompression with perihepatic packing to reduce intrahepatic pressure and subcapsular hemorrhage control as well as angioembolization to control intraparenchymal hemorrhage.

Case presentation: A 12-year-old boy was referred to our emergency department 5 h after sustaining severe bruising in the upper abdomen in a traffic accident. Computed tomography (CT) showed an intraparenchymal hematoma in the right lobe of the liver; nonoperative management was selected based on stable hemodynamic status. Two days after the injury, he complained of severe abdominal pain and shock. CT showed an intraparenchymal and large subcapsular hematoma with right branch compression of the portal vein and extravasation of contrast material. Laboratory data showed progression of hepatocellular damage. We successfully managed this patient with a planned combination strategy of surgical decompression with perihepatic packing for reduction of intrahepatic pressure and subcapsular hemorrhage control, followed by angioembolization for control of intraparenchymal hemorrhage.

Conclusion: Our study suggests that for the management of HCS, a planned combination strategy of damage control surgery and angioembolization is a therapeutic option.

Background

Nonoperative management has become the standard strategy for blunt hepatic injury in hemodynamically stable patients, regardless of the severity of injury [1,2]. However, several disadvantages associated with nonoperative management have been reported: risk of missed intra-abdominal injury; transfusion-related illness; and risks associated with embolization techniques including hepatic necrosis, abscess formation, and bile leak [3]. Reports have found that intrahepatic or subcapsular hematoma can increase

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intrahepatic pressure, excluding the portal vein and inferior vena cava, resulting in marked hepatic dysfunction and obstructive shock in patients with hepatic injury who were treated nonoperatively [4–8]. This pathological condition has been described as hepatic compartment syndrome (HCS) and is most commonly reported in young patients with hard hepatic capsules [9].

Here, we report a pediatric case with HCS due to delayed intrahepatic and subcapsular bleeding, treated with a planned combination strategy of surgical decompression with perihepatic packing to reduce intrahepatic pressure and subcapsular hemorrhage control, followed by angioembolization to control intraparenchymal hemorrhage.

Case presentation

A 12-year-old boy without specific medical history was referred to our emergency department from a local hospital 5 h after sustaining severe bruising in the upper abdomen in a traffic accident. Upon arrival at the local hospital, the patient had a systolic blood pressure of 108 mmHg, heart rate of 100 beats/min, respiratory rate of 20 breaths/min, and Glasgow Coma Scale score of 14 (E3V5M6). Although the patient complained of severe nausea, no peritoneal signs or other indications for immediate laparotomy were observed. Contrast-enhanced computed tomography (CT) performed 2 h after injury showed an intraparenchymal hematoma in the right lobe of the liver and extravasation of contrast material at the anterior segment (Fig. 1a). The patient was then transferred to our institution for further management. CT performed 5 h after injury revealed no changes in hematoma size and no evidence of extravasation (Fig. 1b). Based on the stable hemodynamic status and these radiological findings, we decided to proceed with nonoperative management without arterial embolization.

However, 2 days after the injury, the patient complained of severe abdominal pain and shock. CT showed an intraparenchymal hematoma and a large subcapsular hematoma that compressed the right branch of the portal vein and a recurrence of extravasation (Fig. 2). Laboratory data revealed progression of hepatocellular damage. The patient was diagnosed with HCS due to subcapsular and intraparenchymal hematoma with active bleeding.

We planned a combination strategy with surgical decompression and perihepatic packing to reduce the intrahepatic pressure and control the subcapsular hemorrhage, followed by angioembolization to control the intraparenchymal hemorrhage. Operative findings showed 300 mL of serosanguineous ascites and a huge hematoma under the right lobe capsule of the liver (Fig. 3), but no other visceral damage. We surgically opened and carefully resected the capsule of hematoma and subsequently performed gauze packing. Negative-pressure wound therapy was used to manage the open abdomen. As planned preoperatively, arterial embolization was performed immediately after to control the intraparenchymal hemorrhage (Fig. 4a).

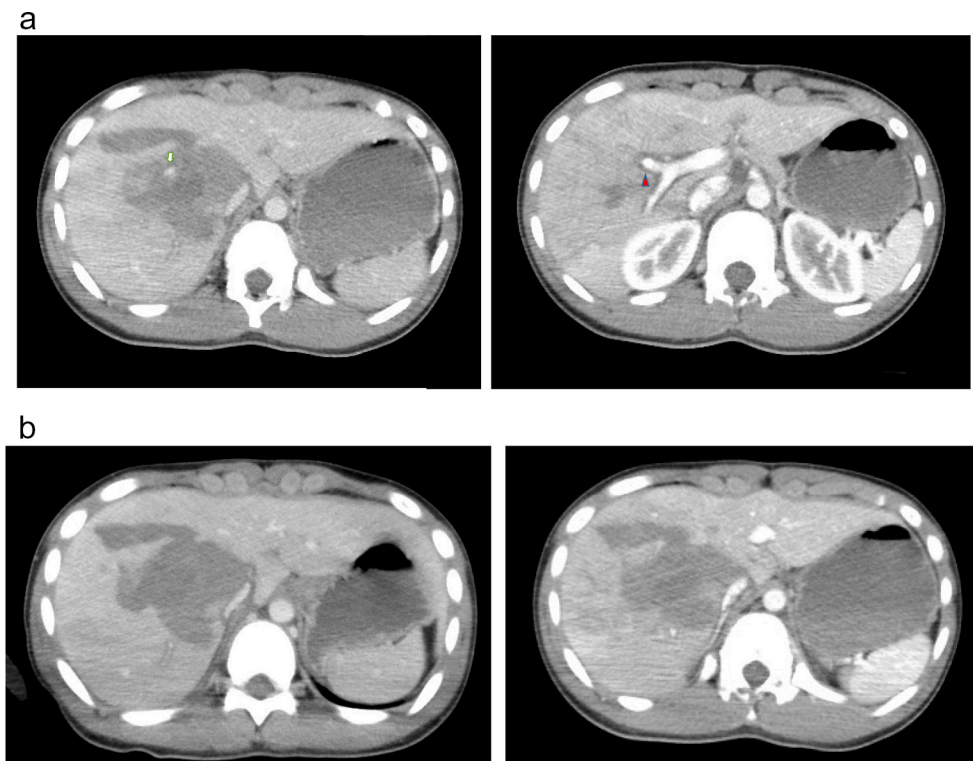


Fig. 1. Findings of computed tomography scan on the day of injury.

a: Contrast-enhanced computed tomography (CT) scan 2 h after injury showing an intraparenchymal hematoma with contrast material extravasation in the anterior segment of the right liver lobe (white arrow; left), with periportal halo (red arrowhead; right).

b: Contrast-enhanced CT scan at 5 h after injury showing no changes in hematoma size and no evidence of extravasation.

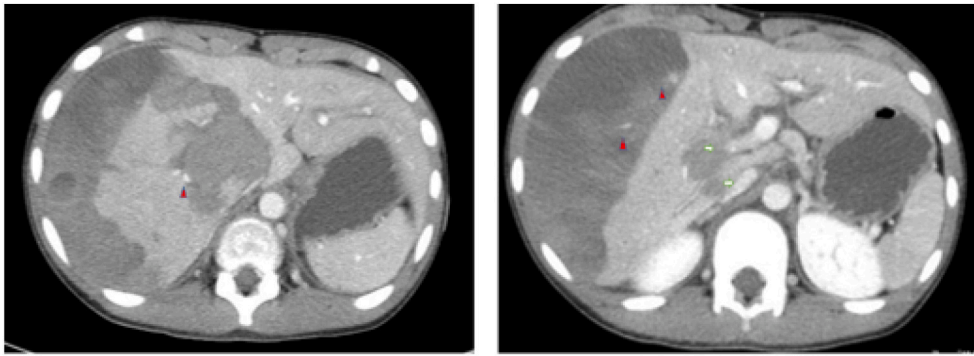


Fig. 2. Findings of computed tomography scan on the day 3 of injury. Contrast-enhanced computed tomography scan on day 3 showing intraparenchymal hematoma, a large subcapsular hematoma with compression of the right branch of the portal vein (white arrow; right), and recurrence of extravasation (red arrowhead).



Fig. 3. Intraoperative findings showing a large hematoma under the capsule of the right liver lobe.

Moreover, CT performed on the following day revealed de novo extravasation in the caudate lobe, which was treated with arterial embolization (Fig. 4b). We performed abdominal wall closure under the stable hemodynamic status.

The patient was stable postoperatively and was discharged from the intensive care unit on day 9 following injury. Follow-up 7

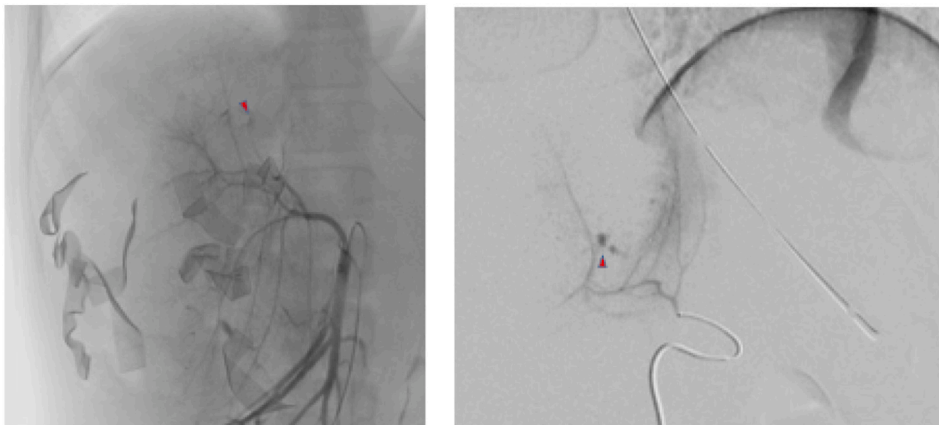


Fig. 4. Findings on digital subtraction angiography on days 3 (a) and 4 (b) day of injury.
 a: Hepatic angiography following removal of subcapsular hematoma and gauze packing demonstrated extravasation from the anterosuperior branch of the right hepatic artery (red arrowhead), which was embolized.
 b: Hepatic angiography on the day after damage control surgery showing extravasation from the caudate branch of the hepatic artery (red arrowhead), which was embolized.

months later showed no further complications.

Discussion

Intrahepatic or subcapsular hematoma can increase intrahepatic pressure, excluding the portal vein and inferior vena cava, resulting in a marked hepatic dysfunction and obstructive shock, i.e., HCS. Decompression and hemorrhage control are essential treatments for HCS. In previous reports, needle drainage or surgical decompression was performed for decompression [4,6–8], and surgical hemostasis or angioembolization was conducted for hemorrhage control [6,7,9]. However, the number of such reported cases is limited, and sufficient evidence has not been established for the management of this complicated condition.

Here, we report a subcapsular and intraparenchymal hematoma with active hemorrhage. Based on these conditions, we planned a combination strategy with surgical decompression and perihepatic packing to reduce intrahepatic pressure and control subcapsular hemorrhage, followed by angioembolization to control intraparenchymal hemorrhage. To the best of our knowledge, this pre-planned combination has never been reported as a management option for HCS caused by a subcapsular and intraparenchymal hematoma with active hemorrhage.

Conclusions

For the management of patients with HCS due to intrahepatic and subcapsular bleeding, planned combination of surgical decompression and perihepatic packing to reduce intrahepatic pressure and control subcapsular hemorrhage, followed by angioembolization to control intraparenchymal hemorrhage, may be considered.

List of abbreviations

CT	Computed tomography
HCS	Hepatic compartment syndrome

Consent for publication

Written informed consent was obtained from the patient's legal guardian for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Ethics approval and consent to participate

This case report was approved by Ethics Committee of Tohoku University Hospital.

CRedit authorship contribution statement

MF and TS performed the surgery. HF, MF and TS performed the perioperative management of the patient. KS and TS performed the transarterial embolization. MF, TS, and SK drafted the manuscript. KT, TS, and HF drafted the manuscript. All authors read and approved the final version of the manuscript.

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Declaration of competing interest

Not applicable.

Data availability

All datasets supporting the conclusions of this article are included within the article.

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